

Open Research Online

The Open University's repository of research publications and other research outputs

Linguistic accessibility of Open Educational Resources: Text Simplification As An Aid To Non-native Readers Of English

Thesis

How to cite:

Rets, Irina (2021). Linguistic accessibility of Open Educational Resources: Text Simplification As An Aid To Non-native Readers Of English. PhD thesis The Open University.

For guidance on citations see [FAQs](#).

© 2020 Irina Rets



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.21954/ou.ro.00012584>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk



**Linguistic accessibility of Open Educational Resources:
Text simplification as an aid to non-native readers of English**

Irina Rets

Thesis submitted to The Open University

for the degree of Doctor of Philosophy

this thesis was supported and funded by the Leverhulme Trust, Open World Learning
Initiative

Faculty of Wellbeing, Education and Language Studies

The Open University

18 September 2020

Abstract

Open Educational Resources (OERs) were pioneered with the intent to support education and widen access to knowledge globally. At the same time, most OERs are offered in English, and their language level creates a barrier to many potential learners who are non-native English readers. This does not suit the inclusive rhetoric of OERs. To investigate this problem, this thesis focused on the notion of linguistic accessibility, which is associated with the language level of learning materials, and evaluated text simplification as a potential solution.

This thesis dealt with the following major gaps in research on OER linguistic accessibility and text simplification: the level of text complexity of OER course materials and its variability across educational levels and subjects; approaches that experts, such as English teachers, take to simplify texts and the perceived influence of their language background on this practice; and the effect of simplification on text comprehension and processing among non-native English readers. These gaps were investigated through a mixed methods research design in four empirical studies using multiple data sources: reading materials from 200 OER courses, 24 English teachers, and 46 non-native English readers.

The first set of key findings related to the text complexity of OERs was that most OERs currently require an advanced level of English language proficiency; no systematic differences in text complexity were yielded across the different educational levels and subjects of the OERs.

The second set of key findings related to teachers' approaches to text simplification was the identification of a taxonomy of 16 text simplification strategies employed by English teachers, and the evidence that text simplification seemed more affected by teachers' attitudes to this practice than by their language background.

The third set of key findings related to the impact of text simplification on non-native English readers was the evidence that simplification not only improves text comprehension but also facilitates higher-level, deep processing.

Altogether, this research provided corroborating evidence that urgent action is needed to improve the linguistic accessibility of OERs and supported text simplification as a potential solution to achieve this. In doing so, a holistic picture of the notion of linguistic accessibility was created, along with recommendations to those designing or teaching with OERs, as well as those working in an EMI context.

Acknowledgements

I would like to thank the Open University (OU) and the Leverhulme Trust for providing me with support and resources over the past three years and making this work possible.

I would like to express my gratitude to my supervisors, Dr Ursula Stickler, Dr Tim Coughlan, and Dr Lluisa Astruc. Thank you for giving me the agency, your guidance, and the distinct expertise each of you brought into this interdisciplinary research project. Additionally, I would like to thank Dr Jekaterina Rogaten for her useful suggestions and comments on my final eye-tracking study. In this acknowledgement, I would also like to commemorate my supervisor, Prof. Stephen Bax, who sadly passed away in the first year of my PhD.

My gratitude extends to the academic and support staff of the Institute of Educational Technology (IET) and School of Languages and Applied Linguistics (LAL) at the OU. Being on campus every day during my PhD enriched my thinking about and knowledge of research. In particular, I would like to thank Prof. Bart Rienties for the additional support he is providing to the IET PhD community and his continuous effort in making the collegial atmosphere within the department even stronger. I value the opportunities I had to grow as a researcher beyond my PhD project.

Thanks are due to the PhD community of IET and LAL. The support we provided to each other in advertising our studies, recruiting participants, holding inter-rater reliability sessions, exchanging experiences with different methodologies was an essential part of my PhD journey.

Altogether, in my PhD I worked individually with 86 participants who deserve special thanks for their time. Seeing how interested you were in eye-tracking and in the results of my studies gave me hope that my research can make a positive impact on practice.

To Csaba, Lidia & Taro, Tatiana & Nikolay – thank you for our friendship. My dear friends, Dr Ina Friesen & Dr Andrew Brogan – thank you for your mammoth work of proofreading my thesis. To my parents, Dr Vladimir & Valentina Rets, I will be eternally grateful. Thank you for your unconditional love and support.

Finally, to my husband, Akin. You have been there for me in highs and lows. It is amazing to grow together as we go side-by-side in life, and I am looking forward to seeing what our next adventure will be.

Declaration of Authorship

I declare that the work contained within this thesis is my own. One section of this thesis has been edited and published. Other sections are in the process of being prepared for publication. Publications to date and articles currently being prepared are listed below.

While the items listed below have multiple authors, I have been responsible for the research design, data collection, data analysis and write-up of the work in this thesis. My academic supervisors (Dr Ursula Stickler, Dr Tim Coughlan, and Dr Lluisa Astruc) are credited co-authorship due to their input into my research conceptualisation and design. Dr Jekaterina Rogaten is credited co-authorship on the paper related to Study 4 due to her suggestions on the data analysis methods used in this study and her comments on the draft copies of the corresponding manuscript.

References to Relevant Work

Rets, I., Coughlan, T., Stickler, U., & Astruc, L. (2020). Accessibility of Open Educational Resources: how well are they suited for English learners? *Open Learning: The Journal of Open and Distance Learning*. doi: 10.1080/02680513.2020.1769585

Rets, I., Rogaten, J. (2020). To simplify or not? Facilitating English L2 users' comprehension and processing of Open Educational Resources in English using text simplification. *Journal of Computer Assisted Learning*, 1-13. <https://doi.org/10.1111/jcal.12517>

Rets, I., Stickler, U., Coughlan, T., & Astruc, L. (submitted). *Simplification of Open Educational Resources in English: exploring its effect on text processing of non-native English readers using qualitative evidence from eye-tracking*.

Rets, I., Coughlan, T., Astruc, L., & Stickler, U. (manuscript in preparation). *Approaches to text simplification: English teachers' views and practices*.

Table of Contents

Abstract	ii
Acknowledgements.....	iii
Declaration of Authorship.....	iv
Table of Contents	v
List of Figures	x
List of Tables.....	xi
1. Introduction.....	1
1.1. Background.....	3
1.1.1. Problem definition	5
1.1.2. One potential solution: text simplification	6
1.2. Research aims and contributions	8
1.3. Structure of the thesis	10
1.4. Chapter summary	12
2. Literature review	14
2.1. Introduction.....	14
2.2. Open education: benefits and challenges for learners	14
2.3. Linguistic accessibility and varying perspectives of texts.....	22
2.4. Text complexity: constituents and difference across levels and subjects	25
2.5. Text simplification: task difficulty.....	31
2.5.1. Motivations for the use of text simplification in this research	31
2.5.2. Approaches to text simplification.....	33
2.6. Text simplification: text difficulty	39
2.6.1. Effect of text simplification on text comprehension	41
2.6.2. Text processing theories that informed this research.....	46
2.6.3. Effect of text simplification on text processing	51
2.7. Chapter summary	55
3. Methodology.....	56
3.1. Introduction.....	56

3.2. Philosophical underpinnings	57
3.2.1. Pragmatic approach.....	57
3.2.2. Mixed methods as a methodology.....	61
3.3. Research design	66
3.4. Data collection methods	69
3.4.1. Readability analysis	69
3.4.2. Interviews	71
3.4.3. Eye-tracking in reading.....	75
3.4.4. Questionnaires	80
3.4.4.1. Post-reading comprehension testing.....	82
3.4.4.2. Controlling for individual factors	86
3.5. Data analysis approaches.....	87
3.5.1. Quantitative approaches to data analysis.....	87
3.5.2. The qualitative approach to data analysis	90
3.6. Validity, trustworthiness, and legitimation	93
3.7. Ethics	96
3.8. Chapter summary.....	97
4. Study 1 Methods and Results	98
4.1. Introduction	98
4.2. Materials and methods	99
4.2.1. OER course platforms.....	99
4.2.2. Procedure	100
4.2.3. Data analysis.....	104
4.3. Results	107
4.3.1. Accessibility of OERs to non-native English readers	107
4.3.2. Text complexity of OERs at different educational levels	107
4.3.3. Text complexity of OERs belonging to different subjects	111
4.4. Study 1 Discussion.....	119

4.4.1. Implications of findings.....	119
4.4.2. Study limitations	122
4.4.3. Links to other studies in this thesis.....	122
5. Study 2 Methods and Results.....	124
5.1. Introduction.....	125
5.2. Materials and methods	126
5.2.1. Participants	126
5.2.2. Texts	127
5.2.3. Eye-tracking equipment.....	129
5.2.4. Procedure.....	130
5.2.5. Data analysis	132
5.3. Results.....	135
5.3.1. Cognitive processing strategy use across the sample	135
5.3.2. Cognitive processing in authentic vs. simplified OER	139
5.4. Study 2 Discussion	141
5.4.1. Implications of findings.....	141
5.4.2. Study limitations	143
5.4.3. Links to the other studies in this thesis	144
6. Study 3 Methods and Results.....	146
6.1. Introduction.....	146
6.2. Materials and methods	148
6.2.1. Participants	148
6.2.2. Procedure.....	150
6.2.3. Data analysis	152
6.2.3.1. RQ3.....	152
6.2.3.2. RQ3a.....	156
6.3. Results.....	157
6.3.1. RQ3: English teachers' approaches to OER text simplification	157

6.3.2. RQ3a: Language background vs. OER text simplification.....	164
6.4. Study 3 Discussion.....	170
6.4.1. Implications of findings	170
6.4.2. Study limitations.....	173
6.4.3. Links to the final study in this thesis	174
7. Study 4 Methods and Results	175
7.1. Introduction	175
7.2. Materials and methods	176
7.2.1. Participants.....	176
7.2.2. Language proficiency.....	177
7.2.3. Texts	177
7.2.4. Background knowledge	178
7.2.5. Topic interest.....	179
7.2.6. Comprehension assessment.....	179
7.2.6.1. Free recall	179
7.2.6.2. Multiple-choice comprehension tests	180
7.2.7. Eye-tracking	180
7.2.7.1. Eye-tracking equipment.....	180
7.2.7.2. Eye-movement data	180
7.2.8. Procedure	181
7.2.9. Data analysis.....	182
7.3. Results	183
7.3.1. Individual factors vs. text comprehension and text processing.....	183
7.3.2. Effect of text simplification on text comprehension.....	184
7.3.3. Effect of text simplification on text processing.....	187
7.3.3.1.1. First pass fixation duration	187
7.3.3.1.2. Second pass fixation duration.....	189
7.4. Study 4 Discussion.....	192
7.4.1. Implications of findings	192

7.4.2. Study limitations	196
8. General Discussion and Conclusions	198
8.1. Introduction	198
8.2. Contributions of this thesis	202
8.2.1. Contributions to knowledge	202
8.2.2. Methodological contributions	210
8.2.3. Contributions to practice	212
8.3. Research limitations	215
8.4. Future directions for research	217
8.5. Concluding remarks	218
References.....	219
Appendix 1: Study 2 and Study 4 ethical approval	238
Appendix 2: Study 3 ethical approval	239
Appendix 2: Study 3 participant recruitment advertisement.....	240
Appendix 3: Study 3 texts for the online text simplification task.....	241
Appendix 4: Study 3 typological differences between participants' mother tongues	242
Appendix 5: Study 3 interview questions	243
Appendix 6: Study 4 participant recruitment advertisement.....	244
Appendix 7: Study 4 texts with the list of the text simplification changes.....	245
Appendix 8: Study 4 sample gaze plot	250
Appendix 9: Study 4 language proficiency test.....	251
Appendix 10: Study 4 background knowledge questionnaire	255
Appendix 11: Study 4 topic interest questionnaire	256
Appendix 12: Study 4 multiple-choice comprehension tests for Texts 1 and 2	257

List of Figures

Figure 1. Representation of linguistic accessibility in this thesis	24
Figure 2. Gaps in open education and text complexity research addressed in this thesis .	30
Figure 3. Gaps in task difficulty research addressed in this thesis	38
Figure 4. Model of cognitive processing in reading (Khalifa & Weir, 2009, p. 43)	48
Figure 5. Gaps in text difficulty research addressed in this thesis	54
Figure 6. Operationalisation of linguistic accessibility using mixed methods.....	65
Figure 7. Research questions addressed in each study	66
Figure 8. Conceptual links between studies	67
Figure 9. Visualisation of mixed methods used in this thesis.....	68
Figure 10. Dendrogram excerpt of OpenLearn OERs	113
Figure 11. Dendrogram of Saylor OERs	114
Figure 12. Intra-cluster similarity and inter-cluster dissimilarities: OpenLearn.....	115
Figure 13. Intra-cluster similarity and inter-cluster dissimilarities: Saylor.....	116
Figure 14. Visualisation of data collection procedure in Study 2	132
Figure 15. Screenshot of the online task administered in Study 3.....	151
Figure 16. Visualisation of the data collection and analysis procedure in Study 3	152
Figure 17. Approaches and strategies to text simplification across the sample (in %).....	157
Figure 18. The use of the elicited simplification approaches (in %) by language group ...	164
Figure 19. Visualisation of data collection procedure in Study 4	182
Figure 20. Estimated marginal means for first pass fixation duration by condition	188
Figure 21. Estimated marginal means for second pass fixation duration by condition	190
Figure 22. Three-way interaction between sentence type, text organisational structure, and condition.....	190

List of Tables

Table 1. Positive and negative effects of text simplification on readers.....	39
Table 2. A brief overview of common research paradigms	59
Table 3. Advantages of mixed methods highlighted in the methodological literature	62
Table 4. Advantages and disadvantages of readability analysis	71
Table 5. Advantages and disadvantages of stimulated recall interviews	73
Table 6. Definition of the eye-tracking measures used in this thesis	77
Table 7. Advantages and disadvantages of eye-tracking.....	78
Table 8. Advantages and disadvantages of using multiple-choice tests.....	82
Table 9. Advantages and disadvantages of using free recall	84
Table 10. Steps taken to conduct content analysis (CA) in this thesis.....	88
Table 11. Steps taken to conduct thematic analysis (TA) in this thesis.....	92
Table 12. Examples of top ten OpenLearn courses analysed in Study 1	101
Table 13. Applied readability metrics output by Textinspector and their description.....	102
Table 14. A structured overview of CEFR levels related to text comprehension	104
Table 15. Results of Shapiro-Wilk Test for OpenLearn courses.....	105
Table 16. Results of Shapiro-Wilk Test for Saylor courses.....	106
Table 17. OpenLearn and Saylor OERs (in %) in each scorecard.....	107
Table 18. OpenLearn readability metrics: complexity progression between levels.....	108
Table 19. OpenLearn readability metrics: no complexity progression between levels.....	109
Table 20. Saylor readability metrics: complexity progression between Level 0 and more advanced levels	110
Table 21. Saylor readability metrics: no complexity progression between levels	111
Table 22. Sum of squares between and within groups: OpenLearn 7 cluster solutions ...	115
Table 23. Sum of squares between and within groups: Saylor 6 cluster solutions	115
Table 24. OpenLearn readability metrics for 5 cluster solutions.....	116
Table 25. Examples of OpenLearn subjects assigned to the 5 th and the 3 rd clusters	117
Table 26. Saylor readability metrics for 5 cluster solutions.....	118
Table 27. Examples of Saylor subjects assigned to the 5 th and the 3 rd clusters	118
Table 28. Text simplification strategies used in Study 2	128
Table 29. Texts used in Study 2.....	128
Table 30. Procedure for reading the texts by participants in Study 2	130
Table 31. Deductive coding categories and their descriptions used in Study 2	133

Table 32. Final version of the coding scheme used in Study 2 with example quotes.....	134
Table 33. Stimulated recall data analysis results: authentic vs. simplified OER	139
Table 34. Study 3 participant demographics (N = 24)	149
Table 35. Excerpts of an authentic text and the corresponding simplified version.....	153
Table 36. Deductive coding categories and their descriptions used in Study 3.....	153
Table 37. Final CA coding scheme with category descriptions used to answer RQ3	155
Table 38. Inductive TA coding scheme used to answer RQ3a	156
Table 39. Text simplification strategy use per language group.....	165
Table 40. Pearson correlation coefficients for all Study 4 variables	184
Table 41. Means and standard deviations for two types of comprehension by text and condition.....	185
Table 42. Results of ANCOVA analysis for two types of comprehension.....	185
Table 43. Means and standard deviations for two types of eye-tracking measures (in log-transformed ms/char) by text and condition	187

1. Introduction

'Most of the fundamental ideas of science are essentially simple, and may, as a rule, be expressed in a language comprehensible to everyone.'

Albert Einstein (The Evolution of Physics)

Linguistic accessibility of educational materials is a topic that I value greatly on a personal level. In 2006 I was lucky to have obtained a prestigious scholarship from the U.S. Department of State to spend my senior high school year in the U.S. Since English is not my mother tongue, I had to pass several language tests, and have a visa interview in English before I could go. With good language test scores, good grades, and a high intrinsic motivation to study, I thought that understanding the school course content would be the least of my concerns. Unfortunately, that was not the case. While I still greatly appreciate that time, the language barrier put me at an academic disadvantage against my American peers, despite the long hours of study. Having returned to Russia, my home country, and later graduated from a linguistics department, I started teaching academic courses in English to undergraduate and graduate students first at a university in Russia, and then in Turkey. I noticed that my students were facing similar challenges. They grew up in a monolingual state, they were non-native readers of English, and even though they spent more than ten years learning English, they struggled with the course materials in English. There seemed to be something about the way those materials were written that did not let them learn freely. Many students felt demotivated, received low grades because they simply did not understand the material well enough, or they did not enjoy learning through English.

English as a Medium of Instruction (EMI), that I reflected on in the second part of this personal story, is defined as 'the use of the English language to teach academic subjects (other than English itself) in countries or jurisdictions where the first language (L1)/the mother tongue of the majority of the population is not English' (Dearden, 2015, p. 2). This definition signals that the use of English is a marked novel practice, as compared to English-dominant settings where EMI is by contrast a well-established and unmarked practice (Coleman, Hultgren, Li, Tsui, & Shaw, 2018). Another practice that EMI is markedly different from is CLIL (Content and Language Integrated Learning). In contrast to CLIL, in a typical EMI situation, content experts do not focus on language teaching; the primary goal is to build learners' subject knowledge. EMI is a rapidly growing global phenomenon. As Doiz, Lasagabaster and Sierra put it, although plurilingualism is nurtured as an ideal, 'reality

indicates that it is English which is pre-eminent and has become the main foreign language used as a means of instruction at universities in Europe and worldwide' (2012, p. 213). Recent figures from Europe indicate a 239% growth in undergraduate- and graduate-level programmes that are fully taught in English from 2,389 in 2007 to 8,089 in 2014 (Hultgren, Jensen & Dimova, 2015). At the same time, it has been documented that EMI learners often experience difficulties, and text comprehension, in particular, is considered one of the biggest challenges that prevent learners from successfully engaging with the course content (Floris, 2014; Chapple, 2015; Uchihara & Harada, 2018).

Another area where EMI is actively used by millions of learners, and one which originally was intended to widen access to Higher Education (HE) is Open Educational Resources (OERs). OERs are learning, teaching and research materials in any format and medium that are freely available in the public domain and which are licenced for use and adaptation without cost (William and Flora Hewlett Foundation, 2020). OERs were pioneered with the intent to support education, and widen access to knowledge globally, particularly for learners in developing countries, irrespective of their motivations, backgrounds, capacities, and limitations (Heiman, Coughlan, Rangin & Deimann, 2020). A common and popular form of OERs are courses designed for self-study. They are mostly produced by HE institutions as adapted extractions from paid-for university modules and are intended to be used autonomously without the support of a tutor (Nti, 2015). As there are no formal entry requirements for OER courses, they can be viewed as a bridge into or an alternative to HE, or a means of supporting a HE study (e.g., Cobb, 2018; Coughlan & Goff, 2019). While OER courses include filmed lectures, problem sets and community interactions among learners, the biggest part of the OER courses are reading materials (Stracke, Downes, Conole, Burgos & Nascimbeni, 2019).

The EMI aspect of the OER learning environment manifests itself in the fact that most OERs are created in English by top EMI universities, as well as in a high proportion of non-native English readers among OER learners (Hatakka, 2009; Kanwar, Kodhandaraman & Umar, 2010; Rets, Coughlan, Stickler & Astruc, 2020). The term '*non-native English reader*' in this thesis refers to anyone who speaks more than one language, and for whom English is not their mother tongue (Cook & Wei, 2016). This broad term is adopted here in deference to its common usage, as well as to avoid discrimination of OER learners at high levels of English proficiency (as is the case with the term 'English learners'), or OER learners who acquired English as their third or fourth foreign language (e.g., 'English L2 speakers').

The term 'non-native English speaker' is not deemed suitable in this thesis, as this thesis has a particular focus on reading and text accessibility rather than vocal or speaking ability.

Since OERs should enable learners to exercise their human right of equitable access to education (UNESCO, 2012), there is a moral imperative to explore the linguistic accessibility of these resources. A better understanding of how to improve access to OERs can help more non-native English readers around the globe to use them successfully.

To set the stage for the work undertaken in this thesis, the introductory chapter outlines the overarching problems that are addressed by the research. Section 1.1 provides background information on the broader research context of open education and text accessibility. Section 1.2 describes the research aims and contributions. Finally, Section 1.3 outlines the structure of the remaining chapters.

1.1. Background

Open Educational Resources (OERs) are an increasingly important part of the contemporary provision of education. Discussions about OERs are generating significant interest regarding how these resources can widen access to and increase the quality of education, providing a bridge, or an alternative to HE (e.g., Hatakka 2009; Kanwar et al., 2010). Discussions about OERs also concern their capacity to reduce educational inequality, and decrease the cost of education, particularly in developing countries (e.g., Cobo, 2013; Cobb, 2018; Papathoma et al., 2020). The interest towards OERs has been further increased by the Covid-19 global pandemic. Given that the pandemic caused widespread school closures in 185 countries, OERs were reported to have temporarily served as the primary form of education for those who were unable to access other forms of learning (UNESCO, 2020).

In 2015, a set of guidelines was developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2015) to promote OERs worldwide. These guidelines contain recommendations for different stakeholders: governments, HE institutions, academic staff, student bodies, and quality assurance or accreditation organisations. A common thread among these recommendations is the critical need to adapt pedagogical approaches and learning materials that comprise OERs for learners in developing countries. Similar ideas have been put forward by the William and Flora Hewlett Foundation, one of the largest grant making institutions that has provided over \$170 million to develop and extend the reach and effectiveness of OERs. Among their strategic

funding priorities for 2020 is the call to advocate for greater attention to educators' and learners' experiences of using OERs, as well as to the design of customisable OERs that can enable more responsive teaching and better learning ('The Next Phase for Open Education,' 2020).

The policy attention devoted to OER accessibility reflects current problems associated with open education. While OERs intend to increase educational benefits, particularly in developing countries (UNESCO, 2015), a number of research studies on the use of OERs in such contexts are critical of these claims. The tensions identified between OERs and their stated purpose mainly concern the design of these resources. The design of OERs seems to target learners who already know how to use online resources. Such design excludes learners without internet access or who are less capable of being autonomous, which questions the pronounced emancipating power of open education (Cobb, 2018; Coughlan, Lister, Seale, Scanlon & Weller, 2019). Thus, although OERs present opportunities for learning at scale, most OER users are still well-educated learners either from developed or English-speaking countries (e.g., Farrow, de los Arcos, Pitt & Weller, 2015)

Another frequently mentioned obstacle to the wider use of OERs in developing regions is the predominant use of EMI (Hatakka, 2009; Kanwar et al., 2010; Cobo, 2013). While the use of EMI in OERs is necessitated by a number of factors (Hodgkinson-Williams & Paskevicius, 2012; Nti, 2015; *see Section 2.2*), a bigger challenge is the language level in which these resources are written. The English language barrier has already been documented among OER learners in China (Huang, Lin & Shen, 2012), Russia (Knyazeva, 2010), and Italy (Banzato, 2012). Thus, for the global non-native English reading audience, the linguistic accessibility of OERs is an important concern. It does not suit the OER rhetoric of inclusion and instead creates divides (Coughlan & Goff, 2019).

Notwithstanding calls for more accessible OERs as part of quality guidelines, and research findings that suggest the need for a new understanding of access to the learning content (Knyazeva, 2010; Banzato, 2012; Huang et al., 2012), very few studies so far have explored the accessibility of existing OERs to non-native English readers. Research on OERs to date has focused on adapting OERs to specific national contexts through the use of case studies (e.g., Tlili, Huang, Chang, Nascimbeni & Burgos, 2019; Issack, 2011), and on the perceptions of different stakeholders on OERs through the use of interviews and opinion surveys (e.g., de los Arcos, Farrow, Pitt, Weller & McAndrew, 2016; Mtebe & Raisamo,

2014). OER research lacks studies that use observational data, or studies that conceptualise and evaluate solutions on how to improve the accessibility of OERs, which can be generalised for an international learning context (Casserly & DeBarger, 2020).

This research aims to address the language barrier currently associated with OERs. Understanding the extent to which OERs are accessible provides direction for whatever action is necessary to fulfil the inclusive educational potential of these resources. Rather than exploring how to adapt OERs to one specific context, this thesis adopted an approach proposed in the EMI literature to address the linguistic accessibility of OERs. This thesis tests the assumption that text simplification, an approach suggested by several EMI studies (e.g., Galloway, Kriukow, Numajiri, 2017; Uchihara & Harada, 2018), can potentially lessen the language barrier for the international audience of OER learners.

1.1.1. Problem definition

Accessibility in education is defined as the practice of optimising learning activities to give equal access and opportunities to all learners wherever possible (Jisc, 2018), and accessibility practices mainly address physical disability (Zhang et al., 2020). To some extent, OER practices were able to build on the insights of accessibility research. Such developments as an introduction of read-aloud recordings of text, enlargement of text sizes, display of content in custom colour combinations, or provision of text transcripts for audio content into the design of OER platforms made it possible to overcome some physical barriers to education for disabled learners (e.g., Heiman et al., 2020).

Another research field that is concerned with accessible education and which addresses accessibility issues particularly in HE, is research on widening participation practices. This field focuses on a broader group of learners who might need additional support, including learners from lower-income families, disabled learners, ethnic minorities, as well as mature and part-time learners (Allen & Storan, 2005). When describing the current trends in research on this topic, Bateson, Somerville, Griffin and Hancock (2018) note that there is an emerging shift from framing widening participation as a deficit, where any shortcomings are situated within the learner to framing widening participation as part of a societal issue or university approach to accessible learning:

... the greatest problem with the current procedures may relate to the fact that we conceptualize the problem as being within each child as opposed to systemic issues and then conceptualize our jobs as being to help students (after they fail) in place of systems.

(Bateson et al., 2018, p. 105)

This criticism of the 'deficit mindset' has also been voiced in the context of OERs. A growing number of studies stress that drawing implicitly on the cultural capital of the middle-class in pedagogy, and expectations for independent learning when designing OERs alienates underserved populations in developing non-English speaking regions (e.g., Cobo, 2013; Coughlan & Goff, 2019).

Research on accessibility and widening participation has focused little on the issues around language and the barriers it creates to accessing the learning content. As stated above, since the mission of open education is to facilitate access to education globally, it is important to consider international OER learners when addressing this issue. Most open courses, such as OERs, are created in English, while the OER audience is comprised of many non-native English readers, who report experiencing a language barrier when learning from the OERs (e.g., Cobo, 2013). As a number of studies showed that one size does not fit all, particularly in online education, which gives immense opportunities for a personalised learning (e.g., Rets, Rienties & Lewis, 2020; Rienties, Lewis, O'Dowd, Rets & Rogaten, 2020), there is a need to explore further OER accessibility, and the linguistic accessibility of these resources to non-native English readers. Linguistic accessibility in this thesis is defined as the extent to which the language used in the learning materials is understandable and matches the language proficiency level of the learners who use these materials.

To the best of my knowledge, no study to date has investigated the linguistic accessibility of OERs to non-native English readers. Furthermore, no study has yet evaluated potential solutions that can reduce the current language barriers associated with the OER courses, irrespective of the OER learners' language backgrounds. One such solution explored in this thesis is text simplification, which is described next.

1.1.2. One potential solution: text simplification

One solution that can potentially increase the linguistic accessibility of OERs is text simplification. Furthermore, text simplification as a strategy for increasing linguistic accessibility can support the shift from framing the language level as a deficit of the learners to framing it as a more systemic issue in open education. Text simplification is concerned with the way OERs are designed by OER providers rather than with the actions that OER learners need to take to overcome the language barrier they face. Text simplification is defined in this research as the process of modifying authentic texts, or texts written for

native readers of a given language, with the intent to reduce the language level of these texts and increase their accessibility for the non-native readers of this language (Tickoo, 1993). In this thesis, the idea of simplifying OER materials is drawn from the EMI literature (e.g., Galloway et al., 2017; Uchihara & Harada, 2018), as open education research to date has not yet addressed this issue.

Text simplification was chosen as potential support for international OER learners because related research has suggested that this approach offers a number of benefits. Previous studies on text simplification showed that simplified materials can enhance the reader's comprehension of the text (e.g., Crossley & McNamara, 2016). Claims have been made that text simplification also reduces the reader's cognitive load and makes better use of their available memory resources (e.g., Crossley, Allen & McNamara, 2012). Other advantages of simplified texts are reported to be increased learner autonomy (Tickoo, 1993), and increased opportunities to have a learning success scenario (Tomlinson & Masuhara, 2017) (*for more examples, see Table 1*).

Despite these potential benefits, several questions arise from the existing text simplification research. One issue concerns the difficulty of commenting on the value of text simplification using the current empirical evidence. Existing research into the benefits of text simplification has some important limitations, and the evidence is not always consistent between the different studies. To exemplify some of the limitations, most existing studies did not control for participants' individual factors, or text factors (e.g., Yano, Long, & Ross, 1994; Tweissi, 1998; Oh, 2001; Crossley, Yang & McNamara, 2014; Crossley & McNamara, 2016), which might impact the effect of text simplification. Furthermore, empirical evidence in these studies is obtained using traditional methods of reading research, such as comprehension tests and moving window techniques, which might limit the breadth and depth of the analysis.

Besides these two points that need to be taken into account when researching text simplification, another issue concerns the procedure of simplifying texts. Since texts are mostly simplified intuitively in foreign language classrooms (Crossley et al., 2012), this practice is guided by the beliefs and experiences of language teachers. At the same time, few empirical studies have attempted to provide an overview of the most frequently employed approaches to text simplification used by language teachers. Moreover, there is currently limited understanding of the effect of teachers' language background on their choice of text simplification strategies. This understanding can, in turn, shed light on

whether text simplification can potentially cater for OER learners with different language backgrounds.

These limitations and the lack of empirical evidence concerning the effect of text simplification might account for the ongoing debate about the perceived advantages and disadvantages of this practice. Furthermore, there is uncertainty about the level of English proficiency at which learners experience the highest gains from simplified texts (*see Section 2.6.1*). Text simplification within the open education context also remains unexplored, despite the calls for more accessible OERs (e.g., Cobo, 2013).

This thesis attempts to address these limitations. Its aims, contributions, as well as an elaboration on how the aforementioned gaps are addressed in this research are outlined in Section 1.2 next.

1.2. Research aims and contributions

This research seeks to explore the linguistic accessibility of OERs and evaluate a potential solution for supporting their successful use among non-native English readers. It was born out of a practical need and addresses a specific gap identified by the literature review: while there are calls for more accessible OERs, no study to date has explored linguistic accessibility particularly within the open education context. As a first step, this research addresses this gap by examining the text complexity of a sample of 200 course materials from two major OER platforms (*see Chapter 4*).

As suggested in the literature, text simplification might increase the linguistic accessibility of the learning materials by facilitating non-native English readers' text comprehension and text processing. However, there is also a need for more research evidence to support the claims concerning the benefits of this practice to learners. There is a further need for more empirical investigation as to how an expert group, such as English teachers, simplify OER texts, and what effect this practice has on non-native English readers. This research aims to address these gaps by collecting the emerging evidence on non-native English readers' response to text simplification and investigating how English teachers from different language backgrounds simplify OER texts. This thesis also aims to evaluate the facilitative effect of these approaches in relation to text comprehension and text processing of non-native English readers by triangulating the results yielded by two different types of behavioural measures, while also statistically controlling for participant- and text-related factors.

Set against this context and addressing the gaps in the current knowledge base, the findings of this research project will make a number of substantial contributions to the field:

- A case for raising the awareness of educators and material designers working in the OER context about the current level of linguistic accessibility of OERs in English;
- A taxonomy of text simplification strategies by breaking down what English teachers conceptualise as a more accessible OER text in English;
- A more nuanced understanding of the role that text-related factors play in the understanding and processing of the text;
- Robust empirical evidence of the effect of text simplification on non-native English readers supporting the potential use of this practice to increase access to OERs globally.

In order to accomplish these goals, the remainder of this thesis outlines four empirical studies that were undertaken to address the following research questions:

RQ1: To what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

RQ2: What is the effect of text simplification on text processing, as evidenced in the frequency of use of cognitive processing strategies by non-native English readers?

RQ3: What approaches and strategies to text simplification do English teachers employ when intuitively simplifying OER texts for lower-level proficiency non-native English readers?

- **RQ3a:** Does the mother tongue have an effect on the choice of text simplification strategies, as perceived by English teachers?

RQ4: What is the effect of text simplification on text comprehension and text processing among non-native English readers when English proficiency, background knowledge, and topic interest are controlled?

The adoption of a mixed methods research design allows the research to address the complex nature of the research questions in this thesis listed above: quantitative methods through the use of reliable tools and testing and qualitative methods through the

analysis of multiple individual narratives (*see Chapter 3 for the epistemological stance of this research*).

Initially, the thesis will place the research questions into the context of existing knowledge, as well as detail the underlying topics related to the problems that this thesis focuses on. A more detailed explanation of the structure of the thesis is provided below in Section 1.3.

1.3. Structure of the thesis

The introductory chapter outlined the context of this research. This chapter also briefly summarised the gaps in the literature on open education and text simplification that are addressed and outlined what contributions this thesis provides to knowledge and practice, thus justifying the exact research questions.

The remaining chapters within this thesis provide an overview of the literature, the overarching methodology of this research, four subsequent studies with their methods, findings and results, as well as an overview of the final discussion and conclusion. In detail, the overall structure of the remaining chapters is as follows:

Chapter 2: Literature Review

Chapter 2 includes an in-depth review of up-to-date research on the topics of open educational resources, linguistic accessibility, text simplification, and, more generally, reading. This chapter also presents information on the theoretical frameworks that underpin this research. The literature review in this thesis highlights the complexity of the topics that this thesis focuses on, and the need to address them from multiple perspectives. Chapter 2 also critically reviews gaps in current knowledge and understanding, providing a rationale for the research questions addressed by this research.

Chapter 3: Methodology

Chapter 3 outlines the overarching methodology and assumptions adopted, including a justification for the pragmatic and mixed methods approach. The chapter provides an overview of the research design of the thesis and describes the strengths and weaknesses of the data collection tools used to answer the research questions. Chapter 3 then progresses to outlining the adopted approaches to data analysis. It concludes with an overview of the steps taken to ensure the research rigour and address ethical

considerations. For ease of reference, specific research procedures, and analysis techniques of the four research studies are outlined in their corresponding chapters (*Chapters 4 through 7*).

Chapters 4: Study 1 Methods and Results

In Chapter 4, RQ1 unpacks the linguistic accessibility of the English language OERs offered on major platforms in terms of their text complexity and explores the association between educational levels and subject matter of the OERs on the accessibility of OER reading materials. In this chapter, an outline of the specific methods used to address this research question is provided, including information about the study setting and procedures. This chapter also describes results from the analysis of Study 1 data, which highlighted that most OERs across different educational levels and subject labels require an advanced level of English proficiency. A brief discussion of the research findings is provided, as well as the limitations of the study and implications for the subsequent work carried out in the thesis.

Chapter 5: Study 2 Methods and Results

To obtain some emerging evidence on whether text simplification might be a suitable solution to the problem addressed in this thesis, Study 2 was conducted. Chapter 5 describes Study 2, which used qualitative data to explore the effect of text simplification on text processing (RQ2). The chapter also describes the methods used to answer this research question, including the setting, participants, and procedures. Results from Study 2 are provided, which indicated the extent to which text simplification facilitates higher-level processing of the OER texts among non-native English readers. These findings are discussed, along with the study's limitations and implications for further work.

Chapter 6: Study 3 Methods and Results

To better understand what changes to OER texts English teachers make to increase their linguistic accessibility to non-native English readers, the rationale behind such changes, as well as what perceived effect their mother tongue has on this practice, Study 3 was conducted using qualitative interviews (RQ3 and RQ3a). Study 3, therefore, aimed to develop evidence-based guidelines for simplifying OERs. Chapter 6 outlines the specific research methods used to address these research questions, information about study

participants, and research procedures, as well as the results of the analyses. At the end of the chapter, a short discussion is provided, including the study's limitations and implications for the two remaining studies.

Chapter 7: Study 4 Methods and Results

Chapter 7 describes the final research study, Study 4, which evaluated text simplification based on the approaches elicited in Study 3 by using quantitative methods (RQ4). In doing so, Chapter 7 outlines the specific methods used to answer the final research question and provides information about the setting, participants, and procedures. The analysis of Study 4 is also described, which indicated the extent to which text simplification facilitates text comprehension and text processing of different sentence types among non-native English readers at high and low levels of English proficiency. The wider implications of these findings and limitations of the study are presented in a brief discussion.

Chapter 8: General Discussion and Conclusions

The final chapter synthesises the findings of the four studies. It provides final conclusions and outlines the novel theoretical and methodological contributions to knowledge. In addition, it discusses implications for practitioners based on the results of Chapters 4 through 7. Overarching limitations of this work and directions for future research are also described.

1.4. Chapter summary

This chapter provided an overview of the research context and the origins of the work described in the remaining chapters. Altogether, the work outlined in this thesis seeks to obtain a well-rounded understanding of the linguistic accessibility of OERs to non-native English readers. This thesis also seeks to provide a critical evaluation of the potential of using text simplification to increase accessibility of OERs to non-native English readers. Both goals address a practical need of reducing the language barrier international OER learners currently experience. In doing so, this thesis also addresses crucial gaps in previous research on open education and text simplification. Chapter 2 will expand upon the brief summary of literature concerning the linguistic accessibility of OERs, text simplification, as well as text comprehension and processing during reading. This chapter will also include a

critical overview of the gaps in current knowledge and provide a more in-depth justification of the research questions stated in this chapter.

2. Literature review

2.1. Introduction

Chapter 2 outlines prominent findings in the existing literature on open education, linguistic accessibility, and text simplification. This chapter also reviews the theoretical foundations and the evidence of the potential of text simplification to support non-native English readers in understanding and processing OERs in English. Furthermore, this chapter addresses essential gaps in current knowledge, which have driven the research questions of this thesis. This chapter also provides an overview of ongoing contributions to the problems this work has addressed.

Section 2.2 problematises the benefits and challenges associated with OERs and provides a rationale for the focus of this research. The term 'linguistic accessibility' alongside its related elements – text complexity, task difficulty, and text difficulty – are introduced in Section 2.3. Next, Sections 2.4. through 2.6. focus on each of these elements separately: the complexity of OERs (Section 2.4), task difficulty and teachers' approaches to text simplification (Section 2.5), text difficulty and the reported effects of simplification on text comprehension and text processing (Section 2.6). The final section also describes the text processing theories that underpin this research.

2.2. Open education: benefits and challenges for learners

The turn of the twenty-first century marked the beginning of the open education movement, which is rooted in several phenomena. Open education originated in the principles of instructional design for distance education with its associated flexibility of self-paced and self-regulated learning (Stracke et al., 2019). However, the present understanding of open education and HE distance education courses is different. In contrast to most distance education courses, open education does not set any entry course requirements, and allows learners to study at variable levels of intensity (Coughlan et al., 2019). Open education is also based on the principles of open content, which was made possible by the introduction of Open Intellectual Property Licenses, public copyright licenses that enabled the free distribution of an otherwise copyrighted work (Creative Commons, 2020). Open education is also considered to have been 'enabled and inspired' by the advent of the Internet with its associated democratisation of communication, and, particularly, by Web 2.0 technologies that allow anyone to create and share information or material they have created online (Brown & Adler 2008, p. 18; Weller, 2020).

A key point in the development of the open education initiative was the OpenCourseWare project. It was launched in 2001 by the Massachusetts Institute of Technology (MIT) and included 50 undergraduate- and graduate-level courses published online, freely and openly available to anyone, anywhere. In 2005, OpenCourseWare formally moved beyond MIT with over 100 universities joining the initiative and supporting the open publication of materials from more than 3000 university courses. Although this initiative was still a predecessor of modern open education because it was based on materials used by academics in the classroom, OpenCourseWare became emblematic of the movement for Open Educational Resources. The term 'Open Educational Resources' (OERs) was first coined at the UNESCO Forum on the Impact of OpenCourseWare for HE in Developing Countries in 2002 (Abelson, 2008).

At present, alongside OERs, there are other popular forms of open education, such as Massive Open Online Courses (MOOCs). Similarly to OERs, MOOCs facilitate online learning at scale and allow learners to self-regulate their learning by determining how and when they engage (Littlejohn & Hood, 2019). However, this thesis focuses specifically on OERs rather than MOOCs in light of the differences in the use of these two forms of open education and the type of licencing involved, as described below.

First, in contrast to OERs, most MOOCs are commercial entities (Coughlan et al., 2019). MOOC providers may charge their learners either for the full access to the course or for some additional features, such as identity verification, proctored assessments, or certificates of completion. MOOCs, therefore, do not have the same degree of focus on serving the needs of underserved populations. In direct contrast to MOOCs, the idea behind the launch of OERs was to catalyse universal access to and use of high-quality academic content on a global scale and to enable learners to exercise their human right of equitable access to education by removing educational costs. The long-term goal of OERs is to 'eradicate extreme poverty and hunger' (UNESCO, 2012) since a poor education is often seen as an underlying reason for poverty, as well as for a correspondingly low level of human capital, in developing countries (Casserly & DeBarger, 2020). The OER concept assumes that learners residing in developing regions will find available content usable and that doing so will provide educational opportunities that these countries need in order to be liberated from poverty (Nti, 2015).

Secondly, most MOOCs are based on copyrighted resources hosted within proprietary platforms and restrict access to a specific time. Thus, while OERs are defined

by the '5R' permissions to freely reuse, revise, remix, retain, and redistribute content, users of MOOCs are typically not granted these permissions (Stracke et al., 2019). This is particularly relevant in this thesis, as the solution evaluated and supported by this research, text simplification (*see Sections 1.1.2 and 2.5.1*), implies that it should be possible to revise and modify the learning content of educational resources. Under the '5R' permissions, OER licences support the potential to simplify course materials and republish these without restrictions.

Having distinguished between the two primary forms of open education – OERs and MOOCs, it is also important to differentiate different types of OERs. These resources can be broadly characterised as 'big' and 'little' OERs (Weller, 2010), where:

Big OERs are institutionally generated resources, which usually arise from projects. These are of high quality, contain explicit teaching aims, presented in a uniform style and form on a portal, and have the associated user data.

Little OERs are individually produced low-cost digital resources. They are produced by anyone, not just educators, may not have explicit educational aims, have low production quality, and are shared through a range of third-party sites and services. (Weller, 2010).

An example of little OERs, provided in Weller (2010), can be an image shared on Flickr, which depicts a collection of toys, and is used in a presentation as a representation of diversity within a community. Big OERs can be further divided into OER courses and open textbooks. OER courses are hosted on a dedicated platform and include learning materials in text and video format with some interactive features, such as games and quizzes (William and Flora Hewlett Foundation, 2020). Each course is designed for a specific number of hours of study, and the content is arranged in different thematic sections. Most of such courses are adapted extractions from paid-for university modules and enable learners to earn a statement of participation. Some examples of OER course platforms include OpenLearn (2020) and Saylor Academy (Saylor) (2020). Another form of big OERs is Open Textbooks, which are textbooks licensed under an open copyright license and made available online to be freely used for learning and teaching purposes (Pitt, 2015). Open Textbooks are written by experts in common core subject areas under initiatives such as OpenStax (2020). Big OERs can be used with the guidance of a tutor or an academic as additional support for a formal study or as part of a professional learning programme (e.g., Cannell & Macintyre, 2017). However, they can also be used without the tutor, and many

OER course providers, such as the aforementioned course platforms OpenLearn and Saylor, purposefully develop OERs from paid-for university curriculum to be studied online independently from the tutor and free of charge.

To further situate this thesis in the research context, it is important to note that the focus of this research is on big OERs. The use of little OERs is often unpredictable because they are of a smaller granularity and do not have the same level of learning intentionality associated with them (Weller, 2010). Within big OERs, this research is further focused on OER courses that are ready-to-use and are intended to be followed without the support of a tutor. Text simplification, the solution to increasing accessibility evaluated in this research, implies that the learner is autonomous and needs support through a customised accessible content (Tickoo, 1993).

In some ways, OERs have succeeded in standing up to their moral mission of increasing access to education. These resources have, indeed, provided learning at scale with the major OER platforms receiving millions of visitors each year. OpenLearn, since its launch in 2006 by the Open University in the United Kingdom (UK), has recorded over 10 million unique visits to its course pages (personal communication, November 17, 2018). Saylor, on average, registers more than 800 thousand monthly visits (SE Ranking, 2020). Open textbooks have shown the potential to make a positive difference on student retention (e.g., Pitt, 2015). While commercial textbooks are frequently criticised for their high prices which creates a barrier to learning for low-income and ethnic minority students, the meta-analysis of the literature on open textbooks published between 2012 and 2019 found that where open textbooks were involved, there was a significant reduction in the likelihood of students withdrawing from the course (Clinton & Khan, 2019).

The digital medium through which learning is delivered in OERs has also removed some of the barriers to education associated with traditional face-to-face classrooms. Besides the flexibility of self-paced learning, some OER platforms provide notifications and offer a range of accessibility features including access to subtitles and transcripts when playing videos, read-aloud recordings of text, and access to different font sizes and text colours. These features, together with assistive technologies (hardware and software designed to help people with disabilities), have contributed to optimising learning in OERs to a certain extent and improving access to education for some vulnerable learners. Furthermore, the permissions granted by the open license remove legal barriers to

adapting OERs, making it possible to create learning environments that are better tailored to different types of learners (Zhang et al., 2020).

A worldwide reach, however, does not necessarily translate into universal accessibility. In fact, open education initiatives are critiqued for being subject to (over)inflated expectations as change agents (Rodriguez, Pérez, Cueva, & Torres, 2017). Despite the aspirations to fundamentally open up education, OERs are still mainly used by well-educated learners. Farrow and colleagues (2015), in their survey with more than 3,000 users of OpenLearn and Saylor OER courses, as well as the users of iTunesU OER materials, showed that most respondents were often already graduates of HE institutions. In the study, this was particularly evident with the Saylor courses: 59% of the respondents who reported to use Saylor were already in possession of at least an undergraduate degree. Although the information on the geographical location of OER learners is not openly shared by OER providers, available data suggest that the majority of OER learners reside either in developed or English-speaking regions. In the study of Farrow and colleagues (2015), a large proportion of respondents were from the USA ($n = 862$) and the UK ($n = 473$). My personal communication with the OpenLearn development team for this research (personal communication, November 17, 2018) revealed that the top ten most popular courses in 2017-2018, in terms of unique visitor numbers to the introductory course page, were followed by learners from the UK (for some courses, up to 89% of the visits), the USA, Australia, Canada, and India.

A number of studies expressed disappointment in the ability of OERs to radically transform education in developing and non-English-speaking regions (e.g., Willems & Bossu, 2012; Cobo, 2013). Some obstacles are highlighted in the literature that prevent engagement with OERs and their long-term sustainability in these areas. These obstacles include the need for technological infrastructure to be in place, the historical effects of colonisation and the local relevance of OERs, as well as the need for learners to have the necessary literacy skills to be able to use OERs and self-regulate their learning (Willems & Bossu, 2012; Cobo, 2013; Coughlan & Goff, 2019).

Another limitation associated with OERs, which is highlighted particularly often in relation to developing countries, is the language barrier. The majority of OERs are produced in English from top English as a Medium of Instruction (EMI) university programmes. As noted by Macaro, Hultgren, Kirkpatrick and Lasagabaster (2019), it is crucial to recognise that EMI is not always, perhaps not even principally, adopted as a result of deliberate

strategies. Rather, it happens as an unintended consequence of other policy decisions and the global use of English, particularly in knowledge dissemination. Another reason for the use of EMI in OERs is the high production cost associated with OERs, which institutions in developing regions might not be able to bear. Despite EMI not being a deliberate practice in the design of OERs, it does result in the tension between the stated purpose of OERs and their design and use. As Cobo (2013) described the current situation around open education:

In the case of OER, a particular tension exists between the inclusive rhetoric about OER and the reality that most of OER are in English... while the majority of learners worldwide come from non-English-speaking backgrounds... Thus, the use and repurposing of OER remain limited to people who have had the privilege to learn one of those elite (foreign) languages [English].

(Cobo, 2013, p. 112)

Besides the predominant use of English in OERs, another 'disabler' of open education evident in this quote from Cobo (2013) is the fact that learners need to have adequate knowledge of the language of instruction for the process of learning to occur. As mentioned before, the English language barrier caused by the language level of OERs has already been voiced among the learners in different countries: e.g., China (Huang et al., 2012), Russia (Knyazeva, 2010), and Italy (Banzato, 2012).

Despite the scepticism, registered in a range of studies (e.g., Willems & Bossu, 2012; Cobo, 2013), towards the ability of open education to help learners in developing countries and from non-English-speaking backgrounds, there is a lack of OER studies that conceptualise and test solutions on how to improve the accessibility of OERs for non-native English readers (*see Section 1.1*). Some solutions described in the OER studies focus on how to customise OERs to specific national contexts. Yet, such approaches do not generalise to a wider learning context (Casserly & DeBarger, 2020). One such solution focuses on involving local universities in developing countries in providing their course materials as open content (e.g., Tlili et al., 2019). Another solution suggests that teachers in developing countries should be encouraged to adapt and use OERs in English in formal instructional settings (e.g., Mtebe & Raisamo, 2014). The latter, however, cannot be applied to online OER courses, where the learner does not have the instructor's support and the scaffolding associated with formal instruction.

Another approach to customising OERs is the translation of the English OER content into local languages (e.g., Hodgkinson-Williams & Paskevicius, 2012; Nti, 2015). MIT's OpenCourseWare has, for example, translations into Spanish, Portuguese, Chinese, Thai, Persian, Korean, and Turkish (Nti, 2015). Although greater production of OERs in other languages, or translation of English content, would offer a means to increase access, there are several drawbacks in using this approach. First, there are currently 7117 languages spoken globally (Ethnologue, 2020). Even with just 23 languages presently accounting for more than half of the world's population (Ethnologue, 2020), translating each OER course into 23 languages would require much additional work on the part of OER platforms. Secondly, the translation might be skewed towards certain known non-English groups, particularly those who have a strong presence in the countries that have the most OER providers (Nti, 2015). Another drawback of customising OERs by using translation is the difficulty of finding equivalencies for certain academic and technical words in the languages that might not have the corresponding vocabulary. These disadvantages make the translation approach not ideal for facilitating the universal global use of the OERs. Thus, this also suggests that OER learners should be able to follow the language of instruction – English – for access and use of OERs to occur.

The research fields that can potentially inform the research around the facilitation of the global use of OERs is accessibility research and widening participation practices. Accessibility explores ways of optimising learning activities to adjust the learning environment to the needs of as many learners as possible (Jisc, 2018). With the main focus on learners with disabilities, some work has been done in researching accessibility in open education (e.g., Rodriguez et al., 2017; Heiman et al., 2020; Zhang et al., 2020). The systematic review by Zhang and colleagues (2020) of the literature published between 2009 and 2019 on this topic identified the key issues addressed in accessibility research. Although the authors noted that accessibility within OERs is still in its infancy, the identified issues addressed by accessibility research so far were:

- a) system design with the focus on investigating ways of designing OERs in line with existing (web) accessibility guidelines;
- b) personalisation with the focus on analysing personalised learning experiences based on the 'type of disability' as a personalisation parameter;
- c) metadata with the focus on exploring ways to enhance the retrieval of OERs and provide a friendly navigation experience to the learners;

d) authoring tools with the focus on analysing the integration of assistive technologies when designing accessible content in OERs.

Widening participation is largely associated with HE and explores ways of removing social, cultural, economic, or institutional barriers to HE that learners from lower-income and other disadvantaged backgrounds face (Bateson et al., 2018). While the target group of learners for accessibility research is learners with disabilities, widening participation focuses on a broader group of learners who might need additional support (*see Section 1.1.1*). It is important to distinguish increasing participation from widening participation as, despite periods of expansion in HE, the former has not resulted in the latter, similarly to the situation around open education (Chowdry, Crawford, Dearden, Goodman & Vignoles, 2013). Research on widening participation is mainly concerned with interventions and strategies that can make HE available equally and fairly for all. As the systematic literature review of Younger, Gascoine, Menzies and Torgerson (2019) on the topic showed, most frequently used interventions include mentoring, guidance through the university application process and activities on campus, additional tutoring and writing instruction, financial incentives to learners and scholarships to the sponsoring universities. One study featured in the systematic review of Younger and colleagues (2020) included analysing the efficiency of strategies designed for learners for whom English was not their mother tongue, which mainly involved additional on-site English instruction (Myers, Olsen, Seftor, Young & Tuttle, 2004).

Accessibility and widening participation research linked to OERs provides a useful starting point for this thesis. However, it is apparent that there is a gap in this literature due to a lack of focus on the learners who do not speak the language of instruction fluently and, thus, need additional support, as well as the investigation of the strategies that can make the learning content more accessible to them. While OERs are viewed as having the potential to widen access to HE, linguistic accessibility of open education to non-native English readers has received very little research attention as well. This is despite the current challenges open education is experiencing with fostering inclusion in non-English-speaking regions and with widening access to information, knowledge, and learning.

Linguistic accessibility is conceptualised in Section 2.3 next.

2.3. Linguistic accessibility and varying perspectives of texts

Reading, the process of obtaining meaning from print (Berendes et al., 2018), is one of the major channels of information intake during learning (e.g., Crossley & McNamara, 2016; Catrysse, Gijbels & Donche, 2018; Ariasi, Hyönä, Kaakinen & Mason, 2017). Some readers may have a higher tolerance for uncertainty when dealing with a text they do not understand. However, a challenging text generally frustrates the reader and creates a barrier to learn the content presented in the text (Reed & Kershaw-Herrera, 2016). Understanding and learning from a written text creates further vexing challenges for non-native readers of a given language (Brysbaert, Keuleers & Mander, 2020). A study on international students studying in English at an Australian university found substantial gaps in materials comprehension between English mother-tongue students and international students who were non-native English readers (Mulligan & Kirkpatrick, 2000). Only one in ten international students surveyed reported being able to understand the content and intent of their lectures very well. Erling, Adinolfi and Hultgren (2017) in their review of 77 studies on the use of EMI in low- and middle-income countries published between 2000 and 2015 found that English curriculum and textbooks in those contexts were at a level far beyond students' competences and realistic achievement levels. These barriers with materials comprehension in English faced by non-native English readers exemplify the notion of linguistic accessibility, which is the focus of this research.

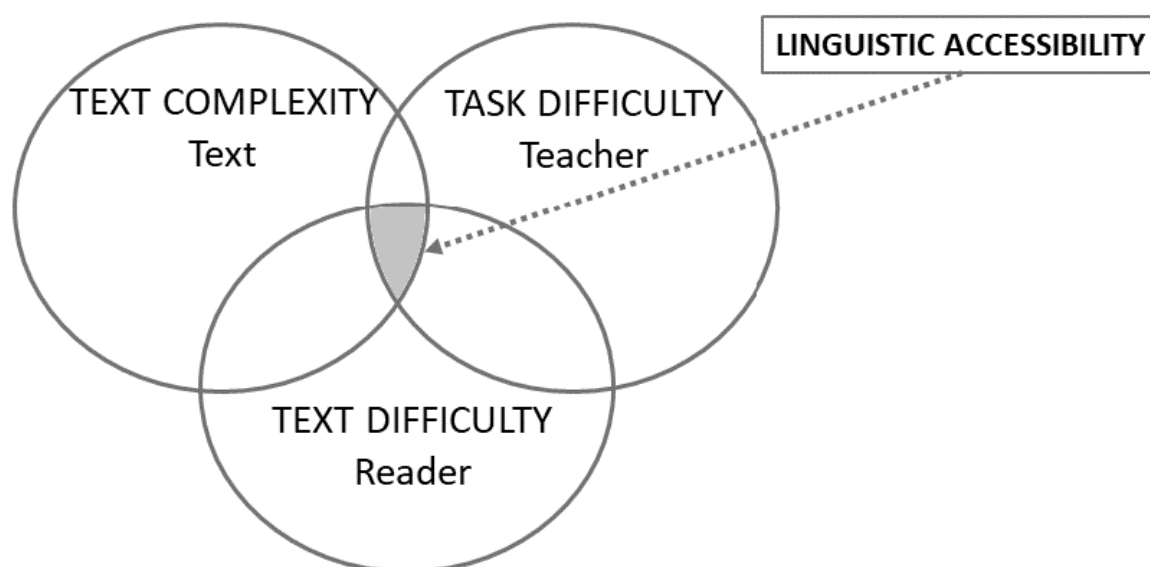
Current conceptualisations of linguistic accessibility vary. Some have used the term *text complexity* to refer to linguistic accessibility (e.g., Jatowt & Tanaka, 2012; Berendes et al., 2018; Xie, Wang & Chinnadurai, 2018). In line with this conceptualisation, texts at higher levels of complexity are judged as being less linguistically accessible. According to this text-centric view of linguistic accessibility, certain text features make one text more complex than another (Amendum, Conradi & Hiebert, 2018). Text complexity is generally measured through the readability analysis (*see Section 3.4.1*). As part of the readability analysis the linguistic features of the text are converted into numeric values and compared with certain predetermined standards that index complexity (Flesch, 1979; Crossley, Greenfield & McNamara, 2008). Thus, for example, a text about the discovery of vitamins might be deemed a university-level text or a text suitable for advanced language proficiency learners based on the results of the readability analysis, which takes into account a variety of features of the text.

Others have moved beyond this text-centric understanding of linguistic accessibility and have used the term *task difficulty*. They argue that what makes one text more accessible than another is the way in which the teacher supports the reading task to facilitate learners' successful reading (e.g., Valencia, Wixson, & Pearson, 2014; Amendum et al., 2018). In this scenario, a teachers' choice of pedagogical techniques and approaches to the text can provide favourable conditions for the learners. Thus, certain pedagogical approaches can help learners understand the text faster and better, direct their attention to certain aspects of the content of the text, and ultimately, help them learn from the text that otherwise might be deemed too difficult (e.g., Glass & Oliveira, 2014; Young, 1999). Supporters of using the term task difficulty to conceptualise linguistic accessibility argue that reading tasks are malleable and can be used by the teacher to increase or reduce the accessibility of the text (Amendum et al., 2018).

The third conceptualisation of linguistic accessibility manifests itself in the term *text difficulty*, which conceptualises linguistic accessibility as dependent on what the reader brings to the text and specific text features. Supporters of this conceptualisation argue that what makes one text more linguistically accessible than another depends on the interaction between the reader and the text (e.g., Fountas & Pinnell 1996; Morris et al., 2013; Amendum et al., 2018). From this perspective, linguistic accessibility is not an inherent attribute of the text but a quality of the text that is co-created by the response of the reader (LaBerge & Samuels, 1974). Text difficulty has generally been measured through post-reading comprehension testing (e.g., Long & Ross, 1993; Yano et al., 1994; Tweissi, 1998; Oh, 2001). A number of studies conducted on early reading measured text difficulty by using different assessments of fluency, e.g., reading accuracy, reading rate (e.g., Powell-Smith & Bradley-Klug, 2001; Cheatham, Allor, & Roberts, 2014; Amendum et al., 2018). The limited number of studies that looked at text difficulty and readers' text processing have used word-by-word moving window techniques (e.g., Crossley et al., 2014; Crossley & McNamara, 2016). This method involves displaying individual words or word combinations in the text to the readers through a 'window', which moves forward through the text at a set rate. Using the previous scenario to illustrate text difficulty, one reader's extensive background knowledge of or interest in the discovery of vitamins would make such a text far less difficult than it would be for a less knowledgeable or interested reader, despite its complex vocabulary or syntax.

This thesis incorporates all three approaches to linguistic accessibility. In this research, linguistic accessibility is examined from the perspectives of text complexity (Study 1, *see Chapter 4*), task difficulty (Study 3, *see Chapter 6*), and text difficulty (Study 2 and Study 4, *Chapters 5 and 7*). The aim of investigating linguistic accessibility from multiple perspectives was to obtain a more in-depth and well-rounded understanding of linguistic accessibility of OERs in English, how it can be achieved, and what effect it has on non-native English readers. The representation of how linguistic accessibility is approached in this thesis is visualised in Figure 1 below (as modified from Amendum et al., 2018).

Figure 1. Representation of linguistic accessibility in this thesis



In this representation in Figure 1, 'Text', 'Reader' and 'Teacher' refer to the three approaches to conceptualising linguistic accessibility described above. To summarise these approaches:

- text complexity is concerned with the text features that make one text more complex than another (*see Study 1, Chapter 4*);
- task difficulty is concerned with the approaches the teacher takes to make the text more accessible to the target reader (*see Study 3, Chapter 6*);
- text difficulty is concerned with the extent to which the reader finds the text understandable and the kind of effort they need to take to understand the text (*see Study 2 & Study 4, Chapters 5 and 7*).

Although these are three different approaches, they are closely linked with one another. Analysis of text complexity can help estimate the difficulty of the text and

identify the need for the work on task difficulty to be carried out. The efficiency of the task difficulty work can further be evaluated through the analysis of text difficulty.

The next section will focus on the first approach to linguistic accessibility, text complexity, and its constituents.

2.4. Text complexity: constituents and difference across levels and subjects

As text complexity involves the analysis of the features of the text (e.g., Amendum et al., 2018), text complexity is assessed by taking into account certain linguistic factors. Text complexity is usually measured through the factors that belong to the surface level of the text, which conveys the literal meaning and is concerned with the 'exact' text elements the readers see (e.g., Flesch, 1979; Teng Fatt, 1991; Berndt & Wayland, 2013; Crossley, Kyle & McNamara, 2016). The surface-level text factors include semantic and syntactic features of the text. In terms of the semantic features, research studies consistently find a strong association between vocabulary and text complexity. In particular, the measures of word length and frequency were shown to have strong correlations with text complexity, with longer and less frequent words increasing text complexity (e.g., Harrison, 1980; Brysbaert et al., 2020). Word length is measured in syllables or letters per word, and word frequency – by the number of times a word is used in the language (Brysbaert et al., 2020). Other semantic features traditionally used to measure text complexity are lexical diversity, or proportion of unique vs. repeated words in the text, and the proportion of noun elements. The higher percentage of unique words and noun elements are associated with higher text complexity (e.g., Flesch, 1979; Mikk, 1997). Sentence length is among the syntactic features analysed as part of the text complexity assessment. Similarly to longer words, longer sentences, which are measured by the number of words per sentence, were shown to also contribute to text complexity (e.g., Flesch, 1979; Crossley et al., 2008).

These semantic and syntactic features lay the basis of readability analysis, which is the most common method to measure text complexity (Flesch, 1979; Crossley et al., 2008) (*see Section 3.4.1*). Among the outcomes of the readability analysis is the score produced by readability formulas, which serves as the estimate of a reading grade required for relative ease of text comprehension for a given written text. This assessment of text complexity extends back to Thorndike (1921), who was among the first scholars to tabulate the frequency of words used in general literature. Among the three formulas that are reported to be suitable for all kinds of texts, and that are most commonly used for

benchmarking to the Common European Framework of Reference for Languages (CEFR) (Council of Europe, 2001) are the Flesch-Kincaid Grade, Flesch Reading Ease, and Gunning Fog index (Textinspector, 2020). Each of these formulas is calculated according to a ratio of total words, sentences, and syllables in a given written text.

Although readability formulas offer a quantitative and relatively fast prediction of text complexity, their usage as sole measurements of text complexity has been questioned. The claim was put forward that readability formulas do not account for all factors related to text complexity. The examination of linguistic features that go beyond the surface level of the text was claimed to better reflect the cognitive processes which the reader brings to the text, such as constructing a mental representation of the text or rehearsing its key points (e.g., Crossley et al., 2016; Khalifa & Weir, 2009). Thus, more recently, research on text complexity has started to include added features, such as text cohesion (e.g., Crossley et al., 2008; Xia, Kochmar, & Briscoe, 2016).

Text cohesion refers to the ways in which the ideas conveyed in the text are connected. These connections are grounded in explicit linguistic markers (e.g., logical connectives *'in addition'*, *'but'*, *'thus'*; frame markers *'finally'*, *'to repeat'*, *'here we try to'*) (Crossley et al., 2008; Textinspector, 2020). Drawing from the literature on the effects of text cohesion on readers' comprehension, high cohesion implies lower text complexity (e.g., Reed & Kershaw-Herrera, 2016). However, since high cohesion often results in lower readability, as indicated by readability formulas, the importance of accounting for cohesion features when measuring text complexity has been further emphasised in a number of studies (e.g., Todirascu, François, Gala, Fairon, Ligozat, & Bernhard, 2013; Crossley et al., 2016). To exemplify, as was shown by Crossley and colleagues (2016), an excerpt *'one part of the cloud develops a downdraft. Rain begins to fall'* has lower causal cohesion than *'one part of the cloud develops a downdraft, which causes rain to fall'*. The first excerpt has a higher readability result as judged by the Flesch-Kincaid grade level (3.4 vs. 4.9, respectively, with 3.4., indicating a lower grade, and thus higher accessibility of the text). Similar patterns with empirically documented comprehension effects were found in earlier studies. For instance, a high-cohesion text in McNamara (2001) resulted in better comprehension but had a Flesch-Kincaid grade level of 11.2, compared to 9.3 for the low-cohesion text.

A more recent development in text complexity research is the use of advanced computer readability tools (e.g., Coh-Metrix Second Language (L2) Reading Index, Crossley

et al., 2008; Textinspector). On the one hand, such tools have expanded the text features that can be used to measure text complexity. Computer readability tools analyse both surface-level text features, text cohesion features, and features relevant for non-native English readers (e.g., Xia et al., 2016). Textinspector (2020), for example, is linked to English Profile Wordlists, which determine the language proficiency level, as defined by CEFR (Capel, 2012), at which different vocabulary items are acquired. Thus, the use of computer readability tools, such as Textinspector, allows the researcher to obtain a relatively fast and more nuanced measurement of text complexity. On the other hand, due to the proliferation of computer readability tools, which analyse a variety of linguistic features, there is no consensus about a single combination of text features that should be used to evaluate the complexity of the text (Berendes et al., 2018).

Readability analysis serves an important practical need as it helps to assess the extent to which materials are accessible to the reader. A number of studies have been conducted on the accessibility of printed textbook materials (Berendes et al., 2018; Maslin, 2007). Yet, the accessibility of open education materials and specifically linguistic accessibility of OERs to non-native English readers is underrepresented in the research literature. This is despite the calls for more accessible OERs and the moral imperative to make OERs more linguistically accessible globally (e.g., Knyazeva, 2010; Huang et al., 2012; Cobo, 2013).

Most studies on the topic of linguistic accessibility of online materials concentrate in the field of healthcare and include freely available online patient education materials (e.g., Kher, Johnson & Griffith, 2017; Xie et al., 2018). These studies (e.g., Betschart et al., 2017; Kher et al., 2017; Sanghvi, Cherla, Shukla & Eloy, 2012; Xie et al., 2018) have measured text complexity by triangulating the analysis of the scores produced by a range of readability formulas. All these studies found the language of the analysed materials too complex for the average native English reader. Recommendations were made to update the content of the websites hosting these materials to gear them towards improving the accessibility of medical education 'as part of a systematic approach to increase reader comprehension' (Xie et al., 2018, p. 117). The main limitation of these studies is the design of the analysis based solely on the results of the readability formulas, which contrasts the recommendations concerning the importance of accounting for text cohesion features when analysing text complexity (e.g., Todirascu et al., 2013; Crossley et al., 2016).

Besides the lack of studies on text complexity of OERs, another topic that has not received much academic attention is the investigation of the relationship between the educational levels of materials, their subject matter, and their text complexity. In line with the systematic complexification assumption (Berendes et al., 2018), text complexity of materials is expected to vary across grade levels or years of study as a function of readers' competences, and the amount of subject knowledge they have. As noted by Berendes and colleagues (2018), the U.S. has become a pioneer in the systematic complexification of the written materials presented in textbooks by implementing the Common Core State Standards, which call for a staircase of increasing text complexity in what students read (CCSS; NGACBP & CCSSO, 2010).

A similar expectation of materials variability across levels applies to open education. Similarly to a school or a university curriculum where different courses are offered at different points in time within the programme of study, OER platforms also assign an educational level to each open course they offer¹. While there are no entry requirements for the learners to join OER courses, these levels suggest the order in which these courses should ideally be followed and the educational level (e.g., undergraduate/postgraduate) each course is suitable for (*see Section 4.2.1*).

The studies that have compared the text complexity of materials across educational levels have so far focused on printed textbooks in the formal classroom context. The study of Maslin (2007) explored the text complexity of reading materials across five top-selling U.S. first grade reading programs. The author used the measures of overall word counts, average words per page, sentence length, the number of unique words, as well as the scores from readability formulas for each sampled text. The study found that there was a progression of difficulty with passages being easier at the beginning of the year and more difficult at the end. The evidence of grade-level-based complexification was further supported by the study of Berendes and colleagues (2018). The authors found that there were significant differences between textbook reading materials of grades 5/6 and 9/10 for seven of the ten linguistic features with 9/10 grade materials being more demanding. Three features (word length, the ratio of genitive nouns to all nouns, and the ratio of derived nouns to all nouns) showed significant differences for all grade comparisons.

¹ More detailed information about the description of the educational levels assigned to the OER courses on the OpenLearn platform can be found at:

<https://www.open.edu/openlearn/about-openlearn/frequently-asked-questions-on-openlearn>

The authors explained the choice of the ten text features they used in the analysis by claiming that those features were expected to have a significant impact on the comprehension of texts written for educational or academic contexts. However, as there is a lack of consensus about a single combination of text features that should be used in the text complexity analysis mentioned above, the authors also acknowledged that ‘the [selection] criteria leave room for interpretation, and it could be argued that another research group may have rated other features as more important’ (Berendes et al., 2018, p. 522).

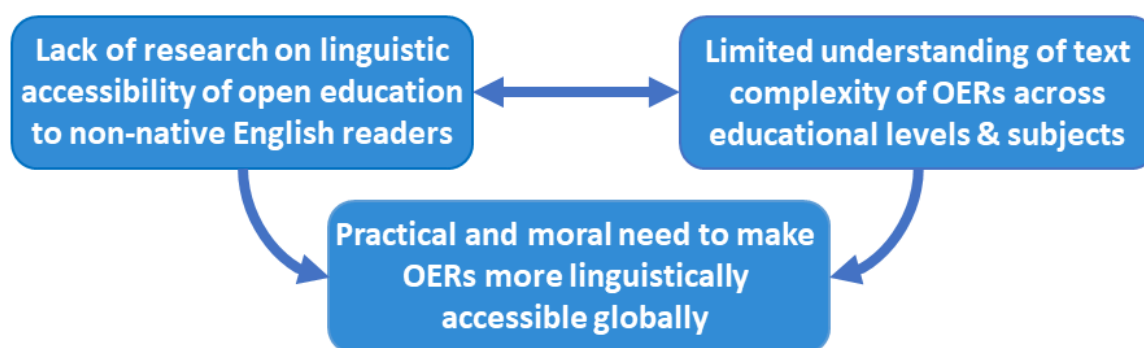
An investigation of whether the subject matter has any influence on text complexity could also be of interest to the accessibility of OERs, for example, by identifying the subject matter in which particular effort is needed to make texts accessible. Jatowt and Tanaka (2012) have undertaken such an analysis with online materials. The authors compared the readability of Wikipedia subject categories, namely Wikipedia articles on biology, chemistry, computing, economics, history, literature, mathematics, and philosophy, using the results of applied readability formulas. While different categories produced varying results in terms of their readability levels, the study found that articles in the computing category were the most readable. The authors attributed this finding to the ‘ubiquitous character of IT technology’, and the fact that the terms in the computing category have higher frequency of usage in English than the technical terms from other domains (Jatowt & Tanaka, 2012, p. 2609).

On the one hand, online patient materials and Wikipedia articles reviewed above are similar to OERs in that they are freely available online materials hosted on public platforms that aim to inform and educate a broad audience. On the other hand, OERs are not equivalent to these resources. OERs are different from the online patient materials, as the latter reflect concerns of medical, rather than educational outcomes. Similarly, OERs are different from Wikipedia as OERs are produced by universities and constitute a more academic learning context. Thus, it is tenuous to extend the comparison from these platforms to OERs.

It is evident from this literature review that there is a lack of research on linguistic accessibility of OERs. Research on the text complexity of materials across educational levels and subject categories is also limited. Therefore, research conducted in the OER context that takes into account educational levels and subject categories of these resources has the potential to provide a more comprehensive picture of the linguistic accessibility of OERs.

Considering the gaps in accessibility and widening participation research in general (see *Section 2.2*), gaps in research on open education, as well as the moral imperative to ‘open up’ open education globally, there is a need to conduct more studies that investigate linguistic accessibility of OERs to non-native English readers. This empirical contribution of the research is visualised in Figure 2 below.

Figure 2. Gaps in open education and text complexity research addressed in this thesis



In summary, this thesis addresses two gaps in current research on open education and text complexity. In the first instance, there is a lack of studies on the linguistic accessibility of OERs. Open education research cannot draw on accessibility or widening participation practices, as the research in these areas has focused little on non-native readers of a given language and the barriers they face with the language of instruction.

In the second, research on text complexity that investigates whether text complexity of materials varies depending on their educational level and subject matter is also limited. Since text complexity is one of the approaches to conceptualising linguistic accessibility, additional research that investigates text complexity of OERs across educational levels and subject labels can provide more comprehensive evidence of whether OERs need to be simplified. This evidence can also raise awareness of OER educators about the meaning of current groupings of OERs into levels and categories on OER platforms. Studies on both linguistic accessibility and text complexity of OERs can potentially fulfil the practical and moral need to make open education more accessible to learners across the world (UNESCO, 2012; Casserly & DeBarger, 2020). Given these gaps and motivations, this thesis adopted the following first research question:

RQ1: To what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

As mentioned in Section 2.3, the remaining two approaches to conceptualising linguistic accessibility are task and text difficulty. Text simplification has the potential to increase the linguistic accessibility of OERs (*see Section 1.1.2*). Thus, it is important for this research to explore how teachers adapt texts for their target learners, and to evaluate text simplification as a potential solution to the problem.

Since in this thesis both Study 2 and Study 4 examined linguistic accessibility from the perspective of text difficulty, the justification of the research questions of these studies is grouped together in Section 2.6.

2.5. Text simplification: task difficulty

2.5.1. Motivations for the use of text simplification in this research

As research on open education to date has not yet addressed this issue, a potential solution for improving linguistic accessibility of OERs – text simplification – has been drawn from the EMI literature in this research. OERs represent an EMI context for international learners, as OERs are mostly subject courses developed by universities in English, and many OER learners who try to access OERs are non-native English readers (*see Section 2.2*).

Furthermore, similar challenges have been reported in the EMI and OER contexts in terms of access to the learning content. In relation to the OERs, a major barrier to learning is associated with the lack of proficiency in English among OER learners, combined with the language level used in these resources (*see Section 2.2*). Likewise, in the EMI context, it has been documented that learners often lack adequate proficiency in English (Chapple, 2015; Floris, 2014; Uchihara & Harada, 2018). English proficiency was found to be a crucial factor underlying EMI learners' success, with materials comprehension rated as the most challenging part of the EMI course (e.g., Uchihara & Harada, 2018; Thompson, Rose, Curle & Aizawa, 2019). Similar evidence was obtained by Hua (2019) who explored EMI learners' perspectives on the factors facilitating or hindering their learning. The study showed that participants reported often feeling lost in the material due to a challenge of double information processing. Participants in the study emphasised the need to simultaneously process new subject knowledge and the language in which they were not fully proficient.

Research suggests that the primary source of this problem stems from the lack of vocabulary knowledge among EMI learners (Evans & Morrison, 2011; Hellekjær, 2010; Tatzl, 2011), and the lack of reading stamina, or consistency of comprehension across different sections of the reading material (Pessoa, Miller & Kaufer, 2014). In light of these

findings, it was suggested that EMI educators should cater for the linguistic needs of low English proficiency learners and support these learners by facilitating their comprehension of the course content (Uchihara & Harada, 2018; Macaro et al., 2019). This suggestion was further supported by empirical studies with EMI learners. Galloway and colleagues, in their study with 579 university students registered in 12 EMI programmes, found that ‘there is a desire [among students] for teachers to adapt the content of the class according to students’ English level’ (2017, p. 33). In another study, Erling et al. (2017) having conducted fieldwork on the use of EMI in low- and middle-income countries, provided recommendations for improving learning in those contexts. The authors included a recommendation to develop a guidance for EMI educators concerning how to make lessons more accessible to learners at lower levels of English proficiency. A need for such guidance, and, more generally, professional development of EMI educators has been further voiced in several more recent studies. Farrell (2020) and Yuan (2020) demonstrated that many EMI educators felt they taught in a ‘trial and error’ fashion and pointed out that existing teacher training programmes did not offer courses aimed at equipping teachers with pedagogical strategies for effective EMI course implementation.

Given the need for EMI educators to adapt the learning content to their students’ English level (e.g., Galloway et al., 2017), it is important to note that the most common method of adapting educational materials is text simplification (Crossley et al., 2012). As this research is focused on non-native English readers, text simplification in this thesis is related to the linguistic modifications made in the text. To reiterate the definition of text simplification adopted in this thesis, text simplification is understood in this research as the process of modifying authentic texts, or texts written for native readers of a given language, with the intent to reduce the language level of these texts and increase their accessibility for the non-native readers of this language (Tickoo, 1993; *see Section 1.1.2*).

The origins of text simplification can be traced back to the mid-twentieth century’s massification of education. The student demographic landscape, mainly in the U.S., started to rapidly change at the time with education ceasing to be the privilege of the elite (Altbach, Reisberg & de Wit, 2017). As a result, a wider audience who previously did not have access to formal education began to enrol in high schools and universities, and the materials needed to be adapted to become more accessible to the new learner audience (Tickoo, 1993). Rooted in the Vygotskian notion of the zone of proximal development (ZPD; 1978), according to which the learner needs to be appropriately challenged in order for learning

to occur, the idea was developed that there should be a match between the text and the language proficiency or skills of the learner, which can be achieved through text simplification (e.g., Betts 1946; Amendum et al., 2018).

Modern-day text simplification practice combines approaches to modifying the texts that are aimed at a diverse target group of learners, including low literacy level learners, elderly learners, learners with disabilities, and language learners or non-native readers of a given language (Crossley et al., 2012). All simplified texts share the same goal: increase accessibility to the text's content (Chandrasekar, Doran & Srinivas, 1996). However, given the focus of this research on removing the barriers to the use of OERs in non-English-speaking regions, this research focused on the text simplification approaches aimed particularly at the latter group – non-native English readers. Existing approaches to text simplification are reviewed in Section 2.5.2.

2.5.2. Approaches to text simplification

Using the terms from Vygotsky's social development theory (1978), text simplification represents a kind of scaffolding or instructional technique performed by language teachers, EMI educators or material writers to assist the learner to move towards new concepts, skills or understandings (Tickoo, 1993). Therefore, elicitation of approaches to text simplification in this research forms part of the task difficulty approach to linguistic accessibility (see *Figure 1 in Section 2.3*). Task difficulty is associated with the ways the teacher supports the reading task to facilitate learners' successful reading (e.g., Valencia et al., 2014; Amendum et al., 2018).

Crossley and colleagues (2012) divide existing approaches to text simplification aimed at non-native readers of a given language into two types – the structural and intuitive approaches. The structural approach is commonly associated with the simplification of the literary material and can be found in graded reader schemes. Graded reading is aimed at advancing learners' language acquisition through extensive reading by allowing the learners to be largely independent of the teacher and self-reliant during reading. As West (1964), the developer of the early graded readers put forward:

If we can ensure that every child who begins to study a foreign language shall, at the end of two years, be able to derive pleasure from reading it, we shall have ensured that no child who begins a foreign language will ever in the future, be able to regret it afterwards as a waste of time.

(West, 1964, p. 147)

The structural approach to text simplification utilises controlled vocabulary and grammar and is based on word and structure lists predefined for each CEFR (Council of Europe, 2001) proficiency level (Nunan, 1999). A strategy subsumed under the structural approach is text simplification guided by the use of traditional readability formulas. As discussed in Section 2.4, readability formulas are used to assess text complexity based on sentence and word length measures. Thus, text simplification performed in line with this strategy mainly involves shortening sentences and employing shorter words in the text (Crossley et al., 2008). At the same time, the sole use of readability formulas has been demonstrated to be less effective at predicting text difficulty than using them in combination with the text complexity indices that tap into cognitive processing (e.g., text cohesion) (see Section 2.4). As exemplified by McNamara (2001), there can be high readability scores, as shown by readability formulas, and low comprehension scores, as shown by comprehension testing, for the same given written text. In light of such evidence on the potential conflict between structural simplification of surface-level text features and aggravated processing difficulties for the readers that this type of simplification may lead to, the use of structural approaches to develop simplified texts has been criticised (e.g., Crossley et al., 2012; Long, 2020).

The second approach to text simplification, according to the review of Crossley and colleagues (2012), is an intuitive simplification. Given the extensive criticism of the structural approach to text simplification, Crossley and colleagues (2012), and Crossley and McNamara (2016) report that the intuitive approach has become the most common type of text simplification aimed at non-native English readers. This approach is based on the intuition of the expert or the person performing simplification. Their intuition is influenced by their personal beliefs, experiences as language teachers, EMI educators, learners and/or course designers concerning what makes a text more accessible to the target group of learners. In other words, under the intuitive approach, the expert performing text simplification relies on their own subjective approximations of what learners or readers at a particular level should be able to understand.

Considering the wide use of intuitive text simplification, as well as the necessary competence that such an expert population as language teachers have on material adaptation, and meaning negotiation, research on this topic with this expert group has some important theoretical and practical implications. A fine-grained analysis of specific text simplification strategies that language teachers choose can contribute to a clearer

conceptualisation of the elements of intuitive text simplification. Such an understanding of simplification strategies can, in turn, support multiple versions of a resource to be produced more easily for the diverse audiences of learners in the EMI and OER contexts.

Research studies on intuitive text simplification with teachers, and particularly with language teachers, are limited, however. In one of the few existing studies on text simplification conducted with EMI teachers, Basturkmen and Shackleford (2015) analysed eight hours of recorded EMI lectures on accounting and focused on the classroom interaction between the lecturers and learners. The authors found that the EMI lecturers had to use strategies to accommodate learners' understanding of the learning content once every three minutes during the lecture. This finding further highlights the barriers that learners in such contexts as EMI have with materials comprehension (*see Section 2.5.1*). In terms of the simplification strategies employed by the EMI lecturers in this study, most of these strategies were found to be related to vocabulary (46%) and conventional articulation of ideas in the register of accounting (41%). Another frequently used strategy in the study was expansion, which involved the lecturer repeating the meaning of the learner's incorrect utterance in English but providing a linguistically accurate version and expanding on it.

In another study conducted with teachers, Glass and Oliveira (2014) researched the accommodation strategies used by science teachers to promote student comprehension in class. Through qualitative micro-ethnographic analysis, four strategies used by the participating teachers were identified. These strategies are listed below from the most to the least commonly used among participating teachers in the study:

- a) simplified rewording, or rewording statements from books with synonymous terms or expressions more familiar to students;
- b) simplified questioning, or posing questions on the reading passages using simpler terms and encouraging students to articulate their own understandings of them;
- c) reversed simplification, or encouraging students to rearticulate their previous response to the query in more sophisticated terms;
- d) simplified definition, or providing explicit definitions for the particular terms encountered in the reading.

Glass and Oliveira (2014) showed the strategies employed by the participating science teachers were primarily aimed at ensuring content comprehension and information

recall, while the promotion of student acquisition of the scientific vocabulary was given only secondary consideration.

Green and Hawkey (2012) conducted a study with test item writers adapting source texts for a test of academic reading. This study is not a text simplification study per se, as participants were adapting journalistic texts for the academic test reading component. However, similarly to the previous studies described in this section, in the study of Green and Hawkey (2012), the source texts were made more accessible to the target group of non-native English readers who were non-specialist in the topic of the text and not fully proficient in English. The study elicited several strategies employed by the item test writers, which are presented below in the descending order by the frequency of their use:

a) deletion, or cutting the information in the text participants found redundant (e.g., journalistic elements) or repetitive;

b) substitution, or replacing technical vocabulary in the text with the words that might be more familiar to the reader;

c) expansion, or adding to a stretch of text to make implicit information in the text clearer to the reader;

d) move, or changing the position of elements within a text to reduce overall text length.

The results in the three studies described above (Green & Hawkey, 2012; Glass & Oliveira, 2014; Basturkmen & Shackelford, 2015) showed that the strategies most often used by teachers and test writers to simplify or adapt texts were related to vocabulary simplification. A substantial number of strategies also involved content elaboration, i.e., expanding the context of the sentence to make its meaning more explicit. However, these studies are limited in the way that they mostly focus on classroom interaction and verbal simplification of the learning content. These studies also lack the insight from language teachers who might choose different strategies when simplifying texts intuitively.

To the best of my knowledge, the only study on intuitive text simplification conducted with language teachers is the study of Young (1999). The author recruited two theoretical linguists and four pairs of university-level Spanish instructors to simplify magazine articles to second-year university-level Spanish learners and explain the rationale for each change they made. While Young (1999) focused primarily on the effect of text simplification on learners' text comprehension scores, the author also showed that similar types of modifications were made across all texts, irrespective of whether the

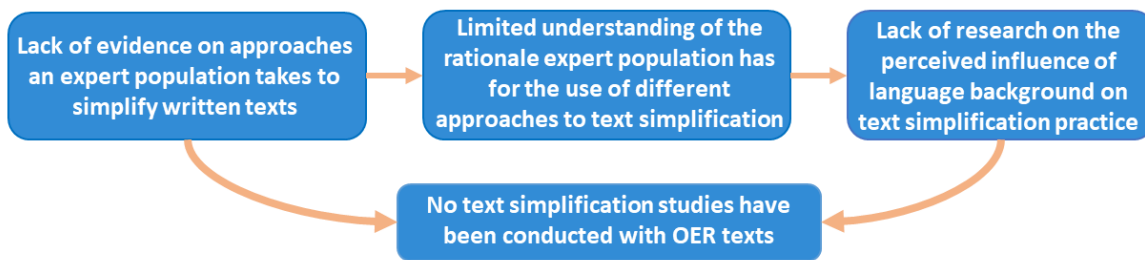
modifications were made by the instructors or the linguists. Another finding of the study concerned the observation that the linguists tended to make fewer modifications than the instructors. This study also showed a similar tendency towards predominantly using the vocabulary-related rewording strategy to simplify the texts. The author concluded that a high percentage of the total modifications were lexical, the modifications were described as 'substitute words or phrases that are less common with words, or phrases students have a higher probability of knowing' (Young, 1999, p. 352).

Besides the lack of studies on intuitive text simplification conducted with teachers, another gap concerns the fact that previous research on the topic has been carried out in single settings. It has not investigated the use of simplification strategies across teachers who have different language backgrounds: taking into account teachers' language background can add an important dimension to a study. In simplification, teachers might rely on the use of cognates – words that have the similar phonetic and lexical form – when simplifying the text, as there is a proven record that cognates facilitate reading comprehension of the non-native readers of a given language (e.g., D'Angelo, Hipfner-Boucher & Chen, 2017). Teachers might also favour structures that echo the syntactic typology of their mother tongue (e.g., word order, noun-adjective order). However, teachers might also rely on some universal processes of text processing, (e.g., the use of shorter sentences, words of higher frequency, fewer noun elements) that have been shown to facilitate text comprehension, irrespective of the readers' language background (Pae, 2018; *see Section 2.4*). Drawing on the implications of these existing text comprehension and text processing studies, opposing hypotheses can be derived regarding the potential impact of language background on teachers' choice of simplification strategies. Given the lack of research on this topic, one way to start addressing this issue is by exploring the perception of the language teachers themselves on the effect of their mother tongue on the approaches they take to simplify texts through the use of qualitative methods and interviews with them. It is widely recognised that the perceptions teachers hold about certain phenomena affect their actions and their choices of classroom activities (e.g., Alisaari, Heikkola, Commins & Acquah, 2019; Borg & Sanchez, 2020).

In view of the aforementioned gaps in research on task difficulty, there is a need for more studies that investigate how English teachers with different language backgrounds simplify written texts and investigate the perceived effect of their mother tongue on this

practice. The contribution of this thesis towards filling these gaps in text simplification research is visualised in Figure 3 below.

Figure 3. Gaps in task difficulty research addressed in this thesis



In addition to the gaps in research on open education and text complexity of OERs described previously in Section 2.4, this thesis also addresses the gaps visualised in Figure 3 above. English language teachers can be considered an expert population on the topic in light of their direct experience with and knowledge of non-native English readers and educational materials. By exploring how the expert population simplifies written OER texts and by providing an in-depth analysis of their rationale for the choice of specific strategies, guidelines can be derived from this thesis for effective OER simplification. Emerging evidence from this study on the perceived influence of the teachers' language background on this practice can help identify the extent to which these guidelines can, in turn, be potentially applied to non-native English readers from diverse language backgrounds. A particular contribution of this thesis is the use of OER texts as study materials.

Given these gaps and motivations, this thesis adopted the following research questions:

RQ3: What approaches and strategies to text simplification do English teachers employ when intuitively simplifying OER texts for lower-level proficiency non-native English readers?

- *RQ3a:* Does the mother tongue have an effect on the choice of text simplification strategies, as perceived by English teachers?

The final approach to conceptualising linguistic accessibility is text difficulty. Focusing on text difficulty can provide important insights for this research: a more comprehensive understanding of the OER linguistic accessibility; the evidence-based

response of non-native English readers to the text simplification strategies elicited as part of this research. The effects of text simplification on the reader’s text comprehension and text processing are discussed next.

2.6. Text simplification: text difficulty

When conceptualising linguistic accessibility through text difficulty, the extent to which a text is accessible is determined through the response of the reader and the amount of effort they take to comprehend and process the text (e.g., Crossley & McNamara, 2016). In line with this conceptualisation, text simplification should also be related to the reading behaviour of the target audience rather than only be considered in terms of the approaches teachers choose to simplify the text (Tomlinson & Masuhara, 2017; Amendum et al., 2018).

The debate concerning the potential strength and harm of the text simplification practice is still ongoing. Table 1 below summarises the recurring advantages and disadvantages of using text simplification described in the research literature.

Table 1. Positive and negative effects of text simplification on readers

Supporters of text simplification	Detractors of text simplification
Facilitation of text comprehension	There might be no significant gain in text comprehension when cohesion features are ignored in simplification
Reduction in the reader’s cognitive load	Inhibition of language acquisition
Facilitation of learner autonomy	Loss of the aesthetic qualities of the original
Facilitation of a learning success scenario	Inauthentic: the reader is presented with the model of writing that is markedly different from the form of language used in actual communication
A lead-in to unadapted books/original writing	-

(Based on Long & Ross, 1993; Tickoo, 1993; Yano et al., 1994; Tweissi, 1998; Oh, 2001; Crossley et al., 2012; Crossley et al., 2014; Crossley & McNamara, 2016; Tomlinson & Masuhara, 2017)

Supporters of text simplification mainly highlight the potential of this practice to facilitate information extraction from the text. The effect of text simplification on the reader’s cognitive load, the load that performing a task imposes on the individual’s use of working memory resources (Paas, Tuovinen, Tabbers & Van Gerven, 2003), has not been directly measured. However, the reduction in cognitive load when reading simplified texts has been hypothesised based on the evidence that in simplification the reader has to take

less effort associated with maintaining the references in the text, as well as less effort associated with processing unfamiliar words (Crossley et al., 2012).

Another line of evidence in favour of text simplification is the facilitation of learner autonomy (Tickoo, 1993). Simplification has the potential to support the learner in understanding the text independently of the teacher, which is particularly important in OERs, which are often used in self-regulated learning settings (*see Section 2.2*). Consequently, a more autonomous learner might have higher chances of having a learning success scenario. Simplified texts reflect what the reader already knows about language, which might make the process of extending one's knowledge through reading an easier and more pleasant experience (Tickoo, 1993). Finally, in the context of language teaching, it is claimed that text simplification can introduce the learner to reading for pleasure by providing a 'ladder' to less simplified and finally authentic texts given to the learners of higher levels of language proficiency (Tomlinson & Masuhara, 2017; *please, see below the definition of authenticity adopted in this thesis*).

Detractors of text simplification mainly raise their concerns in the context where the primary objective is learners' language acquisition or in the context that value the literary merit of the text. Within the first context, claims have been made that simplification inhibits language acquisition, as the learner is not exposed to the natural and full sample of the given language (Yano et al., 1994). This is consistent with the purpose of most language classes that use reading materials. The main goal of such classes is not the comprehension of a particular text, but the learning of the language in which the text is written and the development of transferable reading skills. Furthermore, this claim can be connected to the discussions around incidental learning. This type of learning occurs as a result of using language with no particular intention to learn a specific linguistic element (Pellicer-Sánchez, 2016). Reading has a proven record for being effective for the incidental acquisition of vocabulary (e.g., Pellicer-Sánchez & Schmitt, 2010; Pellicer-Sánchez, 2016). This can be undermined in text simplification, as simplified texts have low lexical diversity and use words that are already more familiar to the target reader. Within the second context, the negative effect of text simplification raised in the literature is the sacrifice of the aesthetic merits of the original. Text simplification practice attaches more importance to the linguistic needs of the readers than to the literary value created by the author of the text (Tickoo, 1993).

Since both claims touch upon the idea of originality and authenticity, it is important to note that there is an ongoing debate about the attributes of true authenticity, similarly to the discussion about the advantages and disadvantages of the text simplification practice. Aftab (2017) gave an overview of this debate and identified various approaches to defining authenticity. Authentic texts have been referred to as follows:

- (a) texts created by native speakers for native speakers;
- (b) 'real' texts under the assumption that they don't incorporate imaginary and fairy-tale content;
- (c) texts which can be understood;
- (d) texts which are relevant for the target learners;
- (e) texts which provide occasions for interaction;
- (f) texts which motivate learners and personally engage them in real-life behaviour activities.

In this thesis, the first approach to defining authentic texts is used – (a) texts created by native speakers for native speakers. Authentic texts in this thesis also served as the initial unmodified text versions, which were then simplified (*see Chapters 5 through 7*). Authenticity is defined through the approach (a) in this thesis, as the other listed approaches could also characterise simplified texts depending on how they are being used and the response of the reader.

At the same time, the most commonly cited effect of text simplification is its impact on text comprehension (Long & Ross, 1993; Tickoo, 1993; Yano et al., 1994; Tweissi, 1998; Oh, 2001; Crossley et al., 2012; Crossley et al., 2014; Crossley & McNamara, 2016), which is discussed next.

2.6.1. Effect of text simplification on text comprehension

Previous research into text simplification generally supports the facilitative effect of this practice on text comprehension. Yet, some results are contradictory, as reflected in Table 1 in the previous section. Long and Ross (1993), as well as Yano and colleagues (1994) conducted research with over 400 non-native English readers reading simplified and authentic versions of texts in English. In these studies, two simplification conditions were used – simplification of surface-level text features (reduced clause length and utilisation of high-frequency vocabulary) and simplification through elaboration (providing explicit additional details about the information described in the text). The authors found that text

comprehension, assessed by a multiple-choice test, was higher in both simplification conditions, as compared to participants reading the authentic unmodified version. Nonetheless, text comprehension was the highest among participants in the first simplification condition, but not significantly different from those reading the elaborated version. The question that remained unanswered in these studies was whether simplification based on cutting sentence length and changing the word frequency only assisted readers in extracting surface-level literal information from the text, or whether it also stimulated the depth of processing by encouraging a more active inference making.

Oh (2001) conducted a follow-up study with a similar research design; 180 non-native English readers were assigned to an authentic and two simplification conditions (surface-level and elaboration simplification). The study, however, provided contradicting results to those of Long and Ross (1993) and Yano and colleagues (1994). Oh (2001) showed that it was the elaborated simplification condition in which participants had the highest and statistically significant difference in text comprehension scores.

A different research design was used in the text simplification study of Tweissi (1998). The author looked at the approach to and amount of text simplification that would bring 200 intermediate proficiency non-native English readers to the highest scores on the text comprehension test. The study operated five text conditions:

- a) an authentic version;
- b) fully simplified version with the highest number of modifications that included both lexical (changing word frequency), syntactic (shorter sentences, 'transparent structures', Tweissi, 1998, p. 195) modifications;
- c) semi-simplified version with half the amount of parts simplified at the lexical and syntactic level;
- d) simplified version with only lexical modifications;
- e) simplified version with only syntactic modifications.

In line with the previous two studies (Long & Ross, 1993; Yano et al., 1994), Tweissi (1998) also showed that all groups that read the simplified versions scored higher on the multiple-choice comprehension test, as compared to those who read the authentic version. However, when comparing the test scores between the different conditions, the study revealed no statistically significant difference between conditions *b* and *c* (fully and semi-simplified), as well as between conditions *d* and *e* (lexical and syntactic simplifications). The study found a statistically significant difference between conditions *b* and *d* (fully simplified

and lexical simplification), suggesting that simplification at the lexical level has the highest positive effect on text comprehension of non-native English readers.

Besides measuring readers' text comprehension through multiple-choice tests, some text simplification studies explored the effect of this practice by using text recall measures. For example, Crossley and McNamara (2016) assessed the text comprehension of beginning, intermediate-level simplified texts and authentic texts among non-native English readers engaged in a text-retelling task. The results of the study demonstrated that simplified texts led to greater information recall and text retention with beginning level texts leading to the greatest number of information units recalled among the three text groups.

Another line of research on text difficulty is the investigation of the effects of text cohesion on readers' text comprehension (e.g., McNamara, 2001; Reed & Kershaw-Herrera, 2016). The results of such studies informed research on text complexity, where the analysis based solely on surface-level text features (namely, word and sentence length) was questioned, and the analysis started to account for text cohesion features as well (see *Section 2.4*). To elaborate on the effect of text cohesion, Reed and Kershaw-Herrera (2016) conducted a study with 103 native English readers. Participants read versions of the same two texts but were assigned to four conditions:

- a) challenging readability (as measured by surface-level text features: word and sentence length), high cohesion;
- b) easier readability, low cohesion;
- c) challenging readability, low cohesion;
- d) easier readability, high cohesion.

The study showed that participants performed best on the multiple-choice comprehension test with a statistically significant difference in test scores in condition *d*. The authors concluded that text comprehension is dually influenced by a text's surface-level features and cohesion. Studies on this topic conducted with non-native English readers remain to be limited.

Besides inconsistent evidence concerning the effect of text simplification on text comprehension, another gap in the research on the topic is the dearth of understanding of the level of English proficiency at which non-native English readers experience the highest gains from simplified texts. A number of studies have revealed a robust effect of language proficiency, and particularly vocabulary knowledge, on text comprehension (e.g.,

Yamashita & Shiotsu, 2015; Crossley & McNamara, 2016). There is a strong relationship between readers' English proficiency and their text comprehension scores, with more proficient readers exhibiting better comprehension. Research evidence seems to support the notion that simplified texts are best suited for lower-proficiency non-native English readers (e.g., Crossley et al., 2014; Crossley & McNamara, 2016). However, these results are inconsistent with the earlier study of Oh (2001), who reported that simplified texts showed significant comprehension gains over authentic texts for high English proficiency readers, but not for low proficiency readers.

A potential explanation for the inconsistency of results in text simplification research might be the fact that most studies conducted on this topic have not controlled for other individual and text factors that influence text comprehension. One such individual factor is the reader's background knowledge of the topic of the text. This factor has been theorised as playing a strong role in how the reader constructs meaning in the text (Davis, Huang & Yi, 2017). From a schema-theoretic perspective, background knowledge is thought to provide an ideational scaffold for the reader. Reading the information in the text that fits the knowledge about the topic the reader already possesses results in superior comprehension and learning of that information (Anderson, Spiro, & Anderson, 1978).

Another individual factor that has been shown to have significant effects on text comprehension independently of background knowledge is the reader's interest in the topic of the text (e.g., Schiefele, 2009; Renninger & Hidi, 2016). In the literature on interest, there is a distinction between individual interest and situational interest (Renninger & Hidi, 2016; Catrysse et al., 2018). Individual interest refers to the reader's habitual interest in a specific topic domain. In contrast, situational interest is a more short-lived state that is induced by the characteristics of the text (Schiefele, 2009). There is a debate on whether topic interest is a form of individual interest or situational interest. Some researchers believe it can be an indicator of both types of interest (e.g., Catrysse et al., 2018). In any case, both types of interest were shown to have a positive influence on text comprehension (Schiefele, 2009; Catrysse et al., 2018).

Finally, among the text factors that affect text comprehension is the organisational structure of the text, such as narrativity and exposition (Sáenz & Fuchs, 2002; Kraal, Koornneef, Saab & van den Broek, 2018). Narrative and expository texts mainly differ in the degree of causal coherence of information (Kraal et al., 2018). Texts with narrative structure unfold as a story, have a higher cohesion and feature characters with goals and

motives, have event sequences, and themes (Berman & Slobin, 1994; Primor, Pierce & Katzir, 2011). In contrast, expository texts are more topic-oriented and deal with more abstract concepts and ideas. These types of texts feature lower cohesion, where ideas are linked through often implicit logical relations (Berman & Katzenberger, 2004). Research has found that expository texts are harder to comprehend and to retell or recall as compared to narrative texts (Sáenz & Fuchs, 2002).

While these factors, namely English language proficiency, background knowledge, topic interest, and text organisational structure, were reported to influence text comprehension in addition to the difficulty level of the text, most studies on text simplification did not control for these factors. Notable exceptions are Crossley and colleagues (2014), and Crossley and McNamara (2016). In these studies, the authors randomly assigned 49 non-native English readers to three experimental conditions: reading authentic texts, reading texts simplified to intermediate English language proficiency level, and texts simplified to the beginner level. Besides reading the texts, participants in the study also completed a background knowledge survey, reading proficiency test, and answered yes/no comprehension questions (in Crossley et al., 2014), or completed a text retelling task (in Crossley & McNamara, 2016). The results of these studies showed that the effect of simplification on text comprehension (true/false comprehension scores, text recall) remained significant when accounting for language and reading proficiency, and background knowledge. Participants comprehended simplified texts significantly better than their authentic versions. However, Crossley and colleagues (2014) reported that this effect did not remain significant on reading time when including some of these factors as covariates in the analyses (*see Section 2.6.3 for the review of simplification studies on text processing*). While providing empirical evidence on the importance of controlling for these factors, Crossley and colleagues (2014), as well as Crossley and McNamara (2016) fell short of controlling for other aforementioned factors that were shown to influence reading, such as topic interest and text organisational structure. Controlling for more individual and text factors might provide a more refined understanding of the extent to which text simplification facilitates text comprehension.

Another shortcoming of the earlier text simplification studies is the usage of only one indicator of text comprehension – mainly the outcome indicator, which involves quizzing participants on the text (i.e., *the product of reading*). Studies that have assessed the effect of text simplification by using two or more qualitatively different indicators

appear to be very limited. One such indicator that can be assessed in parallel to text comprehension is text processing, which is described in the next two sections.

2.6.2. Text processing theories that informed this research

Reading is a complex cognitive activity that involves various levels of information processing, as the reader attempts to make sense of the text (e.g., lower- and higher-level processing in Khalifa & Weir, 2009; surface- and deep-level processing in Dinsmore & Alexander, 2016). Thus, research on reading does not only involve investigating the *'product of reading'*, which is text comprehension, but also the *'process of reading'*, which involves the interaction of those different levels of text processing (e.g., Spranger, Sandral & Ferrari, 2011; Alkhaleefah, 2017). An increasing number of studies investigate text processing through the use of eye-tracking (Conklin, Pellicer-Sánchez & Carrol, 2018). In the field of reading research, eye-tracking is defined as the real-time registration of an individual's eye movements, typically as they read the information on a computer screen with an eye-tracking technology integrated or attached to it (Godfroid, 2019) (*see Section 3.4.3*). Eye-tracking is also used as a stimulated recall interview technique in reading research, as part of which the recorded eye movements of the reader are played back to them after the reading task in order to stimulate the thoughts they were having during reading (e.g., Brunfaut & McCray, 2015; *see Section 3.4.2 for the detailed description of this method*).

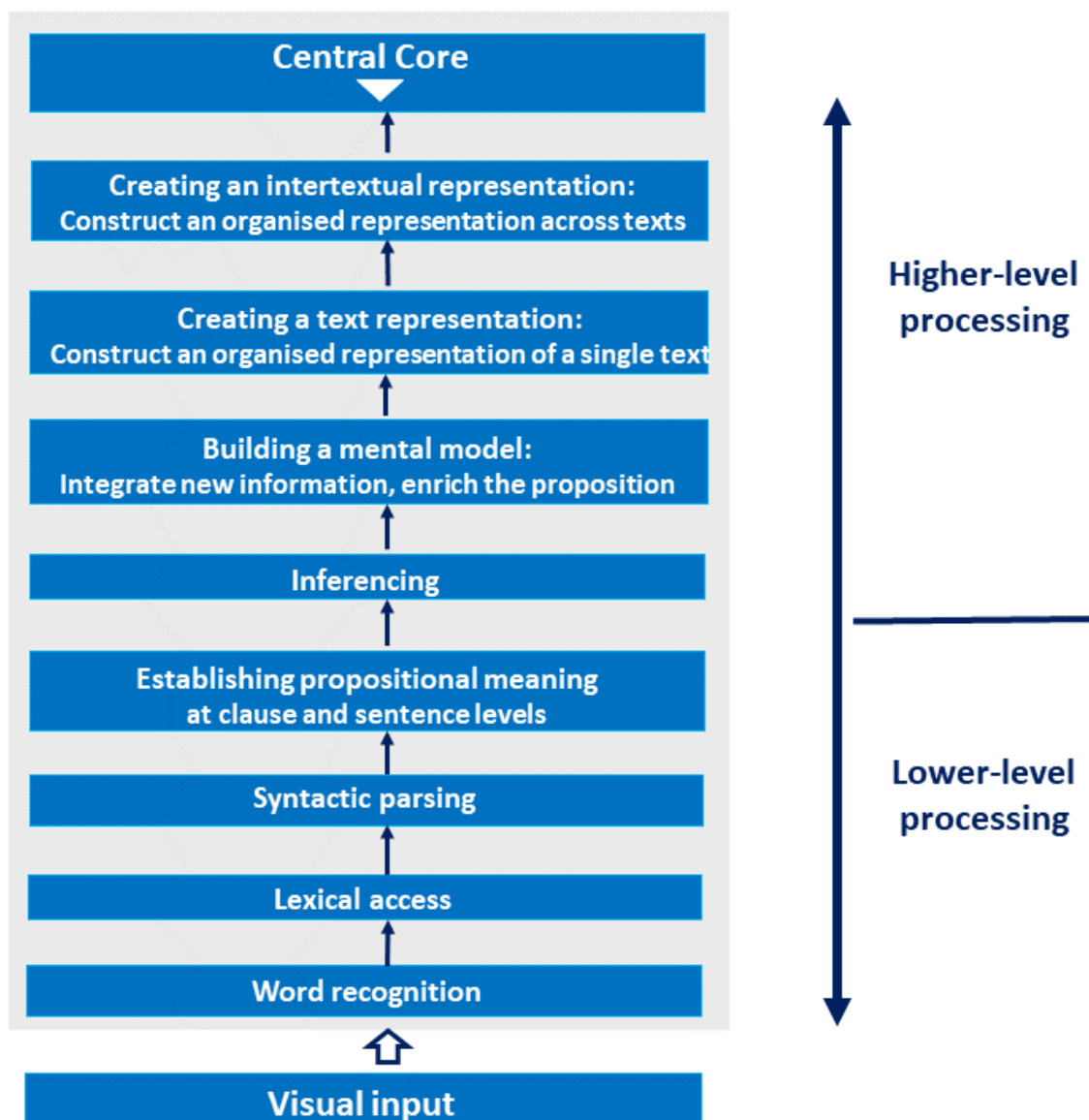
Conceptualisations of processing levels vary depending on the focus of the underpinning reading theory. This thesis is mainly informed by three text processing theories: the central core of the model of reading (Khalifa & Weir, 2009), the model of deep and surface processing during reading (Marton & Säljö, 1976; Dinsmore & Alexander, 2016), and automatic information processing theory (LaBerge & Samuels, 1974). As described by Catrysse and colleagues (2018), combining insights from several theories results in greater strength than relying on one single model. All three theories are particularly relevant for the linguistic accessibility research undertaken in this thesis as they assign a central role to the interaction between the text, the task, and the reader.

The central processing core of Khalifa and Weir's (2009) model comprises a hierarchical system of eight distinct cognitive processes, which are thought to tap into different levels of processing complexity and which by working together result in text comprehension:

- the so-called lower-level processes – word recognition, lexical access, syntactic parsing, and establishing propositional meaning;
- the higher-level processes – inferencing, building a mental model and creating a text level or intertextual representation (Khalifa & Weir, 2009; Brunfaut & McCray, 2015).

The distinction between lower- and higher-level processing has been made in the model in light of the fact that lower-level processing can become strongly automatised and not subject to conscious processing, as well as because higher-level processes are activated beyond the sentence level. Word recognition involves recognising the printed symbols (orthographic processing), sounding out the words in mind (phonological processing), and making use of information on expected grammatical forms (morphological processing). Lexical access concerns retrieval of information about the form and meaning of a word from the vocabulary stored in the reader's mind (the mental lexicon) to establish the word's meaning. Syntactic parsing involves the integration of the word at the clausal level. In parallel with these processes, the clauses and sentences are converted into units of meaning to establish propositional meaning. Readers may also bring in their own knowledge of the world, of the topic of the text, and of the text itself to bear on the comprehension of the text. This process is referred to as inferencing. The integration of individual propositions into the overall meaning framework of the text is called the building of a mental model. This may lead to the creation of a text level representation whereby the text is constructed as a hierarchy of ideas, allowing the differentiation of the gist of the text. Finally, information from multiple text sources may be combined to create an intertextual representation. The central core of Khalifa and Weir's (2009) model is visualised in Figure 4 below.

Figure 4. Model of cognitive processing in reading (Khalifa & Weir, 2009, p. 43)



Another relevance of Khalifa and Weir’s model (2009) for this research is its componential approach to researching text processing, which makes the model amenable to transformation into a research instrument to be used for data analysis and data coding purposes (see Chapter 5). Among the studies that explored text processing of non-native English readers and were both informed by this model and used it as a coding framework for qualitative data analysis is Brunfaut and McCray’s work (2015). The study used eye-tracking stimulated recall interview data to describe the kind of text processing participants were engaged in during reading in language test conditions. The study showed that the entire range of cognitive processes, as specified by Khalifa and Weir (2009) (except for intertextual representation), was used by participants while completing the test reading component. This suggested that the test quite comprehensively tapped into the construct

of reading. Furthermore, the study found some processing trends associated with participants' language proficiency, such as relatively more frequent use of syntactic parsing and paragraph-level representations, but less frequent use of lexical access processing by more proficient participants.

The second theory that underpins this research is the model of deep and surface processing during reading (Marton & Säljö, 1976; Dinsmore & Alexander, 2016). Similarly to Khalifa and Weir's model (2009) of reading, the model of deep and surface processing is relevant to this research due to its potential to inform the findings in this thesis and the feasibility to operationalise it through the adopted methods of data collection and analysis (see Chapter 7). The focal point of this model is the reader's intentionality during reading. In this model, text processing levels refer to the aspects of the text which the reader pays attention to during reading. Surface-level processing indicates that the reader has a reproductive conception of the text and directs their attention towards the features of the text itself. Deep-level processing indicates that the reader directs their attention towards comprehending what the author has to say, or what the features of the text signify (Marton & Säljö, 1976). Thus, the distinction between the two levels is similar to that between the intention to memorise vs. internalise the text (Dinsmore & Alexander, 2016). Previous research on the levels of processing during reading showed that deep processing activities include critiquing the text, linking the text to prior knowledge, paraphrasing parts of the text, interpreting information in the text, connecting the text to personal experiences, focusing on the main themes and elaborating. Surface processing activities refer to re-reading parts of the text, literally retelling, focusing on the details, and rehearsing (Schellings, van Hout-Wolters, Veenman, & Meijer, 2012; Dinsmore & Alexander, 2016; Catrysse et al., 2018).

A study informed by the model of deep and surface processing is Catrysse and colleagues (2018). The authors used eye-tracking methodology and stimulated recall interviews to examine how participants' levels of processing during reading shaped their learning from the text. For the eye-tracking data analysis the authors coded the sentences in the text as key (superordinate sentences that integrate several of the sentences in the paragraph, e.g., *'hope is the expectation that things will turn out in a good way in the future'*), detailed (sentences that give detailed information about a concept, e.g., *'recent research shows that 61% of people have good hopes to reach important goals in their live'*), and as sentences containing other information. The authors hypothesised that longer

second pass fixation durations (i.e., re-reading the text) would reflect deeper cognitive processing, and participants scoring higher on deep processing would reread key sentences longer than detailed sentences. This hypothesis was only partially confirmed, since the study showed that participants scoring higher on the depth of processing took less time for re-reading the text (i.e., for all sentence types). However, since the authors found that participants who used more deep processing spent more total processing time on key sentences than detailed sentences, in line with the study hypothesis, the authors concluded that there is an association between deep processing and focusing on the key sentences (Catrysse et al., 2018).

Finally, the research in this thesis is also informed by the automatic information processing theory (LaBerge & Samuels, 1974). A systematic literature review of text difficulty research (Amendum et al., 2018) showed that most of the reviewed text simplification studies (84%) were not situated in any explicit theoretical framework or did not explicitly articulate how theoretical frameworks undergird their study. The theory most often mentioned among the studies that did articulate their theoretical stance was LaBerge and Samuels' automatic information processing theory (1974). This theory describes how visual information in the text is transformed and processed by the reader through a series of stages until it is comprehended. Similarly to the model of deep and surface processing described earlier, this theory places attention at the heart of text processing at each stage during reading. The presumption in this theory is that individuals have a limited amount of attention available for any cognitive task, including the task of reading. Automatic word recognition, defined in the theory as quick and effortless identification of words out of context, leaves more available attention for text comprehension (LaBerge & Samuels, 1974). Following the premise of this theory, text simplification studies claim that replacing words in the text with the words more familiar to the reader, shortening sentences, and increasing text cohesion by providing explicit clear references between the ideas in the text leave more cognitive resources available to the reader for comprehending the text better (e.g., Crossley et al., 2012; Amendum et al., 2018).

The next section will summarise some empirical evidence on the effect of text simplification/text modification on text processing.

2.6.3. Effect of text simplification on text processing

To date, very limited research has explored text processing during the reading of simplified vs. authentic texts. One such study that looked at both text simplification, text comprehension and text processing is Crossley and colleagues (2014). The study's procedure and elicited effect of simplification on text comprehension has been described previously in Section 2.6.1. Participants' text processing in the study of Crossley and colleagues (2014) was evaluated mainly in terms of reading time (ms per word) by using the word-by-word moving window technique (*see Section 2.3 for the description of the technique*). The study revealed a significant effect of text level (beginner, intermediate, authentic texts) on reading time, with beginner level texts taking significantly less time to read than authentic texts. However, when reading proficiency was included as a covariate, the differences in reading time as a function of text level were no longer significant. The authors pointed out that reading proficiency tended to drive the reading times for non-native English readers, more so than the difficulty level of the text. Furthermore, as described previously in Section 2.6.1, the study revealed a significant effect of text simplification on comprehension. These results confirmed that the beginner level simplified texts were comprehended better than authentic texts, and these effects remained when reading, and language proficiency were included as covariates. Crossley and colleagues (2014) concluded that overall simplified texts were read more quickly, and they were better understood by non-native English readers than their authentic versions. While the focus on text processing in Crossley and colleagues (2014) provided an additional insight into the effect of text simplification on non-native English readers, the word-by-word moving window technique used in this study to assess text processing has a number of caveats. Studies that use this methodology have low ecological validity, as words and word combinations are presented to the reader one at a time. This limits natural engagement with the text by slowing down the reading rate and not allowing the individual to fixate multiple times on the elements in the text and reread them (Rayner, 1998). Moreover, since the word-by-word moving window technique only allows investigations into text processing during the first encounter of the text by the reader, exploration of the different levels of text processing is beyond the capacity of this methodology.

To my knowledge, no previous study has explored the effect of OER text simplification on text processing of non-native English readers and used methodologies different from the word-by-word moving window technique to evaluate this effect. Due to

very limited research on the topic, it is difficult to hypothesise what effect text simplification might have on text processing. Some insights can be drawn from the previous research that explored the impact of other types of text modifications and used eye-tracking (*see Section 3.4.3 for eye-tracking and the measures used in this thesis*).

Hyönä and Lorch (2004), as well as Ariasi and colleagues (2017) used eye-tracking to investigate the effect of different types of text modifications on text comprehension and text processing. Specifically, Hyönä and Lorch (2004) explored the effect of adding topic-headings to multi-topic texts. Ariasi and colleagues (2017) explored the effect of adding a refutation effect – refuting misconceptions the reader may hold about a phenomenon and presenting the correct scientific explanations. In both studies, participants read two texts on different topics – one text modified in a certain way (e.g., with or without headings in Hyönä & Lorch, 2004) and one authentic text. The eye-tracker was used to capture participants' eye movements, followed by a text recall comprehension check. The authors analysed the eye movement records for three types of sentences: a) topic-introducing; b) last sentences of each paragraph (topic-end); and c) all intervening sentences (topic-medial). In both studies, the analyses of comprehension scores showed that participants recalled more information from the modified texts.

Furthermore, the eye-tracking analyses in these studies supported the facilitative effect of text modifications. In Hyönä and Lorch (2004), the facilitative effect was linked to the reduced processing difference between topic-introducing and medial sentences. In the authentic texts, the first pass processing that corresponds to the initial processing of the text when the reader's gaze lands on the text during the first encounter was found to be longer for topic-introducing sentences as compared to the modified texts. The authors linked this effect to extra processing demands that these sentences impose on the individual. Hyönä and Lorch (2004) also hypothesised that an additional facilitative effect of headings would be an increase in topic wrap-up processing, as observed through extended processing time for end sentences. The study did not show support for this prediction. The authors concluded that the lack of extended processing time for end sentences might be due to the limitation of how the texts were presented to participants on the computer screen.

Similarly, the facilitative effect of text modification in the study of Ariasi and colleagues (2017) was linked to speeding up of initial text processing for both topic-introducing and topic-medial sentences. An additional facilitative effect in that study was

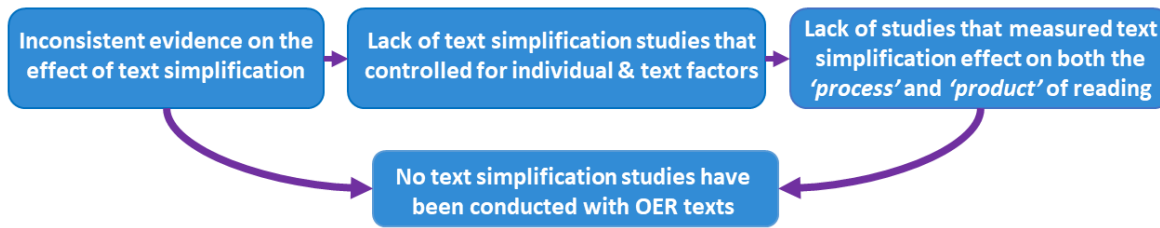
linked to longer fixation time for topic-end sentences in the modified texts as compared to the authentic texts. The integration of new information seemed to occur when participants were reading topic-end sentences that summarised the key points, unlike when reading the authentic texts. This was interpreted as the benefit of text modification (namely, refutation in a scientific text).

Mason, Pluchino, Tornatora and Ariasi (2013) used a different research design and explored the effect of adding concrete and abstract illustrations to scientific texts on text processing and comprehension of non-native English readers. Their study showed that at the immediate post-reading test on the topic of the text, participants who read the text illustrated by either a concrete or abstract picture outperformed the group of participants in the non-illustrated text condition. However, at the delayed post-reading test, the best learning gains were shown by the readers of the text illustrated with the concrete picture. The eye-tracking provided evidence for the support of using abstract pictures to facilitate text processing. This facilitative effect of the abstract illustration over the concrete one was found in a shorter reinspection (look-back) of the overall text for wrap-up processing.

Conclusively, Hyönä and Lorch (2004), Ariasi and colleagues (2017), and Mason and colleagues (2013) showed that the eye-tracking methodology can provide new insights into the effect of text modification. To the best of my knowledge, no previous study has combined traditional comprehension check methods with eye-tracking methodology to explore the effect of text simplification on non-native English readers' processing of OER texts. Eye-tracking can supplement traditional comprehension check methods in a way that it allows to measure participants' text processing throughout the whole reading of the text, rather than in recall as captured by comprehension tests (Godfroid, 2019). Thus, combining eye-tracking, as a direct measure of the processing effort during reading (*'process of reading'*), with traditional comprehension checks as a recall measure (*'product of reading'*), can yield a more in-depth understanding of the effect of text simplification.

The contribution of this thesis towards filling the aforementioned gaps in linguistic accessibility research when the latter is conceptualised through text difficulty is visualised in Figure 5 below.

Figure 5. Gaps in text difficulty research addressed in this thesis



In addition to the gaps in linguistic accessibility research as conceptualised through text complexity and task difficulty described previously in Sections 2.4 and 2.5.2, this thesis also addresses gaps visualised in Figure 5 above. Evaluating the effect of text simplification on non-native English readers by looking at both the ‘process’ and ‘product’ of reading, while controlling for individual and text factors, can provide a more comprehensive understanding of this practice and resolve some inconsistencies evident in the previous research on this topic. Since, to the best of my knowledge, no previous research on text simplification has been conducted in the OER context, a particular contribution of this thesis is the use of OER texts as study materials.

Given these gaps and motivations, this thesis adopted the following two research questions. As mentioned in Section 2.4, since both research questions focused on text difficulty and non-native English readers’ response to the text, they are grouped together below. RQ2 aimed to obtain some emerging evidence on the presence or absence of text simplification effect. RQ4 aimed to evaluate the effect of text simplification performed in line with the strategies elicited as part of RQ3 (see Section 2.5.2).

RQ2: What is the effect of text simplification on text processing, as evidenced in the frequency of use of cognitive processing strategies by non-native English readers?

RQ4: What is the effect of text simplification on text comprehension and text processing among non-native English readers when English proficiency, background knowledge, and topic interest are controlled?

Together, these two research questions provided an empirical analysis and critical evaluation of the effect of text simplification on non-native English readers. This added to current knowledge by suggesting that text simplification can be a potential solution to increase the linguistic accessibility of OERs globally.

2.7. Chapter summary

In this thesis, linguistic accessibility is conceptualised through text complexity, task difficulty, and text difficulty (Amendum et al., 2018). In summary, this thesis addressed several gaps in the recent research related to the text complexity of OERs across the educational levels and subjects, the analysis of the approaches a sample from the expert population takes to simplify texts, as well as the critical evaluation of the effect these approaches have on non-native English readers. Altogether, this chapter has provided an in-depth summary of up-to-date research and the essential gaps that led to the four research questions. Having identified a particular gap around the linguistic accessibility of OERs, this chapter identified how extensions to current research around text comprehension and processing could be applied to address this gap.

Chapter 3 will next describe the overarching research methodology adopted in order to meet these goals.

3. Methodology

3.1. Introduction

Chapter 2 provided a critical overview of literature on OER accessibility and text simplification, highlighting the key gaps, and the research questions addressed in this thesis. As stated in Section 1.3, this thesis consists of four studies, which are presented in Chapters 4 through 7. A detailed report of the specific methods for each study is provided in its corresponding analysis chapter. Therefore, this chapter outlines the overarching methodology and methods that formed the basis of the research design of the thesis, and which were adopted across the four empirical studies.

The choice of specific research methodologies and methods is informed by the research questions which were raised in Chapter 1. These are:

RQ1: To what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

RQ2: What is the effect of text simplification on text processing, as evidenced in the frequency of use of cognitive processing strategies by non-native English readers?

RQ3: What approaches and strategies to text simplification do English teachers employ when intuitively simplifying OER texts for lower-level proficiency non-native English readers?

- **RQ3a:** Does the mother tongue have an effect on the choice of text simplification strategies, as perceived by English teachers?

RQ4: What is the effect of text simplification on text comprehension and text processing among non-native English readers when English proficiency, background knowledge, and topic interest are controlled?

In this chapter, Section 3.2 describes the philosophical underpinnings and the overarching methodology. Section 3.3 outlines the research design of the thesis. Section 3.4 provides an in-depth discussion of each method of data collection, and Section 3.5 describes quantitative and qualitative data analysis methods employed in the empirical studies. Section 3.6 justifies the validity, trustworthiness, and legitimation of this research. Finally, Section 3.7 addresses ethical considerations.

3.2. Philosophical underpinnings

The importance of describing the overarching philosophical underpinnings of research has been widely recognised, as such understanding and description facilitate meaningful interpretation of research results as well as shed light on the decisions made that affect research outcomes. These decisions are underpinned by some key philosophical principles. As Pring (2000) argues, an examination of such principles clarifies the premises on which the arguments are based that justify research processes and findings.

In this thesis, several philosophical underpinnings are important to the design of the four research studies. In Section 3.2.1., the pragmatic paradigm is described, followed by a discussion of mixed methods as a methodology in Section 3.2.2.

3.2.1. Pragmatic approach

When designing a research study and deciding on specific research methods to use, it is crucial to consider which methodological and philosophical assumptions best address the research questions (Mittelmeier, 2017). A detailed discussion of the research questions, which are driving this thesis, and which are based on the motivation for this research and on the results of the literature review, were outlined in Chapter 2, as well as in Chapter 1, Section 1.2.

A set of philosophical assumptions that guide researchers in their decisions during the research inquiry process is generally referred to as a 'research paradigm'. However, there is an ongoing debate on what constitutes a paradigm (e.g., Freshwater & Cahill, 2013; Shannon-Baker, 2016). Some scholars choose an 'aparadigmatic' approach to research. For example, Alise and Teddlie (2010) reviewed 600 mixed methods studies published across five journals on nursing, education, sociology, and psychology. They found that only one article explicitly stated the paradigm used (pragmatism). 'Aparadigmatic' researchers argue that paradigms are an unhelpful concept in that they marginalize other beliefs and restrict all aspects of research (e.g., Biesta, 2010; Greene & Hall, 2010; Maxwell, 2011).

In this research, a paradigm is viewed not as a static, unchanging entity but rather as a conceptual framework that can help find an approach to a research problem and offer suggestions for how to address it. In line with Morgan, in this thesis 'paradigm' is conceptualised as 'a system of beliefs and practices that influences how the researcher selects both the questions they study and methods that they use to study them' (2007, p. 49).

Table 2 in the next page provides a comparative summary of five commonly used research paradigms. It also includes their underlying ontologies (beliefs on the nature of reality) and epistemologies (beliefs on how knowledge is constructed) (Bryman, 2012), the relationship between the researcher and reality, as well as some corresponding examples related to the methods of data collection and analysis.

Table 2. A brief overview of common research paradigms

	Positivism	Interpretivism/ Constructivism	Subjectivism	Critical realism	Pragmatism
Ontological views	There is one single external reality	There is no single reality because the researcher and the reality are inseparable	There is no single reality because realities exist as intangible mental constructions	The reality is stratified. The appearances of reality differ from underlying mechanisms, but mechanisms leave observable traces	There can be single or multiple realities that are open to empirical inquiry
Epistemological views	Reality is explained through valid, reliable tools	Reality is created and/or understood through 'perceived' knowledge	Reality is interpreted from the perspective of the individual researcher	Reality is discovered through facts, events, and 'perceived' experience	Reality is explored by the method that suits the problem best
Researcher's relationship to reality	Researcher is detached, external observer	Researcher is an attached, internal observer	Researcher is grounded in the context and has a strong relation to the community involved	Emphasised relationships throughout; complete objectivity is not possible	Reality exists both independently from the researcher and is interpreted by the researcher in light of their lived experience
Methods of data collection	Experiments Scales Tests	Interviews Observations Visual data analysis	Discourse Deconstruction Journals	Action Research Design-based research Mixed methods	Mixed methods
Methods of data analysis	Quantitative analysis Content analysis	Qualitative analysis Grounded Theory	Qualitative analysis Literary analysis	A combination of quantitative and qualitative methods	A combination of any of the methods that can help find practical solutions

(Based on Bryman, 2012; Shannon-Baker, 2016; Creswell & Creswell, 2017; Mittelmeier, 2017)

Considering the complex nature of the research questions in this thesis that approach linguistic accessibility from three diverse perspectives (*see Section 2.3*), it follows that they can be addressed from the standpoints of multiple research paradigms. On the one hand, exploration of text complexity of OERs, and investigation of the impact of text simplification on non-native English readers yield numeric data. Quantitative methods of data analysis are best suited to explore these research problems. Since the assumption is made that the text complexity of reading materials and impact of text simplification can be measured with reliable tools and/or testing, this assumption falls within a positivist research paradigm. On the other hand, identification of English teachers' approaches to OER text simplification and their perceptions concerning the effect of their language background on this practice yield data in the form of multiple individual narratives, and qualitative methods of data analysis are best suited to explore this research problem. Such narratives are subjective, individually constructed, and cannot be represented by one single reality.

Exploring OER text complexity and impact of text simplification in isolation from the language teaching and foreign language reading context would be one dimensional and rather descriptive. At the same time, a solely subjective perspective of English teachers and non-native English readers on text simplification would not have enabled conducting comparisons across larger groups. It would have generated only recall data rather than process data of participants' engagement with the simplified texts. Finally, it would not have provided a full picture of the potential influence of the confounding factors on OER comprehension.

Therefore, to be able to address these complex and multidimensional research questions, and to expand the scope of this research, the flexibility of the pragmatic approach with a mixed methods methodology was needed. The flexibility of pragmatism manifests itself in its acceptance of multifaceted realities that can be studied through both objective measures and 'perceived' knowledge (Creswell & Creswell, 2017). Pragmatism embraces both positivist perspectives with quantitative methods and deductive reasoning, and constructivist perspectives with qualitative methods and inductive reasoning. It, thus, provides a more flexible, reflexive approach to research design (*see Table 2*). In that sense, pragmatism frees researchers from being 'the prisoners of a particular [research] method or technique' (Robson, 1993, p. 291).

Another characteristic of pragmatism is its focus on solving practical problems in the real world. Deriving from the Ancient Greek stem *pragma* – ‘act’, it emerged as a research method for more practical-minded researchers (Creswell & Clark 2011), for whom research is only effective if it achieves its purposes (Kaushik & Walsh, 2019). The research questions in this thesis also address a specific practical problem – how to make OER course materials more linguistically accessible to non-native English readers. Finding the solution to this problem might help non-native English readers around the world (Beare, 2018) by easing their reading burden when they try to learn from OERs in English.

Since the pragmatic paradigm places the practical research problem as central and ‘brushes aside the quantitative/qualitative divide’ (Feilzer, 2010, p. 14), it is seen as an underlying philosophical framework for the mixed methods research (Tashakkori & Teddlie, 2003; Somekh & Lewin, 2005). With this in mind, Section 3.2.2 provides an overview and justification for using mixed methods as a methodology in this thesis.

3.2.2. Mixed methods as a methodology

Many scholars emphasise that absolute links do not exist between certain philosophies and research methods (e.g., Tashakkori & Teddlie, 2003; Clark & Ivankova, 2015). However, it is widely argued that the focus in mixed methods is on practical, procedural issues about how to combine the strengths of qualitative and quantitative methods (e.g., Creswell, 2014; Clark & Ivankova, 2015). Therefore, mixed methods methodology is considered to build on pragmatism due to the latter’s appeal to practicality and flexibility.

As defined by Creswell and Clark, ‘mixed methods research is a methodology that

- focuses on research questions that call for real-life contextual understandings, and multi-level perspectives;
- employs rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research exploring the meaning and understanding of constructs;
- utilizes multiple methods (e.g., experiments and in-depth interviews); and
- intentionally integrates or combines these methods to draw on the strengths of each’ (2011, p. 4).

This definition of mixed methods provides motivation for the use of this methodology to explore complex research topics, such as the linguistic accessibility of OERs

to non-native English readers. The opportunity to draw on the strengths of each method mentioned in the definition allows the researcher to increase the legitimation, or quality of the interpretations drawn from the results (Onwuegbuzie, Johnson & Collins, 2011) through triangulation. Triangulation is the process of comparing the results from the quantitative and qualitative methods to check for convergence and divergence (Clark & Ivankova, 2015). It also enables an increase in interpretability and meaningfulness of the results by elaborating, illustrating and clarifying the results from one method with the results from another. Finally, it allows the researcher to increase the breadth and depth of results and their interpretations by discovering potential contradictions and exploring surprising results from one method by employing another (Greene, Caracelli, & Graham, 1989). A different frequently mentioned rationale for the use of mixed methods is their potential to inform the overall research design by using the results from one method to optimise sampling, research instruments and protocols for further data collection as part of the research study (Collins, Onwuegbuzie & Sutton, 2006). The advantages inherent to mixed methods research are summarised in Table 3 below.

Table 3. Advantages of mixed methods highlighted in the methodological literature

Rationale	Explanation
Completeness	Obtaining a more comprehensive contextual and refined account of the research topic by using quantitative and qualitative methods
Validity and credibility of results	Increasing validity and enhancing the integrity of the findings by employing the two methods
Sequential contributions	Using the results from one method to help inform the research procedures and implementation of another method
Exploration of unexpected results	Understanding surprising results from one method by employing another
Expansion of the research scope	Increasing the scope of the study by using different methods for different study components

(Based on Clark & Ivankova, 2015; Greene et al., 1989; Collins et al., 2006)

As such, the mixed methods methodology was advantageous in this thesis due to the focus of this research on a specific practical problem of linguistic accessibility of OERs to non-native English readers. Another advantage of using mixed methods was the opportunity it provided to explore this research problem from multiple perspectives: by investigating text complexity of OERs, exploring English teachers' practices of simplifying OER materials and analysing non-native English readers' behaviour in response to OER

simplification. Furthermore, mixed methods research speaks to different audiences, which allows a wider dissemination of the research results.

Apart from its numerous advantages, it is recognised that the mixed methods methodology, like all methodologies, has its inherent weaknesses. One practical limitation is a large amount of time that an in-depth and multi-layered mixed methods study requires from the researcher (Mittelmeier, 2017). However, the full-time PhD scholarship allowed me to fully focus on the four studies conducted as part of this thesis. Secondly, mixed methods require a variety of resources to collect data from multiple sources (Clark & Ivankova, 2015). In this research, data were collected at different points from two different OER platforms, from a sample of 24 English teachers, as well as from two groups of non-native English readers. Taking into account the premise of mixed methods to employ rigorous quantitative and qualitative methods, another weakness or difficulty of this methodology is the need for the researcher to be highly competent in a wider range of data collection and analysis methods. The lack of such competence can potentially compromise the robustness and reliability of the research. To compensate for this, I took a number of courses on quantitative and qualitative methods during my PhD to develop a more well-rounded knowledge about these methods. Steps were also taken to cross-validate the research methods of the four studies in this thesis, as well as to analyse the legitimisation of the findings (*see Section 3.6*).

Additional criticism of mixed methods concerns the danger of tokenism, particularly as this methodology is becoming increasingly more popular. There is a danger that deploying multiple methods in a single project comes to be seen as good in itself, irrespective of the logic of their combination (or lack thereof) (Froehlich, Rehm & Rienties 2020). To mitigate this risk, it is recommended to consider several aspects specific to mixed methods (Creswell, 2014; Clark & Ivankova, 2015). One common theme across these recommendations is the order in which data are collected. As Creswell (2014) elaborates, there can be different types of research designs in mixed methods studies depending on the order of data collection:

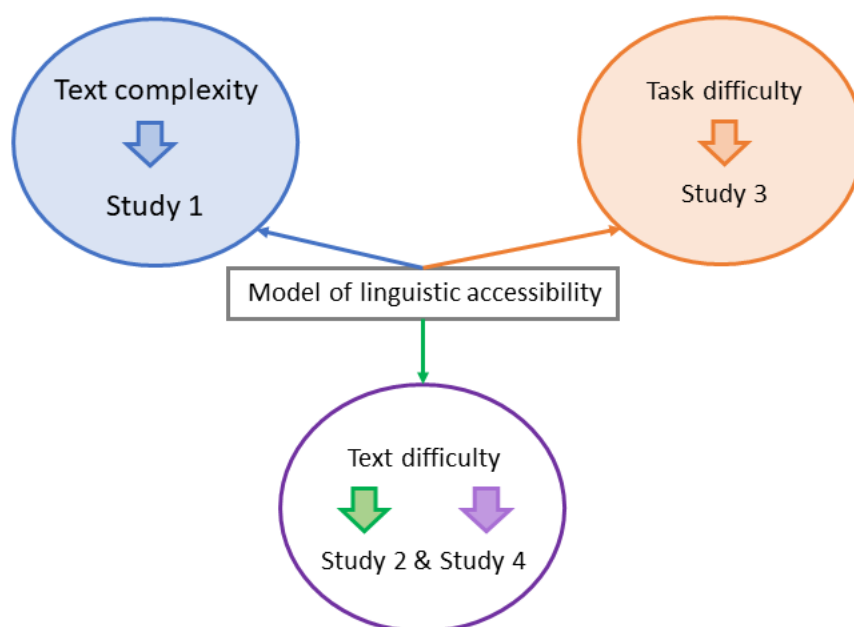
- *convergent* research design/*concurrent* data collection, as part of which the researcher collects and analyses quantitative and qualitative data at the same time, and then merges the two analyses to compare and triangulate the results;
- *explanatory* research design/*sequential* data collection, as part of which the researcher first collects and analyses quantitative data and then collects qualitative

data in the later stages of the research project, which helps explain the quantitative results in more depth;

- *exploratory research design/sequential data collection*, as part of which the research first explores the problem with qualitative methods, where there is limited evidence in research literature concerning the research problem or population, and then uses the qualitative findings to build a second quantitative phase of the project.

In this thesis, the order of data collection was thus carefully considered as part of the research design, and specifically, how different methods could build upon each other. As mixed methods research can incorporate several features of the three basic designs described above (Creswell, 2014), in this thesis, advanced *multistage evaluation design* was used. This research was conducted in four stages over time with the central objective of exploring and evaluating the linguistic accessibility of OERs to non-native English readers. Within this objective, four separate studies were used (*see Figure 8 and Figure 9*). The first stage of the research involved problematisation of the linguistic accessibility of OER course reading materials by exploring their text complexity level (Study 1). The second stage involved obtaining emerging evidence on the impact of text simplification on text processing among non-native English readers (Study 2). The third stage involved developing a conceptual framework, which served as the guidelines for OER text simplification. This was achieved by exploring experienced English teachers' practices of simplifying OER texts to non-native English readers (Study 3). The last stage comprised of a testing study (Study 4), which investigated the effect of the collated text simplification guidelines on non-native English readers' text comprehension and text processing (*see Section 3.3 for a more detailed overview of the research design*). Furthermore, as mentioned above, this thesis aimed to examine linguistic accessibility from three different perspectives, namely text complexity, task difficulty, and text difficulty (*see Section 2.3*), to arrive at a more well-rounded understanding of this notion. Operationalisation of linguistic accessibility in the four empirical studies in this thesis is visualised in Figure 6 below.

Figure 6. Operationalisation of linguistic accessibility using mixed methods



Note: the colours in this figure that illustrate the four studies were chosen randomly and correspond to the colours used in Figures 7-9 in Section 3.3.

Besides the order in which data are collected, two other considerations of mixed methods designs are the priority, or relative importance assigned to qualitative and quantitative methods, and mixing, or explicit interrelation of the quantitative and qualitative methods in producing integrated conclusions. The priority of the quantitative and qualitative methods of data collection and analysis is driven by the types of research questions the study aims to answer as well as the emergent study results (Murphy, 2020). In this thesis, equal priority was assigned to the methods used as both types of data played an equally important role in answering the research questions.

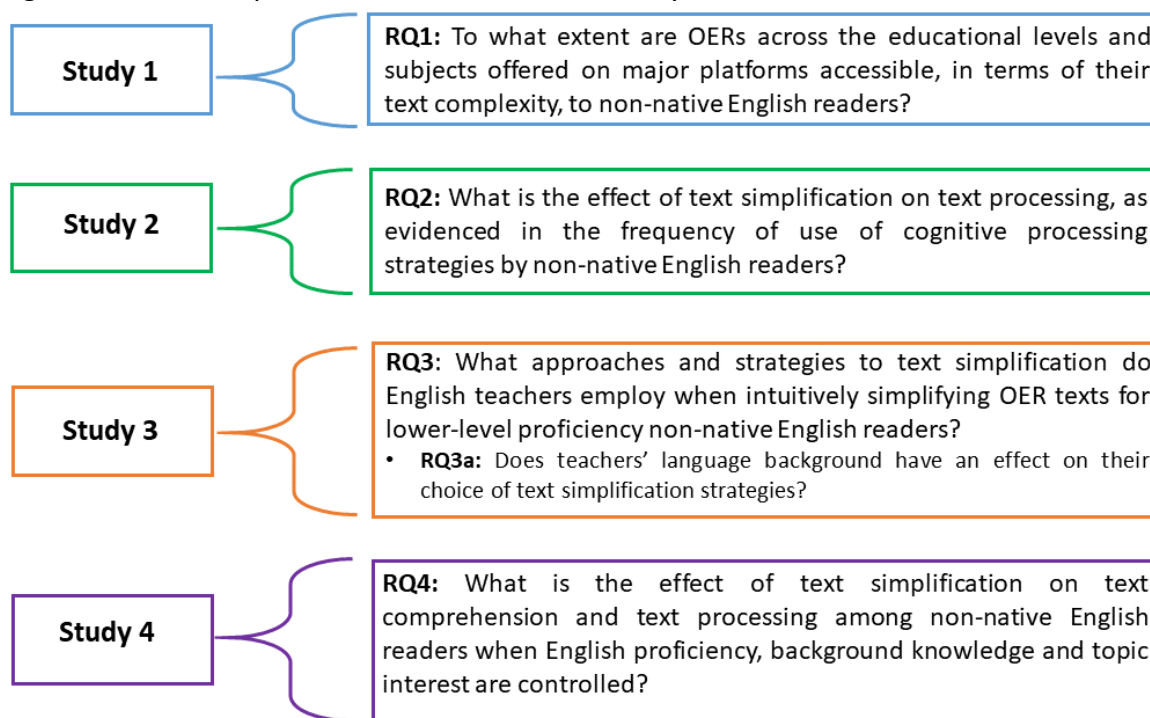
The consideration of mixed methods research outlined above – a clear understanding of how the two types of methods mix – constitutes, perhaps, the most challenging aspect of designing and subsequently reporting mixed methods research. Integration can then take several forms: merging, explaining, building, and embedding, depending on the type of research design. In this thesis, integration mainly consisted of building on and expanding one stage of research into other stages over time. To facilitate the development of such an understanding of how data were collected and combined, and additionally to facilitate readers' understanding of these processes, a visualisation of the research design has been suggested (Creswell, 2014; Murphy, 2020). Research design visualisation intends to demonstrate the relative importance of qualitative and quantitative data and detail the procedures of each stage in the research.

A review of the research design together with the relevant visualisations, and a review of the methods adopted to meet these goals are provided in Sections 3.3 and 3.4 below.

3.3. Research design

This thesis addressed four research questions (see Section 1.2 and Chapter 2) through four interlinking studies. Figure 7 below demonstrates the research questions that each study addressed.

Figure 7. Research questions addressed in each study



As also briefly outlined in section 3.2.2, the multiple stages of this research included four studies. Study 1 served the purpose of problematising the linguistic accessibility of OERs to non-native English readers through the analysis of text complexity of reading materials from 200 courses on two well-established OER platforms.

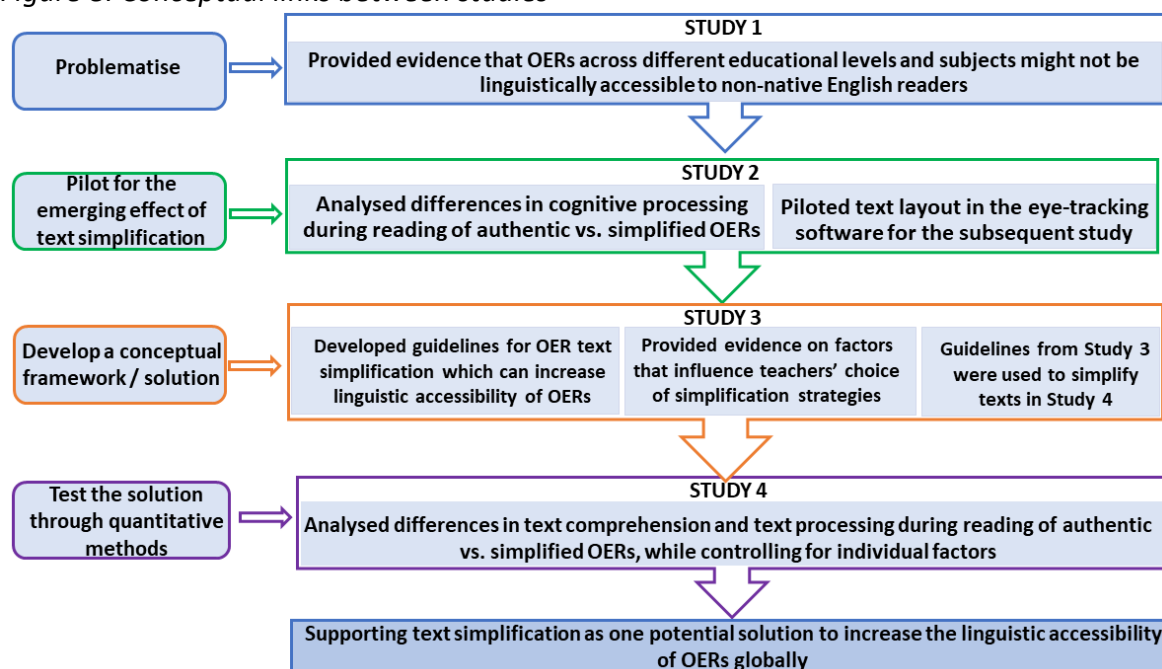
Study 2 served the purpose of piloting a potential solution for increasing the linguistic accessibility of OERs to non-native English readers. Study 2 analysed the effect of text simplification on nine non-native English readers at the lower level of English proficiency who read authentic and simplified OERs. Eye-tracking stimulated recall interviews used in this study allowed a comparison between the types of processing strategies verbalised by participants across the two text conditions. Study 2 also served as

an exploratory study to pilot the design and layout of the study materials for the subsequent eye-tracking study.

Study 3 served the purpose of developing a conceptual framework. It aimed to put together the guidelines for OER text simplification as a potential solution for making OERs more linguistically accessible to non-native English readers. This study used qualitative stimulated recalls and semi-structured interviews with 24 experienced English teachers from different language backgrounds. Study 3 also aimed to identify whether English teachers' language background has any effect on their choice of text simplification strategies, as perceived by participating teachers themselves.

The effectiveness of the elicited guidelines to text simplification was analysed next in Study 4. This study investigated the effect of text simplification by using comprehension scores of 37 non-native English readers at different levels of English proficiency as indices of text comprehension and eye-tracking measures as indices of text processing, while controlling for individual factors. In doing so, the studies filled important gaps in current knowledge, as discussed in Chapter 2 in this thesis. This conceptual relationship between the four studies is summarised in Figure 8 below.

Figure 8. Conceptual links between studies

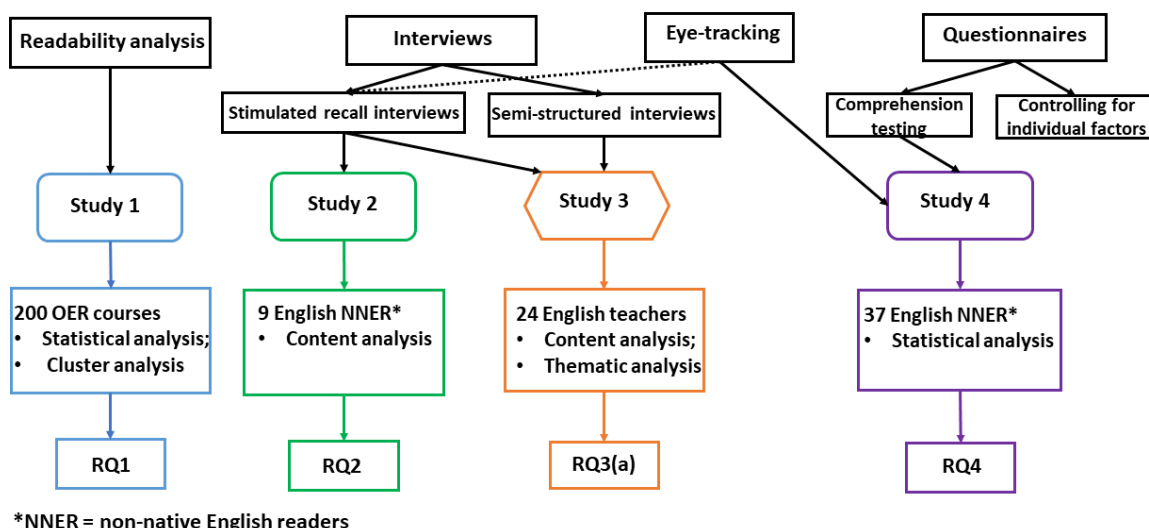


To summarise, mixed methods research design enabled an exploration of the research problem of the linguistic accessibility of OERs to non-native English readers from multiple perspectives (as outlined in Section 3.2.2). The pragmatic approach (described in

Section 3.2.1) allowed choosing research methods of data collection and analyses that can best address individual research questions. Data collection methods included readability analysis, interviews (stimulated recalls and semi-structured interviews), eye-tracking, and questionnaires (see Section 3.4).

As recommended by Creswell (2014), it is helpful to visualise how the methods of data collection and data analyses correspond to one another in the mixed methods research, since the procedure of bringing together different data sources can be quite complex. This was true in the case of this thesis as well, in which several types of data sources were analysed in the four interlinking studies. Figure 9 below maps out the relationship between the data collection methods used, study components, data sources, methods of data analyses, and research questions.

Figure 9. Visualisation of mixed methods used in this thesis



Note: a hexagon is used for Study 3 in the figure to mark that both quantitative and qualitative data analysis methods were employed in the study

As this research involved multiple and diverse sources of data collection (OER courses, English teachers, and two groups of non-native English readers), the detailed description of these sources and the description of the participant sample are provided in the respective analysis chapters (*Chapters 4 through 7*). Section 3.4 next discusses and justifies the use of each data collection and data analysis method in relation to the research questions.

3.4. Data collection methods

As can be seen from Figure 9 above, four main data collection methods were used in this thesis, namely readability analysis, interviews, eye-tracking, and questionnaires, which are discussed in Sections 3.4.1 through 3.4.4 next.

3.4.1. Readability analysis

RQ1 in this thesis was concerned with the extent to which reading materials from two OER course platforms are accessible to non-native English readers in terms of their text complexity level, as well as with potential differences in their complexity across OERs at different educational levels (e.g., introductory vs. advanced) and subjects (e.g., Science, Technology, Engineering, and Mathematics or 'STEM' courses). As described in Section 2.4, this research topic has not been previously explored in the OER context. However, the existing studies that investigated accessibility of other types of online educational materials used readability analysis to determine the language level of these resources (e.g., Jatowt & Tanaka, 2012; Berendes et al., 2018; Xie et al., 2018). By using quantitative measures, readability analysis allows the researcher to explore a large number of course materials, which fits well with the overarching problematisation purpose of Study 1 in this research.

As has been described in Section 2.4, readability analysis involves an evaluation of linguistic factors, and mainly semantic and syntactic features of the text, such as word length, word frequency and sentence length (Harrison, 1980; Crossley et al., 2008; Berndt & Wayland, 2014). These surface-level text features also serve as the basis of a range of readability formulas (e.g., Flesch-Kincaid Grade, Flesch Reading Ease, and Gunning Fog index). Readability formulas calculate the score that predicts the difficulty of a given text or estimate a reading grade required for the relative ease of comprehension of a text, mostly by taking a ratio of total words, sentences, and syllables in the text. To give an example, if Flesch Reading Ease formula assigns a score of 30 or below to a given written text, this score is interpreted as 'very difficult to read' and would assign the analysed text to the highest difficulty level as 'best understood by university graduates' (Brewer, 2019).

Most studies that used readability analysis to explore text complexity of online educational materials relied on the scores produced by readability formulas. For example, the studies of Betschart and colleagues (2017), Kher and colleagues (2017), Sanghvi and colleagues (2012), Xie and colleagues (2018) conducted a readability analysis of online

health materials by triangulating the analysis of the scores produced by several readability formulas.

Given the current criticism of the sole use of readability formulas to measure text complexity (*see Section 2.4*), a more recent trend in readability research is to use computer-based readability tools and a wider variety of metrics. Such tools have been shown to yield more accurate results than the traditional readability formulas (Crossley et al., 2008; Xia et al., 2016), since the automatic readability analysis accounts for both surface-level text features that convey literal meaning of the text and text cohesion features that are concerned with more implicit connections between and within sentences (*see Section 2.4*).

In line with this trend, in this research readability analysis was conducted by using an online automatic readability tool called Textinspector (2020). Textinspector was chosen due to the additional scores it provides that estimate the level of English language proficiency required for a non-native English reader to understand a given text in English. Thus, readability analysis of OER course materials conducted as part of Study 1 in this thesis combined the scores from three readability formulas with the metrics that describe other surface-level text features, such as lexical diversity, proportion of advanced lexis, level of nominalisation, as well as cohesion text features (*for the full list of metrics and their interpretation used in Study 1, see Table 13 in Chapter 4*). These scores automatically output by Textinspector were then interpreted in relation to the level of text complexity of these materials, as well as subsequently used in statistical analysis to compare the accessibility of OERs across different educational levels and subjects.

With this previous literature on text complexity in mind (Xia et al., 2016; Xie et al., 2018; Crossley et al., 2008), there is a clear rationale for the use of readability analysis to estimate the linguistic accessibility of OERs to non-native English readers. Yet, when opting for this data collection method, it is important to keep in mind its relative strengths and weaknesses, which are described in Table 4 below.

Table 4. Advantages and disadvantages of readability analysis

Advantages	Disadvantages
Most readability scores correspond to specific proficiency levels or reading grades, which allows ease of interpretation	No standard combination of readability tests
Readability can be ‘quantified’ for use in statistical analysis	Readability analysis does not pinpoint how the text needs to be changed to increase its accessibility
Allows for analysis of courses on a large scale in a relatively short time frame (e.g., compared to human judgments of text complexity), particularly with the advent of automated tools	No understanding of individual factors that influence relative ease of comprehension of a given text or real-time readers’ response to the text

(Based on Crossley et al., 2008; Xia et al., 2016; Textinspector help page, 2020)

RQ1 in Study 1 explored the text complexity of the OERs using a large sample of OER course materials at different educational levels and subject areas, which is a strength of the readability analysis method. However, as listed in Table 4 above, readability analysis is limited in the way that it lacks real-time readers’ response and does not identify how the text needs to be changed to make it more accessible to non-native English readers. There is also no consensus on the standard combination of readability tests. These three motivations provided a rationale for conducting a pilot study using qualitative stimulated recall interviews to explore English non-native readers’ response to text simplification (see *Chapter 5*). Furthermore, Study 1 provided the rationale for conducting qualitative stimulated recall and semi-structured interviews with English teachers who constitute an expert group and can identify efficient ways of increasing OER accessibility to non-native English readers (see *Section 3.4.2 and Chapter 6*). Finally the limitations of the readability analysis also motivated the subsequent study with non-native English readers to explore their reading of authentic and simplified OER texts using quantitative methods (see *Sections 3.4.3 and 3.4.4; Chapter 7*). Next, Section 3.4.2 will discuss in more depth the interview techniques used in this research that contributed to a more multidimensional understanding of the notion of OER linguistic accessibility.

3.4.2. Interviews

By using readability analysis Study 1 provided an overarching understanding of the extent of linguistic accessibility of a sample of OER course materials. However, as highlighted in Section 3.4.1, one prominent weakness of this method is that it does not

enable an exploration of a real-time readers' response to higher or lower complexity of the text. Furthermore, readability analysis does not provide an understanding of the specific approaches that can be applied to the text to make it more accessible to non-native English readers.

Due to the limited research on the topic, one key goal of Study 2 was to obtain some emerging evidence of how non-native readers at lower levels of proficiency process authentic vs. simplified texts. Having identified that text simplification is beneficial to this target audience, Study 3 next explored how an expert group, English teachers, make OER texts more accessible to non-native English readers. The second goal of Study 3 was to feed forward in this research project by providing a conceptual framework and the guidelines for OER text simplification, which could be tested and evaluated in the subsequent Study 4.

With this in mind, RQ2 in Study 2 required an analysis of the effect of text simplification on non-native English readers by looking at the differences in their verbalised cognitive processes. Text simplification in this study was performed based on the categories of the readability analysis used in Study 1. RQ3 in Study 3 required an analysis of the approaches and strategies that English teachers from different language backgrounds take to OER text simplification. RQ3a required an analysis of English teachers' perceptions on the influence of their mother tongue on their choice of approaches to text simplification.

Thus, for both Study 2 and Study 3, it was important to understand readers' and teachers' cognition. Just analysing participants' eye movements alone in Study 2 would not have given insight into the type of text processing they engaged in during reading. Similarly, studying English teachers' simplifications in Study 3 would not have made clear the reasons that necessitated changes in the authentic OERs.

As outlined by Gass and Mackey (2016), a data collection method that can gain access to cognitive processes that are unavailable by other means is a stimulated recall interview. This method falls within a larger umbrella of verbal reporting methods that gather data by asking individuals to vocalise their thought processes as they are solving a problem or performing a task. Stimulated recall interview is different from other verbal reporting methods in two aspects – retrospection, and support. As the stimulated recall interview occurs after the event, it is assumed that it does not create interruptions to participants' natural engagement with the task (Bowles, 2018). It is also assumed that the

support provided as part of the interview, in the form of the artefact of the event (i.e., stimulus), serves as the reminder of the event for participants and aids them in reengaging with it (Gass & Mackey, 2016; Vesterinen, Toom, & Patrikainen, 2010). The stimulus in Study 2 was the eye-tracking data collected from each participant reading authentic and simplified texts (*for more about eye-tracking, see Section 3.4.3*). The stimulus in Study 3 in this thesis was the simplification task performed by each English teacher participant.

Stimulated recall interviews, like all research methods, come with inherent advantages and disadvantages. These are outlined in Table 5 below.

Table 5. Advantages and disadvantages of stimulated recall interviews

Advantages	Disadvantages
Access to cognitive processes that cannot be observed unless verbalised by individuals, particularly useful in strategy research	Recall accuracy/veridicality
Reliable, in that the collected data correlate with behaviour	Reactivity: verbalizing might alter thought processes
Does not rely heavily on memory unlike a traditional post-hoc interview, and does not require training of participants unlike other verbal reporting methods	Inaccessibility of some cognitive information
Participants' reflections support their own awareness raising and help them develop as teachers and learners	Dependent on participants' reflection ability

(Based on Stickler & Shi, 2017; Gass & Mackey, 2016; Vesterinen et al., 2010)

One major strength of using stimulated recall interviews is that they provide an insight into participants' cognition and help elicit information on the type of strategies participants used when performing a task, as well as the potential reasons behind their choices of these strategies. This was important in this thesis as the other methods used, such as readability analysis (*see Section 3.4.1*), do not provide answers as to *how* an OER text needs to be changed, and *how* the readers would engage with it. An additional strength of stimulated recall interviews is that participants are not viewed as mere research informants from whom the data are collected. Their voice is respected alongside the researcher's, and their reflection on their own performance during the task can help them grow as teachers and learners (Stickler & Shi, 2017).

As described in Table 5 above, one important weakness of the stimulated recall interview lies in veridicality, or the extent to which participants' verbalisations of their thought processes are accurate. The second weakness lies in reactivity, when the

verbalisation act might alter participants' thought processes about the stimulus (Gass & Mackey, 2016). As indicated by Nisbett and Wilson (1977), one of the opponents of using verbal reporting methods, participants' reports might be 'based on a priori, implicit causal theories, or judgments about the extent to which a particular stimulus is a plausible cause of a given response' (p. 231). For this reason, following the recommendations of Gass and Mackey (2016), steps were taken in this research to reduce the time lag between the task and the interview. In Study 2, the recall was immediate after each participant finished reading. In Study 3, the recall took place as soon as practical, two to three days after the task. Another recommendation to overcome these limitations is to keep in mind the effect of the researcher questions and focus the recall questions on participants' thought processes that occurred at the time of the stimulus, rather than on their general reflections about the task (Gass & Mackey, 2016). In this thesis, research protocols with the interview script were put together, which outlined the interview procedure and the recall questions to ensure the interview consistency.

Additionally, the recall was separated from any other testing that further aimed to evaluate the effect of text simplification, as post-reading tests could serve as an additional rehearsal of the task for participants. For this reason, Study 4, which included these tests (*see Sections 3.4.4.1 and 3.4.4.2*), was conducted separately from and after Study 2. Finally, as the stimuli used in Study 2 and Study 3 were each participants' own performance of the task, it might have provided additional help to overcome the veridicality and reactivity limitations and make participants' recollections more accurate.

The final two limitations of stimulated recalls, outlined in Table 5, include the inaccessibility of some cognitive information, as this method taps into the mental processes that participants are mostly conscious of, and participants' reflection ability, as some participants might be more naturally reflective than others. While it has been shown that stimulated recall correlates with behaviour (Gass & Mackey, 2016), Study 4 was conducted to triangulate and further evaluate the results from stimulated recall interviews with the findings based on objective measures of participants' response to text simplification (*see Sections 3.4.3 and 3.4.4.1*).

While the stimulated recall interview is referred to as an advanced interview method (Vesterinen et al., 2010), another type of interview technique used in Study 3 was semi-structured interviews. Similar to stimulated recalls, semi-structured interview is a conversation between a researcher and participant, in which the researcher focuses on

understanding and analysing participant's thoughts on a certain phenomenon (Mittelmeier, 2017). However, semi-structured interviews are mostly centred around a bigger theme, unlike stimulated recalls. The latter is mainly comprised of strategy research and revolves around a specific task performed by participants. In semi-structured interviews, all participants are asked open-ended questions from the same loose set of questions, but there is no predefined ordering of the questions (Dearnley, 2005).

In this thesis, semi-structured interviews were conducted in addition to stimulated recall interviews in Study 3 to answer RQ3a. With the lack of research on the topic, semi-structured interviews were used to get an in-depth understanding of the perceptions that English teachers hold about the influence of their mother tongue on their choice of text simplification strategies and to explore other factors that might influence this practice, such as English teachers' attitudes towards text simplification.

Limitations that semi-structured interviews and stimulated recalls have in common are the potential subjectivity of participants' responses, as well as the considerable amount of time it takes to conduct interviews, often resulting in a smaller sample size. To overcome these overarching limitations of the interview methodology, this research aimed to have a high level of transparency when reporting the decisions made during the research design process and data analyses. This research also used other techniques such as performing data triangulation (e.g., between the findings of Study 2 and Study 4), conducting inter-rater reliability sessions with several independent raters in Studies 2-4 to add to reliability of the findings (*see Section 3.6*).

The data collection method that provided the stimulus for stimulated recall interviews in Study 2, and which was also used in Study 4 was eye-tracking, is discussed next.

3.4.3. Eye-tracking in reading

RQ4 required a quantitative evaluation of the effect of OER text simplification on non-native English readers' text comprehension and text processing when their individual factors were controlled. This evaluation based on objective measures of participants' response to text simplification was important to be able to overcome the potential subjectivity in participants' responses concerning their engagement with authentic vs. simplified OERs, which is a common limitation of the interview methodology, as described in Section 3.4.2. Thus, using mixed methods (*see Section 3.2.2*), which involved qualitative

stimulated recall analyses in Study 2 and Study 3 and quantitative assessment of participants' text comprehension and text processing in Study 4, allowed a more comprehensive understanding of text simplification. It also enabled an evaluation of the effectiveness of the text simplification strategies elicited in Study 3.

With this in mind, eye-tracking was used in Study 4, along with another method of data collection (*see Section 3.4.4*). Eye-tracking was also used in Study 2, however, the eye-tracking data only served as the stimulus for participants' reflections, while Study 4 included the analysis of the eye-tracking data as part of RQ4. In this thesis, Tobii Pro X3-120 (dark pupil tracking, sampling frequency 120 Hz) eye-tracker, manufactured by Tobii, integrated into a desktop computer (Study 2), and a laptop (Study 4) was used to collect participants' eye movements.

Eye-tracking belongs to a larger umbrella of online (real-time, concurrent) methodologies that provide information about a participant's engagement with or processing of the text as it happens. Online methods stand in contrast with offline methods, such as stimulated recalls (*see Section 3.4.2*) or post-reading comprehension testing (*see Section 3.4.4.1*), which are temporally disconnected from the task processes under investigation (Godfroid, 2019). Although offline measures also provide an important understanding of text processing, supplementing them with eye-tracking contributes to a richer and time-sensitive account of ongoing processing (e.g., Ariasi et al., 2017; Hyönä & Lorch, 2004; Mason et al., 2013). Eye movements serve as an index of attention, indicate what participant pays attention to and how much processing effort is expended (Pellicer-Sánchez, 2020).

Eye-tracking provides a range of metrics for where the participant's eyes land (*fixations*), how many times they land in that region (*fixation count*), how long each fixation lasts (*fixation duration*), as well as how many times and for how long a participant looks back in the text (*look-back fixation counts and durations*) (Conklin et al., 2018). During fixations, the participant's cognitive system perceives and processes the visual input, as well as plans when and how far to move the eyes next (Rayner, 1998). Eye-tracking is particularly useful in comparative research, as the eye-tracking measures are relative and need to be analysed for the related sentences/areas of interest that differ in certain controlled features (Conklin et al., 2018). That is why eye-tracking was deemed particularly suitable in this thesis, as, in Study 4, it was important to compare text processing when reading authentic vs. simplified texts.

While it is recommended to use multiple eye-tracking measures that could provide converging evidence for or against the research hypothesis, it is important to sample a range of measures that do not overlap in their temporal properties to safeguard the independence of the statistical tests (Godfroid, 2019). Eye-tracking allows a separate analysis of the initial reading of the text from later reprocessing efforts (Ariasi et al., 2017; Catrysse et al., 2018). Furthermore, the systematic literature review of the eye-tracking studies with English learners (Godfroid, 2019) showed that 94% of studies on reading mostly used fixation duration measures. Thus, in Study 4 in this thesis, two fixation duration measures were used in the analyses. These measures are defined in Table 6 below.

Table 6. Definition of the eye-tracking measures used in this thesis

The eye-tracking measures used in Study 4	Definition
<i>First pass fixation duration</i>	Summed duration of fixations that land on unread regions of an area of interest (AOI), such as a sentence, during the first encounter (forward fixations)
<i>Second pass fixation duration</i>	Summed duration of fixations returning to the AOI that has already been processed (look-back fixations)

(Based on Ariasi et al., 2017; Catrysse et al., 2018)

Note: An area of interest (AOI) is a selected region of the text for which the eye-tracking metrics are extracted for analysis.

While first pass fixation duration reflects early effects in processing, second pass fixation duration reflects a more strategic, conscious behaviour, and a number of studies have linked look-back fixations to participants' efforts to better integrate the information they have read in case there are comprehension difficulties (Catrysse et al., 2018).

When using eye-tracking, it is important to consider the strengths and weaknesses of this data collection method. These are described in Table 7 below.

Table 7. Advantages and disadvantages of eye-tracking

Advantages	Disadvantages
Automatic and relatively fast output of eye-tracking metrics, including visualisations, by the eye-tracking software	Still requires a lab setting (limited natural light) and calibration
High ecological validity, as the recording of eye movements can take place during normal task completion	Requires adjustment of the layout of the original text for the eye-tracking software, often resulting in need of a pilot study
Provides a direct measure of the processing effort during reading rather than in recall	Provides data which are highly skewed and not-normally distributed
Provides rich quantitative data that can be used in statistical analyses	Viewing the text is not equal to learning from it
High temporal and spatial resolution which allows separating initial processing from later reprocessing efforts	Time-consuming to conduct as eye-tracking allows only individual experimental sessions

(Based on Conklin et al., 2018; Pellicer-Sánchez & Siyanova-Chanturia, 2018; Godfroid, 2019; Pellicer-Sánchez, 2020)

A strength of the eye-tracking method is the relatively fast output of eye-tracking metrics by the software, such as Tobii-Studio (3.2), which was used in this thesis. Eye-tracking is also commended for its high ecological validity as it allows participants to engage with the text as they normally would: read and re-read it at their own pace and look where they want in the text (Pellicer-Sánchez & Siyanova-Chanturia, 2018). At the same time, eye-tracking may compromise natural reading in two aspects. First, eye-tracking still requires a lab setting, which includes the need for limited natural light to enable the technology to do the dark pupil tracking, and the need for the participant to sit still and not look away from the screen when reading. One way to overcome this limitation is to use a portable eye-tracker integrated into a laptop, as was done in Study 4 in this thesis, which might facilitate a more natural reading environment by holding the research session in the room where participants usually have their classes.

A calibration conducted with each participant before recording their eye movements can help control participants' position at the computer screen (Conklin et al., 2018). The calibration consists of the tracker displaying a series of points on the screen, which a participant must fixate in turn. The level of calibration accuracy is reported on the screen following completion, and the calibration process can be repeated until a high level of accuracy is obtained. However, as eye-tracking data quality is a common problem with eye-tracking (Holmqvist et al., 2011; Catrysse et al., 2018), visual inspection of the collected eye-tracking data is required before the analysis. If drift or complete track loss occur (i.e.,

when the eye-tracking camera loses track of the participant's eye gaze), these data are best discarded (Ariasi et al., 2017; Catrysse et al., 2018), which results in data loss. In Study 2 and 4 in this thesis, the visual inspection of the eye-tracking data was conducted using the replays of each participant's reading in the eye-tracking software.

Besides the need for the lab conditions, the second aspect is that eye-tracking does not allow keeping the original formatting of the text in research on reading (Ariasi et al., 2017). The text needs to be transferred to a format that would enable the interpretation of the eye traces (Study 2), and that would allow separating the eye movements for the different areas of interest (Study 4). Such layout adjustment often includes enlarging the font of the text, increasing the spacing between the lines, and introducing broad margins. A pilot study can help identify which layout contributes to the highest quality data with minimal change to the original formatting (Conklin et al., 2018). In this thesis, several trial tests with volunteers were conducted before data collection in Study 2. The final text layout was piloted as part of Study 2 and was subsequently used in Study 4 with a larger participant sample.

The third limitation of eye-tracking is that the eye-tracking variables tend to be highly skewed and not normally distributed, which reduces the power of statistical tests, and requires the researcher to do some eye-tracking data transformation before the analyses (Godfroid, 2019). The first step in data transformation involves dealing with outliers. In eye-tracking reading research outliers are overly short fixations (less than 50 ms for non-native English readers), which reflect other events, such as blink, rather than cognitive processing. Outliers are also overly long fixations (more than 800 ms for non-native English readers), which signal a lapse in attention (Keating, 2014; Godfroid, 2019; Rayner, 1998). While the eye-tracking default filters (the algorithms for detecting fixations, Olsen, 2012), such as the Tobii I-VT fixation filter used in this thesis, automatically merge fixations shorter than 60 ms, the researcher still needs to manually delete overly long fixations, as was the case in Study 4. Two percent of the overly long fixations were discarded in Study 4.

The second step in eye-tracking data transformation is to convert the collected eye-tracking data to time-per-character measures (ms/char) to control for the differences in length between the different areas of interest (Ariasi et al., 2017; Catrysse et al., 2018).

The third step involves performing logarithmic transformation of the data, or creating a new variable X that equals the logarithm of the original variable. The new log-

transformed variable approximates normality more closely, and thus, can be used in statistical analyses (Godfroid, 2019). Although the normality assumption (i.e., the assumption that the dependent variable is normally distributed, Field, 2013) is central to most statistical tests, the systematic literature review of Godfroid (2019) showed that it has not always been checked consistently in eye-tracking research. While no authors reported their eye-tracking variables were normally distributed (as mentioned, eye-tracking data are generally skewed), only 26% of the reviewed studies reported performing a logarithmic or other transformation. Thus, Godfroid (2019) stated that 'it is possible that some of the remaining 74% of researchers actually transformed their data, but failed to report it, which would be less than ideal in terms of research transparency and could potentially make interpretation of findings more difficult' (p. 263). In Study 4, both eye-tracking variables were transformed, and the distribution of the transformed variables was checked.

The final criticism of eye-tracking is that when interpreting the results of an eye-tracking study, one can not necessarily comment on the 'quality' of the reading that took place. While eye-tracking measures serve as indices of text processing, cognitive effort, and attention, analysis of eye movements does not provide insight into the extent to which the text was comprehended by each participant (Ariasi et al., 2017). Moreover, without a purposeful task, such as reading a text for comprehension, participants might end up surfing the text aimlessly during eye-tracking, and therefore produce data that are difficult to interpret (Conklin et al., 2018). To overcome these limitations and to explore the effect of text simplification more comprehensively questionnaires were used in addition to recording participants' eye movements in Study 4. Through questionnaires data were collected to obtain participants' comprehension scores when reading authentic and simplified texts (*see Section 3.4.4.1*). This tool was also used to control for some individual factors, such as participants' background knowledge of the topic of the text, their interest in the topic, and language proficiency (*see Section 3.4.4.2*). The questionnaire method is discussed next.

3.4.4. Questionnaires

As described in detail in section 3.4.3, in this thesis, eye-tracking provided an insight into online text processing, and specifically what areas of the text participants paid attention to and how much cognitive effort was expended when reading authentic vs.

simplified OER texts. However, eye-tracking did not allow inferences about the extent to which the texts were understood by participants, which can be another important characteristic of text simplification effect. Several previous studies on text simplification reported its positive facilitative effect on text comprehension among non-native English readers (e.g., Long & Ross, 1993; Yano et al., 1994; Tweissi, 1998; Oh, 2001). Yet, most of these studies did not statistically control for some individual factors (*see Section 2.6.1*). In addition to text simplification, these factors might also impact text comprehension (e.g., Crossley et al., 2014; Crossley & McNamara, 2016; Ariasi et al., 2017; Clapham, 1996) and text processing (e.g., Catrysse et al., 2018).

To obtain data on participants' comprehension scores, their background knowledge, topic interest scores for the text they read, as well as to determine their language proficiency level, in Study 4, eye-tracking was supplemented with questionnaires. Questionnaires are tools for collecting individual data regarding participants' knowledge, experiences, or responses about a specific topic or theme (Cohen, Manion & Morrison, 2011; Mittelmeier, 2017). They aim to objectively measure participants' knowledge or understanding of a problem, such as post-reading comprehension or language proficiency testing in this research (*see Sections 3.4.4.1 and 3.4.4.2*). They can also be based on participants' self-report (*see background knowledge and topic interest questionnaires in Section 3.4.4.2*), which involves participants answering questions about themselves, their attitudes, or feelings (Chauliac, Catrysse, Gijbels & Donche, 2020). Therefore, questions incorporated into questionnaires can take a variety of forms (Mittelmeier, 2017; Groves et al., 2009; Wolf, Joye, Smith & Fu, 2016). They can be more quantitative-minded and lend themselves to statistical analysis, such as multiple-choice or Likert scales. The latter refers to questions with a series of answers to choose from, ranging from one extreme attitude to another (Chauliac et al., 2020). Alternatively, questions can collect written text responses, such as open-ended questions in the form of free recall or retelling of the text and lend themselves to qualitative analysis. These can also be scored and then lend themselves to further quantitative analysis. In this sense, the questionnaire method can be flexibly adapted to meet the needs of the research questions.

In this thesis, a separate statistical analysis was conducted with post-reading comprehension test scores, while background knowledge, topic interest, and language proficiency scores were used as control variables. The next two sections describe how

questionnaires were used to obtain comprehension scores (*see Section 3.4.4.1*) and to obtain the scores that concerned these three individual factors (*see Section 3.4.4.2*).

3.4.4.1. Post-reading comprehension testing

As text comprehension cannot be observed directly, the most common method to assess text comprehension is to quiz participants on the text – require them to recall its gist, its details, or ask specific questions about its content (Pearson & Hamm, 2005). In Study 4 in this research, two types of questionnaires were used to determine participants’ understanding of the authentic and simplified OERs they read – multiple-choice comprehension tests and free recall.

Multiple-choice comprehension testing is reported to be the most widespread quantitative reading comprehension assessment method, particularly after the advance of automated machine scoring tools (Pearson & Hamm, 2005; Downing, 2006). In a multiple-choice comprehension test, participants are required to choose an answer to a question that covers some content of the text they have read from a listing of several possible answers (Downing, 2006). As part of Study 4 two multiple-choice comprehension tests were designed to assess participants’ understanding of the authentic and simplified OER texts.

The advantages and disadvantages of assessing reading comprehension with a multiple-choice test are outlined in Table 8 below.

Table 8. Advantages and disadvantages of using multiple-choice tests

Advantages of MC comprehension test	Disadvantages of MC comprehension test
Participants’ answers can be easily scored with accuracy and objectivity	Time-consuming to design in order to meet the requirements of item construct validity
Does not place the poorer reader at a great disadvantage, which an open-ended test question can do	Answers can be randomly guessed by participants
Allows representativeness of content sampling	An offline method, and, thus, participants might not remember what they have understood from the text

(Based on Chan & Kennedy, 2002; Roever, 2006; Downing, 2006; Mckee, 2012).

Note: MC – multiple-choice.

The first key advantage relevant to this research is that multiple-choice comprehension tests demonstrate nearly perfect agreement among the raters concerning the correctness of the keyed answer, which achieves objectivity in scoring. Moreover, as

Study 4 included participants with different English proficiency levels, this test format does not discriminate against participants at lower levels of proficiency by requiring them to use additional language skills, such as their language production and writing ability (Chan & Kennedy, 2002). An additional strength of this comprehension assessment method is that it enables a check of participants' understanding of a comprehensive number of the content areas of the text (Downing, 2006; Roever, 2006).

One of the limitations of the multiple-choice assessment method, as outlined in Table 8, is participants' potential random guessing of the answers. To overcome this limitation, it is recommended to have a sufficient number of items in the test, and particularly – multiple-choice answer options (Downing, 2006). It has been shown that the total number of options in a test item determines the statistical probability of randomly guessing the correct answer, with three options being typically sufficient (Haladyna, Rodriguez & Stevens, 2019). Each multiple-choice comprehension test used in Study 4 included ten questions and four answer options, with one correct answer and three distracters that were thematically related (same theme but incorrect).

However, the leading weakness of the multiple-choice test format is the difficulty of developing well-written multiple-choice items that meet the requirements of construct validity, or the extent to which a test measures what it claims to measure (Kyle, Crossley & McNamara, 2016). Three steps were taken as part of Study 4 in this thesis to ensure sound multiple-choice item construct validity. First, Cronbach's alpha measure of internal consistency was calculated for each administered test to make sure that the scores were reflective of actual differences between test-takers rather than were due to chance (Roever, 2006). Second, a qualitative validation was conducted in the form of critical expert judgments (Downing, 2006). As part of Study 4, two independent experienced language teachers tested the initial design of the tests and provided suggestions. After that, four independent English native readers provided further feedback on how to improve the design of the questions and multiple-choice answers. The final third step included triangulation of the results of the multiple-choice comprehension test with the results obtained from a different comprehension assessment method (Downing, 2006).

In line with this third step, the second method of post-reading comprehension assessment used in Study 4 was a written text recall task. Substantial research evidence that readers extract meaningful idea units during reading supports the notion that text recall is strongly related to text comprehension (Chen, 2016; Crossley & McNamara, 2016).

Free recall belongs to an open-ended type of questionnaire. In Study 4, as part of free recall, participants were asked to write down everything they could remember from the authentic or simplified OERs they had read, which was then quantified, in line with Chang (2006).

Like any data collection method, free recall also has its inherent strengths and weaknesses, which are outlined in Table 9 below.

Table 9. Advantages and disadvantages of using free recall

Advantages of free recall	Disadvantages of free recall
Authentic task measure, answers cannot be guessed	Time-consuming to assess, leads to subjective assessment criteria
Provides rich data for subsequent analyses	Involves other skills such as language production/writing ability
Minimal tester interference	An offline method, and, thus, participants might not remember what they have understood from the text

(Based on Heinz, 2004; Chang, 2006; Berkemeyer, 1989)

Berkemeyer (1989) summarised the advantages that free recall has over the multiple-choice comprehension assessment method described earlier in this section in the following way:

[free recall] does not allow students to guess their way through the text...nor does it influence students' understanding of the text. In short, the immediate recall protocol demands that the reader comprehends the text well enough to be able to recall it in a coherent and logical manner.... This procedure allows misunderstandings and gaps in comprehension to surface; a feature that other methods of evaluation cannot offer.

(Berkemeyer, 1989, p. 131)

In addition to this, free recall presents participants with an authentic task. The retelling of what someone has read is a daily, rather common occurrence – e.g., children relating stories they read at school to their parents or friends sharing their accounts of the information they read online (Heinz, 2004). Moreover, while multiple-choice comprehension method produces mostly quantitative data, free recall produces richer data that can be analysed both quantitatively and qualitatively (Chen, 2016). In this research, the free recall was used quantitatively to count the number of idea units participants could reproduce from the text to allow for a statistical comparison across the reading of authentic vs. simplified texts.

One disadvantage that free recall and multiple-choice comprehension assessment methods have in common is that they are both offline tasks and are temporarily disconnected from participants' reading of the texts (Godfroid, 2019). Thus, both multiple-choice comprehension and free recall test not only text comprehension but also participants' memory capacity, as participants might not remember everything they have understood from the text (Chang, 2006). At the same time, supplementing post-reading comprehension testing with online methods of text processing, such as eye-tracking (*see Section 3.4.3*), as was done in this research, helped to potentially overcome this limitation. Besides the requirement of memory in free recall, participants' English language production and writing ability may also bias the researcher's understanding of participants' text comprehension (Chang, 2006; Chan & Kennedy, 2002). Triangulating the results of multiple reading assessment methods, as was done in Study 4, contributed to a more valid and comprehensive account of the effect of text simplification on participants' text comprehension.

One key disadvantage of free recall, which is not associated with the multiple-choice comprehension method, is the subjective scoring of participants' answers. When scoring, the researcher first needs to divide each participant's written account of the text into a list of meaningful idea units, and then count how many of these idea units were recalled correctly from the text (Chen, 2016). In some cases, this number is compared against the total number of idea units covered in the text (e.g., Spencer et al., 2019). Thus, the judgment concerning the granularity of the idea units that need to be counted, as well as the extent to which they are recalled correctly, may both substantially affect the scoring (Downing, 2006). In Study 4, steps were taken to have inter-rater reliability sessions with one independent rater who scored each participant's recall. Disagreements on the idea units were discussed until a consensus was reached to arrive at the final scores for participants' accounts of the authentic and simplified texts, which were then used in the analysis (*see Chapter 7*).

While it is important to employ multiple assessment methods to cross-check participants' comprehension (Ariasi et al., 2017), comprehension and testing are linked by other variables. Previous research showed that background knowledge, topic interest and language proficiency play an important role in text comprehension (*see Section 2.6.1*) and influence text processing (e.g., Ariasi et al., 2017; Catrysse et al., 2018). The questionnaires

used in Study 4 in this thesis to control for these individual factors are discussed next in Section 3.4.4.2.

3.4.4.2. Controlling for individual factors

Considerable effort was put into the design and scoring of post-reading comprehension assessment tests as part of Study 4 in this thesis (*see Section 3.4.4.1*). Moreover, data on individual factors were needed to control for these factors in the statistical analyses. Thus, it was important to employ the questionnaires on background knowledge, topic interest, and language proficiency validated in previous research. Therefore, Study 4 adopted already existing questionnaires that were used in previous research to explore these constructs.

Similar to the post-reading comprehension tests, the language proficiency questionnaire used in Study 4 was a multiple-choice test. This was an adapted version of the 'Use of English' section of a practice Cambridge Proficiency English (CPE) test, which was used previously in the study of Jung and Révész (2018). The language proficiency test used in Study 4 had 25 items, each item containing four multiple-choice answer options, aimed mainly at measuring participants' lexico-grammatical knowledge of English, and their pragmatic knowledge (knowledge of various situational contexts in English). This test also allowed benchmarking of the resulting score against CEFR (Council of Europe, 2001), which helped determine participants' language proficiency level, as defined by CEFR.

Unlike the language proficiency questionnaire, background knowledge and topic interest questionnaires were based on participants' self-report. Both questionnaires had a seven-point Likert scale as a response answer, which allowed participants to express how strongly they agree or disagree with a statement for each item. The background knowledge questionnaire had five items and was adapted from Khabbazzbashi (2015). The topic interest questionnaire had seven items and was adapted from Schiefele and Krapp (1996) (*see Appendices 10-11 for the employed questionnaires*). Cronbach's alpha measure of internal consistency was calculated for all questionnaires used in Study 4. A more detailed procedure of Study 4 is described in Chapter 7.

3.5. Data analysis approaches

As this research utilised the mixed methods methodology (*see Section 3.2.2*), two types of data analysis approaches were used: quantitative and qualitative approaches. A brief overview of these approaches is provided in Sections 3.5.1 and 3.5.2 below.

3.5.1. Quantitative approaches to data analysis

As can be seen from Figure 9, Study 1, Study 2, and Study 4 in this thesis used quantitative data analysis methods, and Study 3 used both quantitative and qualitative methods. Since these studies had different data sources and research questions, a variety of quantitative approaches were used to analyse the data in these studies.

Study 1 (*see Chapter 4*) aimed to compare the readability metrics generated by Textinspector (*for readability analysis see Section 3.4.1*) for OERs at different educational levels and subject areas. Thus, statistical analysis approaches that allow comparing group means were needed to conduct this analysis. Having explored the distribution of the readability metrics, an ANOVA analysis was conducted with normally distributed readability metrics as dependent variables. Kruskal-Wallis H test was conducted with non-normal variables (Field, 2013).

Additionally, cluster analyses were conducted (Aristeidou, Scanlon & Sharples, 2017) to understand what OER subject categories are similar in their readability metrics and are statistically grouped in the same cluster. The detailed procedure of the cluster analysis employed in this thesis is provided in Chapter 4.

The aim of Study 4 was to identify the effect of OER text simplification and text organisational structure (narrative vs. expository OERs) on participants' comprehension (*see Section 3.4.4.1*), and on text processing (*see Section 3.4.3*) when controlling for background knowledge, topic interest, and language proficiency (*see Section 3.4.4.2*). Thus, statistical analysis approaches were needed that would allow comparing means between the groups of participants who read authentic and simplified versions of narrative and expository OERs, while eliminating the confounds – separating factors that may influence the dependent variables from the main analysis. In line with this goal, an ANCOVA was used (Field, 2013; Crossley et al., 2014) to perform this analysis.

The aim of Study 2 was to identify cognitive processes that occur when non-native English readers read authentic vs. simplified OERs. The aim of Study 3 was to identify approaches and strategies that English teachers from different language backgrounds take

to simplify OER texts. The data in these studies were collected using qualitative interview methods (see Section 3.4.2). However, it was important to quantify what strategies and processes were used most and least often. In Study 2, quantification of qualitative data was important to understand the extent to which non-native English readers processed simplified OERs differently from the authentic texts. In Study 3, this was important for the understanding of the extent to which these approaches were consistent between different participating teachers. Thus, content analysis (CA) was used, which is a quantitative analysis approach to qualitative data.

Following Ahuvia (2001) and Neuendorf (2016), in this thesis, CA is defined as objective quantitative analysis of written data (or transcribed verbal data), as part of which the data are coded into categories or labels, followed by counting the frequencies of occurrences within each category. Thus, the core task of CA is to put numerical values, either counts or amounts, to qualities or characteristics of a phenomenon (Neuendorf, 2016).

There is a shared set of assumptions and a standard procedure for other quantitative data analysis methods, such as an ANOVA or an ANCOVA (Field, 2013). In contrast, due to CA having roots in different research paradigms and emphasising the quantitative vs. qualitative dichotomy, there is still no consensus among scholars as to what may be called a CA (Smith, 2000; Krippendorff, 2013; Neuendorf, 2016). Thus, in this section, it was deemed important to outline the steps that were taken to conduct CA as part of Study 2 and Study 3.

An integrative approach to CA was used in this thesis following the processes summarised by Neuendorf (2016), which were comprised of three ‘flows of activity’, as outlined in Table 10 below.

Table 10. Steps taken to conduct content analysis (CA) in this thesis

Step		Process	Description
1	Preparation	Theory and rationale	What content is examined, and why?
2		Conceptualisations	What variables are used in the study, and how are they defined conceptually?
3		Operationalisations	What unit of data collection is used? An <i>a priori</i> coding scheme describing all measures must be created.
4	Coding	Coding	The coding form with all variable measures fully explained must be created. Are the variables measured well? Are the created

			categories exhaustive and mutually exclusive?
5	Inter-rater reliability	Sampling	How can a subset of the content be randomly sampled for the subsequent inter-rater reliability sessions? (e.g., by time period, by page, by participant, etc.)
6		Training and pilot reliability	During a training session in which coders work together to establish whether they can agree on the coding of variables. Then in an independent coding test, note the reliability on each variable. Revise the coding form as needed.
7		Inter-rater coding	Use at least two coders to establish intercoder reliability.
8		Final reliability	Calculate a reliability figure (percent agreement, Scott's pi, Spearman's rho, or a Pearson's r, for example).

(Based on Neuendorf, 2016)

In this thesis, CA was used from the perspective of positivist epistemologies, which regard data as 'pre-existing' forms of evidence in an external reality (*see Table 2*), and which give priority to deductive coding (Neuendorf, 2016). As part of deductive coding, the researcher puts together an a priori coding scheme using existing theories or previous studies about the phenomenon under investigation, and then assigns these codes to the collected qualitative data (Neuendorf, 2016; Graneheim, Lindgren & Lundman, 2017). CA can also be conducted using inductive coding rather than deductive coding, which involves looking for similarities and differences in the data (i.e., patterns), and then assigning new codes to these patterns on various levels (e.g., Lindgren, Sundbaum, Eriksson & Graneheim, 2014; Graneheim et al., 2017). As Graneheim et al. (2017) noted, both approaches to coding are associated with certain challenges. A challenge of using a deductive approach is deciding how to treat left-over data that do not fit the selected theory. A challenge of using an inductive approach is the risk of getting stuck in the surface structures of recurrent empirical summaries or the researcher's own pre-understanding of the phenomenon under study. In this thesis, to meet the goal of Study 2 of identifying new processing strategies specific to the context of the study, and to meet the goals of Study 3 of adding new dimensions to existing text simplification approaches and providing motivation for using them, both deductive and inductive coding were used. As part of deductive coding, the codes were informed by using Khalifa and Weir's (2009) model of cognitive processing in reading in Study 2 and using the existing literature on text complexity in Study 3. Inductive

coding was used in the second coding cycle where deductive codes were expanded and confirmed inductively using where possible the data from stimulated recall interviews (see Chapter 5 and 6).

As can be seen from Table 10, a substantial amount of space and attention in CA is given to coding reliability. As Neuendorf (2016) put forward:

Given that a goal of content analysis is to identify and record relatively objective (or at least intersubjective [mutually understood]) characteristics of messages, reliability is paramount. Without the establishment of reliability, content analysis measures are useless.

(Neuendorf, 2016, p. 165)

In this research, the steps that were taken to establish inter-rater reliability are outlined in Section 3.6 and Chapters 5-7. Besides CA, Study 3 used a qualitative approach to data analysis, which is discussed next.

3.5.2. The qualitative approach to data analysis

As can also be seen from Figure 9, the qualitative approach to data analysis used in Study 3 in this thesis was thematic analysis (TA). The qualitative approach was used in Study 3 to answer RQ3a with the aim of providing the emerging evidence on the effect of the language background on the text simplification practice, as perceived by English teachers, and to explore other factors that might be of influence.

TA is a popular and widely cited approach to analysing qualitative data that focuses on identifying themes (patterns of meaning) in qualitative data (e.g., Boyatzis, 1998; Braun & Clarke, 2006). Both CA described in Section 3.5.1, and TA are applied to qualitative data and involve coding and interpretation of broader patterns in the data. However, as mentioned earlier, CA is associated with a more positivist paradigm and involves counting the frequencies of categories' appearances (Neuendorf, 2016). Having been used as a structured approach to the data analysis in this thesis, it began with the development of categories, which were mostly conceptualised as data domains or summaries of participants' responses relating to their cognitive processing strategies in Study 2, and the text simplification strategies in Study 3. The a priori categories put together before data analysis were based on the previous studies on text simplification, and Khalifa and Weir's (2009) model of cognitive processing in reading (see Figure 4).

In contrast, TA, and specifically reflexive TA used in this thesis (Braun & Clarke, 2019), is associated with a more constructivist paradigm. Thus, it acknowledges the researcher's active role in knowledge production and begins with the researcher immersing themselves in the data, coding, and generating initial themes. Themes in reflexive TA are defined as patterns of shared meaning underpinned by a central organising concept. Braun and Clarke (2019) described the development of themes as follows:

Themes do not passively emerge from either data or coding; they are not 'in' the data, waiting to be identified and retrieved by the researcher. Themes are creative and interpretive stories about the data, produced at the intersection of the researcher's theoretical assumptions, their analytic resources and skill, and the data themselves. Quality reflexive TA is not about following procedures 'correctly' but about the researcher's reflective and thoughtful engagement with their data and with the analytic process. We increasingly refer to terms like 'developing', 'constructing' or 'generating' to capture this process.

(Braun & Clarke, 2019, p. 591)

Thus, as has been illustrated by the quote above, one important difference between reflexive TA and CA is in the nature of coding. In this thesis in Study 3, the themes in TA were inductively constructed 'stories' about the data from participants' answers to the questions on the perceived effect of the mother tongue and their attitudes to text simplification. In contrast, the categories in CA were mostly deductively emerging 'domain summaries' from the data, albeit expanded and confirmed with inductively constructed codes.

Another difference between the two approaches is in their implementation procedure. As Braun and Clarke (2019) acknowledged, there are no rules for reflexive TA to follow rigidly, but rather a series of practice-oriented tools that guide the analysis and facilitate rigorous data engagement.

Reflexive TA was conducted in this thesis following the processes put forward by Braun and Clarke (2006; 2019), which were comprised of six steps as outlined in Table 11 below.

Table 11. Steps taken to conduct thematic analysis (TA) in this thesis

Step	Process	Description
1	Familiarisation with the data	Reading and re-reading the data, becoming immersed and intimately familiar with data content
2	Coding	Generating succinct labels (codes) that identify important features of the data that might be relevant to answering the research question. It involves coding the entire dataset, and after that, collating all the codes and all relevant data extracts, together for later stages of analysis.
3	Generating initial themes	Examining the codes and collated data to identify significant broader patterns of meaning (potential themes). It then involves collating data relevant to each candidate theme to be able to review the viability of each candidate theme.
4	Reviewing themes	Checking the candidate themes against the dataset, to determine that they tell a convincing story of the data, and one that answers the research question. In this phase, themes are typically refined, which sometimes involves them being split, combined, or discarded.
5	Defining and naming themes	Developing a detailed analysis of each theme, working out the scope and focus of each theme, determining the 'story' of each. It also involves deciding on an informative name for each theme.
6	Writing up	Weaving together the analytic narrative and data extracts and contextualising the analysis in relation to existing literature.

(Based on Braun & Clarke, 2006; Braun & Clarke, 2019)

As part of the first step, reflexive TA began with familiarisation with the data by transcribing the interviews manually – providing a written account of the verbal interview data using audio recordings of the interviews and then checking the transcripts against the recordings for accuracy. As can be seen from Table 11, reflexive TA is an iterative process, which places importance on *'the journeying'* (Braun & Clarke, 2019, p. 592): deep reflection and interaction with the data. Since CA seeks to generate generalizable conclusions from the data, it gives a lot of attention to coding reliability (*see Table 10*). In contrast, reflexive TA does not advocate for multiple coders and inter-rater reliability. According to Braun and Clarke (2006; 2019), whose vision on TA was adopted in this thesis, inter-rater reliability is underpinned by the positivist assumption that there is an accurate reality in the data that can be captured through coding. Thus, inter-rater reliability scores are understood in reflexive TA as showing that two researchers have been trained to code data in the same way, rather than that their coding is 'accurate'. In line with this view, inter-rater reliability was not conducted as part of TA in this thesis.

The steps that were taken to ensure research rigour in TA, alongside validity for quantitative approaches to data analysis, are discussed in more detail in the next section.

3.6. Validity, trustworthiness, and legitimation

The key concepts that describe the quality of research are validity put forward within positivist epistemologies and applied to quantitative approaches, and trustworthiness developed within interpretivist research paradigms and mainly applied to qualitative approaches (Hadi & Closs, 2016).

Yin (2013) and Murphy (2020) describe three types of validity that should be considered: internal, external, and construct. Internal validity describes the strength of the logical arguments to justify any conclusions drawn (Baldwin, 2018; Murphy, 2020). For example, the research design should be based on a theoretical framework, to which results are compared (Yin, 2013). Internal validity was considered in this thesis by conducting a literature review for each of the empirical studies. For example, the research design of Study 2 was built on an explicit theoretical framework (*see section 2.6.2 and Chapter 5*). This allowed the results of that study to be considered within this framework. The review of the text complexity literature (*see Section 2.4*) as part of Study 1 served as the a priori coding scheme for the CA conducted in Study 3 (*see Section 3.5.1 and Chapter 6*).

External validity deals with the generalisability of results (Baldwin, 2018; Murphy, 2020). In this thesis, external validity was considered by providing sufficient details about the settings of the four empirical studies, sample characteristics, data collection, and analysis procedures. Such transparency in reporting results can help the reader evaluate the extent to which the study conclusions are generalisable and transferable to other contexts and populations. External validity was also considered in this thesis by recruiting larger participant samples (200 OER courses in Study 1; 24 English teachers in Study 2; 37 non-native English readers in Study 4). It was also considered by aiming for the representativeness of the samples and using random and purposive sampling techniques. Finally, another way of ensuring external validity in this thesis was providing participants with authentic tasks where possible (e.g., reading an OER from a computer screen in Study 2 and Study 4; asking participants to retell the text in Study 4).

Construct validity refers to whether a method represents an adequate operationalisation of a concept (Kyle et al., 2016). Triangulation is one way to address construct validity in research (Hadi & Closs, 2016; Murphy, 2020). It involves using multiple

methods to collect data, which is a particular strength of mixed methods (*see Section 3.2.2*), as well as using different data sources or researchers (Twining, Heller, Nussbaum & Tsai, 2017). Triangulation in quantitative research design aims to increase the likelihood that the perspective presented by multiple methods is close to reality (Twining et al., 2017). Specifically, in CA, it aims to help ascertain the validity or truthfulness of the inferences derived from the data (Hadi & Closs, 2016). In this thesis, several types of triangulation were performed to ensure construct validity:

- Data triangulation was performed in Study 1 by collecting data from multiple OER platforms to check for the consistency of the elicited patterns in the findings.
- Researcher triangulation was performed in Studies 2-4 by holding inter-rater reliability sessions for CA in Studies 2 and 3 and scoring participants' answers in free recall in Study 4; inviting experts who were not directly involved in the research project to provide critical expert judgments on the design of multiple-choice comprehension tests in Study 4. The aim of researcher triangulation was to ensure research rigour by discussing the research design, data analysis, and interpretations with peers/experts.
- Method triangulation was performed between Study 2 and Study 4 by using different methods: stimulated recall interviews, eye-tracking, and post-reading comprehension testing to obtain a comprehensive understanding of the effect of text simplification. Method triangulation was also used in Study 1 by employing two different types of analysis to make inferences about the association between the subject matter and text complexity of the OERs, as well as in Study 4 by using multiple measures of comprehension assessment.

Another way to ensure construct validity in this thesis was to calculate internal consistency of participants' answers on questionnaires in Study 4, as well as exploring correlations of the variables used in this study. Presenting results back to the population in which the data were gathered can also increase construct validity (Murphy, 2020). The construct validity of participants' text processing in Study 2 and participants' text simplification methods in Study 3, were assessed by presenting participants with their own eye movement patterns during the stimulated recalls, and with the text simplification tasks completed by them.

The qualitative approach to data analysis used in this thesis was TA (Braun & Clarke, 2019) (see Sections 3.3 and 3.5.2). While some researchers have challenged the very idea of having a single pre-determined criterion for evaluating the rigour of diverse approaches within qualitative research (Hadi & Closs, 2016; Levitt, 2015), Braun and Clarke (2006; 2019) put forward some recommendations as to how to ensure trustworthiness of research conducted with reflexive TA. These recommendations involve ensuring that the coding process has been thorough, inclusive, and comprehensive. In this thesis, this was addressed in Study 3 by making coding an iterative and reflexive process, checking the themes against each other, and back to the original data. Another recommendation concerns making sure that the data have been analysed and interpreted rather than paraphrased. This recommendation was addressed by providing participants' quotes when reporting the results of TA in Study 3 to illustrate the analytic claims made in the study, while at the same time aiming to keep balance between analytic narrative and illustrative extracts.

Since overall, this thesis represents mixed methods research, it is also important to consider the concept that describes the quality of mixed methods methodology. The most common term used to assess the rigour of mixed methods is legitimisation (Onwuegbuzie et al., 2011). Legitimation concerns the problem of integrating quantitative and qualitative methods, as well as the quality of inferences drawn from mixed methods research.

As also outlined in Section 3.2.2, the problem of integration was addressed in this thesis by developing a clear understanding of how the two types of methods mix, and reflecting on it during all stages of research. To facilitate the development of such an understanding, visualisation of the research design was prepared (see Section 3.3). Inference quality associated with the evaluation of the methodological rigour and validity of conclusions in this thesis was addressed by using the data, researcher, and method triangulation described earlier in this section. Another way to ensure inference quality in this thesis was data conversion. Quantification employed in Study 2 and Study 3 involved converting qualitative data into numerical codes that were then explored further using descriptive statistics. Quantification of the categories potentially helped to provide more meaning by adding empirical precision to the narrative descriptions, thereby improving the quality of meta-inferences or overall conclusions in the study that could be made (Tashakkori & Teddlie, 2003; Onwuegbuzie et al., 2011).

3.7. Ethics

The Open University Human Research Ethics Committee reviewed and approved all studies described in this thesis that involved human participants [References: HREC/3046/RETS (Study 3), HREC/2774/RETS (Study 2 and Study 4) (*see Appendices 1 and 2*). As the data sources for Study 1 were the readability metrics for OER courses, and Study 1 did not involve people, the ethical approval for this study was not needed.

Throughout this research, the following manuals for ethical guidelines were consulted: British Educational Research Association (2011) and British Psychological Society (2014). Some personal information about participants' backgrounds was collected in three of the empirical studies, including their mother tongue, educational level and the field in which their education was obtained, the amount of English teaching and learning experience, level of institution and country of teaching English (the latter is specific to Study 3). However, no sensitive information, as defined by the Data Protection Act 2018, was collected about participants (e.g., ethnicity, religion, disability, health matters, sexual orientation, political opinions, genetic or biometric data, etc.). Once the collected data were matched with the demographic data, participants' real names were replaced with unique identification numbers, and pseudonyms were used for reporting to preserve participant identities. The data were anonymised in this way before they were shared with the supervision team or with the independent raters for the inter-rater reliability sessions. All data were stored in secure, password-protected files, and only on Open University's servers, in line with the Data Protection Act 2018 requirements.

There were no risks to participants identified in any of the studies. In Study 3, the aim of the study was revealed to participants, as the online task they completed explicitly required them to simplify the texts. Throughout Study 2 and Study 4, the work was framed to participants as seeking to understand how readers for whom English is not their mother tongue read in English. It was not revealed to participants that the research focused specifically on text simplification. Awareness that some of the texts participants read were simplified might have influenced their approach to reading, and biased reflections on the experiences they had with the texts.

All four empirical studies were designed with participant benefit in mind. In particular, the stimulated recall interview, which was the main data collection method in Study 2 and Study 3 (*see Section 3.4.2*), created a kind of participatory research environment, where participants were not seen as mere data informants, but as individuals

who could also take important insights from the project. Seeing their own eye movements that participants cannot do in everyday life (Study 2) and reflecting on their text simplification (Study 3), could potentially support their own awareness about how they teach and read texts in English.

An ethical consideration in Study 4 arises from the use of multiple-choice tests, as it is believed that distractor answer options in test items expose test takers to misinformation and might lead to the development of false knowledge (Roediger & Marsh 2005; Brown, Schilling & Hockensmith, 1999). In Study 4, at the end of each session with participants, information concerning the right answers to the multiple-choice comprehension test and language proficiency test questions were shared with participants upon their request. At the same time, participation in all studies was voluntary and optional (i.e., not mandatory).

Besides ethics towards participants, it is also important to consider ethics that concern research integrity and ethics of honest data analysis and reporting. The steps that were taken in this research to try to ensure validity, trustworthiness, and legitimation of the research procedures were explicated previously in Section 3.6.

3.8. Chapter summary

Chapter 3 outlined the overarching research paradigm and methodological justifications for this research. As noted in Section 3.2.1, the research questions raised in this thesis required approaching them from multiple perspectives to explore and explain the complex practical problem they addressed. For this reason, a pragmatic and mixed methods approach allowed to expand the research scope and to use the methods that best addressed the research questions. The research design of this thesis and methodological choices that concerned data collection and analysis were outlined in Sections 3.3 through 3.5. Finally, Section 3.6 described the steps undertaken to ensure rigour of the research procedures, and Section 3.7 addressed ethical considerations.

With these overarching methodological justifications in mind, Chapters 4 through 7 will next describe the specific procedures adopted in each study and further details of the analyses.

4. Study 1 Methods and Results

As described in Section 3.3 in Chapter 3, the empirical work consists of four interlinking studies. This chapter describes the methods and findings of Study 1, which approached linguistic accessibility from the perspective of text complexity (see Figure 6) and examined the text complexity level of current OERs from two major OER course platforms. This chapter is comprised of four sections. Section 4.1 reiterates the rationale for carrying out the text complexity analysis of OERs and is followed by the description of the methodological procedure in section 4.2. Section 4.3 outlines the findings and answers to the study's research question. The final Section 4.4 discusses the findings and their limitations, examines the implications of these findings, and links them to the other studies in the thesis.

4.1. Introduction

As outlined in Section 2.2, OERs aim to offer learning to all, present possibilities for learning at scale (e.g., OpenLearn, 2020; Saylor, 2020), and increase educational benefits, particularly in developing countries (UNESCO, 2012). However, a number of research studies on the use of OERs in such contexts are critical of these claims (Hatakka, 2009; Kanwar et al., 2010). The predominant use of English as the language of instruction in OERs and particularly the language level used in OERs create divides and present barriers to many potential OER learners (Knyazeva, 2010; Banzato, 2012; Huang et al., 2012).

Notwithstanding calls for more accessible OERs as part of these research findings, very few studies have explored the accessibility of existing OERs to non-native English readers. As outlined in Section 3.3, Study 1 served the purpose of problematising linguistic accessibility of OERs to non-native English readers by exploring the current text complexity level of the OERs. Section 3.4.1 earlier provided rationale for choosing to employ readability analysis to achieve this goal.

² The study presented in this chapter was also published as the following peer-reviewed journal article:

- Rets, I., Coughlan, T., Stickler, U., & Astruc, L. (2020). Accessibility of Open Educational Resources: how well are they suited for English learners? *Open Learning: The Journal of Open and Distance Learning*. doi: 10.1080/02680513.2020.1769585

While this research topic has not been previously explored in relation to OERs, studies that investigated the text complexity level of other types of online educational materials mainly used readability analysis to explore this problem. Moreover, since readability can be 'quantified' for inclusion in statistical analysis, such quantitative design allowed to explore the accessibility of a large sample of courses. Thus, Study 1 in this thesis incorporated a quantitative design using readability analysis to investigate the text complexity level of OER reading materials, and to achieve a wide view of their accessibility.

With this background in mind, the research question that Study 1 addressed is as follows:

RQ1: To what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

The next section provides an in-depth description of the procedure employed in Study 1 to accomplish this goal.

4.2. Materials and methods

4.2.1. OER course platforms

The two OER course platforms selected for this study were OpenLearn (2020) and Saylor Academy (Saylor) (2020) (*see Section 2.2*). Both of these platforms were established between 2006-2010 and currently offer a large variety of OER courses through the medium of English. OpenLearn is a UK-based platform, and Saylor is based in the U.S.A. These two platforms were selected for this research because they are well established in the open education field and receive millions of visitors each year. OpenLearn recorded over 4.3 million unique visitors to its courses in 2017-2018 (personal communication with the OpenLearn team, October 15, 2018), and Saylor registers more than 800 thousand total visits on average per month (Saylor, 2020). Both platforms have been featured in previous research on OER learners' experiences of using OERs (e.g., Farrow et al., 2015).

Both OpenLearn and Saylor assign an educational level to each open course they offer (*see Section 2.4*). In line with the systematic complexification assumption (Berendes et al., 2018), the hierarchy of educational levels assumes some progression of complexity in terms of the language of the course content. However, given the lack of empirical evidence, it is unclear whether this assumption can be applied to the OERs.

OpenLearn offers OER courses across three educational levels. Introductory (Level 1) courses are intended for the learners new to a subject. Intermediate (Level 2) courses are intended for learners who have some familiarity with a subject area, this level corresponds to undergraduate level courses. Finally, Advanced (Level 3) courses are intended for learners who want to gain a more critical understanding of a subject and correspond to postgraduate courses (*see Section 2.4*). Saylor assigns courses to five educational levels, which generally reflect progression in a particular subject of study. For example, '101' is an introductory course and leads to more advanced courses, such as '401'. Courses at level 0 generally indicate 'remedial courses' that prepare students for regular university studies. However, my personal communication with the Saylor development team (personal communication, December 27, 2018) confirmed that this progression sequence might be rather loose as a topic that is covered in the lower level in one school may be covered in the upper level in another school.

Both OpenLearn and Saylor also offer courses across a variety of subject categories. OpenLearn divides the OERs on its platform into eight subject labels (e.g., 'Money & Business', 'Education & Development', 'Science, Maths & Technology'), and this categorisation is based on the type of Open University modules from which the OERs were adapted. The OERs offered on the Saylor platform are divided into 19 subject labels (e.g., 'Art History', 'Biology', 'Business Administration'). The way the OER courses are classified into educational levels and subject categories, thus, varies between the two OER platforms.

4.2.2. Procedure

To select the courses from these platforms whose reading materials would be analysed as part of the readability assessment, I contacted the OpenLearn team and received data on the 150 most popular courses, in terms of unique visitor numbers to the introductory page of the course on the platform in 2017-2018 (personal communication, October 15, 2018). Table 12 below presents examples of the top ten most popular OpenLearn courses with the information concerning the number of visitors in 2017-2018.

Table 12. Examples of top ten OpenLearn courses analysed in Study 1

Rank	Course title	N of people who made unique visits in 2017-2018
1	Start writing fiction	59140
2	Introduction to bookkeeping and accounting	57811
3	Introduction to child psychology	56819
4	Getting started on classical Latin	43354
5	Forensic psychology	36655
6	English: skills for learning	31272
7	Succeed with maths - part 1	30936
8	The autistic spectrum: from theory to practice	30481
9	English grammar in context	30046
10	Attachment in the early years	28366

(Based on my personal communication with the OpenLearn team, October 15, 2018)

As can be seen from the examples of courses in Table 12, the sample of popular courses consisted of very diverse courses in terms of their content. As visitor data were not available for Saylor, 50 courses were selected at random from Saylor, ensuring that there were 10 courses for each of the five educational levels that the platform offers, and a diverse range of subjects.

Having made a list of 200 courses from the two platforms, the reading materials from each course were downloaded into word documents, which were then uploaded into the Textinspector (2020) online readability tool. As indicated in Section 3.4.1, Textinspector is an online automatic readability tool that calculates readability metrics for a given passage, which allows an analysis of the readability of written materials on a large scale in a relatively short time frame. Moreover, it estimates the level of English language proficiency required for a non-native English reader to understand a given text in English, and benchmarks this estimate against the CEFR (Council of Europe, 2001)

Textinspector can analyse a maximum of 10000 words from a text, so only the first 10000 words of the reading materials from each course were analysed for the purposes of this study. All non-text elements (e.g., illustrations, tables, bibliography) were removed from the analysed materials, as the tool does not process such information. Readability assessment metrics produced by Textinspector and used for the analyses are described in Table 13 below.

Table 13. Applied readability metrics output by Textinspector and their description

Readability assessment metric	Characteristics	Interpretation
1. Average sentence length	Average number of words per sentence	<p>Having fewer words per sentence makes the text easier.</p> <p>Having shorter sentences is helpful because it reduces the amount of information one has to store in their working memory during reading.</p>
2a. Type/token ratio (TTR); 2b. vocd-D 2c. Measure of Textual Lexical Diversity (MTLD)	Measures of lexical diversity, the proportion of unique vs. repeated words in the text	<p>These measures refer to the degree of lexical variation in the text. The lower the measures are, the easier the text is.</p> <p>If there is more repetition of the words already used in the text, they become more familiar, and it takes less time for a reader to process the words he/she already processed earlier in the text.</p>
3a. Words with more than two syllables (%); 3b. Average syllables per sentence; 3c. Average syllables per word; 3d. Syllables per 100 words	Measures of word length	<p>The fewer syllables the words have on average in the text, the easier the text is.</p> <p>Shorter words with fewer syllables ‘give the mind much more to think about’ (Flesch, 1979, p. 22).</p>
4a. Flesch Reading Ease 4b. Flesch-Kincaid Grade 4c. Gunning Fog index	Formulas’ calculations are based on the analysis of word length vs. sentence length	<p>4a. Higher scores of Flesch Reading Ease indicate material that is easier to read. E.g., the scores 50.0-30.0 qualify as ‘College, difficult to read’; 60.0-50.0 correspond to 10th to 12th grade and ‘fairly difficult to read’; 70.0-60.0 – to 8th & 9th grade and ‘plain English’.</p> <p>4b. The results of Flesch-Kincaid Grade correspond to the U.S. grade level. The lower the resulting grade is, the easier the text is.</p> <p>4c. Gunning Fog index estimates the years of formal education a person needs to understand the text on the first reading. A score of below 12</p>

		suggests a text that can be read widely by the public, and a score of below 8 indicates a very easy text.
5. Noun elements per sentence	Average number of noun elements per sentence	Less nominalisation contributes to the text being easier. 'Because nouns are merely names of things, they sound as if nothing is actually happening in the sentence' (Flesch, 1979, p. 110).
6a. Elementary lexis (A1-B1) 6b. Advanced lexis (B2-C2)	Proportion of lexis in the text that belongs to each language proficiency level in terms of CEFR	The more A1 lexis and the less C1 and C2 lexis the text has, the easier the text is. Textinspector calculates this metric by using the Cambridge Learner Corpus (CLC). This is a collection of examination scripts written by learners at different proficiency levels. Textinspector help page https://textinspector.com/help/lexis-evp/ (accessed 14 April 2020).
7a. 0-6K 7b. 6K-100K	Measures of word frequency. E.g., '1K' means they are the first 1000 most frequently used/used words in English	The higher the percentage of the numbers before 6K, the more frequently used vocabulary the text includes and, thus, the easier the text is. More frequently used words tend to be recognised more rapidly and better recalled than rare words.
8. Logical connectives	A measure of text organisation, express relations between main clauses: e.g., 'moreover', 'but'	More cohesive connectives between sentences in a text contribute to the text being easier as they make the links between sentences more explicit. Comprehension of the text is fundamentally aided by coherence cues.
9. Scorecard	An instant score that refers to the level of the text in terms of CEFR using all readability factors mentioned above	The Scorecard of above B2 level indicates a difficult text accessible to language learners of the highest level of proficiency.

(Based on Flesch, 1979; Harrison, 1980; Teng Fatt, 1991; Chandrasekar et al., 1996; Rupp, Ferne & Choi, 2006; McCarthy & Jarvis, 2010)

4.2.3. Data analysis

The first part of RQ1 in this study was concerned with the text complexity level of OERs, and specifically with benchmarking this level against CEFR to make the results of the readability analysis relevant to non-native English readers. To answer this part of the research question, Scorecards (as described in Table 13) were examined, and the number of courses that require more than the intermediate level of language proficiency as identified by Textinspector (variable 9, *see Table 13*) were counted. Descriptions of the CEFR levels used in the analysis are provided in Table 14 below.

Table 14. A structured overview of CEFR levels related to text comprehension

Advanced	C2	Can understand with ease virtually everything heard or read.
	C1	Can understand in detail a wide range of lengthy, complex texts, identifying finer points of detail including attitudes and implied as well as stated opinions.
Intermediate	B2	Can obtain information, ideas, and opinions from highly specialised sources within his/her field. Can understand specialised articles outside his/her field, provided he/she can use a dictionary occasionally to confirm his/her interpretation of terminology.
	B1	Can identify the main conclusions in clearly signalled argumentative texts. Can recognise the line of argument in the treatment of the issue presented, albeit not necessarily in detail.
Beginner	A2	Can identify specific information in simpler written material he/she encounters.
	A1	Can get an idea of the content of simpler informational material and short simple descriptions, especially if there is visual support.

(Based on the structured overview of CEFR levels for text comprehension, Council of Europe, 2001)

The second part of RQ1 in this study was concerned with the differences in text complexity levels between the OERs at different educational levels. To address this part of RQ1, first, the descriptive statistics of the readability metrics produced by Textinspector, as described in Table 13, were explored to identify if there was any progression in the readability metrics that index text complexity between the different educational levels among the OpenLearn and Saylor OERs. Then statistical approaches on comparing means were used to understand whether this difference was statistically significant. Statistical analysis was also used to identify which readability metrics showed significant difference consistently between all educational levels in both course samples.

Since there were more than two educational levels from each platform, One-Way ANOVA was conducted separately for OpenLearn and Saylor courses for normally distributed variables. Kruskal-Wallis H test was conducted for non-normally distributed

variables with educational levels as independent variables and the readability metrics described in Table 13 as dependent variables. In total, eight blocks of dependent variables were used for these analyses. To establish the group differences, the Tukey’s post hoc test was used for both OpenLearn and Saylor data.

Normality was tested with Shapiro-Wilk Test and by checking Normal Q-Q Plots in SPSS24 (Field, 2013). The results of the Shapiro-Wilk Test for OpenLearn courses are displayed in Table 15 below.

Table 15. Results of Shapiro-Wilk Test for OpenLearn courses

Dependent variable	Statistic	df.	Sig.
Average sentence length	.992	142	.576
TTR	.963	142	.001
vocd-D	.991	142	.508
MTLD	.907	142	.000
Words with more than two syllables (%)	.868	142	.000
Average syllables per sentence	.900	142	.000
Average syllables per word	.129	142	.000
Syllables per 100 words	.581	142	.000
Flesch Reading Ease	.988	142	.271
Flesch-Kincaid Grade	.989	142	.363
Gunning Fog index	.240	142	.000
Noun elements per sentence	.953	142	.000
Elementary lexis	.986	142	.176
Advanced lexis	.986	142	.146
0-6K	.954	142	.000
6K-100K	.989	142	.362
Logical connectives	.961	142	.000

As can be seen from Table 15, the following readability metrics for OpenLearn data were normally distributed: ‘Average sentence length’, ‘vocd-D’, ‘Flesch Reading Ease’, ‘Flesch-Kincaid Grade’, ‘Elementary lexis’, and ‘6K-100K’. The data for the rest of the readability metrics were not normal. Similar evidence was obtained from the Normal Q-Q Plots.

A similar procedure was followed to test normality of Saylor courses data. The results of the Shapiro-Wilk Test for Saylor courses are displayed in Table 16 below.

Table 16. Results of Shapiro-Wilk Test for Saylor courses

Dependent variable	Statistic	df.	Sig.
Average sentence length	.975	40	.518
TTR	.947	40	.059
vocd-D	.969	40	.344
MTLD	.983	40	.799
Words with more than two syllables (%)	.971	40	.391
Average syllables per sentence	.968	40	.308
Average syllables per word	.975	40	.497
Syllables per 100 words	.976	40	.557
Flesch Reading Ease	.979	40	.662
Flesch-Kincaid Grade	.989	40	.958
Gunning Fog index	.987	40	.927
Noun elements per sentence	.896	40	.002
Elementary lexis	.962	40	.194
Advanced lexis	.966	40	.276
0-6K	.986	40	.890
6K-100K	.942	40	.040
Logical connectives	.967	40	.285

As can be seen from Table 16, only two readability metrics for Saylor data were not normally distributed: ‘Noun elements per sentence’, and ‘6K-100K’. The data for the rest of the readability metrics were normal. Similar evidence was obtained from the Normal Q-Q Plots.

The third part of RQ1 in this study was concerned with the association between subject matter and text complexity of the OERs. To address this issue, One-Way ANOVA was first conducted using the few readability metrics identified earlier as dependent variables, and subject labels predefined by the selected OER platforms as independent variables. However, the subject labelling differed between the two OER platforms, and these labels contained a rather broad selection of courses (e.g., courses ‘Emotions and emotional disorders’ and ‘The ancient Olympics: bridging past and present’ belong to the same subject label on OpenLearn). For this reason, One-Way ANOVA with the subject labels was supplemented with cluster analyses. Hierarchical and K-means cluster analyses were conducted, following the steps outlined in the research of Aristeidou and colleagues (2017), that used these two approaches to classify the profiles of online learners. The aim of the cluster analyses in this study was to identify if similar kinds of courses are clustered close together or placed in one cluster based on their text complexity indices. All statistical analyses were conducted using SPSS24.

Given that the platforms differ in the way that they categorise subjects and educational levels, it is worth clarifying that the primary aim in this study was not to

compare the platforms. Rather, the use of multiple platforms was a means to assess whether the patterns in the findings were consistent and could be considered to have a level of generalisability.

4.3. Results

This section provides an overview of the analyses to answer the research question of Study 1: to what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

4.3.1. Accessibility of OERs to non-native English readers

The scorecards automatically produced by Textinspector for each course are presented in Table 17 below.

Table 17. OpenLearn and Saylor OERs (in %) in each scorecard

Proficiency Level	Proportion of OpenLearn courses	Proportion of Saylor courses
B1+	2%	0%
B2 / B2+	7%	14%
C1/C1+	35%	24%
C2/C2+	56%	62%

As can be seen in Table 17, the minimum level of English proficiency required to be able to follow current OER courses was upper-intermediate (B2 and B2+) level in terms of CEFR (*for the description of CEFR levels see Table 14*). Some courses were identified as intermediate (B1+). However, the percentage of B1+ courses was very small (only 2%) and such courses were found only on one platform. Most courses (91% on OpenLearn and 86% on the Saylor platform) required advanced levels of language proficiency (between C1 and C2+).

4.3.2. Text complexity of OERs at different educational levels

One-Way ANOVA and Kruskal-Wallis H test of the readability metrics of the OpenLearn courses at different levels showed a significant statistical difference in some metrics between all three levels. Comparison of the lowest (Level 1) to the most advanced (Level 3) educational level showed statistically significant difference for six blocks of variables out of eight, intermediate (Level 2) to the advanced (Level 3) – for four variables out of eight and for the lowest to intermediate level – five variables out of eight.

The biggest difference was observed between introductory courses (Level 1) and advanced courses (Level 3). The effect sizes for the variables that showed significant difference between these levels were bigger – e.g., for variable ‘words with more than two syllables, percentage’ $n^2 = 0.78$ for Level 1 vs. Level 2; $n^2 = 0.67$ for Level 2 vs. Level 3, and $n^2 = 1.19$ for Level 1 vs. Level 3. The smallest difference in text complexity was observed between intermediate courses (Level 2) and advanced courses (Level 3), as there were fewer variables that showed significant difference, and the effect sizes for those variables were mostly medium (no effect sizes $> n^2 = 0.75$).

The three variables that showed statistically significant difference between all three educational levels for OpenLearn courses were measures of word length (words with more than two syllables, $F(2, 147) = 22.16, p = .00$); Flesch Reading Ease, $F(2, 147) = 28.44, p = .00$, and amount of elementary lexis (A1, $F(2, 147) = 15.41, p = .00$) and advanced lexis (C1, $F(2, 147) = 26.49, p = .00$).

Comparison of the means of readability metrics showed that Level 3 (advanced) courses are the most difficult to read among the three levels, and the introductory courses are the easiest. Table 18 below presents descriptive statistics for the readability metrics that demonstrated the progression of text complexity between the educational levels.

Table 18. OpenLearn readability metrics: complexity progression between levels

Variables	Level 1		Level 2		Level 3	
	M	SD	M	SD	M	SD
Average sentence length (in words per sentence)	20.96	2.29	22.88	2.8	23.07	2.69
Average word length (% words with more than two syllables)	15.56	3.4	18.31	3.17	20.55	5.22
Low frequency lexis 6K-100K (% words per text)	19.86	5.23	21.18	3.99	21.36	2.80
Advanced lexis: C1; C2 (% words per text)	7.82	1.59	9.29	1.89	10.01	1.28

Note: N = 150, n = 50 courses at each educational level

As can be seen in Table 18, among the courses at the three educational levels advanced Level 3 courses have the highest average sentence length, highest average word length, they contain more words of lower frequency and more advanced lexis.

Results produced by the readability formulas also indicated progression of text complexity between the three levels. Both advanced Level 3 and intermediate Level 2

courses were assigned to the college level and were estimated as 'difficult to read'. However, the scores for Level 2 courses indicated easier readability than Level 3 courses: average score for Flesch Reading Ease for Level 3 was 36.50, and for Level 2 = 42.88. Level 1 courses were estimated as suitable for 10th-12th grade and 'fairly difficult to read' with the average score for Flesch Reading Ease at 51.23.

The remaining three variables indicated some progression of linguistic complexity between Level 1 and Level 3 courses, but not between Level 2 and Level 3, as demonstrated in Table 19 below.

Table 19. OpenLearn readability metrics: no complexity progression between levels

Variables	Level 1		Level 2		Level 3	
	M	SD	M	SD	M	SD
Type/token ratio	.18	.04	.2	.04	.2	.03
Noun elements per sentence (% elements per sentence)	1.85	.52	2.27	.62	2.24	.60
Logical connectives (% per text)	1.15	.30	1.11	.23	1.14	.24

Note: N = 150, n = 50 courses at each educational level

As can be seen in Table 19, Level 1 courses contain slightly fewer unique words, and have more word repetition, they contain fewer noun elements and have more cohesion between/within the sentences than the courses at Level 2 and Level 3. At the same time, this progression was not observed between Level 2 and Level 3. The latter variable, logical connectives in the text, showed very small values in all three educational levels, which indicated that even the introductory courses do not often use cohesion cues between/within the sentences in the texts.

As for the sample of Saylor courses, ANOVA analysis and Kruskal-Wallis H test of the readability metrics of Saylor courses showed a much less pronounced difference between the readability of the courses at different levels as compared to the OpenLearn data, where there were statistically significant differences in some variables between all levels. The only statistically significant difference based on Saylor data was observed between courses at 'remedial' Level 0 vs. courses at Levels 1, 3, and 4 (with large effect sizes, all effect sizes were bigger than $\eta^2 = 1.14$). While there were no variables that showed statistically significant differences between all five levels among Saylor courses, the variables that showed a statistically significant difference between some levels were as follows: measures of word length (words with more than two syllables, $F(4, 46) = 9.7, p = .00$); Flesch Reading

Ease, $F(4, 46) = 11.72, p = .00$; the amount of elementary lexis (A1, $F(4, 46) = 9.74, p = .00$); and logical connectives, $F(4, 46) = 7.38, p = .00$.

The comparison of the means of readability metrics of Saylor courses showed that Level 0 courses were the easiest to read among the five levels according to most metrics. Table 20 below presents descriptive statistics for the readability metrics analysed in the study that demonstrated the progression of text complexity between Level 0 and more advanced courses for Saylor.

Table 20. Saylor readability metrics: complexity progression between Level 0 and more advanced levels

Variables	Level 0		Level 1		Level 2		Level 3		Level 4	
	M	SD	M	SD	M	SD	M	SD	M	SD
Average sentence length	19.65	1.37	21.50	1.97	20.32	1.97	21.68	2.37	20.68	2.07
Average word length	15.04	2.98	22.26	3.13	18.09	1.99	20.63	1.57	20.57	2.12
Elementary lexis: A1	22.07	1.94	16.75	1.68	18.92	1.05	17.22	2.22	17.01	2.02
High frequency lexis 0-6K	67.67	3.87	61.62	4.90	65.67	3.87	62.11	4.91	64.09	5.57
Flesch Reading Ease	51.80	7.69	34.59	7.51	46.12	2.94	37.63	1.51	38.62	5.81

Note: N = 50, n = 10 courses at each educational level

As can be seen in Table 20, Level 0 courses employ shorter sentences, shorter words, the lexis used in these courses is on average easier and is of higher frequency. The scores for Flesch Reading Ease indicated that Level 0 courses are suitable for 10th-12th grade students with the average score at 51.80, as compared to the rest of the levels, which were estimated as college level and 'difficult to read'.

Similarly to the OpenLearn courses, there were some variables that did not demonstrate progression of text complexity between lower and higher educational levels, as outlined in Table 21 below.

Table 21. Saylor readability metrics: no complexity progression between levels

Variables	Level 0		Level 1		Level 2		Level 3		Level 4	
	M	SD	M	SD	M	SD	M	SD	M	SD
Type/token ratio	.18	.00	.2	.02	.18	.01	.21	.03	.19	.02
Noun elements per sentence	1.83	.17	2.44	.43	1.78	.21	2.51	.51	2.12	.48
Logical connectives	.89	.15	.95	.08	1.3	.14	1.07	.2	1.06	.14

Note: N = 50, n = 10 courses at each educational level

As can be seen from Table 20, and Table 21 above, similar variables did not contribute to the progression of text complexity between the educational levels in OpenLearn and Saylor courses. While in OpenLearn courses this progression was still observed between the lowest Level 1 and more advanced courses, in Saylor courses this pattern was not observed between any levels. In fact, Level 2 courses had fewer noun elements per sentence, and Level 3 courses had more logical connectives than Level 0 courses. Similarly to the OpenLearn courses, Table 21 showed that the values for logical connectives were very low, and texts in all educational levels do not use many cohesive links between the sentences, or between the clauses within each sentence.

To sum up, some difference in text complexity levels was elicited between the lowest and more advanced course levels in five blocks of variables out of eight, and this difference was more pronounced among OpenLearn OERs. However, no systematic progression of text complexity between the educational levels was observed on either OER platform. Cohesion values between/within the sentences were low in the courses from both platforms. The three types of variables that showed consistently statistically significant differences between some educational levels from both platforms were measures of word length: ‘words with more than 2 syllables, percentage’; readability formulas: ‘Flesch Reading Ease’; and amount of elementary lexis as benchmarked against CEFR: ‘A1 lexis’.

4.3.3. Text complexity of OERs belonging to different subjects

As described in previous Section 4.3.2, the variables that showed significant statistical differences between the educational levels from both platforms were ‘words with more than 2 syllables, percentage’; ‘Flesch Reading Ease’; and ‘amount of A1 lexis’. This finding facilitated the subsequent analysis to explore the association between subject

matter and OER text complexity. Since Flesch Reading Ease is calculated based on the ratio of word and sentence length, it subsumes the variable 'words with more than 2 syllables, percentage'. Thus, two dependent variables, namely 'Flesch Reading Ease' and 'amount of A1 lexis', were used to answer the third part of RQ1 of this study concerning subject matter vs. the text complexity of the OERs.

First, One-Way ANOVA was conducted to investigate if there were significant statistical differences in readability metrics that index text complexity between the subject labels pre-assigned to the OERs on OpenLearn and Saylor platforms. ANOVA showed significant overall difference between the groups on both platforms: Flesch Reading Ease, $F(7, 142) = 4.06, p = .00$ for OpenLearn, and for Saylor $F(9, 41) = 2.71, p = .02$; A1 lexis, $F(7, 142) = 3.04, p = .01$ for OpenLearn, and for Saylor $F(9, 41) = 3.62, p = .00$. However, post hoc comparisons using Tukey HSD test showed no statistically significant difference between any of the subject labels on both platforms in the two dependent variables.

As the subject classification was not uniform across the two OER platforms and each classification was rather broad, cluster analyses were conducted next to gain further evidence on whether text complexity varies depending on the subject category of the OER courses. The readability metrics were normalized in the interval [0, 1]. To decide on the number of clusters, hierarchical cluster analysis was conducted, and the dendrograms were examined (*see excerpts in Figure 10 and Figure 11*). The hierarchical clustering algorithms indicated between 2 and 7 clusters as the interval to be tested for OpenLearn data and 2 to 6 clusters for Saylor data. The potential number of clusters were formed at several cluster cut-off testing values by drawing vertical lines at the rescaled distance cluster values and counting the number of lines that the vertical line intersects. Figure 10 and Figure 11 in the next two pages illustrate the excerpts of the dendrograms arising from the hierarchical clustering algorithm, with Euclidean distance, that were visually inspected to decide on the number of clusters.

Figure 10. Dendrogram excerpt of OpenLearn OERs

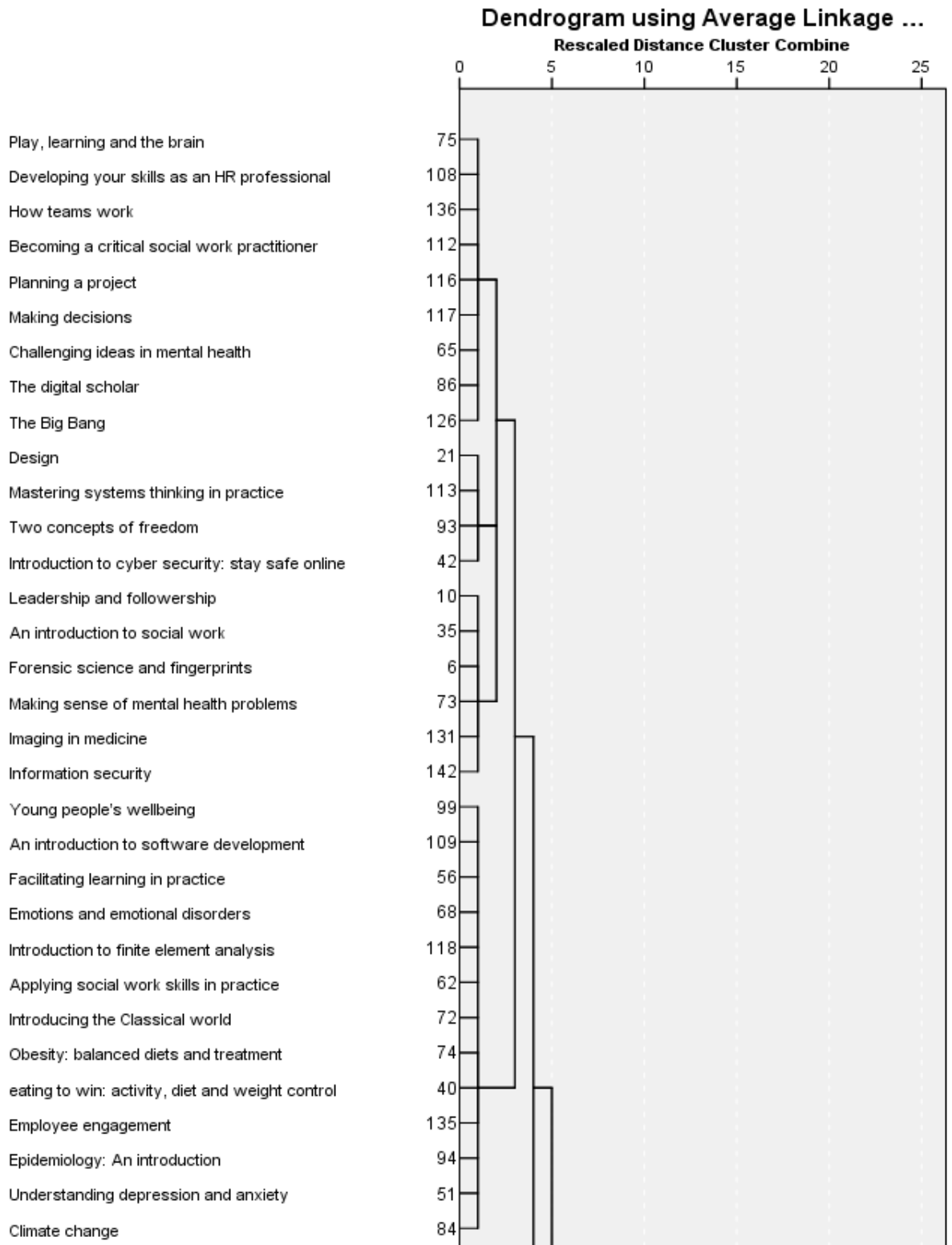
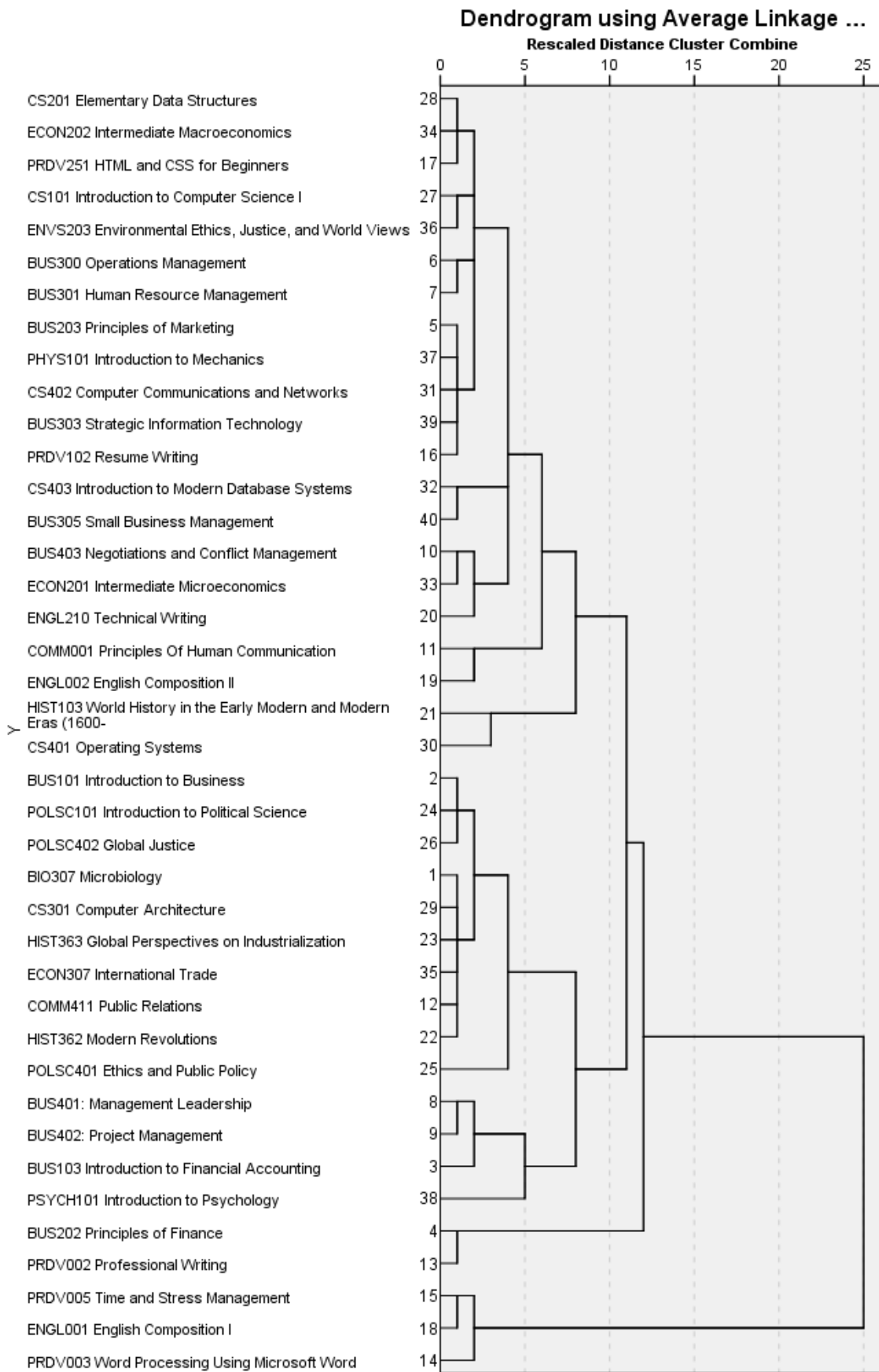


Figure 11. Dendrogram of Saylor OERs



To understand what the best cluster solution was in the identified intervals of 2-7 clusters in OpenLearn data and 2-6 clusters in Saylor data, K-means analysis was conducted for each cluster solution. Then the intra-cluster similarity and inter-cluster dissimilarities were identified amongst clusters for each solution. The results are shown in Table 22 and Table 23 below.

Table 22. Sum of squares between and within groups: OpenLearn 7 cluster solutions

Cluster solution	Between groups	Within groups
2	.85	26.33
3	.13	19.81
4	.56	15.27
5	.15	14.84
6	.43	12.62
7	.40	9.99

Table 23. Sum of squares between and within groups: Saylor 6 cluster solutions

Cluster solution	Between groups	Within groups
2	.00	12.29
3	.11	5.88
4	.26	6.60
5	.40	6.18
6	.87	3.55

Having created a line graph for the inter- intra-cluster similarities, the point where the clusters had maximum similarities within the cluster solutions and maximum dissimilarities between the clusters was identified for the two OER platforms, as shown in Figure 12 and Figure 13 below.

Figure 12. Intra-cluster similarity and inter-cluster dissimilarities: OpenLearn

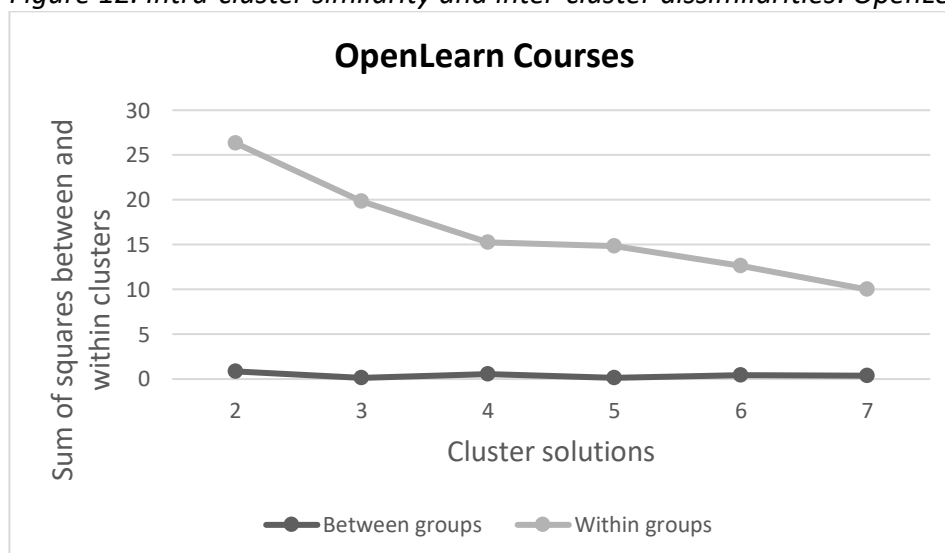
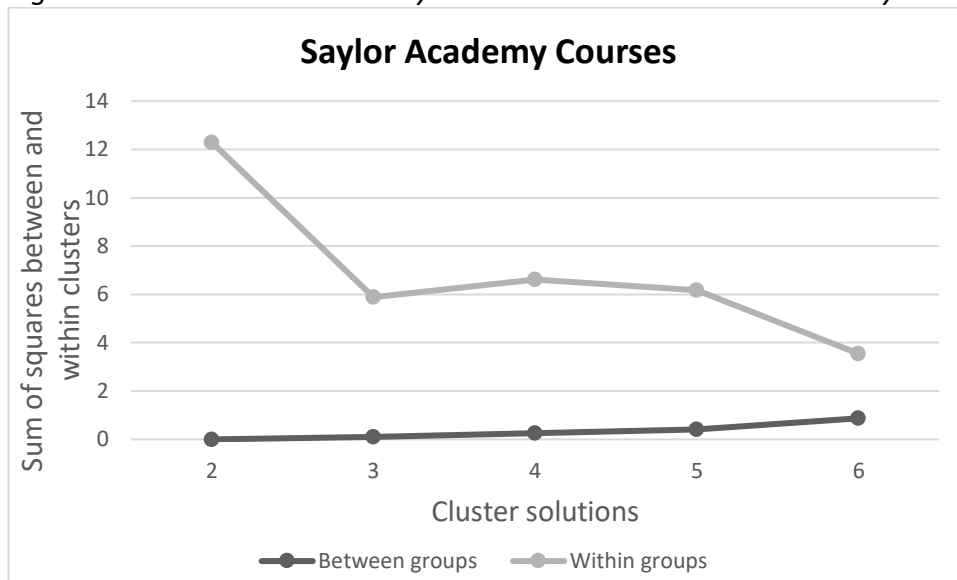


Figure 13. Intra-cluster similarity and inter-cluster dissimilarities: Saylor



The difference between the clusters was much smaller than within the clusters on both platforms, with this difference being more pronounced with OpenLearn courses. Therefore, the focus was placed on within-cluster similarity, which reduced after the 5th cluster solution both for OpenLearn and Saylor courses. The difference between the clusters also slightly increased after the 5 clusters, which made the 5-cluster solution a good case for the analysis for both course samples.

Having decided on the 5-cluster solution, descriptive statistics of the readability metrics of the 5 clusters were then examined to identify which clusters were the easiest and the most difficult in terms of their text complexity. Table 24 below presents the descriptive statistics for the two dependent variables between the 5 clusters of OpenLearn courses.

Table 24. OpenLearn readability metrics for 5 cluster solutions

	Cluster	n	M	SD
Flesch Reading Ease	1	42	51.89	6.00
	2	53	39.64	4.89
	3	15	57.94	5.38
	4	15	42.83	7.02
	5	25	30.59	6.67
	Total	150	43.76	10.49
Amount of A1 lexis	1	42	22.47	1.81
	2	53	18.94	2.14
	3	15	26.42	2.19
	4	15	21.26	2.03
	5	25	16.61	1.73
	Total	150	20.48	3.80

The table shows that the 5th cluster for OpenLearn courses was the cluster with the most difficult texts in both measures. It had the lowest score for Flesch Reading Ease with the estimate of the ‘College level, difficult to read’, and it had the lowest amount of elementary lexis. The 3rd cluster was the cluster with the easiest texts. It had the highest Flesch Reading Ease score with the estimate of ‘10th to 12th-grade level, fairly difficult to read’, and had the highest amount of elementary lexis.

The subjects of the courses that were assigned to each cluster were then examined. To exemplify, the first ten courses assigned to the 5th cluster (with the most difficult texts) and the 3rd cluster (with the easiest texts) are shown in Table 25 below.

Table 25. Examples of OpenLearn subjects assigned to the 5th and the 3rd clusters

Cluster	Title	The subject label assigned on the platform
5	Digital forensics	STEM
5	The autistic spectrum: from theory to practice	STEM
5	Attachment in the early years	Education & Development
5	Understanding dyslexia	Education & Development
5	Organisations and management accounting	Money & Business
5	Factors that influence health: an introduction	Health, Sports & Psychology
5	Exploring the English language	History & The Arts
5	What is politics?	Society, Politics & Law
5	The Enlightenment	History & The Arts
5	Understanding operations and management	Money & Business
3	Business communication: writing a SWOT analysis	Money & Business
3	Diagrams, charts and graphs	STEM
3	Start writing fiction: characters and stories	History & The Arts
3	The science of nutrition and healthy eating	Health, Sports & Psychology
3	Children’s perspectives on play	Education & Development
3	Writing what you know	History & The Arts
3	An introduction to music theory	History & The Arts
3	Introducing philosophy	History & The Arts
3	Digital literacy: succeeding in a digital world	Education & Development
3	Succeed in the workplace	Education & Development

As can be seen in Table 25, although the 3rd cluster with easier readability metrics had fewer STEM and Money & Business courses, the subjects assigned to both clusters were very diverse. For example, ‘The autistic spectrum: from theory to practice’, ‘Organisations and management accounting’ and ‘Exploring the English language’, were assigned to the 5th cluster.

The same procedure was followed for Saylor courses. First, the descriptive statistics of the readability metrics of the 5 clusters for Saylor courses were examined to identify the clusters with the easiest and most difficult texts, as presented in Table 26 below.

Table 26. Saylor readability metrics for 5 cluster solutions

	Cluster	n	M	SD
Flesch Reading Ease	1	5	35.38	6.06
	2	17	41.93	3.79
	3	7	58.41	1.48
	4	9	48.49	2.11
	5	12	34.94	5.71
	Total	50	41.07	7.89
Amount of A1 lexis	1	5	17.33	.56
	2	17	18.98	1.78
	3	7	23.18	1.13
	4	9	19.60	1.08
	5	12	15.50	.96
	Total	50	18.15	2.53

Table 26 shows that the 3rd cluster with Saylor OERs was the easiest, and the 5th cluster was the most difficult in both measures, similarly to the results of the cluster analysis for OpenLearn courses. Next, the subjects of the courses that were assigned to each cluster were examined. To exemplify, the first ten courses assigned to the 5th cluster (with the most difficult texts) and all seven courses assigned to the 3rd cluster (with the easiest texts) are shown in Table 27 below.

Table 27. Examples of Saylor subjects assigned to the 5th and the 3rd clusters

Cluster	Title	The subject label assigned on the platform
5	Principles of finance	Business Administration
5	Negotiations and conflict management	Business Administration
5	Introduction to mathematical reasoning	Mathematics
5	Professional writing	Professional Development
5	HTML and CSS for beginners	Computer Science
5	Ethics and public policy	Political Science
5	Elementary data structures	Computer Science

5	Operating systems	Computer Science
5	Intermediate microeconomics	Economics
5	Environmental ethics, justice, and world views	Philosophy
3	Calculus I	Mathematics
3	Word processing using Microsoft Word	Professional Development
3	Spreadsheets	Professional Development
3	Time and stress management	Professional Development
3	Pre-College English	English
3	English composition I	English
3	Introduction to Western political thought	Political Science

As can be seen in Table 27, similarly to OpenLearn courses, the 3rd cluster with lower text complexity among Saylor OERs had fewer STEM (e.g., Computer Science) and Business Administration courses. At the same time, some of the courses positioned in this cluster among Saylor courses were aimed at introducing learners to the subject and would correspond to remedial Level 0 courses. The subject profiles in both the 3rd and the 5th cluster were still quite diverse.

To sum up, the cluster analyses conducted in this study showed that the clusters were widely mixed in terms of their subject areas. This can be seen from the dendrogram excerpts (*see Figure 10 and Figure 11*), where very different courses subject-wise were positioned close together. This can further be seen from the courses assigned to the clusters with higher and lower readability among both OpenLearn and Saylor courses, as exemplified earlier in this section.

4.4. Study 1 Discussion

4.4.1. Implications of findings

In Study 1, linguistic accessibility was approached from the perspective of text complexity (*see Figure 6*). This study aimed to contribute to the understanding of the extent to which English language OERs across educational levels and subjects are accessible to non-native English readers. To achieve this goal, readability analysis was conducted in this study by using an advanced online readability tool. Textinspector combines traditional readability formulas with the analysis of other semantic, syntactic, and cohesion features of the text, as recommended by research literature (*see Section 2.4*).

The analysis of the scorecards automatically produced by Textinspector showed that more than 86% of the courses on both OER platforms were only considered suitable for the learners at the highest or advanced level of English proficiency. Thus, most OER

might not be accessible to non-native English readers who do not speak English fluently. This finding supports the results of other research studies on the readability of online materials conducted in the field of online healthcare education (Sanghvi et al., 2012; Betschart et al., 2017; Kher et al., 2017; Xie et al., 2018). While those studies were aimed at native English readers, they also found that the language used is too difficult for an average patient/reader.

This study builds on previous research (Hatakka, 2009; Kanwar et al., 2010; Knyazeva, 2010; Banzato, 2012; Huang et al., 2012; Cobo, 2013). The findings of this study provide a new form of evidence that the current level of the English language used in many OERs is likely to create a barrier and prevent those learners who cannot read English to an advanced proficiency to learn through these OERs.

RQ1 in Study 1 was also concerned with variability in text complexity across the different educational levels of the OERs, as both OER platforms under investigation offer materials at levels that require different expertise of subject knowledge. OpenLearn courses demonstrated some progression of text complexity between the levels, as the one-way ANOVA and Kruskal-Wallis H test showed that there were statistically significant differences between OERs in some readability metrics at all three given educational levels. The biggest difference was observed between Level 1 and Level 3 courses. Some progression of complexity was also observed when examining descriptive statistics of the readability metrics between these levels, as five blocks of variables out of eight demonstrated that Level 3 courses were the most difficult and Level 1 courses – the easiest to read. At the same time, the progression of complexity between Level 2 and Level 3 courses was less clear among OpenLearn OERs, as there were fewer variables that showed significant difference and had medium effect sizes.

Furthermore, a similar analysis of Saylor courses showed that this difference between different educational levels was much less pronounced. There was a statistically significant difference only between ‘remedial’ Level 0 courses and more advanced courses. The differences in the results between the two platforms might be due to the differences in the design of the platforms. The OpenLearn website explicitly explains the differences between the educational levels contrary to the Saylor platform. The development team of the latter confirmed that the sequence in complexity progression between the levels might be loose (personal communication, December 27, 2018). In this study, the progression of text complexity between more advanced courses was not clearly observed on both OER

platforms. At the same time, since the educational levels assigned to the OER courses suggest the order in which these courses should ideally be followed (*see Section 2.4*), the text complexity of the courses should be expected to vary, in line with the systematic complexification assumption (Berendes et al., 2018; *see Section 2.4*). In contrast to this assumption, this study yielded no systematic differences in text complexity across the different educational levels of the OERs.

The evidence on the variables that showed statistically significant differences between some educational levels on both platforms mainly concerned the measures of word length, Flesch Reading Ease (word and sentence length) and amount of elementary lexis. This result adds to current knowledge concerning the most prominent linguistic contributors to text difficulty which have also been reported to be word and sentence structure (number of syllables per word and number of words per sentence) as well as word meaning (word frequency and corresponding level of proficiency) (Berendes et al., 2018; Harrison, 1980; Maslin, 2007). While research literature suggests that low cohesion is another factor that makes the text less linguistically accessible (e.g., Reed & Kershaw-Herrera, 2016), this study also showed that the variable ‘logical connectives per text’ demonstrated very low values among all educational levels of OpenLearn and Saylor courses. Low cohesion identified in this study in combination with the analysis of the scorecards and other readability metrics once again demonstrated potential inaccessibility of OERs even on the introductory educational levels to non-native English readers at lower levels of English proficiency.

The third part of RQ1 was concerned with the association between subject matter and the text complexity of OER courses. Post hoc comparisons using Tukey HSD test showed no statistically significant difference between any of the subject labels on both platforms in the two readability variables used in this analysis. This result was further supported by cluster analyses – visual inspection of the dendrograms and the inspection of the course membership of each cluster showed that very diverse courses subject-wise were positioned close together and assigned to one cluster. Thus, both data analysis approaches applied to the two OER platforms suggested that subject matter does not seem to affect the text complexity of the OERs.

4.4.2. Study limitations

In this chapter, the analysis offered insights into the text complexity level of English language OERs across two popular OER platforms and indicated that there might be a gap between many potential OER learners' language abilities and OER courses that purportedly enable inclusive education. However, several limitations were recognised. The first limitation in this study arises from the fact that there is no standard combination of readability tests or consensus on the readability metrics that should be used to evaluate text complexity, which is a general weakness of this methodology (*see Section 3.4.1*). To exemplify, the studies with a deep linguistic focus include such metrics as type of nouns (e.g. genitive nouns, derived nouns), lexical co-referentiality, spatiality or temporal cohesion (Crossley et al., 2008). This study used metrics that are best established in text complexity assessment, automatically provided by the online readability tool, and that can be accessed by an audience with no specialised background in theoretical linguistics.

The second limitation concerns the fact that, despite the ease of interpretation, readability analysis provides overall metrics for each text, and does not indicate specific areas of the text that need to be changed to make it more accessible. Moreover, readability analysis lacks real-time readers' response to the text. For example, the first 1000 most common words in English are assessed by readability tools as easy to understand lexis. Yet, such words as *'the'*, *'as'*, or *'it'* that are among OK frequency lexis (Textinspector, 2020) might create difficulties to those non-native English readers who do not have corresponding grammar structures in their mother tongues. In Study 1, this limitation was partly overcome by using more than one readability metric in the readability analysis. Nine blocks of readability variables explored in this study that included both surface-level text features, such as word and sentence length, as well as features that concerned text organisational structure, such as cohesion, provided a more comprehensive picture of OER accessibility.

4.4.3. Links to other studies in this thesis

Study 1 problematised the linguistic accessibility of OERs to non-native English readers by exploring the text complexity of a sample of 200 OER courses from two popular OER platforms. While the findings of this study showed that the reading materials at introductory levels on both OER platforms are easier to read, the study demonstrated that the majority of English OER texts at different educational levels and subject categories are

only suitable for native English readers or non-native English readers with advanced English proficiency. As there have been no earlier studies that used readability analysis with OERs, this study provided empirical evidence, which supported previous research that documented that OER learners who were non-native English readers experience language barrier when learning from OERs (Hatakka, 2009; Kanwar et al., 2010; Knyazeva, 2010; Banzato, 2012; Huang et al., 2012; Cobo, 2013). However, the findings of Study 1 in this thesis do not offer an actionable understanding of *how* to change OER texts to increase their linguistic accessibility, *why* these specific changes are important, and *what effect* such changes have on non-native English readers at different language proficiency levels and diverse language backgrounds. This is in line with the conceptualisation of linguistic accessibility used in this thesis, as it was important for this research to explore the linguistic accessibility of OERs also from the perspectives of task and text difficulty.

Therefore, Chapter 5 will begin to address the limitations of Study 1 by exploring whether lowering the text complexity of OERs can be a suitable solution to facilitate linguistic accessibility for non-native English readers. Study 2, described in Chapter 5, examined non-native English readers' response to text simplification, performed in line with the recommendations made in the text complexity literature, using qualitative methods. Subsequently, Chapter 6 will address the limitations of Study 1 by investigating the approaches and strategies English teachers take to increase the linguistic accessibility of OERs, and the rationale behind these strategies, which was done in Study 3. English teachers constitute an expert group on text simplification in light of their expertise in matching English learners with learning materials. The final empirical chapter in this thesis will evaluate the approaches and strategies to text simplification elicited in Study 3 by examining their effect on non-native English readers using quantitative methods (*see Chapter 7*).

This research design was used in consultation with methodology literature, which highlighted that a mixed methods design can increase validity and enhance the integrity of the findings, as well as increase their meaningfulness by elaborating and clarifying the results from one method with the results of another (Greene et al., 1989; Creswell, 2014; *for an in-depth justification for the mixed methods design, see Section 3.2.2*).

5. Study 2 Methods and Results

This chapter describes the second study in this thesis, in which linguistic accessibility was approached from the perspective of text difficulty (*see Figure 6*). This study analysed the effect of text simplification on text processing through qualitative eye-tracking stimulated recall interviews. As mentioned previously, there is a lack of research evidence on the effect of text simplification on text processing. The main objective of Study 2 was to capture the emerging evidence of this effect. Study 2 compared the frequency of use of different cognitive processing strategies during reading of authentic vs. simplified OERs using participants' verbalisations in stimulated recall interviews.

Reading is a cognitive activity that involves lower- and higher-level processes, as the reader attempts to make sense of a text (*see Section 2.6.2*). For that reason, previous research highlighted the need to also explore the 'processes of reading' rather than only investigate the 'product of reading', which is text comprehension (Spranger, Sandral & Ferrari, 2011; Lin & Yu, 2015; Alkhaleefah, 2017). At the same time, as has also been stressed in Section 2.6.1, most previous studies on text simplification have measured its effect on non-native English readers predominantly through comprehension tests (e.g., Crossley et al., 2014). Eye-tracking stimulated recall interviews employed in Study 2 in this thesis helped to tap into the 'processes of reading', which in turn allowed to understand the extent to which text simplification facilitated higher-level processing of the OER text. This chapter is divided into four sections. The Introduction (Section 5.1) presents the research question for Study 2. The materials and methods section (5.2) provides an overview of the specific methods used for Study 3, including information about participants, study materials, procedure and data analysis approach. Section 5.3 provides an overview of the findings in relation to the research question. The final section, Discussion (5.4), summarises the findings of Study 2, outlines their implications, as well as limitations of the study and its influence on the subsequent studies conducted in this research project.

³ The study described in this chapter was presented at EuroCALL 2018 conference at Jyväskylä University, Finland. This chapter is also based upon the following manuscript in preparation:

- Rets, I., Stickler, U., Coughlan, T., & Astruc, L. (submitted). Simplification of Open Educational Resources in English: exploring its effect on text processing of English learners using qualitative evidence from eye-tracking.

5.1. Introduction

Study 1 in this thesis problematised the linguistic accessibility of OERs and provided evidence that action is needed to reduce the text complexity of these resources. Such action can help fulfil the inclusive educational potential of OERs. At the same time, as stated in Section 4.4.3, while Study 1 identified that the text complexity of the current OERs might create barriers to the use of OERs globally, Study 1 fell short of providing any evidence on whether reducing text complexity of OERs would have a facilitative effect on non-native English readers.

As pointed out earlier, one potential solution that can increase linguistic accessibility of reading materials is text simplification. Furthermore, text simplification must also be related to how the readership responds to the text and their reading behaviour, rather than solely being considered in terms of the absolute linguistic indices of simplicity (Tomlinson & Masuhara, 2017). With this in mind, the primary goal of Study 2 was to understand if there is any effect of text simplification on text processing of non-native English readers. As this thesis incorporated a mixed methods research design, Study 2 constituted an exploratory research phase (*see Section 3.2.2 on the mixed methods methodology*) – it used qualitative data to collect some emerging evidence on the effect of text simplification on text processing, for which there is a lack of research evidence (*see Section 2.6.3*). The second goal of Study 2 was to pilot the design and layout of the texts in the eye-tracking software for subsequent Study 4. Since each text displayed to participants in the eye-tracking software needed to be transferred to a format that would enable the interpretation of the gaze traces (*see Section 3.4.3*), Study 2 piloted the layout (e.g., font, line spacing, margin size) that contributed to the highest quality data, which was then used in Study 4.

Altogether, the following research question were addressed in Study 2:

RQ2: What is the effect of text simplification on text processing, as evidenced in the frequency of use of cognitive processing strategies by non-native English readers?

The next section provides an in-depth overview of the methods employed in Study 2 to address this question.

5.2. Materials and methods

5.2.1. Participants

The aim of this study was to recruit a participant sample that would reflect the diversity of the population of OER learners. Since OERs are developed as universally available educational resources (Mishra, 2017), OER learners constitute a diverse audience of learners regarding their educational background, age, and location. As the overall aim of Study 2 was to explore how lower-level proficiency non-native English readers respond to OER text simplification, only participants' language proficiency was controlled during sampling.

Twelve adult non-native English readers took part in this study on a voluntary basis. Due to calibration problems and common problems with eye tracking data quality (Holmqvist et al., 2011; Catrysse et al., 2018), only data of nine participants ($M_{\text{age}} = 37.6$, $SD = 5.41$) were available for the analysis. All participants were female which was a reflection of the classroom population from which they were recruited and which was predominantly female. All participants were recruited from the same classroom, an intermediate (B1) English language course, at a local adult community learning centre in the UK. Their language level was determined by this education centre through the entrance language examination and was benchmarked against the CEFR (Council of Europe, 2001). In terms of participants' educational background, most participants were university graduates ($n = 6$), $n = 2$ had vocational degrees, $n = 1$ had an A-level qualification. Seven participants indicated they had degrees in humanities (e.g., law, arts) and one participant – in sciences (radio-engineering). Participants' language backgrounds also varied to reflect the diversity of the OER learner population: $n = 2$ had Russian as the mother tongue; $n = 2$ Spanish; $n = 2$ Italian; $n = 1$ Hungarian; $n = 1$ Romanian, and $n = 1$ had Tamil.

The aim of recruiting a diverse sample of non-native English readers in this study was to obtain heterogeneity in participant profiles and to provide stronger generalisability of findings that can project to the population of OER learners who experience language barriers when learning from the OERs (Knyazeva, 2010; Banzato, 2012; Cobo, 2013).

All participants had normal or corrected-to-normal vision and reported having no learning disorders.

5.2.2. Texts

Two OER texts in the domain of natural sciences were selected from the OpenLearn (2020) platform: Text 1 (160 words, two paragraphs) was selected from the OER course ‘Why sustainable energy matters’, and Text 2 (145 words, one paragraph) – from the OER course ‘Galaxies, stars and planets’. Both selected texts were part of the first section of introductory courses; the courses required no prior educational background. Since each participant read two texts, participants could potentially improve their knowledge about the text’s topic after reading the first given text and approach the reading of the second text differently. To avoid this kind of learning effect between the two readings, the selected texts represented different topics, but were within a largely similar topic domain. Shorter texts were preferred for this study to avoid flipping pages on the screen during eye-tracking, which might lead to participants looking away from the screen. Additionally, such experimental setup allowed readers to go back to earlier areas of the text during reading – something that would not be possible if the text was divided into smaller paragraphs (Conklin et al., 2018). It was important for this study to be able to discuss in depth each eye movement, including look-backs, with participants during the subsequent stimulated recall interview.

Since there is a lack of research on approaches to text simplification conducted with teachers, and existing studies focus on verbal simplification of the learning content, text simplification in this study was performed in line with the recommendations in the text complexity literature (e.g., Chandrasekar et al., 1996; Rupp et al., 2006; McCarthy & Jarvis, 2010). Thus, I manually simplified each authentic OER text using the categories from the readability analysis conducted in Study 1 (*see Table 13 in Chapter 4*). Two categories that concerned readability formulas and scorecards were removed from text simplification, as they involve automatic readability calculations.

Text simplification strategies used in Study 2 are presented in Table 28 below.

Table 28. Text simplification strategies used in Study 2

Text simplification strategy	Description of the strategy
Sentence length	Reduce the average number of words per sentence
Word repetition	Increase the proportion of repeated words in the text
Word length	Reduce the average number of syllables per word
Noun elements per sentence	Reduce the average number of noun elements per sentence
Amount of elementary and advanced lexis	Decrease the proportion of advanced lexis in terms of CEFR
Word frequency	Increase the proportion of 0K-6K lexis
Logical connectives	Increase the proportion of logical connectives between/within sentences.

(Based on Harrison, 1980; Teng Fatt, 1991; Chandrasekar et al., 1996; Rupp et al., 2006; McCarthy & Jarvis, 2010; Textinspector, 2020)

The global structure and the content of the authentic texts were kept intact in simplification. Two independent experienced English language teachers gave qualitative judgements on the linguistic accessibility of each text and provided feedback on the performed text simplification. They both found that none of the authentic texts was suitable for non-native English readers at lower English proficiency levels, while the linguistically simplified versions of these texts were identified as more comprehensible. The two teachers also highlighted any potential language mistakes in the simplified texts and observed that the meaning of the simplified texts was kept close to the originals.

The final version of simplified Text 1 contained 164 words, two paragraphs; and simplified Text 2 – 147 words, one paragraph. Thus, a total of four texts were used. All text versions were displayed in Times New Roman 14.5 black font on a white background and were presented 1.5-spaced on the screen with the left and right page margins set at 0.2 cm. The two texts and their simplified versions can be found in Table 29 below.

Table 29. Texts used in Study 2

Text 1 Authentic	Text 1 Simplified
<p>Where do we get our energy from?</p> <p>The world's current energy systems have been built around the many advantages of fossil fuels, and we now depend overwhelmingly upon them. Concerns that supplies will 'run out' in the short-to-medium term have probably been</p>	<p>Where do we get our energy from?</p> <p>The modern energy systems in the world are based on fossil fuels. Fossil fuels offer us many advantages. We now heavily depend upon these resources. Experts probably overstate the fears that these resources will end soon. We might not use</p>

<p>exaggerated, thanks to the continued discovery of new reserves and the application of increasingly advanced exploration technologies. Nevertheless, it remains the case that fossil fuel reserves are ultimately finite. In the long term they will eventually become depleted and substitutes will have to be found.</p> <p>Moreover, fossil fuels have been concentrated by natural processes in relatively few countries. Two-thirds of the world's proven oil reserves, for example, are located in the Middle East and North Africa. This concentration of scarce resources has already led to major world crises and conflicts, such as the 1970s 'oil crisis' and the Gulf War in the 1990s. It has the potential to create similar, or even more severe, problems in the future.</p>	<p>up all the resources soon because there is now a continued discovery of new resources and new ways to find them. However, fossil fuel supplies are still limited. In the long term we will one day have no more fossil fuels and we will have to find alternatives for them.</p> <p>And only few countries have fossil fuels because of natural processes. Over 65% of the discovered oil supplies in the world, for example, are in the Middle East and North Africa. This concentration of limited resources has already led to major world crises and conflicts: the 1970s 'oil crisis', the Gulf War in the 1990s. It can cause the same or even bigger problems in the future.</p>
Text 2 Authentic	Text 2 Simplified
<p style="text-align: center;">The Universe today</p> <p>Astronomy is the study of all celestial bodies and the regions of space that separate them. It is a vast subject: quite literally as big as the Universe. It encompasses objects ranging in size from the incredibly small (the atoms from which planets and stars form) to the unbelievably vast (superclusters of thousands of galaxies, with each galaxy containing many billions of stars). The distances of these objects are also so enormous that the units of measurement, such as kilometres (km), that are familiar to many people on the Earth can't be used. The Universe is around 14 billion years old and contains materials with a range of properties that far exceeds anything that can be replicated in laboratories on the Earth. Temperatures range from close to absolute zero ($-273.15\text{ }^{\circ}\text{C}$) in dense clouds of gas and dust from which stars form.</p>	<p style="text-align: center;">The Universe today</p> <p>Astronomy studies all objects in space and the regions between these objects. It is a very big topic: as big as the Universe. Astronomy includes very small objects (for example, the atoms which form planets and stars). It also includes really big objects (for example, superclusters of thousands of galaxies. Each galaxy has many billions of stars). The distances between these objects are also very large. Many people use kilometres (km) here on the Earth to measure distances. However, we can't use km with the objects in space because the distances there are so big. The Universe is about 14 billion years old. It contains materials of such different properties that we can't make anything similar in laboratories on the Earth. The lowest temperature in the universe is $-273.15\text{ }^{\circ}\text{C}$. This is the temperature of dense clouds of gas and dust which form stars.</p>

5.2.3. Eye-tracking equipment

The Tobii Pro X3-120 (dark pupil tracking) eye-tracker, manufactured by Tobii Technology (Stockholm, Sweden) was used to collect participants' eye movements. The

eye-tracking component was integrated into a 23-inch TFT monitor of a desktop PC with a maximum resolution of 1920 × 1080 pixels. The eye-tracker used in this study was located in the human-computer interaction lab at the Open University campus. The eye movements were recorded with Tobii-Studio (3.2) software and were used in this study only as a stimulus to help readers reflect on the kind of text processing that occurred during their reading of authentic vs. simplified texts.

5.2.4. Procedure

As mentioned in Section 3.7, the ethical clearance for this study was obtained from the research ethics committee at the Open University (*see Appendix 1*). The visualisation of the study procedure is presented in Figure 14 at the end of this section.

The session started with participants signing a consent form, completing a participant background questionnaire, and receiving oral instructions for their reading task. It was explained to participants that in this study their text comprehension would not be tested. However, since reading is a purpose-driven process, and in line with Catryse and colleagues (2018), they were asked to read the texts as if they were taking the final language examination at their language learning centre. Reading was self-paced, and participants were asked to indicate they finished reading each text by pressing the escape button on the keyboard. After receiving the task instructions, each participant was seated about 60 cm from the monitor, and a technical 9-point eye-tracking calibration test was conducted. This was followed by participants reading from the computer screen, while their eye movements were recorded. The texts were presented one at a time on the screen. Each participant read two texts: they first read either an authentic or a simplified OER, on one of the two topics outlined in Section 5.2.2. Table 30 below indicates the combination and the order of the texts given to participants in this study. As can be seen from the table, the order of the four texts used in this study was counterbalanced across participants. The eye-tracker was recalibrated before the second text. The order of the combinations in which the texts were read was repeated after each four participants.

Table 30. Procedure for reading the texts by participants in Study 2

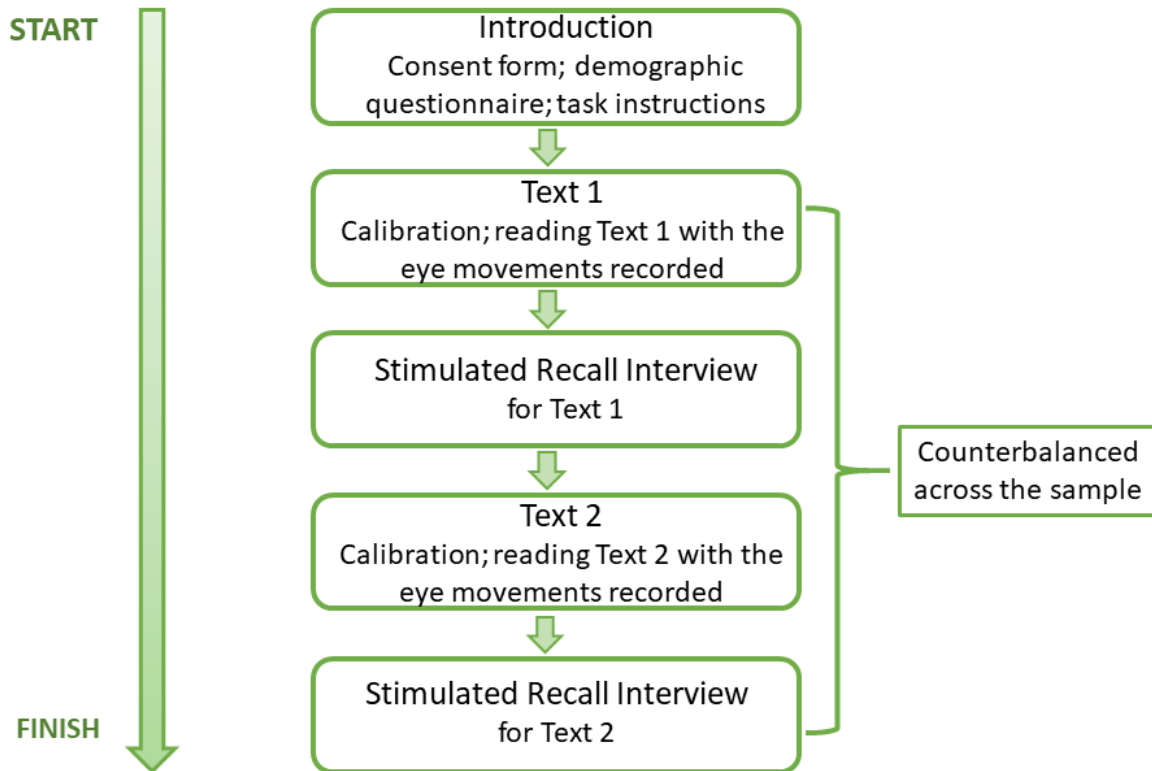
Combination	1st reading	2nd reading
1	Text1 Simplified	Text2 Authentic
2	Text1 Authentic	Text2 Simplified
3	Text2 Simplified	Text1 Authentic
4	Text2 Authentic	Text1 Simplified

The reading of each text was immediately followed by a stimulated recall interview in English on participants' cognitive processes during reading. The interviews were conducted using the gaze plot videos produced by Tobii Studio software (3.2). Before each interview, I visually inspected each gaze plot video to check the eye-tracking data quality. Eye-tracking data from three participants had a drift, which would not have made these data an insightful stimulus for the subsequent stimulated recall interviews (Ariasi et al., 2017; Catrysse et al., 2018). Thus, due to the low quality of the data, stimulated recalls were not conducted with these three participants.

In the gaze plot videos with the remaining nine participants, a moving red dot represented the point of fixation and the size of the dot was an indication of how long a fixation lasted. The replay was slowed in order to give participants time to verbalise what they were thinking about during reading. The replay was paused after each fixation and a look-back in the text. The research protocol with the interview script used in this study included such questions as: *Here you fixated a lot. Why, do you think, you fixated on this word / element in the text? What were you doing / thinking about? Here you are going back in the text. Why did you look back in that sentence / on that word?*

The stimulated recall interviews were recorded using a video camera to capture both the eye movement replay and participants' verbalisations. The entire session with each participant lasted approximately 90 min. Each participant received a £20 Amazon voucher at the end of the session.

Figure 14. Visualisation of data collection procedure in Study 2



5.2.5. Data analysis

The research question in this study was concerned with the effect of OER text simplification on text processing of non-native English readers using the qualitative evidence from the eye-tracking stimulated recalls. Qualitative data was given preference in this study to obtain emerging evidence on the topic, and to build on the previous studies that explored readers' cognitive processing strategies through qualitative methods (e.g., Brunfaut & McCray, 2015; Alkhaleefah, 2017). Such methods have been recognised to be useful as cognitive processes are not directly observable unless reported by participants (Gass & Mackey, 2016) (see Section 3.4.2).

Data analysed in the study were comprised of 18 stimulated recall interview sessions ($n = 9$ with participants reflecting on their reading of simplified OER texts, and $n = 9$ – on their reading of the authentic texts). All 18 interview sessions were transcribed manually from the videotapes. The data were then manually coded in the qualitative analysis software package NVivo11, using the content analysis (CA) approach, as outlined by Neuendorf (2016) (see Section 3.5.1). The aim of CA was to analyse and code participants' thought processes during each eye fixation and look-back in the authentic and simplified texts they verbalised during the stimulated recalls. The average length of the transcribed interviews was 4000 words.

In the first coding cycle in this study deductive coding was employed, using the central core of Khalifa and Weir’s (2009) model of cognitive processing in reading (see Section 2.6.2) as the a priori coding scheme. The last level of the original model – creating an intertextual representation – was removed from the coding scheme as participants read and reported on only one text at a time. As explained earlier (see Section 2.6.2), this model is useful as a coding framework due to its componential approach to reading. Moreover, this model was used in several earlier studies that employed eye-tracking to explore non-native English reading (e.g., Brunfaut & McCray, 2015).

The a priori categories and their descriptions used in this study are presented in Table 31 below.

Table 31. Deductive coding categories and their descriptions used in Study 2

Level of processing	Category	Description of the category
Lower level	word recognition	detecting individual sounds, recognising letter symbols and morphemes of the word
	lexical access	accessing mental vocabulary and identifying the meaning of the word
	syntactic parsing	incorporating the word at a clausal level
	establishing propositional meaning	converting the clauses and sentences into units of meaning
Higher level	inferencing	going beyond the literal meaning of the sentence and bringing personal knowledge of the topic to understand it
	building a mental model	integrating individual propositions into the overall meaning framework of the text
	creating text level representation	constructing a hierarchy of propositions to identify the gist of the text

In the second coding cycle inductive coding was employed to identify new processing strategies specific to the context of the study, which might not be reflected in the model of Khalifa and Weir’s (2009), since their model was primarily used for test validation. Three additional codes were arrived at during the inductive coding process. Some participants indicated that they focused on (a) word/s during reading because it evoked a certain emotional association in their mind, hence the category ‘emotional resonance’. The category ‘mother tongue interference’ was added because in some cases participants specified that they focused on a word or looked back in the sentence because they were translating the reading material into their mother tongue or tried to understand what was being read by drawing parallel associations to their mother tongue. There were

instances of both positive and negative interference, which were combined into this category in this study. Finally, the category ‘English learning’ was added to the existing coding scheme to refer specifically to those instances when participants reported to be focusing on an element in the text because they wanted to learn how and in what context to use it. All additional categories were marked as lower-level processing, since each of them concerned a word/clause/sentence level.

In line with Neuendorf (2016), two inter-rater reliability sessions were conducted to finalise the coding scheme in this study. The first inter-rater reliability session was conducted with two of my fellow PhD colleagues in language teaching. They were provided with the explanations for the categories in the coding scheme and asked to code four randomly sampled stimulated recall interview sessions ($n = 2$ for the reading of simplified texts). The percent agreement after the first inter-rater reliability session was 75%. Having revised the coding scheme, paying particular attention to the category descriptions, the second inter-rater reliability session was conducted with a different independent rater. The final coding agreement with the third rater was 90%.

The final coding scheme used in this study with example quotes for each category is presented in Table 32 below.

Table 32. Final version of the coding scheme used in Study 2 with example quotes

Level of processing	Category	Example quote
Lower level	word recognition	‘When I saw ‘encompasses’, I tried to pronounce it properly’.
	lexical access	‘Nevertheless...I was thinking to myself, is it ‘unless’ or something?’
	syntactic parsing	‘I didn’t know the previous word, that’s why I slowed down’.
	establishing propositional meaning	‘I think I didn’t understand this at all: replicated? On Earth? In Laboratories? Aren’t we talking about the Universe?’
	emotional resonance	‘Thousands’, ‘billions’ – ‘Oh, that’s a lot of stars, I thought to myself’.
	mother tongue interference	‘1970s’ – ‘I said the year to myself in my language and then I realised I need to speak to myself in English!’
	English learning	‘The Universe’ – ‘we just learnt when to use ‘the’ in our English lesson yesterday, and I wanted to see how it is used in this context’.

Higher level	inferencing	'When I saw the word 'atom' – I remembered a line from my physics book in high school: 'as small as an atom'.
	building a mental model	'When I was nearly to the end of the text, I tried to understand everything before I finish the text'.
	creating text level representation	'Having finished reading the text, I reread the title – 'Where do we get our energy from?' 'We' – I established the reference with 'we as humans', and then I reread the first sentence and the last two sentences of the text to remember its key points'.

The next two sections will provide an overview of how each strategy was used across the sample, as well as analyse the frequency of use of each of the strategies during reading of authentic vs. simplified OERs to answer the research question of Study 2.

5.3. Results

5.3.1. Cognitive processing strategy use across the sample

Altogether, 80 codes were identified through CA in this study, which were then assigned to one of the ten cognitive processing strategies featured in the final version of the coding scheme (*see Table 32 in the previous section for the names of categories*). While the main objective of this study was to compare the frequency of use of different cognitive processing strategies during reading of authentic vs. simplified OER, it is important to first provide a description of how each strategy was used across the sample. Such description is provided below in this section with some corresponding illustrative quotes.

The first two strategies that concerned lower-level processing, namely word recognition and lexical access, were featured in participants' verbalisations when participants gave an account as to why they focused on a particular word in the text. Such accounts were mostly linked to participants experiencing confusion or difficulty in understanding the meaning of single words they encountered. Word recognition strategy seemed to be in use when participants tried to say the words out loud to themselves that they did not immediately recognise during reading. Pronouncing single words was reported by participants to be a helpful way to activate their memory to remember the meaning of those words.

Participant 8: I don't think I've seen the word 'current' before. I wasn't sure how to pronounce it. Usually pronouncing the word to myself helps me identify what kind of word this is and keep this word in my mind during reading.

The evidence that participants used lower level processing strategies when struggling with the meaning of single words in the text was particularly salient when analysing the lexical access processing strategy. Lexical access was featured in participants' verbalisations when they reflected on the reasons for their long fixations on certain words in the text, talked about not knowing the meaning of those words, and trying to compare those words in their mind with the words they already knew that looked similar:

Participant 3: I confused the word 'scarce' with 'scary'. I think I looked at this word longer because I don't know the meaning of this word.

The other two strategies that constituted lower level processing – syntactic parsing and establishing propositional meaning – were also used in the instances when participants could not understand the meaning of single words in the text. However, these strategies were used beyond fixating on only those single words and concerned fixating on larger lexical chunks in the sentence, such as word collocations and clauses. Both strategies were mostly associated with look-backs in the sentence. Syntactic parsing was used when participants tried to associate the meaning of a single word by looking back at a few surrounding words because they formed a conceptual unit together. Establishing propositional meaning was reported to be used when participants were looking back at larger context within a single sentence.

Participant 4: Maybe I focused on the word 'reserves' and then looked back at a couple of preceding words because I tried to read these two or three words together rather than understand them separately [when talking about reading the collocation 'fossil fuel reserves'] [syntactic parsing,].

Participant 9: I saw 'from which' and 'which form' in the same sentence and it caused confusion to me. I had to look back and reread the whole thing to understand the meaning of the phrase [establishing propositional meaning].

The three remaining strategies on the lower processing level, as presented in Table 32, were the additional categories added to the a priori coding scheme after the inductive coding cycle. These categories – emotional resonance, mother tongue interference, and English learning – mostly concerned fixations on single words. However, in some instances

these strategies also included look-backs at the preceding context in the sentence, similarly to the syntactic parsing and establishing propositional meaning strategies. Emotional resonance was reported by participants in the instances when the information they were reading in the text surprised them or resolved a previously held misconception about the fact described in the text. In some cases, participants also reflected on fixating on a word because they had strong emotional associations with it:

Participant 6: I think I focused on the temperature in the universe -273C, because I thought: oh, my God! How many degrees is that!

Participant 5: It is strange but when I saw the word 'fossil' – it reminded me of a watch I used to have with the brand 'fossil' on it.

Mother tongue interference was closely connected with the lexical access processing described earlier. Among the reasons participants gave for fixating on certain words was the need to translate these words into their mother tongue to better understand their meaning. In some cases, this process led to participants arriving at the correct meaning of an English word they encountered in the text. In some instances, mother tongue interference was negative in a way that it took participants longer to decide on the meaning of the word, or it resulted in participants guessing the meaning of the word incorrectly, as can be seen in the following examples:

Participant 1: Middle East is called differently in my native language. It took me some time to understand where it is geographically.

Participant 6: I wasn't sure what 'celestial bodies' mean in the text. But then I remembered that we have 'celeste' in my native language, Italian, and I was able to understand this as bodies in heaven or space.

As part of the final category within lower-level processing, English learning, participants associated the long fixations they had during reading with their attempts to learn the use of certain vocabulary and grammar structures in the text:

Participant 7: I think I paid attention to such word combinations as 'have been built' and 'in the long term', 'they will' because I want to understand better the grammar topic of tenses and time indications in English. It was interesting for me.

While lower-level processing included the strategies participants took to understand the text on a sentence level, the three categories within the higher-level

processing – inferencing, building a mental model, and creating text level representation – were concerned with participants integrating sentences in the text together into a cohesive whole.

Participants used inferencing strategy when they tried to activate their background knowledge of the topic of the text to understand better what was being read, or to interpret the meaning of a series of words in a paragraph using their everyday experience. Similarly to the emotional resonance processing, inferencing mostly concerned the factual information in the text: geographical places, numbers, historical events:

Participant 2: When I read ‘Gulf War’, at first, I confused it with the WWII but then I realized it is a different event.

Building a mental model was used by participants to either confirm their understanding of how ideas in the text were developed, or to resolve any conflicting understanding they had when reading the different parts of the text. In contrast, the strategy of creating text level representation was mostly used when participants tried to apprehend what the text was going to be about when reading the title and opening sentences, or to rehearse the key points in the text to remember them better:

Participant 8: I think when I reached the word ‘Earth’, I looked at it longer because I wanted to connect it to the previous sentences. At first the text talked about astronomy and space, then atoms, and then I really forgot about the atoms. I felt it became a mess [building a mental model].

Participant 5: When I finished reading the text, I looked back at any numbers, places, factual info that the text contained to make sure I remember them, as well as the last two sentences in the text. Usually these are the key points to take away from the text [creating text level representation].

A recurring observation that was made during the qualitative data analysis concerned the plasticity of cognitive processing. In cases when the use of one cognitive processing strategy did not facilitate text comprehension, participants reported having turned to another processing strategy to compensate for this failure. To exemplify, if lexical access was unsuccessful, participants would turn to syntactic parsing, establishing propositional meaning or building a mental model to make a better use of the context of the text:

Participant 8: I don't know the word 'overwhelmingly' and that's why I couldn't understand the preceding sentence and went back to re-reading the previous one [establishing propositional meaning].

5.3.2. Cognitive processing in authentic vs. simplified OER

The analysis of the replays showed that there were more fixations and look-backs to discuss in each participant's gaze plot video that corresponded to their reading of the authentic OER. Thus, in order to proceed to the analysis of stimulated recall interviews and identify the frequency of use of each cognitive processing strategy, the number of each processing strategy from the CA was divided by the total number of processing strategies (N = 80). By calculating this relative measure, it was possible to control for this difference in the amount of cognitive processes verbalised by participants during their reading of authentic and simplified texts.

The results of the stimulated recall data analysis are presented in Table 33 below. The table gives an indication of the amount of use of the different cognitive processes in the total number of readings of authentic ($n = 9$ readings / stimulated recall interview sessions) and simplified OERs ($n = 9$). No comparative statistics were run because of the relatively small sample size in this study.

Table 33. Stimulated recall data analysis results: authentic vs. simplified OER

Level of processing	Category	Authentic OER $n = 9$	Simplified OER $n = 9$
Lower level	word recognition	7	3
	lexical access	66	43
	syntactic parsing	40	28
	establishing propositional meaning	45	36
	emotional resonance	7	11
	mother tongue interference	4	5
	English learning	6	0
Higher level	inferencing	5	12
	building a mental model	15	25
	creating text level representation	11	10

The results in Table 33 indicate that overall the most used processes for both authentic and simplified texts, as judged by the relative frequencies of categories' occurrence in participants' verbalisations, were lower-level processes – lexical access, establishing propositional meaning and syntactic parsing.

When exploring the differences in the frequency of use of different cognitive processing strategies for authentic vs. simplified OERs, three main differences became

apparent. The key difference was in the amount of use of lower- vs. higher-level processing. Participants seemed to rely substantially less on lower-level processing when reading simplified OERs, as compared to their reading of the authentic texts. As has been outlined in Section 5.3.1, lexical access, syntactic parsing, and establishing propositional meaning were mainly employed when participants tried to resolve confusion in understanding the meaning of single words or clauses they encountered in the text. Using fewer strategies within these three categories for simplified OERs might indicate that participants experienced fewer comprehension difficulties, and their reading of the simplified OERs was smoother. On the other hand, increased use of higher-level processing, particularly inferencing and building a mental model, when reading the simplified OERs indicates that participants had more capacity for connecting the text to their personal experiences and focus on the main themes of the text. Among the higher-level processing strategies, creating text level representation was used slightly less when reading the simplified OERs. A potential explanation of this finding could be that participants did not have to take an additional effort, reread and rehearse the text as they might have had more capacity to understand the text well during their initial reading.

The other two differences in the use of processing strategies for authentic vs. simplified OERs concerned the frequency of use of the strategies that were added to the coding scheme after the inductive coding cycle. On the one hand, 'English learning' was mentioned only with the authentic OERs. On the other hand, as can also be seen from Table 33, the use of the strategy 'emotional resonance' was slightly higher for the simplified OERs, as compared to the authentic texts. The latter finding suggests that, similarly to the case with higher-level processing, participants might have had more working memory capacity available to ponder over the simplified texts and to resolve a previously held misconception about a fact described in the text, or to draw stronger emotional associations with it. The frequency of appearance of 'mother tongue interference' strategy was largely similar between the reading of authentic and simplified OER, which suggests that at times participants turned to the resources of their mother tongue to understand the texts, irrespective of the complexity of these texts.

To sum up, the analysis in Study 2 showed that a broad range of cognitive processing strategies were used during the reading of both authentic and simplified OERs. These strategies were associated with resolving comprehension difficulties (most lower-level processing strategies), learning from the text (English learning, emotional resonance) and

elaborating on the text (most higher-level processing). This study also showed that participants used more higher-level processing and seemed to experience more emotional resonance when reading simplified OERs, as compared to their reading of the authentic texts. At the same time participants did not report using the strategy 'English learning' when reading the simplified OERs.

5.4. Study 2 Discussion

5.4.1. Implications of findings

This study aimed to obtain emerging evidence on the effect of OER text simplification on text processing of non-native English readers at lower levels of proficiency, using the qualitative evidence from eye-tracking. To that end, the study focused on comparing the frequency of use of different cognitive processing strategies at lower- and higher-levels of processing, as verbalised by participants in the eye-tracking stimulated recalls after they had read an authentic and a simplified OER.

This study showed that participants engaged in a wide range of cognitive processing when reading both authentic and simplified texts. This finding is partly in line with the earlier test validation studies that used eye-tracking stimulated recalls (e.g., Brunfaut & McCray, 2015) and showed that the entire spectrum of processes specified in the central core of the Khalifa and Weir (2009) model were elicited by the test questions during reading. Yet, Brunfaut and McCray (2015) also found that the frequency of use of lower- and higher-level strategies was largely similar across the sample. In contrast to these studies, Study 2 in this thesis identified proportionally lower reported usage of higher-level processing (inferencing, building a mental model and creating text level representation) when reading both authentic and simplified OERs. Overall, the most used processes in this study were lexical access, syntactic parsing and establishing propositional meaning, as evidenced in the stimulated recall data. This finding might be due to the fact that participants knew there would be no comprehension assessment after reading. Reading the text for an immediate comprehension test (*see limitations 5.4.2*) could have elicited a wider use of different cognitive processing strategies when reading authentic and simplified texts. This finding might also be due to the proficiency level of participants in this study. As has been shown in the study of Brunfaut and McCray (2015), participants at lower levels of language proficiency used lower-level processing strategies more frequently than

participants at higher levels of proficiency. This could be the case in Study 2 in this thesis, where all recruited participants were from an intermediate (B1) English language course.

Study 2 also identified a certain plasticity in participants' cognitive processing during reading of both authentic and simplified OERs. In the instances when one employed strategy was unsuccessful in understanding the text, participants employed a different processing strategy to compensate for this failure. This finding is in line with Brunfaut and McCray (2015), where the stimulated recalls evidenced the use of more than one strategy to arrive at an answer.

In the comparison of the frequency of use of different cognitive processing strategies when reading authentic vs. simplified texts one key difference was observed in the amount of use of lower- vs. higher-level processing. Although lower-level processing was still dominant, participants seemed to rely less on the use of lower-level processing in the simplified OER. To exemplify, the use of 'lexical access' strategy implied that participants took an effort to understand the meaning of a word in the sentence (Khalifa & Weir, 2009). The less frequent use of this strategy during the reading of the simplified OERs suggests that participants had fewer points of confusion or doubt about the meaning of a word, as compared to their reading of the authentic texts. This tendency was also observed when exploring the replays in the eye-tracking software. In the replays, there were fewer areas in the simplified texts where participants had to stop and make long fixations.

Study 2 also provided some empirical evidence that text simplification facilitated higher-level text processing. The categories that concerned higher-level processing occurred more frequently in participants' verbalisations for the simplified OER, as compared to their reflections on authentic OER reading. It can be assumed that participants had fewer instances where they had to use lexical access and other lower-level processing strategies to understand the text on a sentence level. Thus, they had more working memory capacity available for higher-level processing to integrate the ideas in the text together into a cohesive whole and elaborate on the text's main themes. This evidence is in line with LaBerge and Samuels's theory of automatic information processing in reading (1974), which postulates that providing individuals with texts that they can read fluently allows them to devote their attention to better text comprehension (*see Section 2.6.2*).

Besides the use of lower- vs. higher-level processing, another difference in processing of authentic vs. simplified OER concerned the frequency of use of the 'emotional resonance' strategy. Since in this study 'emotional resonance' referred to the instances

where participants talked about feeling surprised, as well as about their emotional associations or ability to learn a new fact from the text, this strategy can also represent situational interest. Situational interest is defined as a relatively short-lived psychological state of focused attention, curiosity, and positive affect (Schiefele, 2009; *see Section 2.6.1*). When defined through the lens of situational interest, the evidence from this study concerning the increase in emotional resonance when reading the simplified OER is in line with the study of Soemer and Schiefele (2019). The authors showed that more difficult texts were perceived by the readers to be less interesting, and less interest, in turn, was associated with reduced focus of the readers towards the text. Furthermore, previous research evidence also suggests that non-native readers of a given language generally are more emotionally distant to what they read in a foreign language as compared to reading in their mother tongue (Iacozza, Costa & Duñabeitia, 2017). The finding of this study on increased emotional resonance to the simplified text suggests that text simplification provides opportunities for the creation of stronger bounds between linguistic and emotional content, which is an aid for foreign language reading. Drawing from the aforementioned pieces of evidence in the literature (Schiefele, 2009; Iacozza et al., 2017; Soemer & Schiefele, 2019), higher emotional resonance suggests a positive effect of text simplification on text processing among non-native English readers.

The final difference in processing of authentic vs. simplified OER was the use of the strategy 'English learning'. 'English learning' was mentioned only with the authentic texts, however. The reason for that might be a higher lexical diversity of the authentic OER, which might have given participants more instances of exposure to various lexis and grammar structures. This finding links back to the debate about the advantages and disadvantages of text simplification and the reservations concerning not exposing the readers at times to more advanced vocabulary and increasing their chances of incidental learning (Yano et al., 1994; Pellicer-Sánchez, 2016) (*see Section 2.6*).

5.4.2. Study limitations

In Chapter 5, an eye-tracking stimulated recall interview method was used to explore and compare the frequency of use of different cognitive processing strategies when reading authentic and simplified OER texts. In doing so, several limitations of the study are noted.

First, as there is very limited research on the topic, the purpose of this study was to explore this topic using qualitative data collection methods, and to provide some emerging evidence on the kind of potential effect that text simplification might have on non-native English readers. As such, this study provided only a small snapshot of the potential effect of text simplification against the backdrop of a wider number of variables that need to be controlled for, such as the topic of the OER texts and their organisational structure, as well as participants' individual predispositions that might influence how they read authentic and simplified OERs.

Secondly, this study showed that participants were more aware of their cognitive processing in the instances where they experienced confusion or doubt. While the stimulated recall interview method allowed to access cognitive processes that were unavailable by other means (Gass & Mackey, 2016; *see Section 3.4.2*), some cognitive information might still have remained inaccessible. This might explain why certain processes, such as word recognition, due to their potentially automatized nature were so infrequently reported by participants. Another potential reason for the inaccessibility of some cognitive processes lies in the reactivity of the stimulated recall (*see Section 3.4.2*). Using eye movements as prompts for the stimulated recall interview might have led participants to describe what they saw in the screen, rather than reflect on their cognitive processes at the time of reading.

The third limitation of this study concerns the fact that some cognitive processing strategies included both fixations and look-backs. Therefore, this study did not allow to separate participants' initial processing of the text from the later reprocessing effort, which would have provided a more detailed understanding of the impact of text simplification.

Finally, this study adopted the simplification strategies from the readability analysis in Study 1 due to the limited research on text simplification conducted with English teachers. However, using more evidence-based simplification strategies would have contributed to a higher ecological validity of this research.

The limitations outlined above were overcome in the subsequent studies in this thesis, which is discussed in the next section.

5.4.3. Links to the other studies in this thesis

Study 2 provided some emerging qualitative evidence on the effect of text simplification on non-native English readers, using a sample of nine participants at the

intermediate level of English proficiency. Furthermore, Study 3 served as a pilot study to test the layout of the OER texts in the eye-tracking Tobii-Studio (3.2) software. This layout was then subsequently used in Study 4. Study 2 showed an increase in emotional resonance, as well as an increase in the usage of higher-level processing when reading the simplified OERs. This finding suggests that text simplification induced different text processing and facilitated non-native English readers' processing of the OER texts.

Yet, these findings do not offer an understanding of what effect text simplification has on non-native English readers when the text is simplified according to the strategies employed by an expert population, such as English teachers. Furthermore, the findings from Study 2 in this thesis do not shed light on how a larger sample of non-native English readers at different levels of English proficiency would respond to text simplification. Finally, as has been emphasised in previous research, individuals' language proficiency, background knowledge of the topic of the text, and their interest in the topic play an important role in how individuals interact with the text (Graesser, Hautt-Smith, Cohen & Pyles 1980; Sáenz & Fuchs, 2002; Shapiro, 2004). Thus, controlling for these individual factors and using OER texts on different topics, and with different organisational structure might provide a different evidence on the impact of text simplification.

As there is very limited research on the procedure of text simplification, Chapter 6 will begin to address this limitation by exploring what approaches and strategies English teachers take to increase linguistic accessibility of OERs, and the rationale behind these strategies. English teachers constitute an expert group on text simplification in light of their expertise in matching English learners with learning materials.

Subsequently, Chapter 7 will describe Study 4, which employed a different research design to that used in Study 2. It aimed to use more diverse OER texts in terms of their topics and organisational structure, and data from participants at different English proficiency levels. Study 4 also aimed to statistically control for some of participants' individual predispositions with the goal to obtain a more comprehensive picture of the effect of OER text simplification. Chapter 7, which is the final empirical chapter in this thesis, will outline the results of Study 4.

6. Study 3 Methods and Results

This chapter describes the third study in this thesis, in which linguistic accessibility was approached from the perspective of task difficulty (see *Figure 6*). Study 3 explored English teachers' practices of making OERs more accessible to non-native English readers and investigated the perceived effect of teachers' language background on this practice through a series of stimulated recalls and semi-structured interviews. Since language teachers hold extensive implicit knowledge on how to simplify a text, their insights into their own practice can prove valuable to conceptualise the elements of text simplification. The practices elicited in this study can form guidelines for text simplification that have the potential to make OER reading materials more accessible to a diverse audience of OER learners from non-native English-speaking backgrounds.

The chapter is divided into four sections. The Introduction (Section 6.1) reiterates the research questions for Study 3. The Materials and methods section (6.2) provides an overview of the specific methods used for Study 3, including information about participants, procedure, instruments, and data analysis approach. The third part, Results (Section 6.3), provides an overview of the findings in relation to the study's research questions. The final section, Discussion (6.4), reviews the implications of Study 3's findings, as well as its limitations and links to the final study conducted in this thesis.

6.1. Introduction

Study 1 in this thesis provided evidence that current OERs require an advanced level of English language proficiency for learners to be able to use them. Study 2 showed that text simplification has some emerging facilitative effect on non-native English readers' text processing. However, since the text simplification performed in Study 2 was not based on the evidence of how English teachers would simplify a text, it was important to obtain an in-depth understanding of the changes that can be made in OER texts to increase their linguistic accessibility, the rationale behind these changes (i.e., how and why), and to collect emerging evidence on the factors that influence this practice.

⁴This chapter is based upon the following manuscript in preparation:

- Rets, I., Astruc, L., Coughlan, T., & Stickler, U. (manuscript in preparation). Approaches to text simplification: English teachers' views and practices.

As discussed in the literature review (*see Section 2.5.2*), there is only one previous study on approaches to text simplification conducted with language teachers (Young, 1999). Research on this topic in the EMI context is also limited (e.g., Basturkmen & Shackleford, 2015), despite the urgent need to accommodate the barriers EMI learners have to materials comprehension (Uchihara & Harada, 2018; Hua, 2019; Thompson et al., 2019). The scarcity of studies involving language teachers and EMI educators is surprising, given that teachers, and particularly language teachers, constitute an expert group on text simplification. They have the necessary knowledge about learners and materials, and skill at judging the level of the text which is right for their learners. Intuitive simplification is guided by the beliefs and experiences of language teachers concerning what makes a text more accessible for non-native readers of a given language (Crossley et al., 2012; *see Section 2.5.2*). Moreover, intuitive simplification has become the most common type of text simplification performed in the classroom (Crossley et al., 2012; Crossley & McNamara, 2016).

Study 3 attempted to fill the current gap in understanding the processes of intuitive text simplification in relation to English teachers. The purpose of the study was to analyse and categorise the types of modifications English as a foreign language (EFL) teachers make when intuitively simplifying OER texts for lower-level proficiency non-native readers of English. Secondly, the study explored the perceptions of EFL teachers on the influence of their mother tongue on their choice of simplification strategies. It may be expected that teachers with mother tongues belonging to different families and typologies (e.g., script, word order, morphology) may choose different simplification strategies (*see Section 2.5.2*). The perceptions teachers hold about the role that their mother tongue plays in this practice may also affect their choices of simplification strategies, as it has been shown that teachers' perceptions shape their pedagogical strategies (Alisaari et al., 2019; Borg & Sanchez, 2020). Thus, exploring the factors that influence these processes can enhance the understanding of the extent to which the collated text simplification guidelines can be used with a diverse audience of international OER learners.

The following research questions were addressed in Study 3:

RQ3: What approaches and strategies to text simplification do English teachers employ when intuitively simplifying OER texts for lower-level proficiency non-native English readers?

- **RQ3a:** Does the mother tongue have an effect on the choice of text simplification strategies, as perceived by English teachers?

The next section provides an in-depth overview of the methods employed in Study 3 to address these questions.

6.2. Materials and methods

6.2.1. Participants

Participants constituted a voluntary purposive sample and were recruited through social media (Facebook, Twitter) and academic mailing lists related to EFL teaching (see *Appendix 3 for the recruitment advertisement*). In this study, two selection criteria were used for recruiting participants. First, the participants' language background was controlled. As RQ3a was concerned with the perceived effect of the mother tongue on how English teachers approach text simplification, participants were recruited whose mother tongues belong to the language families that were among the top ten world languages by the number of native speakers (Ethnologue, 2020). This study focused on just three language backgrounds (Chinese, Spanish, and Russian) that were maximally contrastive and also familiar to me and the supervision team of this research project. Appendix 4 to this thesis exemplifies some major typological differences between the three languages that constituted participants' mother tongues in this study.

As can be seen from Appendix 4, the linguistic typologies of Spanish, Chinese, and Russian are different, with major differences in phonology (e.g., stress vs tone; syllable-timed vs. stress-timed), morphology (e.g., degree of inflection), as well as in the writing systems (alphabetic vs. logographic). As mentioned in Section 2.5.2, teachers whose mother tongues belong to such maximally contrastive languages might take fundamentally different approaches to simplify an OER text in line with the perceptions they hold on the role of their mother tongue on this practice.

The second criterion used in sampling, besides participants' mother tongues, was the amount of time participants spent teaching English. The focus of the study was on experienced teachers and a minimum of five years of teaching experience was chosen in compliance with that used in other studies as the minimum level of practice required to establish teaching expertise (e.g., Ericsson, Krampe, & Tesch-Römer 1993; Webb, Diana, Luft, Brooks & Brennan, 1997). However, primarily in line with Robinson (2014), Study 3

aimed to obtain heterogeneity in participant profile and teaching context with the idea of achieving a stronger generalisability of commonalities and differences found in how English teachers approach text simplification.

24 English teachers volunteered to participate in this study. Most participants were female ($n = 22$), which is representative of the gender split in the language teaching field. All participants held a BA degree in EFL teaching. Information on participant characteristics is summarised in Table 34 below. As can be seen from the table, there is an equal number of participants in the three language groups.

Table 34. Study 3 participant demographics (N = 24)

Category	Percentages
Mother tongue and the country of teaching English	<ul style="list-style-type: none"> Chinese: 33.33%, $n = 8$, all participants teach English in China Spanish: 33.33%, $n = 8$, Peninsular Spain ($n = 4$), Latin America ($n = 4$): Colombia ($n = 1$), Bolivia ($n = 1$), Cuba ($n = 1$), Mexico ($n = 1$) Russian: 33.33%, $n = 8$, all participants teach English in Russia
English teaching experience	<ul style="list-style-type: none"> 5 years: 12.5%, $n = 3$ 6-10 years: 41.66%, $n = 10$ 11-15 years: 12.5%, $n = 3$ 16-20 years: 16.66%, $n = 4$ 21 or more years: 16.66%, $n = 4$
Level of institution	<p>Some participants indicated more than one option. They all teach ELF at the following levels:</p> <ul style="list-style-type: none"> University: 37.03%, $n = 10$ Secondary school: 11.11%, $n = 3$ Primary school: 3.7%, $n = 1$ Private language school or adult continuing education: 48.14%, $n = 13$
Language proficiency level at which participants teach (CEFR)	<p>Some participants indicated more than one option</p> <ul style="list-style-type: none"> Beginners A1-A2: 22.5%, $n = 9$ Intermediate B1-B2: 57.5%, $n = 23$ Advanced C1-C2: 20%, $n = 8$

As can also be seen from Table 34, the English teaching experience of most participants (41.66%) in this study was between six and ten years. At the time of the study, most participants were teaching English either at a HE level (37.03%) or as part of adult continuing education (48.14%), both of which are particularly relevant to the OER context. Finally, most participants in this study had the experience of working with intermediate level non-native English readers (57.5%), as benchmarked against CEFR (Council of Europe, 2001).

6.2.2. Procedure

As mentioned in Section 3.7, the ethical clearance for this study was obtained from the research ethics committee at the Open University (*see Appendix 2*). The methods of data collection for this study comprised of two phases: an online task completed through a web-based survey tool, and a follow-up Skype interview. The online task consisted of a short demographic questionnaire and a simplification task of two OER texts, approximately 300 words in length. The OER texts were chosen from OpenLearn (2020), a major OER platform, the course materials from which were also used in Study 1 in this thesis to explore their linguistic accessibility to non-native English readers (*see Chapter 4*).

There were two criteria for the selection of these OER texts. One criterion was that the texts should be part of the first section of introductory courses, so that they do not assume prior knowledge of the subject matter. Another criterion was that the texts represent different topics ('Introduction to vitamins', subject label: STEM; 'Social workers', subject label: Health, Sports & Psychology) to control for the effect of topic on approaches to text simplification. The two OER texts used in this study are reproduced in Appendix 3.

Participants were asked to type the simplified version of each of the two texts in the web-based survey tool to make it more understandable to B1 proficiency learners, as defined by CEFR (Council of Europe, 2001; *see Table 14*). Participants were able to make as many modifications to the original text as they felt were important. The online task was not timed; participants took as much time as they needed to complete the task. The design of the online task instructions for Study 3 is shown in Figure 15 below.

Figure 15. Screenshot of the online task administered in Study 3

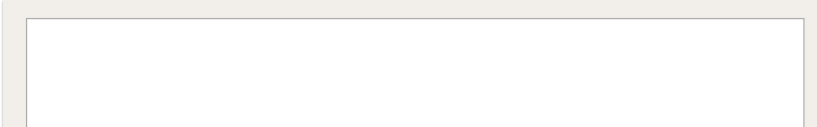
Having completed the background questionnaire, please, look at Text 1 ('Introduction to vitamins and why we need them'). It is an authentic text written for English native speakers. If you were to use it with lower level proficiency English learners (at intermediate B1 level), how would you simplify it to make it more understandable for them? Please, simplify it the way you normally would, keeping the meaning of the text largely intact.

Please, type your simplified version in the answer box below the original text.

Before the 19th century, one of the hazards of long sea voyages was a condition called scurvy, whose symptoms were loss of hair and teeth, bleeding gums, very slow healing of wounds, and eventually death. Hundreds of sailors and explorers died from scurvy until a Scottish physician, James Lind, in the 1750s discovered that adding a daily portion of citrus fruit to the rations of those at sea could prevent the condition, whereas adding cider, vinegar or various other substances that he tested, could not. In those days, it was considered that a disease was caused by something bad in the diet, or in the air, but not by the absence of something good, so despite Lind's evidence, his ideas were not accepted by his fellow physicians. Additionally, he was unable to confirm his work by experiments on land since, although he tried to restrict the types of food eaten by a group of volunteers to attempt to produce scurvy in them, he was unable to do so, probably because it can take several months for the condition to develop, and in that time his volunteers occasionally cheated on their diet. However, though he died disillusioned, Lind had actually discovered the importance and source of vitamin C.

Before their detailed chemical structures were known, vitamins were named by being given a letter. They are generally still referred to by that letter, as well as by their chemical name; for example, vitamin C or ascorbic acid. There are two main groups of vitamins: fat-soluble vitamins and water-soluble vitamins. The body can store fat-soluble vitamins, but any excess water-soluble vitamins are easily removed from the body in the urine, so regular intake is necessary. Vitamins are, however, needed in only very small quantities.

5. * Required



The online task was followed by an interview in Skype at a time convenient for each participant and within three days after the submission of the online task. The average length of the interviews was 65 minutes. Each interview was conducted in English and was audio recorded during the Skype call using the functionality of the software. The first part of the interview was semi-structured. It included a few icebreaker questions aimed to build rapport with participants and to collect data on participants' attitudes towards text simplification (e.g., *Do you simplify original texts that you bring to your classroom? Why/Why not?*). The icebreaker questions were followed by a series of questions related to RQ3a (e.g., *when you simplify texts for your learners, does your mother tongue influence how you simplify it? If you don't – what the potential influence of your mother tongue might be on this practice?*).

The second part of the interview consisted of a stimulated recall where participants looked back at the original texts from the online task and the texts they simplified; they were asked to explain the rationale for each change they had made in the simplification (see Appendix 5 for the list of the interview questions). Each participant received a £10

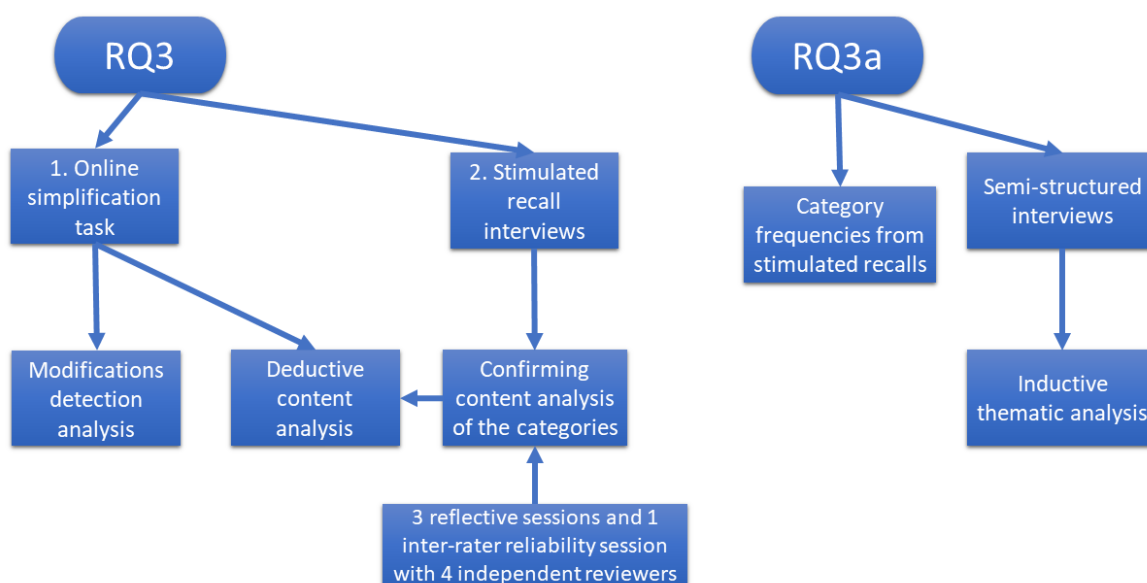
Amazon voucher for their participation. In this study, pseudonyms are used for the names of participants.

All data from the 24 interviews were transcribed manually from the audio recordings and uploaded into NVivo11 for the further analyses. The average length of the interview transcripts was 7500 words.

6.2.3. Data analysis

As it is recommended to visualise how the methods of data collection and data analyses correspond to one another in mixed methods research (e.g., Creswell, 2014; see Section 3.2.2), the visualisation of this study’s procedure is presented in Figure 16 below.

Figure 16. Visualisation of the data collection and analysis procedure in Study 3



6.2.3.1. RQ3

RQ3 was concerned with eliciting approaches and strategies to text simplification that English teachers employ when intuitively simplifying OER texts to lower-level proficiency non-native English readers. To answer RQ3, the analysis of the task responses was conducted through the comparison of the original and simplified texts to detect any modifications that each participant made in the simplified text. An example of how the texts were annotated to perform the modifications detection analysis is provided in Table 35 below, where each detected change in the simplified text is marked with a different colour. The colours in Table 35 are assigned randomly with the aim to highlight each single detected change in simplification.

Table 35. Excerpts of an authentic text and the corresponding simplified version

Authentic Text 1	Excerpt from Diego's simplification (Spanish)
<p>[Paragraph 1]</p> <p>Before the 19th century, one of the hazards of long sea voyages was a condition called scurvy, whose symptoms were loss of hair and teeth, bleeding gums, very slow healing of wounds, and eventually death. Hundreds of sailors and explorers died from scurvy until a Scottish physician, James Lind, in the 1750s discovered that adding a daily portion of citrus fruit to the rations of those at sea could prevent the condition, whereas adding cider, vinegar or various other substances that he tested, could not.</p>	<p>[Paragraph 1]</p> <p>Before the 19th century, one of the risks of long journeys at sea was a disease called scurvy. Its symptoms were loss of hair and teeth, bleeding gums, very slow healing of wounds, and then death. Hundreds of sailors and explorers died from scurvy until James Lind, a Scottish doctor, made an important discovery in the 1750s. He discovered that adding a daily portion of citrus fruit to the food of sailors could prevent the disease. On the other hand, adding cider, vinegar or various other substances that he tested, did not help.</p> <p>[Para 2]</p>

Once each change in each participant's simplification was detected, this analysis was followed by content analysis (CA) in NVivo11 using the processes outlined by Neuendorf (2016) (see Table 10 in this thesis). The unit of CA was each modification that occurred in the simplified text. As part of the CA, these modifications were first coded deductively. Since there is a lack of research on approaches to text simplification conducted with teachers, the a priori categories in this study were informed by the readability metrics used in Study 1 and which also served as text simplification strategies in Study 2 (see Table 13 in Chapter 4 and Table 28). Similarly to Study 2, the two categories that concerned readability formulas and scorecards were removed from the deductive coding scheme, as they involve automatic readability calculations. The a priori categories and their descriptions used in Study 2 are presented in Table 36 below.

Table 36. Deductive coding categories and their descriptions used in Study 3

Text simplification strategy	Description of the strategy
Sentence length	Reduce the average number of words per sentence
Word repetition	Increase the proportion of repeated words in the text
Word length	Reduce the average number of syllables per word

Noun elements per sentence	Reduce the average number of noun elements per sentence
Amount of elementary and advanced lexis	Decrease the proportion of advanced lexis in terms of CEFR
Word frequency	Increase the proportion of 0K-6K lexis
Logical connectives	Increase the proportion of logical connectives between/within sentences.

One confirmation stage of the analysis of the categories was then performed using, where possible, the information from the stimulated recall interviews. The stimulated recalls provided insights into both the types of modifications participants made to simplify the OERs, and the reasons participants gave for making each modification. Thus, the inductive coding applied to the transcribed interview data in NVivo11, allowed both to add to or modify the names of the deductive categories, as well as to refine the descriptions of the categories in the coding scheme. During this process, the categories were also organised into larger category units. The approaches were named ‘surface-level modifications’, ‘content modifications’, and ‘cohesion modifications’. These labels were chosen to reflect on and conciliate the differing perspectives on conceptualising linguistic accessibility (e.g., Valencia et al., 2014; Reed & Kershaw-Herrera, 2016; Amendum et al., 2018; Berendes et al., 2018) (*see Section 2.3*).

In line with Neuendorf (2016) (*see Table 10*) the inductive coding was followed by four reflective sessions with independent reviewers to finalise the exclusionary and inclusionary criteria for the categories. The final inter-rater reliability session with one independent reviewer, who was not involved in the previous stage, showed 95% agreement with the coding.

As can be seen from Table 37 below, the deductive coding scheme was substantially modified in the course of the inductive coding and the reflective sessions with the reviewers. 11 new categories were added to the deductive coding scheme: ‘cut information’, ‘compress meaning’, ‘split paragraph’, ‘convert into SVO order’, ‘convert passive into active’, ‘add clarification’, ‘add emotional emphasiser’, ‘add time reference’, ‘change order of ideas’, ‘resolve pronoun’, and ‘combine sentences’. A more detailed elaboration on each category is provided in the Results section (6.3). The deductive category ‘noun elements per sentence’ was split into two different categories: ‘convert noun into verb’ and ‘break the noun phrase’. The latter category is more concerned with the relationship between the words in the noun phrase, rather than with the proportion of

the noun elements in the sentence. The deductive categories ‘word length’, ‘word repetition’, and ‘amount of elementary and advanced lexis’ were combined into one category ‘change word frequency’. The modifications participants made as part of this category often included shorter words that were already used in the text, and that did not require advanced English proficiency.

The final coding scheme used in this study to answer RQ3 with the corresponding descriptions of each category is presented in Table 37 below.

Table 37. Final CA coding scheme with category descriptions used to answer RQ3

Approaches	Strategies	Interpretation
surface-level modifications	Change word frequency	Replace (a) rare word(s) with what a teacher feels is (a) more common word(s) in language
	Convert into SVO order	Make the subject of the clause/sentence more pronounced; add or replace a phrase with subject-verb-object
	Split sentence	Divide a sentence with two or more clauses into several shorter sentences
	Convert passive into active	Convert passive voice structures into active voice
	Convert noun into verb	Convert nouns into verbs
	Split paragraph	Split longer paragraphs into shorter paragraph chunks
content modifications	Cut information	Cut out (an) item(s) from the text without changing anything else
	Add clarification	Add information that is implied in the text indirectly and that the reader has to infer
	Compress meaning	Express the same or similar idea using fewer words
	Add emotional emphasiser	Add or replace with (a) word(s) that carries emotion
	Add time reference	Add or replace with a time reference
cohesion modifications	Add logical connectives	Add linkers between clauses or between sentences; connect the new sentence or clause to what has been said previously
	Break the noun phrase	Not use too many words before the noun in the noun phrase
	Change order of ideas	Change the position of clauses in the sentence
	Resolve pronoun	Replace the pronoun with its referent
	Combine sentences	Combine the ideas from two sentences into one sentence

6.2.3.2. RQ3a

RQ3a was concerned with exploring the perceptions of participants on the influence of their mother tongue on their use of the identified approaches and strategies to text simplification. To answer RQ3a, first, differences between participants in the three language groups were analysed in terms of the frequencies of use of each category (*see Table 37 above for the names of categories*). In doing so, the number of frequency references for each category from each participant was exported from NVivo11 into SPSS24. However, no inferential statistical test was conducted with the data to investigate the statistical difference in the frequency of use of the elicited strategies between the three language groups. The data did not meet the assumptions of normality, homoscedasticity, and the size of expected frequencies (Field, 2013). Furthermore, since there were only 24 participants in total, such that the number for each group was only eight, the statistical power of the tests would be low. Thus, only descriptive statistical data were explored for RQ3a.

To compensate for this, inductive thematic analysis (TA) was conducted, as outlined by Braun and Clarke (2019) (*see Section 3.5.2*). The analysis was conducted with the answers of participants to the questions in the first part of the interview on the (potential) influence of the mother tongue on their approaches to text simplification, and on their attitudes to text simplification (*see Section 6.2.2*).

The coding scheme derived from the inductive TA and used in this study to answer RQ3a is presented in Table 38 below.

Table 38. Inductive TA coding scheme used to answer RQ3a

Interview questions	Themes	Codes
Influence of mother tongue	mother tongue should be avoided	English is the focus
		Mother tongue is distracting
		Teachers as role models
	mother tongue should not be avoided	Elementary level learners
Attitudes to text simplification	Positive attitude	Authentic style is not an ideal
		Comprehension enhancement
		Building learners' self-confidence
		Current demand
		Fitting learning content with teaching aims
		Scaffolding

	Negative attitude	Authentic style is an ideal
		Information loss
		Fear of language inaccuracies
		Narrow learning
		Time-consuming activity for teachers

6.3. Results

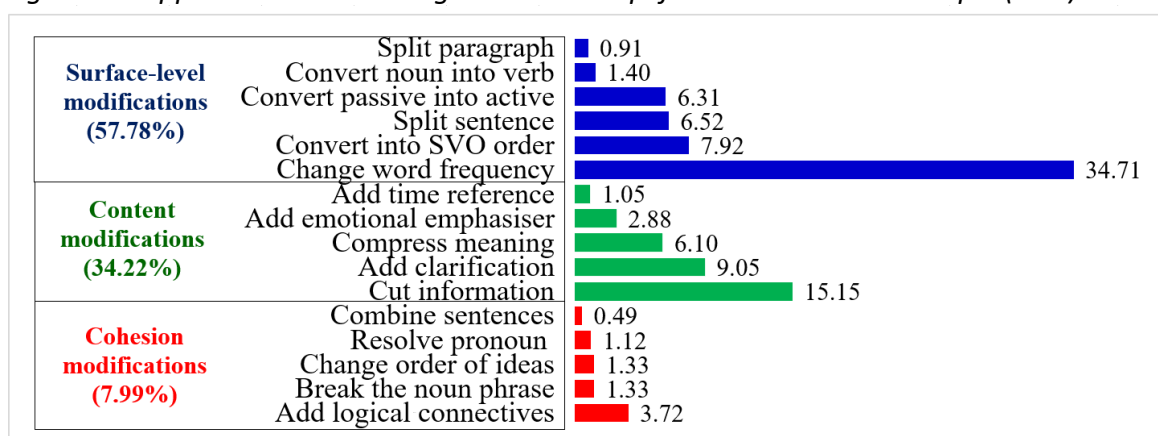
6.3.1. RQ3: English teachers' approaches to OER text simplification

1396 codes were identified through CA in this study. The codes were divided into 16 categories, which are referred to hereafter as 'strategies' to text simplification. The strategies were grouped into three larger category units, which are referred to hereafter as 'approaches' to text simplification. The final coding scheme, with the definitions of the strategies, has been given in Table 38 in the previous section.

Figure 17 below illustrates the relative frequency of different approaches and strategies across the participant sample. As can be seen from the figure, replacing infrequent words with more common words ('change word frequency') was the strategy used most often by the participating teachers (495 instances of use registered), and combining sentences – the least (7 instances).

Although the frequency of use of different strategies varied within approaches, overall, participants mostly modified the surface-level features of the OER texts (57.78% of the strategies), while cohesion features were modified the least (7.99% of the strategies). The strategies in Figure 17 are ordered from less to more frequent within each approach.

Figure 17. Approaches and strategies to text simplification across the sample (in %)



This section will next provide a qualitative account of the different approaches and strategies to text simplification employed by participating teachers.

Surface level modifications

The most commonly used approach to text simplification, which accounted for more than half of the modifications participants made in the authentic texts, was modifying the surface-level text features. The strategies within this approach mostly concerned the facilitation of the literal understanding of the text. This approach included strategies aimed at changing word frequency, presenting ideas in smaller units (splitting long sentences and paragraphs), and changing the voice (passive/active) and the word order in the sentence.

Word frequency strategy implied replacing a word or a word combination with the synonymous expression more familiar to the readers or with what a teacher felt was (a) more common word(s) in the language (e.g., replacing *'kin and networks'* in the authentic text with *'family and friends'* in simplification).

Bai, (Chinese): I changed 'hazards' into 'dangers' because 'hazards' is a difficult word for Chinese students. They don't see it very often in their textbooks and don't use it in their writing. The word they're familiar with is 'danger'.

Sofia (Spanish): 'He died disillusioned' confused me very much, even for me as a teacher I never saw the usage like this. I wasn't even sure if he died because there is another meaning for 'died' like 'dying for', it might mean 'he loved something'. Then I looked up 'disillusioned', and I changed it into 'disappointed', which is a more common word in English.

Participants often identified common words as less abstract, shorter words, and words that are mostly used in daily conversation. Among the reasons participants gave for employing the strategy of changing word frequency was the idea that even a handful of unknown words in the text can discourage the readers from continuing to read the text and learn from it.

Participants also often referred to the length of sentences and paragraphs as the aspect of the text that can cause difficulty for non-native English readers. Participating teachers tended to split complex sentences with more than two clauses and cut the length of long paragraphs. The rationale behind these changes was to help readers unpack and separate the layers of meaning and thus identify the main idea of each sentence faster. Sentence split was identified by participants as an especially important strategy for the opening sentences of the text as such sentences set the tone of the text. This strategy was also employed in the instances when a sentence contained a key word for the topic of the text and a full stop would give a chance for the reader to rest and process that word.

Another reason participants voiced for shortening sentences and paragraphs was the attempt to avoid overloading the readers' working memory with too many ideas.

Alla (Russian): The rhythm of life has become faster, more dynamic. Not many people will take the effort to read a long sentence or structure. I feel like this is the general tendency even when reading in the native language. Not many people are capable of and/or want to read texts where one sentence is half a page long.

The other two strategies within the surface-level modifications approach 'Converting passive into active' and 'Converting into SVO order' concerned using more personal, active structures in the simplified OER texts. 'Passive into active' implied converting passive voice into active voice (e.g., '*before their detailed chemical structures were known*' vs. '*before the scientists knew about their chemical structures*'). The strategy 'Converting into SVO order' involved making the subject of the clause or sentence more pronounced by removing impersonalized subjects (e.g., '*it*', '*there*') and replacing them with subject-verb-object (e.g., '*there often seems to be an unrealistic expectation that social workers...*' in the authentic OER vs. '*social workers often seem to be expected...which is unrealistic*' in simplification).

Among the reasons the teachers gave for using these two strategies was the idea that putting a clear agent into the focus of the clause helps the readers integrate that clause into the meaning-making of the sentence and reminds the reader what the sentence is about.

Heng (Chinese): In the simplified version, I used 'they will die in the end' instead of the original 'whose symptoms were... eventually death'. In the original sentence, there can be a question 'whose death'? And in the simplified version, we change it with the exact subject 'people, they'. I once more emphasised who does the action. I think it's easier for them to understand if the structure is subject-verb-object.

Alla (Russian): I changed 'It can be argued that' into active voice 'people can think that' because I wanted the subject to become animated. Without an animated subject, the text is either not very comprehensible or too abstract or it doesn't sound real.

The final strategy within the surface-level modifications approach concerned avoiding nominalisation ('Convert noun into verb') in the simplified OER texts. The rationale participants gave for employing this strategy, which involved reducing the average number of noun elements in the sentence, was the idea of facilitating faster processing of the text. As emphasised by participants, converting nouns into verbs (e.g., '*in discussion with*' vs.

'discuss with') helps the readers integrate the ideas behind these structures into the meaning-making of the sentence faster.

Diego (Spanish): I used verbs 'lose', 'bleed' and 'heal' in my simplification instead of the original 'loss', 'bleeding', 'healing'. In general, I try to use verbs plus nouns to modify nouns to indicate an action, I seldom use clusters of nouns. It's hard in that case to identify who modifies who and besides the verb stresses the actual action.

Content modifications

The second most commonly used approach to text simplification among participants was making content modifications. Some strategies within this approach were aimed at directing the attention of the reader to the key points of the text and included such strategies as cutting some information in the text and summarising the meaning of certain structures. Other strategies within this approach were aimed at facilitating the implicit meaning of the text, and included such strategies as adding clarifications or elaborations, emotional emphasisers and time references.

Concerning the first set of strategies, participants tended to remove redundancy in the text that they judged as unhelpful in understanding the content of the text. Participants cut items from the text, and in some instances – whole clauses – where they identified these items as not key in understanding the meaning of the sentence or as repetitive.

Evgeniya (Russian): I changed 'in discussion with other significant professional people' into 'in discussion with other professionals'. 'Significant' was removed because this word doesn't bring any important information. The idea that these professionals are 'significant' can be understood from the previous context – if the social workers can't make decisions by themselves and these people are involved, they must be 'significant'.

Compressing meaning or expressing the same idea using fewer words (e.g., *'act where the law permits'* vs. *'act within the law'*) was another strategy often employed by participating teachers, which falls within the approach of making content modifications. Similarly to cutting information, the rationale for compressing meaning was to deliver the core idea more explicitly.

Svetlana (Russian): I simplified 'before their situation arrives at the point of needing' into 'before their situation needs'. I feel like the original is too long, verbose, aimlessly redundant. Normally such circumlocution is used either to create the effect of irony in the text or as an attempt to hide, 'veil' the original message. I don't see any of these in the original text, but I see a desire to make this text sound more academic and more 'elated'.

Counter strategies for removing and cutting information in the text were strategies that implied adding information and elaborating on some points in the text. Participants' choices of these different strategies were guided by their decisions on the importance of the information they encountered in the text.

The strategy 'adding clarification' mainly involved giving more context to understand a concept described in the sentence. Within this strategy, participants provided definitions and examples to certain terms (e.g., '*fat-soluble vitamins*' in the authentic text vs. '*fat-soluble vitamins (e.g., vitamin A)*' in simplification). These elaborated definitions concerned the items participants found important for the readers to know and which they determined highly relevant to the topic of the text (e.g., defining '*scurvy*' in the text about the discovery of vitamins). Another reason for employing this strategy was to provide more context for the instances in the text which were not explicitly described, but which participants found important for understanding the text. As emphasised by participants, such instances in the authentic text would make the readers take considerable effort to access their meaning.

Nai (Chinese): I added the word 'substances' before the names of the terms 'cider, vinegar' because I wanted to help them identify that 'cider and vinegar' are 'substances'. I also added an extra word 'help' to complete the idea of the sentence. In the original, we have 'X could prevent the condition, whereas Y could not', and students may feel puzzled – 'couldn't do what?' So, it's hard for the students to figure out that 'could' refers to 'prevent'.

Another strategy participating teachers employed was adding emotional emphasisers, or words with emotional connotations, which they inferred from the context (e.g., '*died disillusioned*' vs. '*died with great disappointment*'). The reasons participants provided for using this strategy were to help the readers relate more to the text, make certain items of the text more salient and attract readers' attention to them as well as help the readers infer implicit meanings from the context. The frequent usage of such strategies shows that text simplification is a creative process in which an English teacher becomes a co-author of the reading material he/she provides to non-native English readers.

María (Spanish): I changed 'hazards' not just into 'dangers' but 'worst dangers' in my simplification. For me, 'hazard' is more than 'danger'. I just tried to emphasise the fact

that 'scurvy' is a very serious disease that used to happen to sailors during long sea voyages, and it was very, very dangerous.

The final strategy within the content modifications approach was adding time references to the simplified OER texts (e.g., *'they are generally still referred to by that letter'* in the authentic text vs. *'today, they are generally still known by that letter'* in simplification). The rationale participants gave for using this strategy was the idea that the learners at lower levels are used to seeing time references quite often and might expect to see them in the text. According to participants, time references make the text less abstract and help the reader position it in time and space.

Kristina (Russian): I added the time reference 'nowadays' to the opening sentence to create a familiar start for the students. When I was an English learner and was reading texts in English, I found it easier to read texts that start with something familiar like a time reference, which I understood really well on my level of language proficiency. I think I even had expectations of how texts should be structured.

Cohesion modifications

The final and the least frequently used approach to OER text simplification across the sample was modifying text cohesion features within/between sentences in the authentic texts. The five strategies that were used within this approach were adding logical connectives, resolving pronouns, combining sentences, changing the order of ideas and breaking the noun phrase.

The first three strategies listed above were aimed at improving cohesion between sentences: adding logical connectives, resolving pronouns, and combining sentences. Adding logical connectives was the most popular strategy within this approach. Participants explained that adding logical connectives, such as *'first'*, *'second'*, or *'this led to the fact that'* helps to connect the sentences, and it makes the logical relations between the sentences more explicit. It, thus, helps the readers better integrate these sentences into the overall meaning framework of the text.

Heng (Chinese): Since I divided this sentence, the shorter sentence lost connection to the previous one. But by adding a linker, I give a reference to the previous sentence. So, I help my students understand what link is between the sentences, and the linker is not difficult.

Pronoun resolution was another strategy used within this approach and refers to the instances where participating teachers replaced the pronoun with the corresponding noun in the simplified OER (e.g., *'those at sea'* in the authentic OER vs. *'sailors'* in simplification). The rationale behind this strategy was also the idea that a more cohesive text with evident links between the agents in different sentences contributes to an easier and faster understanding of the text. Pronoun resolution concerned not only the replacement of personal pronouns but also relative and possessive pronouns with their corresponding nouns.

Maya (Spanish): I wrote 'before the detailed chemical structures of vitamins were discovered' instead of 'before their detailed chemical structures were known' because I was afraid the students wouldn't understand what 'their' refers to. The anaphoric analysis is always difficult, not just for machine learning but for human reading as well.

Combining sentences was the least used strategy across the sample and involved merging two sentences in simplification (e.g., *'Xs do not make decisions ... alone. Their judgements are made in conjunction with Ys'* in the authentic text vs. *'Xs do not make decisions alone, but they do it together with Ys'* in simplification). Participating teachers followed this strategy in the instances where they identified that the idea of two consecutive sentences was similar and combining them would help avoid redundancy. According to participants, this strategy helps facilitate the understanding of the logical development of the text.

YingFei (Chinese): Yes, I added 'therefore' and combined the two sentences because I think the meaning of these two is tighter, they're closely related, and they're equally important according to the original meaning.

The remaining two strategies within the approach of making cohesion modifications – changing the order of ideas and breaking the noun phrase in the simplified OER texts – aimed to improve the links within sentences. Changing the order of ideas involved repositioning the clauses in the sentence to help the readers better understand the logical development of the text and the sequence of ideas described in the text.

Lidia (Russian): In my simplification, I changed the order of the subordinates. The simplified sentence first talks about him failing the task, and then what he did, and in the original, it's vice versa. I changed it because when the students work with the original text, they might not notice or pay attention to the negative result. So, if you ask them about the result – they will probably talk about his attempt and say they don't know what came out

of it. That makes the sentence complicated. The simplified text makes the link between the ideas and their development clearer.

Breaking the noun phrase refers to the instances where participants placed words describing the main noun in the postposition of the noun phrase (e.g., *'sea voyages'* in the authentic OER vs. *'travelling on sea'* in simplification; *'society's most complex issues'* vs. *'most complex problems in society'*). The rationale participants gave for employing this strategy was the idea of helping the readers identify the relationship between words and speed up their processing of the text.

While these three approaches and 16 strategies to text simplification were used across the sample, it is worth investigating the perceived effect of participants' language background on this practice. This will be discussed next in relation to RQ3a.

6.3.2. RQ3a: Language background vs. OER text simplification

To obtain some preliminary evidence on the perceived presence or absence of the influence of the mother tongue on approaches to OER text simplification, the relative frequency of use of the strategies elicited in this study was compared between participants in the three language groups. The bar chart below shows the frequency of use of the three approaches to text simplification per language group, followed by a descriptive summary of each strategy use by each group (see Table 39).

Figure 18. The use of the elicited simplification approaches (in %) by language group

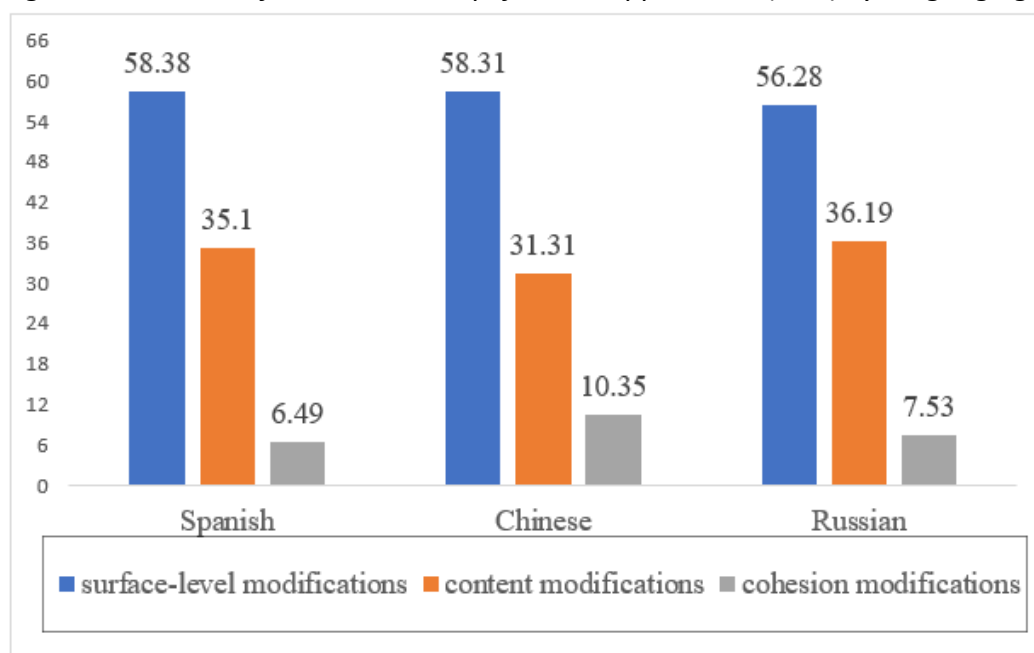


Table 39. Text simplification strategy use per language group

Strategy	n of participants contributed	% of total codes	Spanish		Chinese		Russian	
			Average individual	SD	Average individual	SD	Average individual	SD
Change word frequency	24	34.71	26.38	15.20	18.75	11.59	16.75	13.02
Cut information	24	15.15	11.63	7.38	6.63	9.33	8.75	4.92
Add clarification	21	9.05	6.75	7.12	5.75	4.33	3.63	3.15
Convert into SVO order	21	7.92	4.75	4.89	5.63	5.90	3.75	1.66
Split sentence	23	6.52	3.50	2.5	4.25	3.45	3.88	2.74
Convert passive into active	18	6.31	6.13	7.56	2.38	4.27	2.75	1.75
Compress meaning	20	6.10	5.00	3.11	2.63	3.70	3.25	2.05
Add logical connectives	19	3.72	2.38	2.06	2.25	2.55	2.00	1.60
Add emotional emphasiser	10	2.88	2.00	2.07	1.38	1.76	1.75	1.66
Convert noun into verb	13	1.40	1.25	2.05	0.75	1.75	0.50	0.53
Break the noun phrase	9	1.33	1.25	1.90	1.00	1.06	0.13	0.35
Change order of ideas	11	1.33	0.38	0.74	1.38	1.40	0.63	0.83
Add time reference	9	1.05	0.25	0.46	1.00	1.60	0.63	0.74
Resolve pronoun	10	1.12	0.50	0.75	0.63	1.40	0.88	0.83
Combine sentences	6	0.49	0.25	0.70	0.50	0.53	0.13	0.35
Split paragraph	7	0.91	0.63	1.18	0.63	1.18	0.38	1.06

Note: total number of participating English teachers N = 24

On average Spanish participants made 73 modifications to simplify the OER texts, Chinese participants – 55.5 modifications and Russian participants – 49.75 modifications respectively. Thus, the Spanish group made the most modifications on average, and the Russian group – the fewest. As can also be seen from Table 39 above, although some strategies occupied a very small proportion (e.g., the average use of the pronoun resolution strategy was 0.67 across the three language groups), each of the elicited strategies in the study was used by a minimum of six of 24 participants. Thus, these strategies are likely to represent common strategies used by English teachers to simplify OER texts, rather than constitute individual behaviour.

Since it was not possible to conduct inferential statistical tests with these data, to obtain evidence on the relationship between the language background and teachers' choice of text simplification strategies, the interview data were analysed thematically to elicit the perceived influence of this factor. Inductive TA was first conducted with participants' answers to the question on the potential influence of the language background on their text simplification practices. The analysis revealed that most participants across the sample see their mother tongue as something that should be avoided in a foreign language classroom, and its influence on their teaching is undesirable. The rationale they gave for trying to intentionally eliminate the influence of their mother tongue, especially at the learners' proficiency levels above elementary, was the idea that the focus of participants' teaching is primarily English. According to participants, the mother tongue might be distracting for their learners. The teachers felt they should take on more the role of the native speakers of the language they teach.

Lucia (Spanish): I don't think my mother tongue has any influence on how I simplify a text. All my lessons are only in English. The texts you gave me in the online task – most changes are words that I thought would be easier for them to understand. No, I don't think it will make any difference if my students are Spanish students or students from any other language background.

Nai (Chinese): I think what really matters in my approach to the text is students' proficiency level, and not my or my students' language background. So, if the proficiency level of my Chinese students is equivalent to the level of the students in multilingual classes – I think I will use the same approach to simplify the texts.

Having first eliminated the effect of language background, it was important to further explore what other factors affected teachers' use of simplification strategies. Further TA analysis of participants' answers to the interview questions concerning their

attitudes to text simplification showed that the position of participants in favour of text simplification or in favour of the authentic texts was reflected in the absolute number of modifications they made. This seems to suggest that their approach to text simplification was more determined by their attitudes to this practice rather than by their language background. Participants who made fewer modifications in each language group saw an original text as an ideal sample in which the author's voice should not be altered. Participants who made a higher number of modifications mentioned that authenticity or an output of a native speaker does not necessarily mean they are 'good' language samples. Instead, they tended to focus more on how the text fits with their teaching aims.

Svetlana (Russian): For me, text simplification is the fulfilment of my teaching aims. I can sometimes completely restructure the text – I might lose some authentic aspects of it like connotations, emotions, author's position – I might add or remove things from the text. In that respect I become a co-author of the text. For me a text is not a sacred shrine. I can do whatever I need with it, it's just words. (68 modifications)

Maya (Spanish): Authenticity simply because it's published – is it good? Not really. You have texts published all the time that aren't too good. Editing is an important part of my teaching (110 modifications).

YingFei (Chinese): What disadvantages can there be in an authentic text? Are we talking about the disadvantages of natural language? Normally, I just bring original texts for the students. Because what we do at our school is we let students appreciate the essence of the originality of the language. So, if we change it by ourselves, we can't guarantee the originality. Even though the grammar is correct, we can't guarantee the original style. (44 modifications)

The qualitative analysis also elicited the advantages and disadvantages of the text simplification practice, voiced by participants in this study. Participants with a higher number of modifications tended to emphasise the strengths of text simplification, and particularly its comprehension value. As stressed by participants, this approach can be especially helpful if the teaching aim is for the readers to have a general understanding of the text, a better understanding of the topic, or faster information extraction from the text.

Kristina (Russian): If our pedagogical aim is for them [the students] to understand the text – adaptation is required, I think. If our aim is to teach language or certain linguistic phenomena – then text simplification is not the right thing. Then it's best to simplify everything in the text except those language aspects that we want to teach to our students. If our aim is to speed up the process – make them understand the text as fast as possible so that they can do a bunch of exercises during the lesson after they finish reading the text – then it's best to simplify the text as much as possible. You can still keep the tasks difficult.

Among other frequently mentioned advantages of text simplification was the idea that reading simplified texts creates success scenarios in the reader's mind; they feel more confident and motivated to explore the topic further. Participants also referred to text simplification as an aid for the readers to get used to reading in English, which can help prepare them to read more difficult texts. Finally, text simplification was also seen by some participants as a way to more effective learning. According to those participants, it is much more difficult for the readers to memorise new vocabulary or speak on the topic of the text that they do not thoroughly understand.

María (Spanish): Text simplification makes you feel more motivated because you have a higher sense of achievement. When students struggle a lot with the text, they feel tired and don't want to study.

Evgeniya (Russian): Trying to match the language level of educational materials with the proficiency level of the students – I think that's the idea of teaching, I always try to do that. That's what makes learning effective.

Interestingly, some participants emphasised a new current demand for text simplification. As the communicative approach to language learning has been a dominant teaching approach for over a decade now, some teachers felt that current general English language textbooks offer vocabulary mainly for communication. Current English textbooks do not necessarily prepare the readers for the difficult academic texts they encounter in real life. Another reason for such a demand was the idea that students rely too much on modern technology, such as Google Translate or various dictionary applications. As a result, they are not used to going deeper into the meaning of lexical items or considering multiple meanings of the same word when they encounter a difficult text.

Alla (Russian): I use reading texts in my lessons less and less often because I find many students weak readers, not just in English – even in their mother tongue. They don't seem to have enough patience to finish reading a text. They are used to reading captions and headings and maybe a couple of lines after them that summarise their idea. That's why I try to use mostly videos rather than reading texts – some of them are educational, and some are 'real' authentic snapshots. Or I try to simplify the reading texts I bring to my classroom.

On the other hand, the qualitative analysis also revealed that participants with a fewer number of modifications tended to emphasise the disadvantages of text simplification. Participants who did not favour text simplification in their teaching frequently talked about information loss that text simplification might incur, as well as the

fear of making language mistakes when simplifying a text. Some participants thought that their 'feel' for the language is not as natural as that of native speakers.

Diego (Spanish): When you add things from your side or cut things, there is always a risk you won't do it accurately. When replacing words with their synonyms, you might use the wrong synonym that doesn't collocate with the context. A native speaker might avoid these mistakes, but because we are non-native speakers... It's not fatal, but it's not good when a student remembers an imperfect sample of language.

Another disadvantage of the text simplification practice identified by participants was the idea that it puts forward a more targeted form of learning, whereas exposing the readers to more diverse samples of language can encourage the passive acquisition of new structures and lexical items.

Heng (Chinese): If my teaching aim is not to upgrade their grammar level or expand their vocab, if my aim is just for them to learn important information from the text, then there is still a disadvantage in simplifying texts. It might result in very targeted one-sided learning. It is not like it is shallow, but it's just a very narrow kind of learning – they only extract information and continue working with this information.

Finally, participants also mentioned that it is time-consuming to simplify a text in a busy teaching schedule. It was emphasised that teachers do not always have the agency to bring their own materials to the classroom where the curriculum is developed by the school. They mentioned that under such circumstances, they would rather teach the necessary skills to the students, such as academic English, or the ability to identify grammar structures central to the meaning of a sentence rather than simplify the text for them.

However, at the same time, all participants irrespective of their preference for authentic or simplified texts talked about the scaffolding they provide for their students when providing them with reading materials. Such scaffolding includes text analysis, oral paraphrase, and additional explanations that accompany the reading task, particularly if the teacher identifies that a learner experiences communication breakdown.

Conclusively, qualitative analyses showed that most participants in the sample, irrespective of their language background, try to avoid the use of their mother tongue in their English classes, and accompany the reading materials they give to the learners with some sort of scaffolding. Furthermore, the analyses suggested that participants' attitudes to simplification seemed to influence the number of modifications participants made in the text, which they very rarely associated with their mother tongue in the interviews. These

qualitative findings provide some emerging evidence that teachers' attitudes to text simplification have a greater influence on their text simplification practice than their language background.

6.4. Study 3 Discussion

6.4.1. Implications of findings

In this chapter, Study 3 explored English teachers' practices of making OERs more accessible to non-native English readers, and their perceptions on the effect of their language background on this practice. Modifications detection analysis and CA carried out in this study as part of RQ3 elicited 16 strategies that were categorised into three general approaches to text simplification.

Results showed that the most common approach to text simplification across the sample was modifying the surface-level features of the OER texts. This finding supports the results of earlier studies on text complexity, which claim that simplifying surface-level text features, such as word frequency or sentence length, has been a common approach to lowering the complexity of the text (e.g., Harrison, 1980; Freedle & Kostin, 1993; Crossley et al., 2012). This study also showed that changing the words to the ones more frequently used in the language was the most popular strategy to OER text simplification across the sample. This is in line with the studies conducted with the teachers of other profiles (e.g., Young, 1999; Glass & Oliveira, 2014; Basturkmen & Shackelford, 2015). These studies also identified that rewording or replacing words with synonymous terms or expressions more familiar to students was perceived by the teachers as the most important type of modifications. The finding of this study can further be supported by vocabulary research with non-native readers of a given language, which suggests that there is a relatively linear relationship between the percentage of vocabulary known by the reader and the degree of text comprehension. It has previously been shown that the reader needs to know 98%-99% of the words in the text to be able to understand 70% of the information in it (Schmitt, Jiang & Grabe, 2011; Nation, 2015; Schmitt, Cobb, Horst & Schmitt, 2017)

Participants in this study went beyond mere sentence splitting and changing word frequency as part of the surface-level modifications approach. Participants also split paragraphs and used more personal, active structures in the simplified OER texts by changing the voice and the word order of the sentence. The purported rationale for the

use of these strategies was to help learners unpack the meaning and arrive at the core idea of the sentence faster.

The deductive coding scheme used in this study, which was adopted from Studies 1-2 and was based on the text complexity literature, was substantially expanded in Study 3 with 11 new categories. Moreover, none of the five strategies elicited as part of the second approach to text simplification – making content modifications – ‘cut information’, ‘add clarification’, ‘compress meaning’, ‘add emotional emphasiser’, and ‘add time reference’ were featured in the deductive coding scheme. Few of these strategies were highlighted in the previous research on the strategies to increase accessibility to the learning content (e.g., Young, 1999; Glass & Oliveira, 2014; Basturkmen & Shackelford, 2015). The fact that making these content modifications was the second most common approach across the sample constitutes important evidence for potentially facilitating text comprehension. Thus, this study showed that participating English teachers modified not only the surface-level features of the OER text, but they also made content modifications that concerned the meaning framework of the text.

The final approach to text simplification identified in this study was making the cohesion modifications in the authentic texts. This approach was mainly concerned with making the connections between the clauses and sentences more explicit and helping the readers understand the logical development of the text. Examining cohesion features in linguistic accessibility research is a relatively recent trend. The findings of the few studies that addressed this topic emphasised the importance of text cohesion (e.g., McNamara, 2001; Reed & Kershaw-Herrera, 2016; Xia et al., 2016). This study showed that participating teachers were aware of the strategies concerning cohesion modifications. Although this was the least used approach across the sample, participants did employ these strategies when simplifying both OER texts.

RQ3a in this study was concerned with the effect that teachers’ language background might have on their text simplification practice, as perceived by the participating teachers. English teachers with mother tongues belonging to different families and typologies may be expected to simplify the text differently. The analysis suggested there is a shared understanding among the teachers in the three language groups as to what constitutes a more accessible text, as the descriptive statistics revealed that each of the elicited strategies in the study was used by a minimum of six participants out of 24 participants across language groups. This insight was further supported with the

inductive TA analyses of participants' answers to the interview questions. The analysis showed that the English teachers in all three language groups intentionally avoid using the mother tongue in the classroom. They deliberately take on the role of English native speakers and see their mother tongue as distracting for their learners. While, to my knowledge, there are no previous studies which analysed the differences in how language teachers with different language backgrounds simplify a text, the finding of this study supports the earlier research of Young (1999). Although the author did not recruit participants with different language backgrounds, her study did show that similar types of modifications were made across all texts, irrespective of the participants' profiles (linguists vs. language teachers). However, Young (1999) did not elaborate on the reasons that may account for such similarities in approaches to simplification between participants. In this study, further exploration through the qualitative data showed that text simplification practices were more affected by teachers' attitudes to text simplification rather than by their language background. Participants seemed to be guided in the number of modifications they made by whether they saw an original text as an ideal language sample or whether they saw it as a tool that can help them implement their teaching goals. Fully investigating teachers' attitudes and beliefs concerning text simplification was beyond the scope of this thesis.

Furthermore, this study showed that participants with a higher number of modifications in the OER text emphasised the positive aspects of text simplification in the interview. In contrast, participants who made fewer modifications in the OER text talked more frequently about the disadvantages of this practice. This finding supports the evidence that there is a general divide between language educators concerning the utilisation of simplified texts (Crossley et al., 2012). Most of the advantages (e.g., comprehension value, learners' self-confidence, alliance with the teaching aims) and disadvantages of text simplification (e.g., information loss, narrow learning, the amount of time it takes a teacher to simplify) voiced by participants in this study are in line with the text simplification research (e.g., Yano et al., 1994; Crossley et al., 2012). This study further showed that participants were cautious of the language inaccuracies they might make during simplification, which echoes their intention to be English native speaker role models for their learners, described earlier. At the same time, participants in this study pointed to the current demand for academic text simplification. Many participants felt that the current English learning textbooks mainly focus on communicative competences, and do

not prepare the learners for the challenging academic texts they encounter in their continuous education. Finally, this study showed that English teachers found it important to accompany reading materials with scaffolding, regardless of their attitudes to text simplification. Since such scaffolding is often not in place in self-regulated online learning, such as online OER courses, OER text simplification was deemed an important practice in such settings.

As research is scarce on this topic, more evidence will be needed to draw firm conclusions on the role that the language background plays in text simplification.

6.4.2. Study limitations

Study 3 provided a comprehensive account of text simplification strategies, as well as the definition and rationale for the use of these strategies, as employed by English teachers. It also provided examples of how these strategies were implemented and which strategies were used more regularly. Furthermore, Study 3 also explored the perceived effect of teachers' language background and the effect of other factors on this practice.

Some limitations arise from the online task and self-report approach as this does not build a naturalistic account of how English teachers simplify texts for non-native English readers in their normal context, such as a classroom. The purpose of this study was to gain a more comprehensive and holistic perspective on approaches to text simplification as well as to analyse this practice across English teachers from different language groups. Thus, an online simplification task with a follow up stimulated recall interview were more suitable to answer the research questions in this study.

Another limitation concerns the fact that some of the elicited strategies in this study suggest counteraction when simplifying OER texts: e.g., 'cut information' vs. 'add clarification', 'split sentence' vs. 'combine sentences'. Although some of these strategies were used more regularly, this evidence suggests that text simplification is at times context-bound and depends on how an individual who performs text simplification understands the text. This might limit the generalisability of these strategies to such fields as machine learning that explore the design of automatic text simplifiers (Ferrés, Marimon, Saggion, 2016). At the same time, currently, text simplification is performed mostly intuitively, and few empirical studies have attempted to develop guidelines on the strategies that are regularly used to simplify a text. This study provided such a guideline by recruiting a bigger participant sample and establishing a more sophisticated data analysis framework for text

simplification. The qualitative analysis in this study suggested that there is a shared understanding of how a text needs to be simplified to make it more accessible, and the perceived effect of the language background on this practice is low. This implies that these strategies have the potential to help lower-level proficiency English learners read an OER text, irrespective of their language background.

6.4.3. Links to the final study in this thesis

In Chapter 6, the analysis of English teachers' OER text simplification practices has been collated into guidelines with strategies and approaches on how to simplify an OER text for non-native English readers at lower English proficiency levels. This analysis enabled the identification of the most and least frequently used text simplification strategies among the English teachers from diverse language backgrounds and furthered the understanding of the rationale behind the use of each strategy.

English teachers constitute an expert group on text simplification in light of their knowledge of learners and materials. Study 3 showed that experienced English teachers share a common ground in their understanding of how to make a text more linguistically accessible to non-native English readers. However, such shared understanding does not necessarily mean that these strategies are effective or optimal. Thus, follow-up research was needed that would use diverse, robust research methods to explore the effect of the strategies collated in this study, and to evaluate text simplification as a potential solution to support international OER learners.

The next chapter will outline the results of the final empirical study, Study 4, that explored how non-native English readers with different language backgrounds and English proficiency levels respond to the elicited text simplification strategies. Data analysis in Study 4 was conducted using two different temporal eye-tracking measures, and two measures of comprehension assessment which will further be discussed next.

7. Study 4 Methods and Results

As highlighted in Section 1.3, this thesis is comprised of four studies, and this chapter describes the methods and findings of the final study, Study 4. In doing so, the chapter is divided into four sections. First, the Introduction (7.1) reiterates the research question for Study 4, which aimed to evaluate the effect of OER text simplification on text comprehension and text processing on non-native English readers. While Chapter 3 provided an overview of the overarching methodology adopted in this research (see Sections 3.4.3 and 3.4.4), Section 7.2 (Materials and methods) describes in detail the specific methods adopted in Study 4, including information about participants, texts, eye-tracking equipment, procedure, and data analysis approach. Appendices to this thesis (Appendices 6 through 12) provide samples of test materials used in Study 4. Results Section (7.3), outlines the findings in relation to the study's research question. The final section, Discussion (Section 7.4), comments on the implications of this final study's findings, including limitations and consequences for future work on this topic.

7.1. Introduction

As illustrated in Figure 8 in Section 3.3 on the research design of this thesis, Study 1 problematised the linguistic accessibility of OERs by exploring the text complexity of these resources. Study 2 provided emerging evidence on the effect of text simplification when performed in line with the recommendations in the text complexity literature. Study 3 provided a strong conceptual foundation regarding the ways in which an OER text can be simplified. Study 4 aimed to examine the effect of this conceptualised solution on non-native English readers.

Similarly to Study 2 described in the Chapter 5, the final study in this thesis focused on the text difficulty element of linguistic accessibility (see Figure 6). However, as opposed to Study 2 which used qualitative methods, Study 4 combined eye-tracking methodology and two measures of comprehension assessment to quantitatively evaluate the effect of text simplification on non-native English readers.

⁵The study described in this chapter was presented at the CALRG2020 conference at the Open University (16 June 2020). This chapter is also based upon the following peer-reviewed journal article:

- Rets, I., Rogaten, J. (2020). To simplify or not? Facilitating English L2 users' comprehension and processing of Open Educational Resources in English using text simplification. *Journal of Computer Assisted Learning*, 1-13. <https://doi.org/10.1111/jcal.12517>

This study also accounted for text organisational structure (narrative vs. expository), and participants' individual predispositions. Furthermore, in contrast to Study 2, Study 4 was based on the evidence-based text simplification strategies elicited from Study 3.

The evaluation of the effect of text simplification was necessary in light of some inconsistent evidence concerning the benefits of text simplification for non-native English readers, some methodological caveats in current text simplification research, as well as for the purposes of obtaining a more comprehensive understanding of the topic (*see Section 2.6.3*). Piloting the OER study materials layout in the eye-tracking software in Study 2 made it possible to conduct Study 4 with a larger number of participating non-native English readers.

With this in mind, Study 4 addressed the following research question:

RQ4: What is the effect of text simplification on text comprehension and text processing among non-native English readers when English proficiency, background knowledge, and topic interest are controlled?

In the following section, an in-depth review of the methods employed in Study 4 is outlined.

7.2. Materials and methods

7.2.1. Participants

Initially, 50 participants were recruited for the study, however, the data of 13 participants were removed from the analyses due to poor quality of the eye-tracking data. This is a common issue in eye-tracking research (Holmqvist et al., 2011; Catrysse et al., 2018; *see sections 3.4.3 and 5.2.4*). Thus, the final sample comprised of 37 participants (11 male, $M_{\text{age}} = 33.05$, $SD = 10.33$), who were adult non-native English readers. Participants' language backgrounds varied. Participants' mother tongues were from five language families: Indo-European ($n = 21$), Sino-Tibetan ($n = 12$), Altaic ($n = 2$), Afro-Asiatic ($n = 2$). Similarly to Study 2, the sample in Study 4 was selected to reflect the global diversity of the population of OER learners (*see Section 5.2.1*). Participants were recruited from a local English learning programme at the community learning centre and the English language training centres from two universities in the UK (*see Appendix 6 for the recruitment*

advertisement). Most participants were university graduates ($n = 33$), 19 participants indicated they had university degrees in sciences (e.g., engineering, medicine), and 14 participants – in humanities (e.g., arts, literature), four participants were high school leavers. All participants had a normal or corrected-to-normal vision, reported having no learning disorders.

7.2.2. Language proficiency

In line with Jung and Révész (2018), an adapted version of the ‘Use of English’ section of a practice Cambridge Proficiency (CPE) Test was used in this study to determine participants’ language proficiency (*see Appendix 9*). This 25-item test, each item containing four multiple-choice answer options, aimed to measure mainly participants’ lexicogrammatical knowledge of English, and their pragmatic knowledge (knowledge of various situational contexts in English). This test also allowed to benchmark the resulting score against CEFR (Council of Europe, 2001), and to determine participants’ language proficiency level. Thus, it was possible to categorise participants as high or low English proficiency by using the average CPE score across the sample of 16.24 (SD = 4.64) as the mean split. Cronbach’s alpha for the CPE scores was $\alpha = 0.80$.

7.2.3. Texts

The same OER texts as those used in Study 3 (*see Section 6.2.2 and Appendix 3*) were employed in Study 4. The aim of choosing similar materials in Study 4 was to reach a higher ecological validity and a greater validation of the text simplification strategies (*see Section 6.4.3*).

The two texts used in the study had two different types of organisational structure: Text 1 was a narrative text about the discovery of vitamins (subject label: STEM; 299 words, two paragraphs) and Text 2 was an expository text about the role of social workers (subject label: Health, Sports & Psychology; 282 words, four paragraphs). As the focus of the study was on OER texts, both texts were selected from the introductory section of two courses on the OpenLearn platform (2020). Both courses required no prior educational background. To control for the learning effect in each reading, the selected texts represented different topics.

Following a similar rationale as in Study 2, shorter texts were used in this study to avoid flipping pages on the screen, which might not have allowed participants to go back

to earlier areas of the text during reading (*see Section 5.2.2*). For each text, I manually prepared a simplified version in line with the approaches and strategies to text simplification identified in Study 3. The text complexity level of each text was also checked with the Textinspector (2020) online readability tool. Simplified texts had lower text complexity, as indicated by all types of readability metrics in Textinspector (*for the interpretation of the readability metrics, see Table 13*):

a) simplified texts had an average Flesch Reading Ease score of 51.09 (10-12th grade level), as compared to the authentic texts with the score of 37.34 (college level);

b) simplified texts had lower lexical diversity: vocd-D score of 91.78, as compared to the authentic texts with the vocd-D score of 100.1;

c) simplified texts utilised more words of higher frequency: 87.9% of the words within 0-6K frequency range, as compared to the authentic texts with 82.5% of words in this frequency;

d) simplified texts contained more logical connectives on average: 11.55% as compared to the authentic texts with 10.3% of elements in the text classified as logical connectives.

The global structure, the number of paragraphs, and the content of the authentic texts were kept intact in simplification. Simplified Text 1 contained 293 words, and simplified Text 2 – 268 words. Thus, a total of four texts were used. Similar text formatting to that of Study 2 was used in this study (*see Section 5.2.2*). All text versions were displayed in Times New Roman 14.5 black font on a white background and were presented 1.5-spaced on the screen with the left and right page margins set at 0.2 cm. The two texts, their linguistically simplified versions, and the changes that were made in each text as a result of text simplification, are presented in Appendix 7 to this thesis. The gaze plot imported from the study project, which exemplifies the design of the texts in the eye-tracking software is presented in Appendix 8.

7.2.4. Background knowledge

Participants' background knowledge of the topic of the text was measured with a 5-item self-report background knowledge questionnaire adapted from the study of Khabbazzashi (2015) (*see Appendix 10*). The same questions were used for Text 1 and Text 2 in the study. Participants' responses were recorded on a seven-point Likert scale ranging from 0 to 6 (e.g., '*I had a clear idea about this topic before reading the text*' – '0', '*strongly*

disagree’; ‘6’, ‘*strongly agree*’). The background knowledge score for each participant was computed by averaging out responses to all five questions. In this study, reliability scores for the four texts ranged between $\alpha = 0.6$ and $\alpha = 0.79$.

7.2.5. Topic interest

Participants’ interest in the topic was measured with a 7-item self-report questionnaire (Schiefele & Krapp, 1996) (see *Appendix 11*). This questionnaire was previously used by Catrysse and colleagues (2018) in their eye-tracking research on students’ characteristics and text learning, which showed that this measure of topic interest is one-dimensional and reliable. In this study, the same questions were used for Text 1 and Text 2. Participants’ responses were recorded on a seven-point Likert scale ranging from 0 to 6 (e.g., ‘*While reading the text I felt stimulated*’ – ‘0’ ‘*strongly disagree*’; ‘6’ ‘*strongly agree*’). For each participant topic interest score was calculated by adding the scores for each question. In this study, reliability scores for the four texts ranged between $\alpha = 0.7$ and $\alpha = 0.89$.

7.2.6. Comprehension assessment

7.2.6.1. Free recall

Text comprehension was measured using two different reading assessment techniques, as a number of previous research studies on text comprehension urged to employ multiple assessment methods to cross-check participants’ comprehension (Ariasi et al., 2017). In this study, to measure text comprehension, participants were first asked to write in English the ideas they remembered from the text they had read as part of the research session. The retelling was self-paced. Specifically, participants were provided with the following instructions: *Please retell the text you just read. Please, write as many ideas as you can remember, and do not worry about spelling mistakes. Please, do not state your opinion about the text.* As part of this task, participants were explicitly instructed not to include their opinions about the text, since it was beyond the scope of this study to explore participants’ extra-textual elaborations. Retellings were typed into a word document on the laptop from which they had read the text earlier. Participants could see their retelling as they typed, but did not have access to the text they had read.

In line with Chen (2016), the idea units recalled correctly in each participant’s retelling were first identified separately with one independent rater, who was my fellow

PhD peer. The rater was blind to the participants' reading condition. The inter-rater reliability was 0.95. The disagreements on the idea units were then discussed until a consensus was reached. One point was awarded for each idea unit in which all the main elements were recalled correctly, and half a point was given if some of the elements in the idea unit were recalled correctly. The maximum possible score on the summaries for the narrative text was 34, and the total score for the expository text was 28.

7.2.6.2. Multiple-choice comprehension tests

Two multiple-choice comprehension tests were designed for Text 1 and Text 2 (*see Appendix 12*). Each test had ten questions. The questions included the correct answer and three distracters that were thematically related (same theme but incorrect) (*see Section 3.4.4.1 for the details about the qualitative validation of the tests*). The data for the analysis was obtained from 36 participants – there are missing MC comprehension test data from one participant in the sample. The reliability score for Text 1 authentic was $\alpha = 0.67$, Text 1 simplified $\alpha = 0.69$, Text 2 authentic $\alpha = 0.7$ and Text 2 simplified $\alpha = 0.63$.

7.2.7. Eye-tracking

7.2.7.1. Eye-tracking equipment

The Tobii Pro X3-120 (dark pupil tracking) eye-tracker, manufactured by Tobii Technology (Stockholm, Sweden) was used to collect participants' eye movements data. The eye-tracking component was integrated into a 17.3-inch laptop screen with a maximum resolution of 1920 × 1080 pixels. The sampling frequency was 120 Hz. Tobii Technology reported a gaze accuracy of 0.4°, and gaze precision of 0.20° for this eye-tracker. The eye movements were recorded with Tobii-Studio (3.2) software.

7.2.7.2. Eye-movement data

The Tobii fixation filter was used in this study for fixation identification (Olsson, 2007). For each sentence in all four texts, an area of interest (AOI) was defined. Eye movements were analysed on a sentence level to obtain a more sensitive account of the effect of text simplification and identify what parts of the text participants paid attention to in the simplified texts, as compared to their authentic versions.

In line with Hyönä and Lorch (2004) (*see Section 2.6.3*), the sentences that introduced the ideas in the text were coded as topic-introducing. The sentences that

elaborated these ideas were coded as topic-medial or topic-final, depending on their position in the paragraph. In line with Hyönä and Lorch (2004), and Ariasi and colleagues (2017), topic-medial and topic-final sentences were separated in the analyses, as topic-final sentences were likely to be where readers would carry out an integrative wrap-up processing before moving on to the next topic in the text.

First pass and second pass fixation duration were calculated per AOI. As described in Section 3.4.3, and in line with Ariasi and colleagues (2017) and Mason and colleagues (2013) (see Section 2.6.3; 3.4.3), the first pass fixation duration is defined in this study as the summed duration of fixations that land on unread regions of the sentence during the first encounter (*forward fixations*). Second pass fixation duration is defined as the summed duration of fixations returning to a sentence that has already been processed (*look-back fixations*). It is possible that the first pass fixation duration also included some level of re-analysis (look-back fixations) of elements within the AOI. However, a finer distinction between additional measures that concern forward and look-back fixations was less important for the RQs in this study. When combined, first pass and second pass fixation duration capture most of the viewing activity on the AOI and can provide converging evidence on the presence or absence of the effect of text simplification.

To control for the length of AOI's, the eye-tracking measures were converted to time-per-character measures (ms/char) and were then logarithmically transformed to normalise the distributions (Godfroid, 2019). Since simplified texts had more sentences due to the sentence split, mean fixation durations were calculated for each sentence type for the two eye-tracking measures.

7.2.8. Procedure

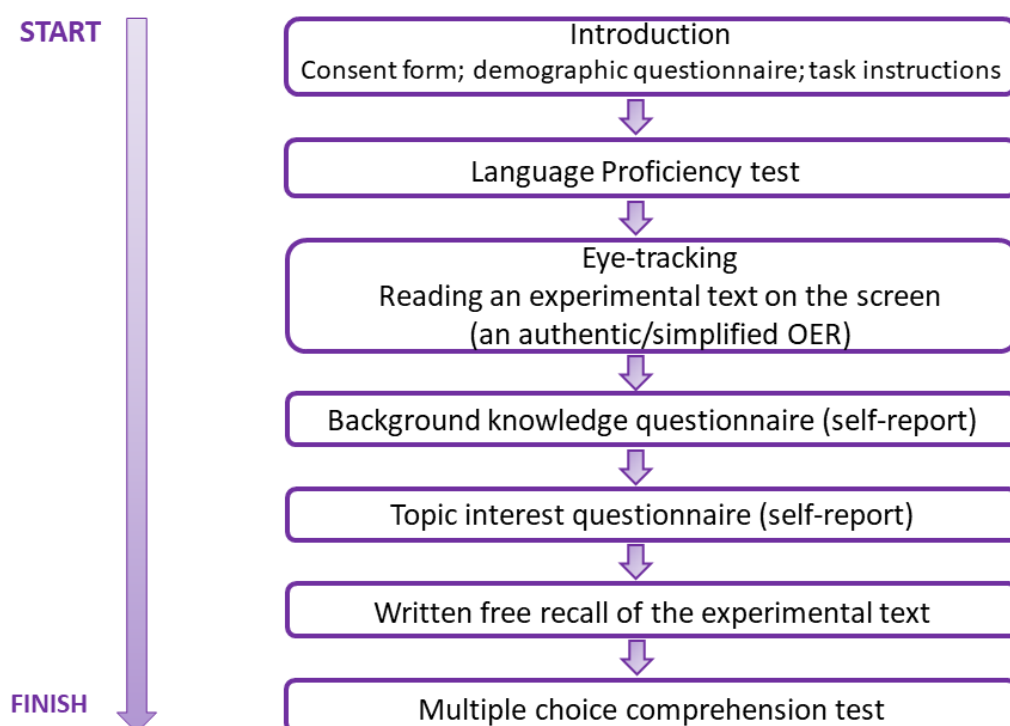
As mentioned in Section 3.7, the ethical clearance for this study was obtained from the research ethics committee at the Open University (see Appendix 1). The visualisation of the study procedure is presented in Figure 19 at the end of this section.

The session started with participants filling out a consent form, completing a demographic background questionnaire, and a language proficiency test. All participants were then randomly allocated to one of the study conditions, i.e., four OER texts read from the screen. Participants were informed that they would need to read a text for comprehension, and there would be two comprehension tests at the end of the session. Participants were seated about 60 cm from the screen for the 9-point eye-tracking

calibration. Reading was self-paced, and participants were asked to press the escape button on the keyboard when they felt they had understood the text. To secure independence of observations for the employed data analysis method (see Section 7.2.9), this study adopted a between-subjects design. Thus, each participant read only one of the four experimental texts.

After reading the text, participants completed the background knowledge and topic interest questionnaires. They were then asked to first complete a free recall task for the text they had read, and then to complete a multiple-choice comprehension test. The sequencing of the comprehension measures was set in this order to avoid the carry-over effect from seeing multiple-choice answer options to free recall. The entire experimental session lasted approximately 60 min. Participants were debriefed at the end of the session and received £20 Amazon vouchers.

Figure 19. Visualisation of data collection procedure in Study 4



7.2.9. Data analysis

The distribution of the dependent variables in this study was tested. Comprehension via multiple-choice scores and comprehension via free recall all showed to be relatively normally distributed. The first and second pass fixation duration variables across three sentence types were skewed and therefore were log-transformed (see

Sections 3.4.3 and 7.2.7.2). The transformed variables met the assumption of being relatively normally distributed.

To answer the research question in this study, first the relation between individual factors, namely language proficiency, background knowledge, and topic interest, and the variables that concerned participants' text comprehension and text processing were examined. Pearson correlation was conducted with all study variables.

The second step in the data analysis in this study concerned examining whether there was a difference in participants' text comprehension among simplified versions and authentic versions of narrative and expository texts when controlling for language proficiency, background knowledge, and topic interest. For this step, between participants 2x2 Univariate ANCOVA was used. The first factor was condition with two levels (i.e., authentic vs. simplified). The second factor was text organisational structure with two levels (i.e., narrative text vs. expository text). The covariates in this analysis were language proficiency, background knowledge, and topic interest scores. The test was performed twice for each of the dependent variables, i.e., 1) comprehension via multiple-choice; and 2) comprehension via free recall.

The third step concerned examining whether there was an effect of text simplification on text processing as measured by first pass and second pass fixation duration. As part of this step, mixed effects 3x2x2 ANCOVA was used. The within-participants factor was sentence type with three levels (i.e., topic-introducing, medial, and final sentences). Between-participants factors were condition with two levels (i.e., authentic vs. simplified) and text organisational structure with two levels (i.e., narrative text vs. expository text). Similarly to the second step, in step three, language proficiency, background knowledge, and topic interest scores were entered in the model as covariates. In the first analysis, the dependent variable was first pass fixation duration, and in the second analysis – second pass fixation duration. Both eye-tracking measures were in ms/char, log-transformed.

7.3. Results

7.3.1. Individual factors vs. text comprehension and text processing

In order to get an overview of the relation between the participant-related variables used in this study, correlations were computed. The correlations among the variables are presented in Table 40 below.

Table 40. Pearson correlation coefficients for all Study 4 variables

Variable	1	2	3	4	5	6	7	8	9	10
1. LP										
2. BK	-0.186									
3. TI	0.073	.566**								
4. MC	0.261	0.191	0.252							
5. Recall	.386*	0.196	.426**	.675**						
6. First pass Intro	-0.042	-0.182	-0.036	-0.026	-0.044					
7. First pass Med	-0.290	.355*	.395*	0.308	0.239	0.232				
8. First pass Final	-0.185	0.171	0.080	-0.115	-0.149	.382*	0.174			
9. Second pass Intro	-.335*	-0.113	-0.131	-0.147	-0.153	0.216	-0.029	-0.161		
10. Second pass Med	-.381*	-0.069	-0.313	-0.070	-0.231	0.201	0.029	-0.054	.687**	
11. Second pass Final	-0.092	-0.187	-.337*	-0.001	0.027	.342*	-0.055	0.164	0.145	.400*

*p < 0.05 level; **p < 0.01.

Note: LP - language proficiency; BK – background knowledge; TI – topic interest; First pass – first pass fixation duration; Second pass – second pass fixation duration, intro – topic-introducing sentences; med – topic-medial sentences; final – topic-final sentences

As can be seen from Table 40, background knowledge of the topic of the text (BK) strongly positively correlated with interest in the topic (TI). Language proficiency (LP) moderately positively correlated with the free recall and moderately negatively correlated with the second pass fixation duration for the topic-introducing and medial sentences. Background knowledge and topic interest related positively to the first pass fixation duration for the medial sentences. In addition, topic interest negatively correlated with the second pass fixation duration for the final sentences. There were also significant relations between the eye-tracking measures: for first pass fixation duration between topic-introducing and topic-final sentences. The second pass fixation duration measure intercorrelated positively i.e., topic-introducing sentences with medial, and medial with final sentences.

7.3.2. Effect of text simplification on text comprehension

The descriptive statistics for multiple-choice comprehension scores and free recall scores are presented in Table 41 below. The maximum score for multiple-choice

comprehension was ten points for all texts. As previously stated in Section 7.2.6.1, the maximum score for free recall for the narrative texts was 34, expository texts – 28.

Table 41. Means and standard deviations for two types of comprehension by text and condition

	Comprehension MC			Comprehension recall		
	n	M	SD	n	M	SD
Text 1 Narrative Authentic	8	5.75	2.19	9	8.77	3.35
Text 1 Narrative Simplified	10	6.6	2.17	10	9.2	5.07
Text 2 Expository Authentic	10	5.2	2.66	10	4.9	4.99
Text 2 Expository Simplified	8	6.38	1.92	8	5.5	2.61

Note: MC – multiple-choice.

MC comprehension test was lost for one participant in the sample

As can be seen from Table 41, on average, the comprehension scores as measured by both multiple-choice and free recall were higher for the simplified condition than the authentic condition. In order to test whether the differences were significant, 2x2 Univariate ANCOVA was used. The results are presented in Table 42 below.

Table 42. Results of ANCOVA analysis for two types of comprehension

	Comprehension MC			Comprehension recall		
	F	df	η^2	F	df	η^2
Condition	4.45*		0.12	1.63		-
Text structure	0.885	1,31	-	9.26**	1,31	0.23
Condition*Text	0.11		-	0.4		-

* $p < .05$; ** $p < 0.01$

Note: MC – multiple-choice.

The covariates in the analysis were language proficiency, background knowledge and topic interest scores

As can be seen from Table 42, in relation to the multiple-choice comprehension scores, there was a significant main effect of condition (simplified vs. authentic texts) meaning that participants comprehended simplified texts significantly better than the authentic texts, and there was no effect of text organisational structure (narrative vs. expository) when controlling for language proficiency, background knowledge, and topic interest scores. In addition, language proficiency had a significant effect on multiple-choice comprehension scores, $F(1, 30) = 5.26$, $p = .03$, $\eta^2 = .15$, indicating that participants with

higher multiple-choice scores had higher language proficiency, however, with a small effect size.

To aid an understanding of when text simplification has an impact on comprehension, participants were categorised as high (> 16.24 , $n = 16$) or low in language proficiency using a mean split ($M = 16.24$). ANCOVA (controlling now only for background knowledge and topic interest) for the two proficiency groups showed that condition (simplified vs. authentic texts) only had a significant effect on comprehension through multiple-choice in the low language proficiency group, $F(1, 15) = 11.09$, $p = .01$, $\eta^2 = .43$ with the moderate effect size. There was no significant effect of text organisational structure (narrative vs. expository) in a low language proficiency group, $F(1, 15) = .95$, $p = .35$ and no effect of either condition (simplified vs authentic texts), $F(1, 9) = .00$, $p = .97$, or text organisational structure (narrative vs. expository texts), $F(1, 9) = .02$, $p = .88$ in the high language proficiency group on multiple-choice comprehension.

Somewhat different findings were obtained for participants retelling the text. As can be seen from Table 42, the results indicated that for free recall, text organisational structure had a significant effect, i.e., whether it was narrative or expository when controlling for language proficiency, background knowledge, and topic interest scores, while condition (simplified vs. authentic texts) did not have a significant effect. Similarly to the comprehension via multiple-choice, there was a significant effect of language proficiency on participants' ability to recall the text, $F(1, 31) = 12.09$, $p = .02$, $\eta^2 = .23$. As with the comprehension via multiple-choice, the analysis was run separately for the low and high language proficiency groups. ANCOVA (controlling now only for background knowledge and topic interest) for the two proficiency groups showed that for the low proficiency group both condition (simplified vs. authentic texts), $F(1, 15) = 5.17$, $p = .04$, $\eta^2 = .24$ and text organisational structure (narrative vs. expository texts), $F(1, 15) = 5.34$, $p = .04$, $\eta^2 = .25$ had a significant effect on participants' recall scores. For the high proficiency group neither condition, $F(1, 10) = .00$, $p = .95$ or text organisational structure, $F(1, 10) = 3.03$, $p = .11$ had a significant effect. This result demonstrates that participants with low proficiency scores were able to recall significantly more ideas from the simplified text that had a narrative structure, than from the simplified expository texts or authentic texts.

Conclusively, the results showed that both text difficulty and text organisational structure had an effect on comprehension with simplification being important for multiple-

choice comprehension, and the narrativity of the text being important for text recall. In both cases, the low language proficiency group benefited the most from text simplification.

7.3.3. Effect of text simplification on text processing

The means and standard deviations of the two eye-tracking measures in the authentic and simplified condition for the two texts are presented in Table 43 below.

Table 43. Means and standard deviations for two types of eye-tracking measures (in log-transformed ms/char) by text and condition

		Topic-introducing sentences			Medial sentences		Final sentences	
		n	M	SD	M	SD	M	SD
First pass fixation duration	Text 1 A	9	0.59	0.18	0.41	0.19	0.42	0.15
	Text 1 S	10	0.59	0.19	0.65	0.12	0.65	0.06
	Text 2 A	10	0.48	0.17	0.31	0.1	0.56	0.14
	Text 2 S	8	0.58	0.19	0.65	0.12	0.67	0.11
Second pass fixation duration	Text 1 A	9	1.74	0.14	1.83	0.25	1.80	0.22
	Text 1 S	10	1.73	0.16	1.85	0.13	1.79	0.10
	Text 2 A	10	1.82	0.2	1.86	0.21	1.80	0.14
	Text 2 S	8	1.36	0.53	1.78	0.22	1.76	0.12

Note: Text 1 – narrative, Text 2 – expository; A – authentic condition, S – simplified condition

The next two subsections will describe the analysis of the effect of text simplification as measured by the two eye-tracking measures.

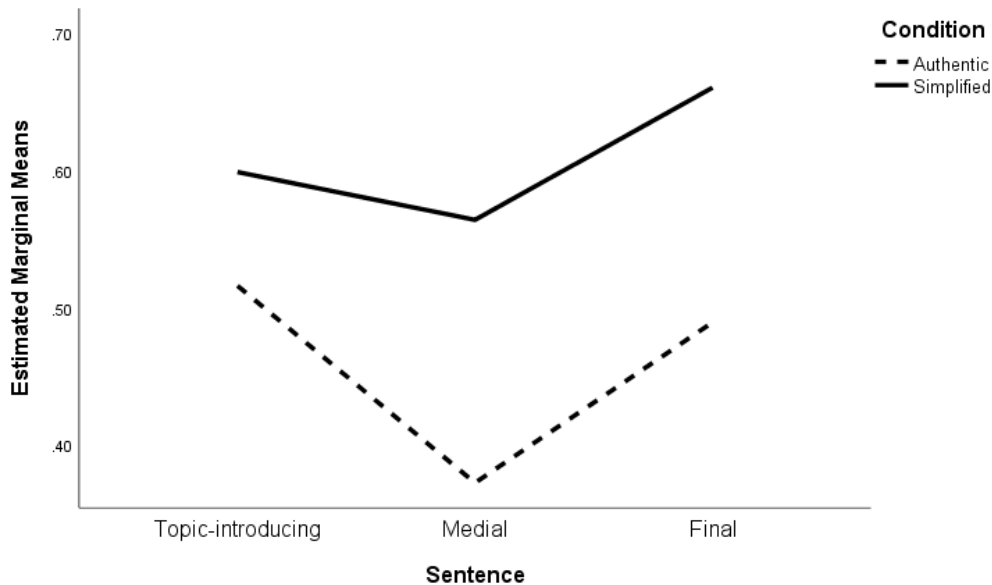
7.3.3.1.1. First pass fixation duration

3x2x2 Mixed ANCOVA analysis of the first pass fixation duration revealed no effect of sentence type on this eye-tracking measure, $F(2, 60) = 1.46, p = .24$. However, the results showed a main effect of condition (simplified vs. authentic texts), $F(1, 30) = 13.4, p = .001, \eta^2 = .32$ when controlling for language proficiency, background knowledge, and topic interest. Participants processed all three sentence types longer in the simplified condition when initially reading them as compared to their reading of the authentic texts. The graphical representation of the main effect of authentic and simplified texts across the three sentence types on first pass fixation duration is illustrated in Figure 20.

There were no main effects of any other variables used in the study: text organisational structure, $F(1, 30) = 0.89, p = .35$; language proficiency, $F(1, 30) = .01, p =$

.91; background knowledge, $F(1, 30) = .32, p = .58$; or topic interest, $F(1, 30) = .09, p = .77$ on first pass fixation duration.

Figure 20. Estimated marginal means for first pass fixation duration by condition



Covariates appearing in the model are evaluated at the following values: Language proficiency score = 16.24, Topic knowledge = 16.38, Topic interest = 30.59

As can be seen from Figure 20, first pass fixation duration was the shortest for topic-medial sentences in both the authentic and simplified conditions. Participants focused the most on topic-introducing sentences in the authentic condition, and – on topic-final sentences in the simplified condition. Figure 20 also shows that while the initial text processing was longer in the simplified condition, there was a smaller time difference in processing between the three types of sentences, as compared to the authentic condition. There was also a significant interaction effect between sentence type and text organisational structure, $F(2, 60) = 3.79, p = .028$. In the narrative texts, participants focused mostly on topic-introducing sentences, and in expository texts – on topic-final sentences.

Thus, in relation to first pass fixation duration, the analysis showed that text simplification induced different initial processing of the text. Participants processed all three sentence types significantly longer in the simplified condition. When comparing first pass fixation duration metrics across the two conditions, the data revealed that participants processed topic-introducing sentences most extensively in the authentic condition, and topic-final sentences – in the simplified condition, with medial sentences receiving the least

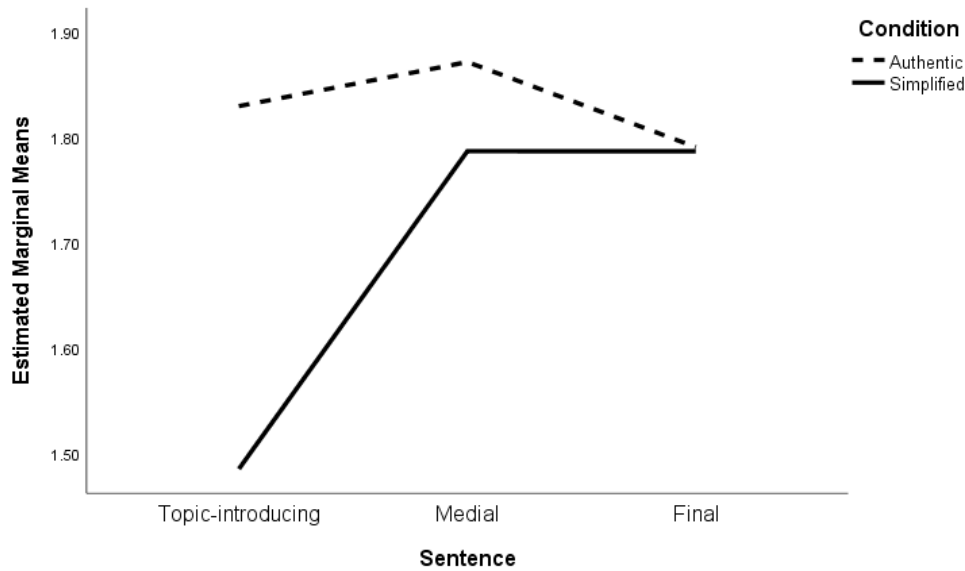
processing time in both conditions. Furthermore, the time difference in the processing of all three sentence types during the initial reading was reduced in the simplified condition. Since text organisational structure yielded interaction with sentence type, when accounting for this factor separately, the data showed that in the narrative texts, participants focused mostly on topic-introducing sentences, and in expository texts – on topic-final sentences.

7.3.3.1.2. Second pass fixation duration

Similarly to first pass fixation duration, 3x2x2 Mixed ANCOVA was used. The results of the analysis of the second pass fixation duration revealed no effect of sentence type, $F(2, 58) = .207, p = .81$, but revealed the main effect of condition (simplified vs. authentic texts) on second pass fixation duration, $F(1, 29) = 5.02, p = .033, \eta^2 = .15$. As can be seen in Table 43, simplified texts received shorter reinspection time in all three sentence types than the authentic texts. There was no main effect of text organisational structure, $F(1, 29) = 0.65, p = .43$, as well as no effect of background knowledge, $F(1, 29) = .84, p = .37$; or topic interest, $F(1, 29) = .03, p = .87$ on second pass fixation duration. However, unlike first pass fixation duration, language proficiency was found to have a significant effect on second pass fixation duration, $F(1, 29) = .6.94, p = .031$.

There was a significant interaction between sentence type and condition, $F(1, 58) = 9.46, p < .001, \eta^2 = .25$. Participants spent significantly less time re-reading topic-introducing sentences in the simplified texts and spent an equal amount of time re-reading medial and final sentences, as compared to the authentic texts. The interaction between condition and sentence type is demonstrated in Figure 21 below.

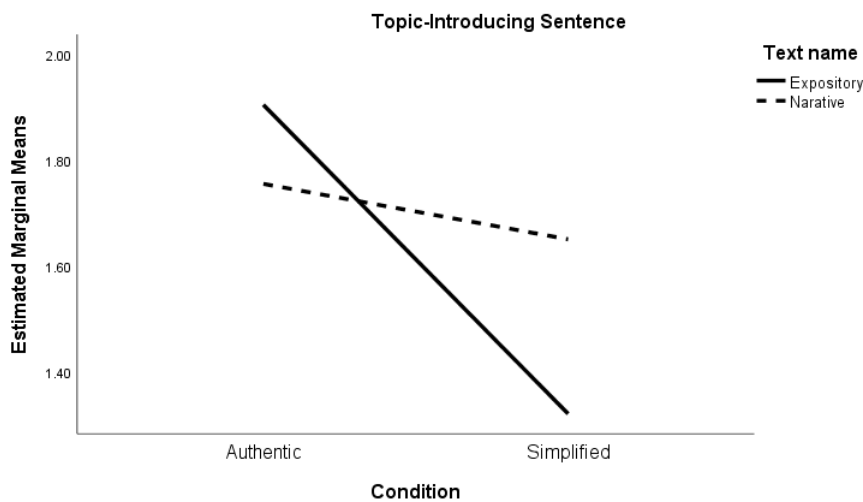
Figure 21. Estimated marginal means for second pass fixation duration by condition



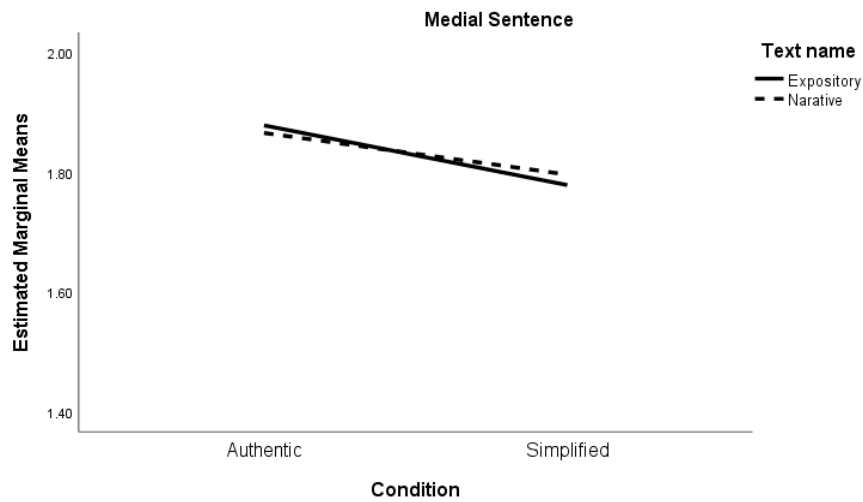
Covariates appearing in the model are evaluated at the following values: Language proficiency score = 16.11, Topic knowledge = 16.25, Topic interest = 30.31

Furthermore, there was a three-way interaction between sentence type, condition and text organisational structure, $F(2, 58) = 5.16, p = .009, \eta^2 = .15$. The three-way interaction is demonstrated in the Figure 22 below.

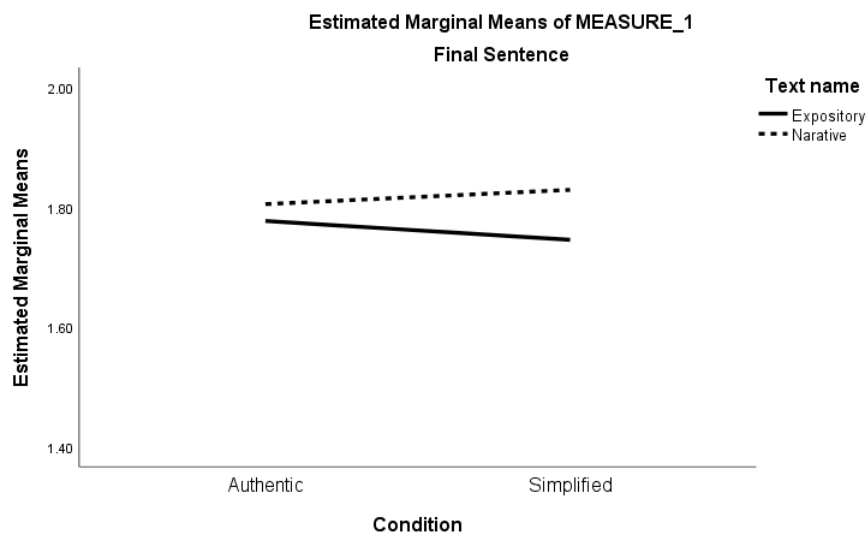
Figure 22. Three-way interaction between sentence type, text organisational structure, and condition



Covariates appearing in the model are evaluated at the following values: Language proficiency score = 16.11, Topic knowledge = 16.25, Topic interest = 30.31



Covariates appearing in the model are evaluated at the following values: Language proficiency score = 16.11, Topic knowledge = 16.25, Topic interest = 30.31



Covariates appearing in the model are evaluated at the following values: Language proficiency score = 16.11, Topic knowledge = 16.25, Topic interest = 30.31

As can be seen from Figure 22, all three sentence types received shorter reinspection times in the simplified condition for both narrative and expository texts. However, topic-introducing sentences received much shorter reinspection times in the simplified expository texts, as compared to simplified narrative or authentic texts, while this difference in reinspection times was less pronounced for the medial sentences. Second pass fixation duration was also shorter for the topic-final sentences in the simplified expository texts, as compared to the simplified narrative texts.

Furthermore, the analysis showed that there was a significant interaction between sentence type and language proficiency, $F(1, 58) = 6.37, p = .003, \eta^2 = .18$. To interpret this effect, the analysis was performed separately for higher and lower English language proficiency participants, using a mean split in language proficiency scores ($M = 16.24$),

similarly to the analysis of comprehension scores. ANCOVA (now only using background knowledge and topic interest as covariates) was used. The results showed that participants in the high English language proficiency group spent significantly less time re-reading the texts, as compared to participants in the lower English language proficiency group. Moreover, condition (simplified vs. authentic texts) only had a significant effect on second pass fixation duration in the high language proficiency group, $F(1, 10) = 17.75, p = .002, \eta^2 = .64$. Participants in the low proficiency group also spent less time re-inspecting the simplified texts, although this difference was not statistically significant from their reinspection times of the authentic texts, $F(1, 15) = .3, p = .87$.

To sum up, in relation to second pass fixation duration, the analysis showed that text simplification also induced different processing of the text. Participants spent less time re-reading simplified texts in all three sentence types in both expository and narrative texts. In contrast to their initial reading, where topic-medial sentences were viewed the shortest when re-reading the texts, participants spent more time re-reading the medial sentences in both conditions. However, in the simplified condition, participants focused on both medial and final sentences, and final sentences seemed to be particularly important in the narrative simplified text. In general, second pass fixation duration demonstrated higher sensitivity to individual and text factors than first pass fixation duration. One additional variable, language proficiency, had a main effect on this eye-tracking measure with text simplification having significance only in the high language proficiency group.

7.4. Study 4 Discussion

7.4.1. Implications of findings

Study 4 in this thesis examined the effect that simplification of OER reading materials has on text comprehension and text processing of non-native English readers from diverse language and educational backgrounds.

The first step undertaken in the analysis was concerned with exploring the relation between the different variables used in the study. The study showed there was intercorrelation between background knowledge and topic interest, between multiple-choice and text recall measures of text comprehension assessment, as well as between the different sentence types in the two eye-tracking measures used in this study. All three individual factors that this study controlled for correlated with some of the variables related to participants' text comprehension and text processing. First pass fixation duration

demonstrated positive relations with individual factors (background knowledge and topic interest), while second pass fixation duration correlated negatively with individual factors (language proficiency, topic interest). This finding supports earlier text simplification studies that urged to account for these factors when investigating the effect of text simplification (e.g., Crossley et al., 2014; Crossley & McNamara, 2016; see *Section 2.6.1*).

The second step undertaken in the analysis was concerned with exploring the effect that the simplification of narrative and expository texts had on text comprehension of non-native English readers when controlling for the individual factors. The analysis showed that across the sample, simplification mainly facilitated comprehension as measured by multiple-choice, while the narrativity of the text facilitated text recall. These findings are partly in line with the previous text simplification research, which showed that participants who read simplified texts scored significantly higher on multiple-choice comprehension tests (Long & Ross, 1993; Yano et al., 1994; Tweissi, 1998; and Oh, 2001) and on free recall (Crossley et al., 2014; Crossley & McNamara, 2016).

Study data showed that language proficiency had a significant effect on both multiple-choice and free recall scores, which is in line with the previous research (Oh, 2001; Crossley & McNamara, 2016). However, the results of some of the previous studies have been inconsistent concerning whether text simplification has a significant facilitative effect on low proficiency, high proficiency or both groups of non-native English readers (Oh, 2001; Crossley et al., 2014; Crossley & McNamara, 2016) (see *Section 2.6.1*). The further analysis which was conducted with high and low English proficiency groups separately showed that it was the low proficiency group that benefited the most from text simplification exhibiting significantly higher scores on multiple-choice comprehension test, higher scores on free recall for the narrative texts. The high proficiency group also had higher scores on simplified texts, but their scores were not significantly different from their reading of authentic and/or expository texts.

Finally, the third step undertaken in the analysis was concerned with the effect of text simplification on text processing as measured by first pass and second pass fixation duration. Since, to the best of my knowledge, there has been no previous study that used eye-tracking to explore the effect of text simplification, it was deemed difficult to hypothesise what kind of processing text simplification would induce. The interpretation of the findings in this study relied on the evidence from previous research that used eye-tracking to explore the effect of other types of text modifications (e.g., Hyönä & Lorch,

2004; Ariasi et al., 2017; Mason et al., 2013), as well as the language acquisition research on the effects of isolating manipulations of word length, frequency, word predictability and syntax on eye movements (e.g., Rayner, Li, Juhasz & Yan 2005; Cop et al., 2017; Howard, Liversedge & Benson, 2017; Conklin et al., 2018). The eye-tracking analysis in this study confirmed the facilitative effect of text simplification on participants' text processing. In line with Hyönä and Lorch (2004), this study found that topic-introducing sentences were processed longer during initial reading in the authentic texts, as these were the likely locations that imposed extra processing demand on participants. In the simplified condition, however, this study found a reduced time difference in the processing of topic-introducing, medial, and final sentences, and participants moved more smoothly through the simplified texts during the initial reading. Furthermore, this study found an extended overall processing time for final sentences in the simplified condition, when looking at both eye-tracking measures. The final sentences were the likely locations for the integration of the information participants read in the texts, and increased focus on this type of sentences has been interpreted as a facilitative effect of text modifications in a number of earlier studies (Hyönä & Lorch, 2004; Ariasi et al., 2017; Mason et al., 2013).

The results in this study showed that text simplification had a main effect on both first and second pass fixation duration. Text simplification slowed down processing for all three sentence types during the initial reading of the text and sped up processing during text reinspection. The finding in this study on slowing down in initial text processing in the simplified condition is not in line with Ariasi and colleagues (2017). The authors linked the facilitative effect of the text modification they investigated to speeding up, and thus, ease of text processing as measured by first pass fixation duration. In contrast, this study found speeding up of text processing during the reinspection of the text. Shorter look-backs in this study might indicate that participants had fewer comprehension difficulties they needed to resolve during the look-backs in the text (Conklin et al., 2018). Using the evidence from the model of deep and surface processing during reading (Marton & Säljö, 1976; Dinsmore & Alexander, 2016), another conclusion that can be drawn from this study is that text simplification induced a deeper-level text processing as compared to the reading of the authentic texts. The evidence from this study concerning participants focusing on the main themes in the text (topic-final sentences) and spending less time re-reading the simplified text indicates that text simplification facilitated internalisation of the text by the readers and helped direct their attention towards comprehending what the

author of the text had to say (Marton & Säljö, 1976). The earlier study of Catrysse and colleagues (2018) also found that the readers scoring higher on the depth of processing took less time for re-reading the text (for all sentence types). Taking into account the findings from the second step in the analysis of this study, which showed that comprehension and text retention scores were higher in the simplified condition, this study supports that text simplification facilitates effective text processing. At the same time, it is important to acknowledge that the findings in Catrysse and colleagues (2018) or Dinsmore and Alexander (2016) on deep/surface processing are based on questionnaires with participants. In Study 4, only eye movements, backed up by the evidence from those previous studies, were used to gain insights into the levels of processing. Given the little research in the area, as well as the fact that other variables could influence the eye movement patterns found in this study (Conklin et al., 2018), it is important to conduct further research on the topic to have a more solid understanding of the connection between eye movements and the levels of processing.

Another insight from this study is that language proficiency also played an important role in text processing. The data revealed both a main effect of language proficiency on second pass fixation duration and a significant interaction between sentence type and language proficiency in relation to this eye-tracking measure. When analysing second pass fixation duration separately for low and high English proficiency groups, the results demonstrated it was participants at high levels of English proficiency that spent significantly less time reinspecting the simplified texts than participants at low proficiency levels. This is in line with the eye-tracking research literature that reports that as language proficiency decreases, the fixation duration increases (Brunfaut & McCray, 2015; Conklin et al., 2018). Since the strength of the eye-tracking methodology lies in its functionality that allows to separate the initial reading of the text from later reprocessing efforts, our study further showed that language proficiency had a bigger influence on reinspection time than on the initial text processing duration.

Finally, the analysis revealed that text organisational structure had a main effect on text recall and had significant interactions with sentence type in both initial reading and text reinspection. Thus, as has been shown in this study, it is important to account for this factor when exploring the effect of text simplification, which has not been done in earlier studies (Long & Ross, 1993; Yano et al., 1994; Tweissi, 1998; Oh, 2001; Crossley et al., 2014; Crossley & McNamara, 2016).

7.4.2. Study limitations

This study intended to overcome the limitations of previous research on text simplification by controlling for individual factors, accounting for text organisational structure, using diverse methods of data collection, and multiple measures of text comprehension assessment. At the same time, this study also has some limitations. First, the group sizes in the study were relatively small. However, eye-tracking measures allowed a performance of analysis on the sentence level, which yielded more data points per participant for analysis. Therefore, it was possible to use the selected statistical analysis methods. Future research should aim to replicate the results of this study using a bigger sample to gain higher statistical power.

A second limitation concerns the length of the texts. They were shorter than the texts OER learners usually deal with when they study online. Future research should rely on longer reading materials. A third limitation concerns the eye-tracking data loss in this study. As described in Section 7.2.1, the data of 13 participants were discarded due to poor data quality. While data loss is a common issue in eye tracking studies (Holmqvist et al., 2011), the considerably high percentage of data loss in this study might be due to the specific eye-tracking equipment used, in particular in relation to its sampling rate (see Section 7.2.7.1). Future research should employ the eye-tracking equipment with a higher sampling rate for reading research (Conklin et al., 2018).

Furthermore, it would have been interesting to further analyse the association between text reinspection time, as measured by second pass fixation duration, and long-term retention of the information in the text. Participants in this study spent a significantly shorter amount of time re-reading the simplified texts. On the one hand, this suggests ease of processing, as participants had fewer comprehension difficulties they needed to resolve during the look-backs in the text. On the other hand, this also suggests deeper processing of the text, as it is the surface processing activities that are associated with re-reading parts of the text (Schellings et al., 2012; Dinsmore & Alexander, 2016; Catrysse et al., 2018). It has been shown that deeper text processing leads to greater information recall both in immediate recall and delayed recall tests (e.g., Loaiza, McCabe, Youngblood, Rose & Myerson, 2011), and this study showed that immediate free recall scores were higher for the simplified text (see Section 7.3.2). However, the text comprehension measures used in this study and eye-tracking in particular, do not provide insights into the 'quality' of the learning from the text (see Section 3.4.3). Since it was beyond the scope of the present

study to explore the effect of text simplification on learning from the text, a future study that adds a delayed post comprehension test might provide a further understanding of the effect of text simplification on learning.

In contrast to previous anecdotal work on the effects of text simplification on reading among non-native English readers, this study addressed the limitations of previous studies on text simplification and further deepened the knowledge and understanding of the benefits of text simplification. The results converge to show that text simplification leads to better text comprehension, reduces the processing difference between the different sentence types in the initial reading of the text, leads to shorter reinspection time of the text, and directs the readers' focus to the text's final sentences. Altogether, this chapter provided a comprehensive and complex picture of the impact of text simplification on text comprehension and text processing. The next chapter (Chapter 8), will outline the holistic discussion of the contributions made by this thesis to current knowledge, including implications for future work beyond this PhD.

8. General Discussion and Conclusions

The previous chapters described the relevant literature, methodologies, methods, and results of the research that comprised this thesis. Discussion in relation to the analysis, research questions, and a broader landscape of literature was included at the end of Chapters 4-7 that focused on each empirical study conducted in this thesis. This final chapter, Chapter 8, provides general conclusions and discussions related to the research questions and gaps in the literature. First, the Introduction section in this chapter (8.1) provides a summary of the overarching aims of this thesis. Section 8.2 then discusses the novel contributions to knowledge, as well as methodological and practical contributions of this research. Summary of the research limitations is provided in Section 8.3, followed by suggestions for future research related to the topics this thesis focused on (8.4) and concluding remarks (8.5).

8.1. Introduction

Open Educational Resources (OERs) aim to reduce educational inequality and decrease the cost of education, particularly in developing countries with the long-term goal of eradicating poverty in these regions (UNESCO, 2012; Nti, 2015; Casserly & DeBarger, 2020). The demonstrated ability of OERs to enable continuity of education in such situations as the global Covid-19 pandemic has further emphasised the need of robust research in this field (e.g., Bozkurt et al., 2020). Despite the stated intention of OERs to provide learning to all and some emerging success of facilitating learning at scale, OER courses, for the most part, are often only accessible to well-educated learners in English-speaking countries (e.g., Rodriguez et al., 2017). The predominant use of English as a Medium of Instruction (EMI) and the English language level in which these resources are written at present constitute the limiting factors for the use of OERs in developing countries, where the majority of learners who could potentially benefit from OERs are non-native English readers (e.g., Cobo, 2013). As outlined in Section 2.2, translation of OERs into the local languages or provision of OERs by local institutions is not deemed a suitable solution for the universal global use of OERs (e.g., Nti, 2015). While the use of EMI in OERs is consistent with the current trends and developments in education, a barrier to be addressed is the challenging language level of the OER course materials.

The language level of reading materials is associated with the notion of linguistic accessibility, which was the focus of this research. In this thesis, linguistic accessibility was

examined from the perspectives of text complexity, task difficulty and text difficulty (see *Figure 1 and Figure 6 for the representation of linguistic accessibility*) through the four empirical studies carried out as part of this research project. The aim of approaching this phenomenon from these three multiple perspectives was to obtain a more informed understanding of the linguistic accessibility of OERs in English.

While there has been research exploring how OERs can widen participation in (higher) education, there has been very little research on the linguistic accessibility of OERs. This research is limited to raising concerns about the extent to which OERs are accessible to non-native English readers. Studies on the topic of linguistic accessibility have so far focused on such resources as Wikipedia articles and online health educational materials (Jatowt & Tanaka, 2012; Kher et al., 2017; Xie et al., 2018). Thus, the empirical part of this thesis began with the aim to address this gap in the literature, problematise, and provide evidence on the language level of OERs by looking at the text complexity of these resources. This led to the first research question of the thesis:

RQ1: To what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

RQ1 was answered in Study 1. In this study, linguistic accessibility was approached from the perspective of text complexity, and the readability analysis was used to assess the extent to which OERs from the two major platforms – OpenLearn (2020) and Saylor (2020) – are accessible to non-native readers. The results showed that texts are often too complex for this audience of learners. A question that followed from the evidence produced by Study 1 was how better linguistic accessibility of OERs could be achieved. Open education research to date has not yet addressed this issue. At the same time, since EMI and OER learners are reported to experience similar challenges in terms of access to the learning content (e.g., Knyazeva, 2010; Chapple, 2015), a solution evaluated in this thesis to address the language barrier issue was drawn from the EMI literature (e.g., Galloway et al., 2017; Uchiyara & Harada, 2018). Text simplification has the potential to improve the linguistic accessibility of educational materials to non-native English readers (Tomlinson & Masuhara, 2017). While this solution is recommended in the research literature, there is still an ongoing debate about the benefits of text simplification for non-native English readers. A possible reason why this debate has not been resolved might be the inconsistent

evidence between the different studies on the effect of text simplification on readers, as well as the limitations of the existing text simplification research. One such limitation includes assessing the effect of text simplification by using only one measure of text comprehension – mainly quizzing participants on the text (i.e., assessing the ‘product of reading’). RQ2 aimed to overcome this limitation and obtain initial evidence on the presence or absence of the facilitative effect of text simplification on non-native English readers:

RQ2: What is the effect of text simplification on text processing, as evidenced in the frequency of use of cognitive processing strategies by non-native English readers?

RQ2 was answered in Study 2. In this study, linguistic accessibility was approached from the perspective of text difficulty, as this study was concerned with the interaction between the reader and the text. Since the results of the study suggested that text simplification might, indeed, be a suitable solution to overcome the language barrier faced when learning from the OERs in English, Study 2 lay ground for further conceptualisation and evaluation of this solution in this thesis.

Intuitive simplification performed by teachers is currently the most common type of text simplification aimed at non-native English readers (Crossley et al., 2012). However, an in-depth analysis of how an expert population, such as English teachers, simplifies texts, and the rationale for the changes they make in simplification is limited. Furthermore, while OERs are aimed at a global and diverse learning audience, particularly in terms of having different mother tongues, another gap concerns the investigation of whether teachers with different language backgrounds approach text simplification differently. As to the best of my knowledge, no previous study explored the association between language background and teachers’ choice of simplification strategies, opposing hypotheses could be derived regarding the potential impact of this factor on text simplification practice. Given the lack of research on this topic, in this thesis this issue was addressed by exploring the perception of participating language teachers on the effect of their mother tongue on the approaches they took to simplify OER texts. With this problem in mind, the third subset of research questions addressed in this thesis was:

RQ3: What approaches and strategies to text simplification do English teachers employ when intuitively simplifying OER texts for lower-level proficiency non-native English readers?

- *RQ3a:* Does the mother tongue have an effect on the choice of text simplification strategies, as perceived by English teachers?

RQ3 and RQ3a in this thesis were answered in Study 3. In this study, linguistic accessibility was approached from the perspective of task difficulty, as it was concerned specifically with the approaches to the text that English teachers took most often in a text simplification task. While Study 3 elicited shared understanding among English teachers concerning how to simplify an OER text, it cannot be implied that these strategies are effective or optimal for non-native English readers with different language backgrounds. Furthermore, the identified divide in participating English teachers' attitudes towards text simplification echoed the debate in the research literature concerning the potential benefits and drawbacks of this practice (*see Section 2.6*).

Besides the limitation of measuring the effect of text simplification using predominantly one type of assessment discussed above, other limitations of the existing text simplification research include not accounting for individual and text factors that influence the reader's engagement with the text, and ignoring the OER context, despite the calls for more accessible OERs. These limitations and the fact that the simplification performed in Study 2 was based on the recommendations in the text complexity literature rather than on the evidence-based simplification strategies employed by English teachers lay ground for the work conducted in Study 4. RQ4 in this thesis, thus, focused on evaluating the effect of text simplification further and testing the simplification strategies elicited in Study 3:

RQ4: What is the effect of text simplification on text comprehension and text processing among non-native English readers when English proficiency, background knowledge, and topic interest are controlled?

RQ4 was answered in Study 4. Similarly to Study 2, linguistic accessibility in Study 4 was approached from the perspective of text difficulty, as this study also focused on the real-time non-native English readers' response to the text.

With these questions and gaps in mind, the contribution of this thesis to theoretical knowledge can be summarised as:

- Evidence that OER course materials at different educational levels and subject categories in the present form might not be accessible to non-native English readers at lower levels of English proficiency (Chapter 4);
- A taxonomy of OER text simplification strategies by breaking down what English teachers conceptualise as a more accessible OER text in English (Chapter 6);
- The robust empirical evidence on the effect of text simplification on non-native English readers supporting the potential use of this practice to increase access to OERs globally (Chapter 5 and Chapter 7);
- A more nuanced understanding of the role that text-related factors play in the understanding and processing of the text (Chapter 5 and Chapter 7).

Furthermore, the mixed methods research design used in this thesis contributes several innovations to the readability analysis, eye-tracking, and post-reading comprehension testing methodologies. The results of this thesis also have practical implications for practitioners working in the fields of open education and EMI, as well as in the contexts of use of text simplification. These theoretical, methodological, and practical contributions are discussed in detail in Section 8.2 next.

8.2. Contributions of this thesis

8.2.1. Contributions to knowledge

This section first presents key findings as bullet points and then provides an extended summary of how these results were generated and how they relate to other literature.

Text complexity of OERs

RQ1: To what extent are OERs across the educational levels and subjects offered on major platforms accessible, in terms of their text complexity, to non-native English readers?

- Course reading materials at different educational levels and subject categories sampled from two major OER platforms mostly correspond to advanced English language proficiency.
- The progression of complexity between the courses at different educational levels was not clearly observed on either OER platform.
- The variables that showed statistically significant differences in readability between some educational levels on both platforms mainly concern the measures of word and sentence length, as well as the amount of elementary lexis.
- Cohesion measures demonstrated very low values among all educational levels on both OER platforms, which further contributes to the low accessibility of the OERs.
- The subject matter did not appear to be linked to the readability of the courses.

RQ1 was addressed in Study 1, using the readability analysis methodology. Previous research has shown that OER learners, who are non-native English readers, experience difficulties understanding OERs in English (e.g., Knyazeva, 2010; Banzato, 2012; Huang et al., 2012). Study 1 provided empirical support for these claims by demonstrating that a selection of 200 items of course materials sampled from two major OER platforms might not be accessible to non-native English readers, particularly if these OER learners have low English language proficiency. Furthermore, although the courses at the lowest educational levels (Level 1 in OpenLearn, and Level 0 in Saylor) had the highest readability among the given levels, this research yielded no systematic differences in text complexity across the different educational levels of the OERs. This is in contrast to the initial systematic complexification assumption (Berendes et al., 2018), in line with which it was expected that the readability of materials would decrease, as the educational levels become more advanced.

The variables that consistently showed statistically significant differences between the educational levels with lower and higher text complexity levels were the measures of word and sentence length, as well as word frequency (proportion of elementary lexis). This finding supports the large body of research, which showed that surface-level text features, mainly vocabulary and sentence length, are the biggest contributors to text complexity (Berendes et al., 2018; Harrison, 1980; Maslin, 2007; Brysbaert et al., 2020). A more recent trend in text complexity research is to include text's cohesion features into the analysis, which was done in this thesis, as it was shown previously that low text cohesion increases

the difficulty of the text (e.g., McNamara, 2001; Reed & Kershaw-Herrera, 2016). The findings in this thesis concerning very low proportions of logical connectives in OER texts once again demonstrated the potential inaccessibility of OERs even on the introductory educational levels to non-native English readers who experience the language barrier.

RQ1 in Study 1 was also concerned with the association between the subject matter of the OERs and their text complexity. Having triangulated the data from two types of analysis: comparison of means of the readability metrics for the OER subject labels and cluster analyses, it was concluded that subject matter does not appear to be linked with the text complexity of the course materials. This is partly in line with Jatowt and Tanaka (2012), whose analysis did not yield systematic differences in readability between different Wikipedia subject categories either. However, in contrast to the study of Jatowt and Tanaka (2012), who found that texts in the computing category had the highest readability, this research showed that the cluster with the lowest text complexity level texts had fewer STEM and Money & Business courses.

While the answers to RQ1 provided empirical evidence for a gap between many potential OER learners' language abilities and OERs that are expected to enable inclusive education, the next research question focused on piloting the potential solution to making OERs more linguistically accessible.

Text difficulty and initial non-native English readers' response to text simplification

RQ2: What is the effect of text simplification on text processing, as evidenced in the frequency of use of cognitive processing strategies by non-native English readers?

Text processing

- Text simplification facilitates situational interest, as evidenced in increased emotional resonance to simplified texts.
- Processing strategies that refer to English learning were not used in text simplification.
- Non-native English readers at lower levels of proficiency rely more on lower-level processing strategies across the conditions.
- Text simplification facilitates higher-level processing of the text.

In light of very limited research evidence concerning the effect of simplification on text processing, as part of exploratory mixed methods design Study 2 served the purpose of a pilot study and used a qualitative data collection methodology and a smaller sample. Analysis of text processing in this study was informed by the model of reading (Khalifa & Weir, 2009) and automatic information processing theory (LaBerge & Samuels, 1974). In Study 2, the deductive coding scheme adopted from Khalifa and Weir's model of reading (2009) was extended with three novel processing strategies: 'emotional resonance', 'mother tongue interference', and 'English learning' (see Table 32). While the use of the 'mother tongue' strategy was found to be largely similar between the conditions, the analysis demonstrated differences in the use of the other two strategies. On the one hand, Study 2 suggested that text simplification facilitated situational interest towards the contents of the text. This was evidenced in the increased use of the 'emotional resonance' strategy, as part of which participants referred to the instances where they felt surprised or were able to learn a new fact from the text. Since situational interest was shown to have a positive influence on text comprehension (Schiefele, 2009; Catrysse et al., 2018), increased emotional resonance during reading can be considered as a facilitative effect of text simplification. Thus, the evidence from this study can further inform the current discussion about the advantages and disadvantages of this practice on non-native English readers (see Table 1). On the other hand, however, the study showed that participants used the 'English learning' strategy only with the authentic texts. Lower lexical diversity of the simplified texts might not give the readers the full exposure to the diversity of lexis and grammar that can be found in a given language. Similar reservations have been expressed in the literature on text simplification in the language acquisition contexts (e.g., Yano et al., 1994).

Study 2 in this thesis, which had participants at lower levels of English proficiency, also showed that overall, across the conditions (authentic vs. simplified text), the most used cognitive strategies corresponded to lower-level processing: lexical access, syntactic parsing and establishing propositional meaning. This is in line with the earlier studies informed by Khalifa and Weir's model (2009), which showed that participants at lower levels of proficiency use lower-level processing strategies more frequently than participants at higher levels of proficiency.

A novel contribution of Study 2 is the evidence that despite relying on lower-level processing, comparison of the frequency of use of different strategies between the

conditions in Study 2 suggested that text simplification facilitated higher-level processing. Participants used higher-level processing strategies, such as ‘inferencing’ and ‘building a mental model’ more frequently in the simplified texts than in the authentic texts. Since participants’ working memory was taken up by lower-level processing to a lesser extent in simplification, they might have had more capacity to use higher-level processing in the simplified texts (LaBerge & Samuel, 1974).

The answer to RQ2 provided emerging evidence that text simplification can have a facilitative effect on text processing of non-native English readers. The third research question in this thesis focused on the procedure of text simplification and eliciting approaches that English teachers take to improve the linguistic accessibility of OERs to non-native English readers.

Task difficulty and teachers’ approaches to text simplification

RQ3: What approaches and strategies to text simplification do English teachers employ when intuitively simplifying OER texts for lower-level proficiency non-native English readers?

- **RQ3a:** Does the mother tongue have an effect on the choice of text simplification strategies, as perceived by English teachers?
- There is a shared understanding among English teachers as to what makes a text more accessible to non-native English readers at lower levels of proficiency.
- There were 16 common strategies that English teachers took to simplify an OER text.
- The most frequently used strategies concern modifying surface-level text features, the least frequently used strategies were modifying text’s cohesion.
- Text simplification seems more affected by teachers’ attitudes to this practice than by their language background.

RQ3 and RQ3a were addressed in Study 3 using an online text simplification task and interviews with 24 experienced English teachers from diverse language backgrounds. Although the task instructions allowed participants to make the kind and amount of modifications in the authentic texts they felt were important, the study elicited the shared understanding among the teachers as to what makes a text more accessible to non-native

English readers at lower levels of proficiency. In the study, 16 strategies were identified that were categorised into three general approaches to text simplification – surface-level, content, and cohesion modifications.

Study 3 provided the evidence that most modifications made by teachers to the authentic texts concerned surface-level text features, with changing the word frequency being the most popular strategy to OER text simplification across the sample. This finding is in line with the evidence from Study 1, which showed that surface-level text features contributed the most to the differentiation between the educational levels of the OERs in term of the latter's text complexity. This finding is also in line with other studies conducted with EMI subject teachers (Glass & Oliveira, 2014; Basturkmen & Shackleford, 2015), the study of Young (1999) with language teachers, and vocabulary studies with English learners (e.g., Schmitt et al., 2011; Nation, 2015; Schmitt et al., 2017).

Although making cohesion modifications was used the least across the sample, the study showed that participants were aware of these strategies and employed them when simplifying the OERs. This is in line with text complexity and text difficulty studies that urge the researchers to account for text cohesion when investigating linguistic accessibility (e.g., McNamara, 2001; Reed & Kershaw-Herrera, 2016; Xia et al., 2016). This corroborating evidence between this study and other studies on text complexity, task difficulty, and text difficulty indicates that teachers, indeed, represent an expert population who has the necessary skills to increase the linguistic accessibility of reading materials.

In light of very limited amount of previous research conducted with teachers on this topic, the deductive coding scheme in this study was adopted from text complexity research and from Study 1 (*see Table 37*), which was also used to simplify the OER texts in Study 2 (*see Table 28*). While individual elicited strategies were identified in previous studies, such as 'cut information' (Green & Hawkey, 2012), 'add clarification' (Oh, 2001), other strategies had to be added to the deductive coding scheme used in Study 3 (*see Table 37*). Thus, some strategies identified in Study 3 are novel (e.g., 'compress meaning', 'add emotional emphasiser', 'add time reference', or 'change order of ideas') and have not been highlighted in previous research on the linguistic accessibility of educational materials.

Another contribution of this research is the investigation of the perceived effect of teachers' mother tongue on their text simplification practice. Previous research has been carried out in single settings and, thus, has not investigated the use of simplification strategies across teachers who have different language backgrounds. The analysis of

qualitative data performed in this study to answer RQ3a suggested that the factor that appeared to have a bigger influence on this practice than the language background was teachers' attitudes to text simplification, and particularly the extent to which they were supportive of this practice. This was reflected in the different number of modifications made by different teachers. The biggest divide in their opinions concerned the value they assigned to the literary merit of the authentic text, which was irrespective of their language background. Teachers with fewer modifications referred to the authentic text as an ideal language sample, the aesthetic merits of which should not be interfered with. Teachers with a greater number of modifications attached more importance to the linguistic needs of their learners and saw the authentic text as the source that should comply with their teaching aims. This debate about the value of text simplification, as well as other advantages and disadvantages drawn by participants in this study (comprehension value, learners' self-confidence, information loss, narrow learning) are in line with the text simplification literature (*see Table 1*). The novel contribution of this study is the elicitation of the additional insights that shape teachers' attitudes towards text simplification. This includes teachers' fear of introducing language inaccuracies in simplification in their intention to take on the role of English native speakers for their learners. Another insight concerns the criticism of the dominant communicative approach to language teaching, which, according to some participants of this study, does not prepare non-native English readers for efficient academic text comprehension.

While the answers to RQ3 and RQ3a conceptualised the approaches to achieving better linguistic accessibility of OERs globally, the final research question evaluated the effect of these approaches on non-native English readers with diverse language backgrounds.

Text difficulty and the effect of text simplification on text processing and text comprehension

RQ4: What is the effect of text simplification on text comprehension and text processing among non-native English readers when English proficiency, background knowledge, and topic interest are controlled?

Text processing	<ul style="list-style-type: none"> • Text simplification facilitates deep processing of the text.
Text comprehension	<ul style="list-style-type: none"> • Text simplification facilitates better text comprehension. • Low-proficiency non-native English readers benefit from text simplification more than high-proficiency readers in terms of impact on their text comprehension. • Narrativity of the text has a greater impact on text recall than text simplification.
Effect of individual factors	<ul style="list-style-type: none"> • Processing during initial reading correlates positively with background knowledge and topic interest; processing during re-reading correlates negatively with language proficiency and topic interest. Text recall correlates positively with language proficiency.

RQ4 was addressed in Study 4 with 37 non-native English readers using eye-tracking and comprehension assessment methodologies. Study 4 obtained converging evidence on the effect of text processing to the evidence obtained in Study 2. Although underpinned by different theories, higher-level processing has some overlapping elements with deep processing: both types are linked to the reader connecting the text to their personal experiences and focusing on the main themes in the text. Study 4 showed that participants overall focused on the topic-final sentences in the simplified texts, which are the likely locations for the integration of the text's information, and spent less time re-reading the simplified texts. Thus, the emerging evidence both from Study 2 and Study 4 suggested that text simplification induces a different kind of processing and facilitates higher-level and deep processing.

Analysis of the effect of simplification on text comprehension showed that across the sample, the scores for both multiple-choice and text recall were higher for the simplified texts, with a significant main effect of simplification on multiple-choice comprehension when controlling for language proficiency, background knowledge, and topic interest. This is in line with previous research which showed that text simplification generally facilitates comprehension of the text (Long & Ross, 1993; Tickoo, 1993; Yano et al., 1994; Tweissi, 1998; Oh, 2001; Crossley et al., 2012; Crossley et al., 2014; Crossley & McNamara, 2016). Furthermore, as there has been inconsistent previous empirical evidence on the association between language proficiency, simplification and text comprehension (e.g., Oh, 2001; Crossley et al., 2014; Crossley & McNamara, 2016), this study showed that the effect of simplification remained significant on comprehension through both multiple-choice and text recall only for participants at lower English proficiency level. As there is very limited research that looked at both the effect of text

simplification and text organisational structure (narrativity vs. exposition) on text comprehension, another novel finding of this study is that across the sample narrativity had a bigger impact on text retention than text simplification. This is in line with some earlier studies that showed that narrative texts are better retained in memory than expository or descriptive texts, as they are more cohesively organised by causal relationships, whereas exposition is organised more loosely (Sáenz & Fuchs, 2002; Kraal et al., 2018).

Finally, a correlation analysis performed in Study 4 showed that individual factors have an impact on both text processing and text comprehension. In the study, processing during initial reading correlated positively with background knowledge and topic interest; processing during re-reading correlated negatively with language proficiency and topic interest. Text recall correlated positively with language proficiency. This finding provides additional supporting evidence on the importance of controlling for these individual factors when exploring the effect of text simplification, as has also been stressed by more recent text simplification research (Crossley et al., 2014; Crossley & McNamara, 2016).

8.2.2. Methodological contributions

In addition to contributing to current knowledge about open education, linguistic accessibility, and text simplification, this research has also made several methodological contributions worth noting.

First, the findings of the readability analysis conducted in Study 1 suggested that there is potential value in using such online readability tools as Textinspector (2020) to identify problematic OER courses and those that are a good match for non-native English readers at different proficiency levels. In this research, the analysis of the output from Textinspector on the proportion of the scorecards that correspond to advanced proficiency levels, the readability level of the texts, and the proportion of logical connectives provided converging evidence that OERs might not be accessible to non-native English readers at lower levels of proficiency. Thus, while the use of such advanced readability tools is a relatively recent trend in text complexity research (e.g., Xia et al., 2016), this research showed that using a greater repertoire of text features, which is enabled by the tool, can help achieve a more nuanced understanding of the complexity level of a given text.

Secondly, some additional insights can be derived from this thesis for the eye-tracking methodology. One such contribution concerns the supporting evidence from this

research on the importance of using multiple eye-tracking measures that do not overlap in their temporal properties (Ariasi et al., 2017; Catrysse et al., 2018; Godfroid, 2019). The analysis of the first and second pass fixation duration showed that text simplification affects the initial reading and text reinspection differently. This allowed to obtain a more nuanced and time-sensitive account of how non-native English readers respond to simplified texts, which in turn constitutes a novel contribution to theoretical knowledge. Furthermore, this research also showed that text reinspection was more affected by individual factors than the initial reading of the text. This evidence can further inform research on text processing during reading (e.g., Khalifa & Weir, 2009; Crossley et al., 2014; Crossley & McNamara, 2016) and shed more light on the role that such factors as language proficiency or topic interest play in how much time the reader takes to revisit the text, and the parts of the text they pay attention to.

Another contribution to the eye-tracking methodology that can be derived from this thesis concerns the importance of adopting a mixed methods research design when conducting eye-tracking research. To exemplify, the quantitative analysis of the eye-tracking data in Study 4 revealed an extended processing time for topic-final sentences in simplification across the sample. This finding would be uninformative per se if it was not underpinned by theoretical assumptions (focusing on the main themes in the text as an indicator of deep processing, Dinsmore & Alexander, 2016) and corroborating evidence from stimulated recall interviews (increase in higher-level processing in simplification) and comprehension testing (higher comprehension scores in simplification). This is in line with the methodological literature on eye-tracking, which emphasised that it might be difficult to make meaningful inferences from the eye-tracking data unless these data are interpreted within an established framework (Conklin et al., 2018)

The final methodological contribution of this thesis is the evidence of the value of using multiple measures of comprehension assessment. In Study 4, comprehension measured by multiple-choice and by free recall provided converging evidence that text simplification facilitates text comprehension. Furthermore, each of these assessment measures has its weaknesses: participants' random guessing of the answers and threats to construct validity in multiple-choice vs. participants' memory and language abilities and subjective scoring of participants' answers in free recall (e.g., Chang, 2006; Downing, 2006; Mckee, 2012). Methods triangulation performed in this research allowed to offset the

weaknesses inherent to using each of these measures and obtain a more validated comprehensive account of the effect of simplification on text comprehension.

In summary, this research highlighted the value of adopting a mixed methods research design, which helped obtain a nuanced, validated, and well-rounded understanding of the problem, when researching such complex phenomena as linguistic accessibility.

8.2.3. Contributions to practice

The findings outlined in this thesis have practical implications for OER educators and material writers. Although the work outlined in this thesis focused specifically on open education, it is recognised that many of these suggestions are applicable to other contexts as well, such as EMI in HE.

First, this research makes a case for raising the awareness of OER educators about the current complexity level of English language OERs, and about the gap between many potential OER learners' language abilities and the learning materials that purportedly enable inclusive education. Despite the evidence from a number of studies concerning the language barrier experienced with OERs (Knyazeva, 2010; Banzato, 2012; Cobo, 2013; Huang et al., 2012), and the policy recommendations on making OER more customisable to learners (e.g., UNESCO, 2015; William and Flora Hewlett Foundation, 2020), linguistic accessibility in open education has not been addressed. The important practical implication from this research is to encourage OER material writers to check the text complexity level of their materials prior to publication using such online readability tools as Textinspector (2020), as well as to collaborate with language experts when editing or simplifying the OERs.

Furthermore, as this research found no clear progression of complexity between the courses at different educational levels, the implication of this finding is to urge OER material writers to pay greater attention to the meaning of current groupings of OERs into levels on OER platforms. This, in turn, can help OER learners make more informed choices about the OER courses they sign up for.

The areas of inquiry that inform open education practices, such as research on accessibility and widening participation, have also focused little on non-native English readers. However, these fields started to experience a shift from the 'deficit mindset', where students are expected to learn to overcome the disadvantages they have, to

focusing on the systemic problems in how HE institutions approach learning (Bateson et al., 2018). Text simplification, evaluated in this thesis as a potential solution to increasing linguistic accessibility of OERs, is in line with this paradigm shift. In text simplification, the language level is not framed as a deficit of the learners, but as the deficit of how materials are designed for learning. One key contribution of this thesis is the formulation and evaluation of the guidelines for text simplification that can be applied to the design of OER materials. The text simplification guidelines put together in this research can be summarised to points below, each point is illustrated with one or two simplification examples:

Where possible:

1. Choose vocabulary that has more common usage in English.

E.g., replace *'kin'* with *'family'*, *'unmistakable'* with *'correct'*

2. Use shorter sentences and paragraphs.

E.g., split long sentences and paragraphs

3. Put a clear agent into the focus of each sentence in the text.

E.g., change *'it appears that these people'* to *'these people appear...'*;

'advice is available in the office' to *'you can get advice from the office'*

4. Avoid noun clusters, use more verbs in the text.

E.g., change *'we had a discussion'* to *'we discussed'*;

'long sea journey' to *'long journey at sea'*

5. Use concise structures, remove unnecessary redundancy, and repetition.

E.g., change *'act where the law permits'* to *'act within the law'*;

'before you start needing...' to *'before you need...'*

6. Elaborate on the points in the text, which are stated implicitly, and which are essential for the meaning-making of the text.

E.g., change *'social work service-user'* to *'person in need of social services'*

7. Add words with emotional connotations and time references to help the reader relate to the text.

E.g., change *'died disillusioned'* to *'died with great disappointment'*;

'vitamins are still called...' to *'these days vitamins are still called...'*

8. Add logical connectives and links between sentences.

E.g., change *'I will read the literature and prepare the draft'* to *'First, I will read the literature. Then I will prepare the draft'*.

9. Resolve references in the text by replacing pronouns with the corresponding nouns.

E.g., change *'those at sea'* to *'sailors'*

10. Reposition parts of the sentence in a way that clarifies the logical development of the text for the reader.

E.g., change *'although he tried to... he was unable to do so'* to *'he was unsuccessful in... although he tried'*.

In terms of applicability of these guidelines to readers across language backgrounds, this research showed that the mother tongue has little perceived effect on English teachers' choice of simplification strategies. This research also showed that simplified texts had a positive effect on text comprehension and processing of a diverse sample of non-native English readers. This practice improved their comprehension of the text and directed their focus to the sentences that were likely to summarise and wrap up the information in the text. These findings imply that the simplification strategies in the guidelines do not seem to be language-specific and can potentially cater to OER learners from diverse language backgrounds. This translingual nature of text simplification is one key advantage of this approach over other solutions described in those OER studies that target the language barrier, such as translation of OERs into local languages (e.g., Hodgkinson-Williams & Paskevicius, 2012; Nti, 2015). The latter would only allow the customisation of OERs to specific national or language contexts.

Besides OER material designers, the text simplification guidelines developed in this research can be of use to educators working in the EMI context. Similarly to OER learners, it has been documented that EMI learners also often lack adequate proficiency in English and struggle with materials comprehension (e.g., Chapple, 2015; Floris, 2014; Uchihara & Harada, 2018; Thompson et al., 2019). A need has been voiced to develop a set of pedagogical strategies to facilitate EMI learners' comprehension of the course content (Uchihara & Harada, 2018; Macaro et al., 2019), as well as a need to equip EMI educators with strategies for effective EMI course implementation (Farrell, 2020; Yuan, 2020). It is hoped that the findings of this research will lead to opportunities for professional development among EMI educators and suggest ways of how they could enhance materials comprehension for their learners in the classroom.

The text simplification guidelines were formulated in this research by involving English teachers into self-report and reflection. It is also possible that EMI educators themselves could draw on the methods of this research. They could record their own teaching and observe the strategies (or lack thereof) they take to help their learners understand the learning content. This might enable the development of the kind of 'self-

awareness, self-discovery, and personal internalisation', which would lead to a greater teaching efficiency (Basturkmen & Shackleford, 2015, p. 95).

The final implication of this research concerns the professional development of early-career language teachers. This research involved experienced English teachers in the research investigation and encouraged them to reflect on their own teaching practices. The results of this research can potentially strengthen early career teachers in enhancing their own practice by increasing their awareness of the simplification strategies teachers with extensive experience use implicitly.

8.3. Research limitations

This research adopted a rigorous mixed methods design to investigate the linguistic accessibility of OERs, formulate the guidelines for effective text simplification and evaluate the effect of this practice on text comprehension and text processing among non-native English readers. Multiple steps were taken to ensure the rigour, validity, trustworthiness, and legitimation of the research. Nevertheless, there remained several overarching limitations to the research contained within this thesis that should be addressed in future research.

The first limitation concerns the fact that some strategies applied to simplify the texts in Study 2 and Study 4 were different. It was important for the research design of this thesis that Study 2 preceded Study 3 and Study 4 to obtain some initial evidence on the presence or absence of the facilitative effect of text simplification, as well as to pilot the research setup for the subsequent Study 4. Although, Study 2 and Study 4 provided converging evidence on text simplification facilitating higher-level and deep processing, future research may wish to conduct eye-tracking stimulating recalls with the texts simplified according to the text simplification guideline collated in this thesis.

The second limitation concerns the fact that the text simplification guidelines developed in this research consist of a diverse range of simplification strategies that were applied to the OER texts simultaneously. On the one hand, this diversity reflects the complexity of the notion of linguistic accessibility, which goes far beyond surface-level text features and requires more than structural simplification (Xia et al., 2016; Long, 2020). On the other hand, however, it is difficult to conclude which particular adaptations in this research produced the facilitative effect on participants' text comprehension and text processing. Future research, where possible, should test the effect of each strategy in

isolation to understand what strategy and amount of simplification would be most beneficial to non-native English readers.

The third limitation concerns the generalisability of the findings from this research to other practices beyond the OER and EMI contexts that involve non-native English readers. Study 2 in this thesis showed that simplified texts did not encourage language learning among participants, in contrast to the authentic texts. Study 3 further elicited an opinion divide among English teachers on the advantages and disadvantages of text simplification, which is also in line with the current discussions about this practice in the literature (e.g., Tickoo, 1993; Tomlinson & Masuhara, 2017). These results corroborate the findings of text simplification studies with EMI educators, which showed that the key motivation for EMI educators to simplify texts was to facilitate content comprehension and information recall, rather than to promote acquisition of the scientific vocabulary among learners (Glass & Oliveira, 2014). The text simplification guidelines developed in this research, thus, might not be applicable in the contexts that focus on language acquisition, such as EFL learning or CLIL. Future research should investigate in more depth the effect of text simplification on language acquisition to avoid any detrimental effects this practice might have on language learning.

This research also showed that English teachers refer to the amount of time it takes to simplify a text as a disadvantage of this practice. The current automatic text simplifiers, which can speed up the adaptation of textual material, are capable of performing only some surface-level simplifications, such as changing the word frequency, splitting sentences, or converting passive into active (e.g., Ferrés et al., 2016). However, many simplification strategies elicited in this research that concern content and cohesion modifications would still require manual hand-crafted simplification. Strategies that involve highlighting the logical development of the text, making implicit information explicit, or removing redundancy depend on the inferences that the person who performs simplification makes from the text and their understanding of the text's topic. Furthermore, some simplification strategies in the elicited guidelines (e.g., 'Put a clear agent into the focus of each sentence') require understanding of the language rules and some basic knowledge of linguistics from the person who performs text simplification. Thus, as stressed in Section 8.2.3, it is essential for OER material writers and editors to cooperate with language experts when simplifying OERs.

Finally, although in this thesis the elicitation of text simplification strategies and the evaluation of their effect on non-native English readers was done using multiple texts on different topics and with different organisational structure (narrative vs. expository), no two texts can be identical. Thus, the proportion of use of different text simplification strategies will vary between the different texts. For the reasons mentioned above, preparing an alternative simplified version of reading materials would require much additional work on the part of OER platforms. Future research on natural language processing should look into ways of automating these strategies, which would make the process of simplification less time-consuming and increase the capacity of simplification to help more learners access the learning content.

8.4. Future directions for research

There are a number of directions that future research could take to extend the work outlined in this thesis. Study 2 suggested that text simplification facilitates higher-level text processing. Study 3 provided some emerging evidence that the language background has little perceived effect on the teachers' choice of text simplification strategies. A quantitative analysis of the frequency of use of different strategies elicited in the content analyses was not possible in these studies due to the small sample size and data distribution. Thus, besides the directions for further research outlined in the previous section (8.3), future work may also wish to use inferential statistics to obtain further evidence on the claims made in these studies.

Another direction for future research is to expand this research and explore its applicability to other languages besides English. This thesis showed that the simplification strategies do not appear to be language specific. Thus, it would be interesting to investigate whether texts in other languages simplified using these strategies have a similar facilitative effect on text comprehension and text processing of the non-native readers of those languages.

Furthermore, the literature review in this thesis showed that research on text simplification has a number of caveats. These include a lack of evidence on approaches an expert population takes to simplify written texts and inconsistent evidence on the effect of text simplification on readers. To develop a greater conceptual understanding of text simplification, this research was conducted with English teachers and non-native English readers. OER texts were used as study materials in all four empirical studies. Since the

linguistic accessibility of open education is an underexplored area, future work may also wish to recruit larger participant samples among EMI and OER educators, as well as from EMI classrooms and online OER learner communities to further examine the application of text simplification in the design of materials in these contexts.

8.5. Concluding remarks

The introduction to this thesis began with a quote from Albert Einstein who spoke about the value of simple language and the redundancy of complexifying the language of science. The quote was followed by a story of my personal experiences with the accessibility of materials in English, first as an international student, and then as a lecturer in the EMI context. These values and difficulties one may experience when encountering the language barrier during reading and learning have driven the work in this thesis in a quest to evaluate the solution that can help reduce educational inequalities associated with this barrier. As I was conducting this PhD research, I noticed that on a personal level, I started paying greater attention to the complexity level of the language I use in my writing. As a consequence, I also started applying some of the simplification strategies I was researching in the attempts to make my writing less complex. It is hoped that the results of this research will encourage OER educators to do the same. As long as the linguistic accessibility of open education is being ignored, the capacity of these resources to increase and widen access to quality education will only remain a potential.

References

- Abelson, H. (2008). The creation of OpenCourseWare at MIT. *Journal of Science Education and Technology, 17*(2), 164-174.
- Ahuvia, A. (2001). Traditional, interpretive, and reception-based content analyses: Improving the ability of content analysis to address issues of pragmatic and theoretical concern. *Social Indicators Research, 54*(2), 139-172.
- Alisaari, J., Heikkola, L. M., Commins, N., & Acquah, E. O. (2019). Monolingual ideologies confronting multilingual realities. Finnish teachers' beliefs about linguistic diversity. *Teaching and Teacher Education, 80*, 48-58.
- Alise, M.A., Teddlie, C. (2010). A continuation of the paradigm wars? Prevalence rates of methodological approaches across the social/behavioural sciences. *Journal of Mixed Methods Research, 4*(2), 103-126.
- Alkhaleefah, T. (2017). Saudi EFL learners' reported reading problems and strategic processing of text types: a think-aloud case study. *Reading Psychology, 38*(7), 687-730.
- Allen, L., & Storan, J. (2005). *Widening participation: a rough guide for higher education providers*. Bradford: University of Bradford. Retrieved August 11, 2020, from https://www.heacademy.ac.uk/system/files/widening_participation_roughguide_for_education_providers.pdf
- Altbach, P. G., Reisberg, L., & de Wit, H. (Eds.). (2017). *Responding to massification: differentiation in postsecondary education worldwide*. Rotterdam, Netherlands: Springer.
- Amendum, S. J., Conradi, K., & Hiebert, E. (2018). Does text complexity matter in the elementary grades? A research synthesis of text difficulty and elementary students' reading fluency and comprehension. *Educational Psychology Review, 30*(1), 121-151.
- Anderson, R.C., Spiro, R.J., & Anderson, M.C. (1978). Schemata as scaffolding for the representation of information in connected discourse. *American Educational Research Journal, 15*(3), 433-440.
- Ariasi, N., Hyönä, J., Kaakinen, J. K., & Mason, L. (2017). An eye-movement analysis of the refutation effect in reading science text. *Journal of Computer Assisted Learning, 33*(3), 202-221.
- Aristeidou, M., Scanlon, E., & Sharples, M. (2017). Profiles of engagement in online communities of citizen science participation. *Computers in Human Behavior, 74*, 246-256.
- Baldwin, L. (2018). Internal and external validity and threats to validity. In *Research concepts for the practitioner of educational leadership* (pp. 31-36). Leiden, Netherlands: Brill Sense.

- Banzato, M. (2012). Barriers to teacher educators seeking, creating and sharing open educational resources: An empirical study of the use of OER in education in Italy. *2012 15th International Conference on Interactive Collaborative Learning (ICL)*, (pp. 1-6).
- Basturkmen, H., & Shackelford, N. (2015). How content lecturers help students with language: An observational study of language-related episodes in interaction in first year accounting classrooms. *English for Specific Purposes*, *37*, 87-97.
- Bateson, J., Somerville, M., Griffin, R., & Hancock, D. (2018). Different people, different views, different ideas: do widening participation definitions influence the impact and practice of widening access in healthcare? *Widening Participation and Lifelong Learning*, *20(1)*, 102-122.
- Beare, K. (2018). How many people learn English? [Web log post]. Retrieved January 25, 2018, from <https://www.thoughtco.com/how-many-people-learn-english-globally-1210367>
- Berendes, K., Vajjala, S., Meurers, D., Bryant, D., Wagner, W., Chinkina, M., . . . Graham, S. (2018). Reading demands in secondary school: does the linguistic complexity of textbooks increase with grade level and the academic orientation of the school track? *Journal of Educational Psychology*, *110(4)*, 518-543.
- Berkemeyer, V. C. (1989). Recall protocol data: Some classroom implications. *Die Unterrichtspraxis*, *21(3)*, 131-137.
- Berman, R. A., & Katzenberger, I. (2004). Form and function in introducing narrative and expository texts: A developmental perspective. *Discourse Processes*, *38*, 57-94.
- Berman, R. A., & Slobin, D. (1994). *Relating events in narratives: A crosslinguistic developmental study*. Hillsdale, NJ: Lawrence Erlbaum.
- Berndt, A., & Wayland, J. (2014). Evaluating the readability of marketing research textbooks: An international comparison. *Journal of International Education in Business*, *7(1)*, 47-59.
- Betschart, P., Zumstein, V., Bentivoglio, M., Engeler, D., Schmid, H., & Abt, D. (2017). Readability assessment of online patient education materials provided by the European Association of Urology. *International Urology and Nephrology*, *49(12)*, 2111-2117.
- Betts, E. A. (1946). *Foundations of reading instruction*. New York, NY: American Book.
- Biesta, G. (2010). Pragmatism and the philosophical foundations of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Sage handbook of mixed methods in social & behavioural research* (2nd ed., pp. 95-118). Thousand Oaks, CA: Sage.
- Borg, S., & Sanchez, H. S. (2020). Cognition and good language teachers. *Lessons from good language teachers*, 16-27.

- Bowles, M. A. (2018). Introspective verbal reports: think-alouds and stimulated recall. In A. Phakiti, P. de Costa, L. Plonsky, & S. Starfield (Eds.), *The Palgrave handbook of applied linguistics research methodology* (pp. 339-357). London: Palgrave Macmillan.
- Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, CA: Sage.
- Bozkurt, A., Jung, I., Xiao, J., Vladimirschi, V., Schuwer, R., Egorov, G., ... & Rodes, V. (2020). A global outlook to the interruption of education due to COVID-19 pandemic: Navigating in a time of uncertainty and crisis. *Asian Journal of Distance Education*, *15*(1), 1-126.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589-597.
- Brewer, J. C. (2019). Measuring text readability using reading level. In *Advanced methodologies and technologies in modern education delivery* (pp. 93-103). Texas Tech University, USA: IGI Global.
- British Educational Research Association. (2011). Ethical guidelines for educational research. London, UK: BERA.
- British Psychological Society. (2014). Code of human research ethics. Leicester, UK: BPS.
- Brown, A. S., Schilling, H. E., & Hockensmith, M. L. (1999). The negative suggestion effect: Pondering incorrect alternatives may be hazardous to your knowledge. *Journal of Educational Psychology*, *91*(4), 756.
- Brown, J. S., & Adler, R. P. (2008). Minds on fire: open education, the long tail, and learning 2.0. *EDUCAUSE Review* *43* (1), 16-32.
- Brunfaut, T., & McCray, G. (2015). *Looking into test-takers' cognitive processes whilst completing reading tasks: a mixed-method eye-tracking and stimulated recall study* (ARAGS Research Reports Online). Retrieved May 5, 2020, from http://eprints.lancs.ac.uk/72005/1/Brunfaut_and_McCray_final_report_FINAL.pdf
- Bryman, A. (2012). *Social research methods* (4th ed.). Oxford, UK: Oxford University Press.
- Brysbaert, M., Keuleers, E., & Mandera, P. (2020). Which words do English non-native speakers know? New supranational levels based on yes/no decision. *Second Language Research*, 0267658320934526.
- Cannell, P., & Macintyre, R. (2017). Free open online resources in workplace and community settings – a case study on overcoming barriers. *Widening Participation and Lifelong Learning*, *19*(1), 111-122.

- Capel, A. (2012). Completing the English vocabulary profile: C1 and C2 vocabulary. *English Profile Journal*, 3.
- Casserly, C., & DeBarger, A. (2020). Recent trends in global OER research & implications for the future of the open education field. *Paper presented at OER19 conference*, 11 April 2019, Galway, Ireland.
- Catrysse, L., Gijbels, D., & Donche, V. (2018). It is not only about the depth of processing: What if eye am not interested in the text? *Learning and Instruction*, 58, 284-294.
- Cop, U., Dirix, N., Van Assche, E., Drieghe, D., & Duyck, W. (2017). Reading a book in one or two languages? An eye movement study of cognate facilitation in L1 and L2 reading. *Bilingualism: Language and Cognition*, 20(4), 747-769.
- Chan, N., & Kennedy, P. E. (2002). Are multiple-choice exams easier for economics students? A comparison of multiple-choice and 'equivalent' constructed-response exam questions. *Southern Economic Journal*, 957-971.
- Chandrasekar, R., Doran, C., & Srinivas, B. (1996). Motivations and methods for text simplification. In *Proceedings of the 16th Conference on Computational Linguistics*. Volume 2 (pp. 1041-1044). Association for Computational Linguistics.
- Chang, Y. F. (2006). On the use of the immediate recall task as a measure of second language reading comprehension. *Language Testing*, 23(4), 520-543.
- Chapple, J. (2015). Teaching in English is not necessarily the teaching of English. *International Education Studies*, 8(3), 1-13.
- Chauliac, M., Catrysse, L., Gijbels, D., & Donche, V. (2020). It is all in the surv-eye: Can eye tracking data shed light on the internal consistency in self-report questionnaires on cognitive processing strategies? *Frontline Learning Research*, 8(3), 26 - 39.
- Cheatham, J. P., Allor, J. H., & Roberts, J. K. (2014). How does independent practice of multiple-criteria text influence the reading performance and development of second graders? *Learning Disability Quarterly*, 37, 3-14.
- Chen, I. J. (2016). Hypertext glosses for foreign language reading comprehension and vocabulary acquisition: effects of assessment methods. *Computer Assisted Language Learning*, 29(2), 413-426.
- Chowdry, H., Crawford, C., Dearden, L., Goodman, A., & Vignoles, A. (2013). Widening participation in higher education: analysis using linked administrative data. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 176(2), 431-457.
- Clapham, C. (1996). *The development of IELTS: A study of the effect of background on reading comprehension* (Vol. 4). Cambridge University Press.
- Clark, V. L. P., & Ivankova, N. V. (2015). *Mixed methods research: A guide to the field* (Vol. 3). Sage publications.

- Clinton, V., & Khan, S. (2019). Efficacy of open textbook adoption on learning performance and course withdrawal rates: a meta-analysis. *AERA Open*, 5(3), 2332858419872212.
- Cobb, D. J. (2018). Placing the spotlight on open educational resources: Quality alternative or alternative guise? *International Education Journal: Comparative Perspectives*, 17(3), 15-29.
- Cobo, C. (2013). Exploration of Open Educational Resources in non-English speaking communities. *International Review of Research in Open and Distance Learning*, 14(2), 106-128.
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education*. London, UK: Routledge.
- Coleman, J., Hultgren, K., Li, W., Tsui, C. F. C., & Shaw, P. (2018). Forum on English-Medium Instruction. *TESOL Quarterly*, 52(3), 701-720.
- Collins, K. M., Onwuegbuzie, A. J., & Sutton, I. L. (2006). A model incorporating the rationale and purpose for conducting mixed methods research in special education and beyond. *Learning Disabilities: A Contemporary Journal*, 4(1), 67-100.
- Comrie, B. (1989). *Language universals and linguistic typology: Syntax and morphology*. University of Chicago Press.
- Conklin, K., Pellicer-Sánchez, A., & Carrol, G. (2018). *Eye-tracking: A guide for applied linguistics research*. Cambridge University Press.
- Cook, V., & Wei, L. (2016). *The Cambridge handbook of linguistic multi-competence*. Cambridge University Press.
- Coughlan, T., & Goff, J. (2019). Creating open online courses with learner representative partners to widen participation in higher education. *Journal of Learning for Development-JL4D*, 6(2).
- Coughlan, T., Lister, K., Seale, J., Scanlon, E. & Weller, M. (2019). Accessible inclusive learning: Foundations. In: R. Ferguson, A. Jones, & E. Scanlon (Eds), *Educational visions: Lessons from 40 years of innovation* (pp. 51-73). London: Ubiquity Press.
- Council of Europe. Council for Cultural Co-operation. Education Committee. Modern Languages Division. (2001). *Common European Framework of Reference for Languages: learning, teaching, assessment*. Cambridge University Press.
- Creative Commons. (2020). About Open Intellectual Property Licenses. Retrieved June 16, 2020, from <https://creativecommons.org/licenses/>
- Creswell, J. W., & Clark, V. L. P. (2011). *Designing and conducting mixed methods research*, 2nd ed. Thousand Oaks: Sage.

- Creswell, J. W., & Creswell, J. D. (2017). *Research design: qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Creswell, J.W. (2014). *A concise introduction to mixed methods research*. Sage publications.
- Crossley, S. A., & McNamara, D. S. (2016). Text-based recall and extra-textual generations resulting from simplified and authentic texts. *Reading in a Foreign Language, 28*(1), 1-19.
- Crossley, S. A., Allen, D., & McNamara, D. S. (2012). Text simplification and comprehensible input: A case for an intuitive approach. *Language Teaching Research, 16*(1), 89-108.
- Crossley, S. A., Kyle, K., & McNamara, D. S. (2016). The tool for the automatic analysis of text cohesion (TAACO): Automatic assessment of local, global, and text cohesion. *Behavior Research Methods, 48*(4), 1227-1237.
- Crossley, S. A., Yang, H. S., & McNamara, D. S. (2014). What's so simple about simplified texts? A computational and psycholinguistic investigation of text comprehension and text processing. *Reading in a Foreign Language, 26*(1), 92-113.
- Crossley, S., Greenfield, J., & McNamara, D. S. (2008). Accessing text readability using cognitively based indices. *TESOL Quarterly, 42*(3), 475-493.
- D'Angelo, N., Hipfner-Boucher, K., & Chen, X. (2017). Predicting growth in English and French vocabulary: the facilitating effects of morphological and cognate awareness. *Developmental Psychology, 53*(7), 1242-1255.
- Davis, D. S., Huang, B., & Yi, T. (2017). Making sense of science texts: a mixed-methods examination of predictors and processes of multiple-text comprehension. *Reading Research Quarterly, 52*(2), 227-252.
- De los Arcos, B., Farrow, R., Pitt, R., Weller, M., & McAndrew, P. (2016). Adapting the curriculum: How K-12 teachers perceive the role of open educational resources. *Journal of Online Learning Research, 2*(1), 23-40.
- Dearden, J. (2015). *English as a medium of instruction: A growing global phenomenon*. London, England: The British Council.
- Dearnley, C. (2005). A reflection on the use of semi-structured interviews. *Nurse Researcher, 13*(1).
- Dinsmore, D. L., & Alexander, P. A. (2016). A multidimensional investigation of deep-level and surface-level processing. *The Journal of Experimental Education, 84*, 213-244.
- Doiz, A., Lasagabaster, D., & Sierra, J. M. (2012). *English-medium instruction at universities: Global challenges*. Multilingual matters.
- Downing, S. M. (2006). Selected-response item formats in test development. *Handbook of Test Development, 287-301*.

- Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, *100*(3), 363.
- Erling, E. J., Adinolfi, L., & Hultgren, A. K. (2017). Multilingual classrooms: opportunities and challenges for English Medium Instruction in low- and middle-income contexts. *Education Development Trust*. Retrieved July 16, 2020, from <https://files.eric.ed.gov/fulltext/ED586989.pdf>
- Ethnologue (2020). Online database of the language of the world. Retrieved March 2, 2020, from <https://www.ethnologue.com/guides/how-many-languages>
- Evans, S., & Morrison, B. (2011). The first term at university: Implications for EAP. *ELT journal*, *65*(4), 387-397.
- Farrell, T. S. (2020). Professional development through reflective practice for English-Medium Instruction (EMI) teachers. *International Journal of Bilingual Education and Bilingualism*, *23*(3), 277-286.
- Farrow, R., de los Arcos, B., Pitt, R., & Weller, M. (2015). Who are the open learners? A comparative study profiling non-formal user of Open Educational Resources. *European Journal of Open, Distance and E-Learning*, *18*(2), 49-73.
- Feilzer, Y. M. (2010). Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*, *4*(1), 6-16.
- Ferrés, D., Marimon, M., & Saggion, H. (2016, June). YATS: yet another text simplifier. In *International Conference on Applications of Natural Language to Information Systems* (pp. 335-342). Springer, Cham.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.
- Flesch, R. F. (1979). *How to write plain English: A book for lawyers and consumers*. Harpercollins.
- Floris, F. D. (2014). Learning subject matter through English as the Medium of Instruction: Students' and teachers' perspectives. *Asian Englishes*, *16*(1), 47-59.
- Fountas, I. C., & Pinnell, G. S. (1996). *Guided reading: good first teaching for all children*. Portsmouth: Heinemann.
- Freedle, R., & Kostin, I. (1993). The prediction of TOEFL reading item difficulty: Implications for construct validity. *Language Testing*, *10*(2), 133-170.
- Freshwater, D., & Cahill, J. (2013). Paradigms lost and paradigms regained. *Journal of Mixed Methods Research*, *7*(3), 3-5.
- Froehlich, D. E., Rehm, M., & Rienties, B. C. (2020). *Mixed methods approaches to social network analysis*. London: Routledge.

- Galloway, N., Kriukow, J., & Numajiri, T. (2017). Internationalisation, higher education and the growing demand for English: An investigation into the English Medium of Instruction (EMI) movement in China and Japan. *ELT Research Papers*, 17 February 2017. British Council.
- Gass, S. M., & Mackey, A. (2016). *Stimulated recall methodology in applied linguistics and L2 research*. Taylor & Francis.
- Glass, R., & Oliveira, A. W. (2014). Science language accommodation in elementary school read-alouds. *International Journal of Science Education*, 36(4), 577-609.
- Godfroid, A. (2019). *Eye-tracking in second language acquisition and bilingualism: A research synthesis and methodological guide*. New York, NY: Routledge.
- Graesser, A. C., Haut-Smith, K., Cohen, A. D., & Pyles, L. D. (1980). Advanced outlines, familiarity, and text genre on retention of prose. *The Journal of Experimental Education*, 48(4), 281-290.
- Graneheim, U. H., Lindgren, B. M., & Lundman, B. (2017). Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Education Today*, 56, 29-34.
- Green, A., & Hawkey, R. (2012). Re-fitting for a different purpose: A case study of item writer practices in adapting source texts for a test of academic reading. *Language Testing*, 29(1), 109-129.
- Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, 11(3), 255-274.
- Greene, J.C., & Hall, J.N. (2010). Dialectics and pragmatism: being of consequence. In A. Tashakkori & C. Teddlie (Eds.), *Sage handbook of mixed methods in social and behavioural research* (2nd ed., pp. 119-143). Thousand Oaks, CA: Sage.
- Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2009). *Survey methodology* (2nd ed.). Hoboken, NJ: John Wiley & Sons Ltd.
- Hadi, M. A., & Closs, S. J. (2016). Ensuring rigour and trustworthiness of qualitative research in clinical pharmacy. *International Journal of Clinical Pharmacy*, 38(3), 641-646.
- Haladyna, T. M., Rodriguez, M. C., & Stevens, C. (2019). Are multiple-choice Items too fat? *Applied Measurement in Education*, 32(4), 350-364.
- Harrison, C. J. O. (1980). *Readability in the classroom*. Cambridge University Press.
- Hatakka, M. (2009). Build it and they will come? – Inhibiting factors for reuse of open content in developing countries. *The Electronic Journal of Information Systems in Developing Countries*, 37(0). Retrieved June 10, 2018, from <http://www.ejisdc.org/ojs2.../index.php/ejisdc/article/view/545>.

- Heiman, T., Coughlan, T., Rangin, H., & Deimann, M. (2020). New designs or new practices? Multiple perspectives on the ICT and accessibility conundrum. In *Improving Accessible Digital Practices in Higher Education* (pp. 99-115). Palgrave Pivot, Cham.
- Heinz, P. J. (2004). Towards enhanced second language reading comprehension assessment: computerized versus manual scoring of written recall protocols. *Reading in a Foreign Language, 16*(2), 97-124.
- Hellekjær, G. O. (2010). Lecture comprehension in English-Medium higher education. *Hermes: Journal of Language and Communication Studies, 45*, 11–34.
- Hodgkinson-Williams, C., & Paskevicius, M. (2012). The role of postgraduate students in co-authoring Open Educational Resources to promote social inclusion: A case study at the University of Cape Town. *Distance Education, 33*(2), 253-269.
- Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H., & van de Weijer, J. (2011). *Eye-tracking: A comprehensive guide to methods and measures*. OUP Oxford.
- Howard, P. L., Liversedge, S. P., & Benson, V. (2017). Benchmark eye movement effects during natural reading in autism spectrum disorder. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 43*(1), 109.
- Hua, T. L. (2019). Understanding the learning challenges of English-Medium Instruction learners and ways to facilitate their learning: A case study of Taiwan psychology students' perspectives. *Latin American Journal of Content and Language Integrated Learning, 12*(2), 321-340.
- Huang, W.-H. D., Lin, M.-F. G., & Shen, W. (2012). Understanding Chinese-speaking open courseware users: A case study on user engagement in an open courseware portal in Taiwan. *Open Learning: The Journal of Open, Distance and e-Learning, 27*(2), 169-182.
- Hultgren, A. K., C. Jensen & S. Dimova (2015). Introduction: English-Medium Instruction in European higher education: From the North to the South. In Dimova et al. (Eds.), *English-Medium Instruction in European higher education*. Berlin: Mouton, 1-16.
- Hyönä, J., & Lorch, R. F. (2004). Effects of topic headings on text processing: evidence from adult readers' eye fixation patterns. *Learning and Instruction, 14*(2), 131-152.
- Iacozza, S., Costa, A., & Duñabeitia, J. A. (2017). What do your eyes reveal about your foreign language? Reading emotional sentences in a native and foreign language. *PLoS one, 12*(10), E0186027.
- Issack, S. M. (2011). OERs in context – case study of innovation and sustainability of educational practices at the university of Mauritius. *European Journal of Open, Distance and E-Learning*. Retrieved April 15, 2020, from <https://files.eric.ed.gov/fulltext/EJ936383.pdf>

- Jatowt, A., & Tanaka, K. (2012). Is Wikipedia too difficult? Comparative analysis of readability of Wikipedia, Simple Wikipedia and Britannica. In *Proceedings of the 21st ACM International Conference on Information and Knowledge Management*, (pp. 2607-2610).
- Jisc. (2018). Getting started with accessibility and inclusion. Retrieved May 21, 2020, from <https://www.jisc.ac.uk/guides/getting-started-with-accessibility-and-inclusion>
- Jung, J., & Révész, A. (2018). The effects of reading activity characteristics on L2 reading processes and noticing of glossed constructions. *Studies in Second Language Acquisition*, 40(4), 755-780.
- Kanwar, A., Kodhandaraman, B., & Umar, A. (2010). Toward sustainable Open Education Resources: A perspective from the Global South. *The American Journal of Distance Education*, 24(2), 65-80.
- Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a research paradigm and its implications for social work research. *Social Sciences*, 8(9), 255.
- Keating, G. D. (2014). Eye-tracking with text. In J. Jegerski & B. van Patten (Eds.), *Research methods in second language psycholinguistics* (pp. 69-92). London, UK: Taylor & Francis
- Khabbazbashi, N. (2017). Topic and background knowledge effects on performance in speaking assessment. *Language Testing*, 34(1), 23-48.
- Khalifa, H., & Weir, C. J. (2009). *Examining reading* (Vol. 29). Ernst Klett Sprachen.
- Kher, A., Johnson, S., & Griffith, R. (2017). Readability assessment of online patient education material on congestive heart failure. *Advances in Preventive Medicine*, 2017.
- Knyazeva, S. (2010). Open Educational Resources in CIS: Preliminary study of the state-of-the-art and prospects for development. BSU. Retrieved October 13, 2018, from <http://elib.bsu.by/handle/123456789/13100>
- Kraal, A., Koornneef, A. W., Saab, N., & van den Broek, P. W. (2018). Processing of expository and narrative texts by low-and high-comprehending children. *Reading and Writing*, 31(9), 2017-2040.
- Krippendorff, K. (2013) *Content analysis. An introduction to its methodology* (3rd ed). California, CA: Sage Publications.
- Kyle, K., Crossley, S. A., & McNamara, D. S. (2016). Construct validity in TOEFL iBT speaking tasks: insights from natural language processing. *Language Testing*, 33(3), 319-340.
- LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology*, 6(2), 293-323.

- Levitt, H. M. (2015). Interpretation-driven guidelines for designing and evaluating grounded theory research: A constructivist-social justice approach. In *Psychotherapy research* (pp. 455-483)., Vienna: Springer
- Lin, L. C., & Yu, W. Y. (2015). A think-aloud study of strategy use by EFL college readers reading Chinese and English texts. *Journal of Research in Reading, 38*(3), 286-306.
- Lindgren, B. M., Sundbaum, J., Eriksson, M., & Graneheim, U. H. (2014). Looking at the world through a frosted window: Experiences of loneliness among persons with mental ill-health. *Journal of Psychiatric and Mental Health Nursing, 21*(2), 114-120.
- Littlejohn, A., & Hood, N. (2019). *Reconceptualising learning in the digital age: The [un] democratising potential of MOOCs* (No. 1, pp. 1-viii): Springer.
- Loaiza, V. M., McCabe, D. P., Youngblood, J. L., Rose, N. S., & Myerson, J. (2011). The influence of levels of processing on recall from working memory and delayed recall tasks. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37*(5), 1258-1263.
- Long, M. H. (2020). Optimal input for language learning: genuine, simplified, elaborated, or modified elaborated? *Language Teaching, 53*(2), 169-182.
- Long, M., & Ross, S. (1993). Modifications that preserve language and content. In M. L. Tickoo (Ed.), *Simplification: Theory and application* (pp. 29-52). Singapore: SEAMEO Regional Language Center.
- Macaro, E., Hultgren, A. K., Kirkpatrick, A., & Lasagabaster, D. (2019). English Medium Instruction: Global views and countries in focus: Introduction to the symposium held at the Department of Education, University of Oxford on Wednesday 4 November 2015. *Language Teaching, 52*(2), 231-248.
- Marton, F., & Säljö, R. (1976). On qualitative differences in learning: outcome and process. *British Journal of Educational Psychology, 46*(1), 4-11.
- Maslin, P. (2007). Comparison of readability and decodability levels across five first grade basal programs. *Reading Improvement, 44*(2), 59-75.
- Mason, L., Pluchino, P., Tornatora, M. C., & Ariasi, N. (2013). An eye-tracking study of learning from science text with concrete and abstract illustrations. *The Journal of Experimental Education, 81*(3), 356-384.
- Maxwell, J.A. (2011). Paradigms or toolkits? Philosophical and methodological positions as heuristics for mixed methods research. *Mid-Western Educational Researcher, 24*(2), 27-30.
- McCarthy, P. M., & Jarvis, S. (2010). MTL, VOCD-D, and HD-D: A validation study of sophisticated approaches to lexical diversity assessment. *Behavior Research Methods, 42*(2), 381-392.

- Mckee, S. (2012). Reading comprehension, what we know: A review of research 1995 to 2011. *Language Testing in Asia*, 2(1), 45.
- McNamara, D. S. (2001). Reading both high-coherence and low-coherence texts: effects of text sequence and prior knowledge. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, 55(1), 51.
- Mikk, J. (1997). Parts of speech in predicting reading comprehension. *Journal of Quantitative Linguistics*, 4(1-3), 156-163.
- Mishra, S. (2017). Open Educational Resources: Removing barriers from within. *Distance Education*, 38(3), 369-380.
- Mittelmeier, J. (2017). *Supporting intercultural collaborations in blended and online settings: a randomised control trial of internationalised academic content*. (Doctoral dissertation, The Open University).
- Morgan, D. (2007). Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. *Journal of Mixed Methods Research*, 1(1), 48-76.
- Morris, D., Trathen, W., Frye, E. M., Kucan, L., Ward, D., Schlagal, R., & Hendrix, M. (2013). The role of reading rate in the informal assessment of reading ability. *Literacy Research and Instruction*, 52, 52-64.
- Mtebe, J. S., & Raisamo, R. (2014). Challenges and instructors' intention to adopt and use open educational resources in higher education in Tanzania. *International Review of Research in Open and Distributed Learning*, 15(1), 249-271.
- Mulligan, D., & Kirkpatrick, A. (2000). How much do they understand? Lectures, students and comprehension. *Higher Education Research & Development*, 19(3), 311-335.
- Murphy, V. (2020). *Learning from incidents and implementing action: exploring expectations and contradictions in the energy sector*. (Doctoral dissertation, The Open University).
- Myers, D., Olsen, R., Seftor, N., Young, J., & Tuttle, C. (2004). *The impacts of regular upward bound: Results from the third follow-up data collection*. MPR Reference No. 8464-600. Mathematica Policy Research, Inc.
- Nation, P. (2015). Principles guiding vocabulary learning through extensive reading. *Reading in a Foreign Language*, 27(1), 136-145.
- Neuendorf, K. A. (2016). *The content analysis guidebook*. Cleveland State University, USA: Sage.
- Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, 84(3), 231.

- NGACBP & CCSSO. (National Governors Association Center for Best Practices & Council of Chief State School Officers). (2010). *Common Core State Standards for English language arts & literacy in history/social studies, science, and technical subjects. Appendix A*. Washington, DC: Author. Retrieved August 21, 2020, from <http://www.corestandards.org/the-standards>
- Nti, K. (2015). Supporting access to open online courses for learners of developing countries. *International Review of Research in Open and Distributed Learning, 16(4)*, 156-171.
- Nunan, D. (1999). *Second language teaching and learning*. London: Heinle & Heinle.
- Oh, S. (2001). Two types of input modification and EFL reading comprehension: simplification versus elaboration. *TESOL Quarterly, 35*, 69-96.
- Olsen, A. (2012). The Tobii I-VT fixation filter. *Tobii Technology, 1-21*.
- Olsson, P. (2007). *Real-time and offline filters for eye tracking*. KTH Royal Institute of Technology.
- Onwuegbuzie, A. J., Johnson, R. B., & Collins, K. M. (2011). Assessing legitimation in mixed research: a new framework. *Quality & Quantity, 45(6)*, 1253-1271.
- OpenLearn. (2020). Free learning from the Open University. [OER courses website]. Retrieved March 2, 2020, from <https://www.open.edu/openlearn/>
- OpenStax. (2020). High-quality, peer-reviewed, openly licensed college textbooks [Open Textbook initiative website]. Retrieved August 28, 2020, from <https://openstax.org/about>
- Paas, F., Tuovinen, J. E., Tabbers, H., & van Gerven, P. W. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational psychologist, 38(1)*, 63-71.
- Pae, H. K. (2018). The Korean writing system, Hangul, and word processing. *Writing Systems, Reading Processes, and Cross-Linguistic Influences: Reflections from the Chinese, Japanese, and Korean Languages*, 335-352.
- Papathoma, T., Ferguson, R., Iniesto, P., Rets, I., Vogiatzis, D., Murphy, V. (2020). Guidance on how learning at scale can be made more accessible. In *Proceedings of the Seventh ACM Conference on Learning @ Scale (L@S '20)*. Association for Computing Machinery, New York, NY, USA, 289-292.
- Pearson, P. D., & Hamm, D. N. (2005). The assessment of reading comprehension: a review of practices – past, present, and future. In *Children's reading comprehension and assessment* (pp. 31-88). Routledge.
- Pellicer-Sánchez, A. (2016). Incidental L2 vocabulary acquisition from and while reading: An eye-tracking study. *Studies in Second Language Acquisition, 38(1)*, 97-130.

- Pellicer-Sánchez, A. (2020). Expanding English vocabulary knowledge through reading: Insights from eye-tracking studies. *RELC Journal*, 51(1), 134-146.
- Pellicer-Sánchez, A., & Schmitt, N. (2010). Incidental vocabulary acquisition from an authentic novel: Do things fall apart? *Reading in a Foreign Language*, 22, 31-55.
- Pellicer-Sánchez, A., & Siyanova-Chanturia, A. (2018). Eye movements in vocabulary research. *ITL-International Journal of Applied Linguistics*, 169(1), 5-29.
- Pessoa, S., Miller, R. T., & Kaufer, D. (2014). Students' challenges and development in the transition to academic writing at an English-Medium University in Qatar. *International Review of Applied Linguistics in Language Teaching*, 52(2), 127-156.
- Pitt, R. (2015). Mainstreaming open textbooks: Educator perspectives on the impact of OpenStax college open textbooks. *International Review of Research in Open and Distributed Learning*, 16(4).
- Powell-Smith, K. A., & Bradley-Klug, K. L. (2001). Another look at the 'C' in CBM: Does it really matter if curriculum-based measurement reading probes are curriculum-based? *Psychology in the Schools*, 38, 299-312.
- Primor, L., Pierce, M. E., & Katzir, T. (2011). Predicting reading comprehension of narrative and expository texts among Hebrew-speaking readers with and without a reading disability. *Annals of Dyslexia*, 61(2), 242-268.
- Pring, R. (2000). The 'false dualism' of educational research. *Journal of Philosophy of Education*, 34(2), 247-260.
- SE Ranking. (2020). Website traffic analysis. Retrieved August 28, 2020, from <https://seranking.com/>
- Ramat, P. (2011). *Linguistic typology (Vol. 1)*. Walter de Gruyter.
- Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*, 124(3), 372.
- Rayner, K., Li, X., Juhasz, B. J., & Yan, G. (2005). The effect of word predictability on the eye movements of Chinese readers. *Psychonomic Bulletin & Review*, 12(6), 1089-1093.
- Reed, D. K., & Kershaw-Herrera, S. (2016). An examination of text complexity as characterized by readability and cohesion. *The Journal of Experimental Education*, 84(1), 75-97.
- Renninger, K. A., & Hidi, S. (2016). *The power of interest for motivation and engagement*.
- Rets, I. (2017). Vocabulary retention and concordance-based learning in L3 acquisition. *Eurasian Journal of Applied Linguistics*, 3(2), 313-324.

- Rets, I., Coughlan, T., Stickler, U., & Astruc, L. (2020). Accessibility of Open Educational Resources: How well are they suited for English learners? *Open Learning: The Journal of Open and Distance Learning*.
- Rets, I., Rienties, B., Lewis, T. (2020). Transforming pre-service teacher education through Virtual Exchange: a mixed-method analysis of perceived TPACK development. *Interactive Learning Environments*, 1-13.
- Rets I., Rogaten, J. (2020). To simplify or not? Facilitating English L2 users' comprehension and processing of open educational resources in English using text simplification. *Journal of Computer Assisted Learning*, 1-13.
- Rienties, B., Lewis, T., O'Dowd, R., Rets, I., & Rogaten, J. (2020). The impact of virtual exchange on TPACK and foreign language competence: reviewing a large-scale implementation across 23 virtual exchanges. *Computer Assisted Language Learning*, 1-27.
- Robinson, O. C. (2014). Sampling in interview-based qualitative research: a theoretical and practical guide. *Qualitative Research in Psychology*, 11(1), 25-41.
- Robson, C. (1993). *Real world research*. Oxford, UK: Blackwell
- Rodriguez, G., Pérez, J., Cueva, S., & Torres, R. (2017). A framework for improving web accessibility and usability of Open Course Ware sites. *Computers & Education*, 109, 197-215.
- Roediger, H. L., & Marsh, E. J. (2005). The positive and negative consequences of multiple-choice testing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31(5), 1155.
- Roever, C. (2006). Validation of a web-based test of ESL pragmalinguistics. *Language Testing*, 23(2), 229-256.
- Rupp, A. A., Ferne, T., & Choi, H. (2006). How assessing reading comprehension with multiple-choice questions shapes the construct: A cognitive processing perspective. *Language Testing*, 23(4), 441-474.
- Sáenz, L. M., & Fuchs, L. S. (2002). Examining the reading difficulty of secondary students with learning disabilities: expository versus narrative text. *Remedial and Special Education*, 23(1), 31-41.
- Sanghvi, S., Cherla, D., Shukla, P., & Eloy, J. (2012). Readability assessment of internet-based patient education materials related to facial fractures. *Laryngoscope*, 122(9), 1943-1948.
- Saylor. (2020). Free online courses. [OER courses website]. Retrieved March 2, 2018, from <https://www.saylor.org/>
- Schellings, G. L. M., van Hout-Wolters, B. H. A. M., Veenman, M. V. J., & Meijer, J. (2012). Assessing metacognitive activities: the in-depth comparison of a task-specific

questionnaire with think-aloud protocols. *European Journal of Psychology of Education*, 28(3), 963-990.

Schiefele, U. (2009). Situational and individual interest. In K. R. Wentzel, & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 197-222). New York/London: Routledge.

Schiefele, U., & Krapp, A. (1996). Topic interest and free recall of expository text. *Learning and Individual Differences*, 8(2), 141-160.

Schmitt, N., Cobb, T., Horst, M., & Schmitt, D. (2017). How much vocabulary is needed to use English? Replication of van Zeeland & Schmitt (2012), Nation (2006) and Cobb (2007). *Language Teaching*, 50(2), 212-226.

Schmitt, N., Jiang, X., & Grabe, W. (2011). The percentage of words known in a text and reading comprehension. *The Modern Language Journal*, 95(1), 26-43.

Shannon-Baker, P. (2016). Making paradigms meaningful in mixed methods research. *Journal of Mixed Methods Research*, 10(4), 319-334.

Shapiro, A. M. (2004). How including prior knowledge as a subject variable may change outcomes of learning research. *American Educational Research Journal*, 41, 159-189.

Smith, C. P. (2000). Content analysis and narrative analysis. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (p. 313-335). Cambridge University Press.

Soemer, A., & Schiefele, U. (2019). Text difficulty, topic interest, and mind wandering during reading. *Learning and Instruction*, 61, 12-22.

Somekh, B., & Lewin, C. (2005). *Research methods in the social sciences*. Thousand Oaks: Sage.

Spencer, M., Gilmour, A. F., Miller, A. C., Emerson, A. M., Saha, N. M., & Cutting, L. E. (2019). Understanding the influence of text complexity and question type on reading outcomes. *Reading and Writing*, 32(3), 603-637.

Sprainger, N., Sandral, D., & Ferrari, K. (2011). Student think aloud – a window into readers' thinking. *Practically Primary*, 16(1), 33-36.

Stickler, U., & Shi, L. (2017). Eye-tracking methodology in SCMC: A tool for empowering learning and teaching. *ReCALL*, 29(2), 160-177.

Stracke, C. M., Downes, S., Conole, G., Burgos, D., & Nascimbeni, F. (2019). Can Massive Open Online Courses (MOOCs) be considered as Open Educational Resources (OER)? *OE Global 2019 Conference*. Milan, Italy.

Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social and behavioural research*. London: Cassell.

- Tatzl, D. (2011). English-Medium Masters' programmes at an Austrian university of applied sciences: Attitudes, experiences and challenges. *Journal of English for Academic purposes*, 10(4), 252-270.
- Teng Fatt, J. P. (1991). Text-related variables in textbook readability. *Research Papers in Education*, 6(3), 225-245.
- Textinspector (2020). Advanced Readability Tool. Retrieved March 11, 2020, from <https://textinspector.com/>
- The Next Phase for Open Education (2020, April 9), William and Flora Hewlett Foundation. Retrieved September 3, 2020, from <https://hewlett.org/the-next-phase-for-open-education/>
- Thompson, G., Aizawa, I., Curle, S., & Rose, H. (2019). Exploring the role of self-efficacy beliefs and learner success in English Medium Instruction. *International Journal of Bilingual Education and Bilingualism*, 1-14.
- Thorndike, E. L. (1921). *The teacher's word book*. New York City: Columbia University.
- Tickoo, M. L. (1993). *Simplification: Theory and application*. Anthology Series 31.
- Tlili, A., Huang, R., Chang, T. W., Nascimbeni, F., & Burgos, D. (2019). Open Educational Resources and practices in China: A systematic literature review. *Sustainability*, 11(18), 4867.
- Todirascu, A., François, T., Gala, N., Fairon, C., Ligozat, A. L., & Bernhard, D. (2013). Coherence and cohesion for the assessment of text readability. *Natural Language Processing and Cognitive Science*, 11, 11-19.
- Tomlinson, B., & Masuhara, H. (2017). *The complete guide to the theory and practice of materials development for language learning*. John Wiley & Sons.
- Tweissi, A. I. (1998). The effects of the amount and the type of simplification on foreign language reading comprehension. *Reading in a Foreign Language*, 11, 191-206.
- Twining, P., Heller, R. S., Nussbaum, M., & Tsai, C. C. (2017). Some guidance on conducting and reporting qualitative studies. *Computers & Education*, 106(C), A1-A9.
- Uchihara, T., & Harada, T. (2018). Roles of vocabulary knowledge for success in English-Medium Instruction: self-perceptions and academic outcomes of Japanese undergraduates. *TESOL Quarterly*, 52(3), 564-587.
- UNESCO. (2012). Paris declaration on Open Educational Resources. Retrieved June 1, 2018, from http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/Events/Paris%20OER%20Declaration_01
- UNESCO. (2015). Guidelines for Open Educational Resources (OER) in higher education. Commonwealth of learning. Paris. Retrieved September 8, 2018, from <https://unesdoc.unesco.org/ark:/48223/pf0000213605>

- UNESCO. (2020). Fighting COVID-19 through digital innovation and transformation. Retrieved May 19, 2020, from <https://en.unesco.org/covid19/communicationinformationresponse/digitalinnovation>
- Valencia, S. W., Wixson, K. K., & Pearson, P. D. (2014). Putting text complexity in context: refocusing on comprehension of complex text. *The Elementary School Journal*, *115*, 270–289.
- Vesterinen, O., Toom, A., & Patrikainen, S. (2010). The stimulated recall method and ICTs in research on the reasoning of teachers. *International Journal of Research & Method in Education*, *33*(2), 183-197.
- Vygotsky, L. S. (1978). *Mind in society: the development of higher psychological processes* (Cole, M., John-Steiner, V., Scribner, S., & Souberman, E., Eds. & Trans.). Cambridge: Harvard University Press.
- Webb, J. M., Diana, E. M., Luft, P., Brooks, E. W., & Brennan, E. L. (1997). Influence of pedagogical expertise and feedback on assessing student comprehension from nonverbal behavior. *The Journal of Educational Research*, *91*(2), 89-97.
- Weller, M. (2010). Big and little OER. In: *OpenED2010: Seventh Annual Open Education Conference*, 2-4 Nov 2010, Barcelona, Spain.
- Weller, M. (2020). *25 Years of Ed Tech*. Athabasca University Press.
- West, M. (1964). Criteria in the selection of simplified reading books. *ELT Journal*, *18*(4), 146-153.
- Willems, J., & Bossu, C. (2012). Equity considerations for Open Educational Resources in the glocalization of education. *Distance Education*, *33*(2), 185–199.
- William and Flora Hewlett Foundation. (2020). Open Educational Resources. Retrieved May 13, 2020, from <https://www.hewlett.org/strategy/open-educational-resources/>
- Wolf, C., Joye, D., Smith, T. W., & Fu, Y.-C. (2016). *The Sage handbook of survey methodology*. London: SAGE.
- Xia, M., Kochmar, E., & Briscoe, T. (2016). Text readability assessment for second language learners. In *Proceedings of the 11th Workshop on Innovative Use of NLP for Building Educational Applications* (pp. 12-22).
- Xie, D. X., Wang, R. Y., & Chinnadurai, S. (2018). Readability of online patient education materials for velopharyngeal insufficiency. *International Journal of Pediatric Otorhinolaryngology*, *104*, 113-119.
- Yamashita, J., & Shiotsu, T. (2017). Comprehension and knowledge components that predict L2 reading: A latent-trait approach. *Applied linguistics*, *38*(1), 43-67.

- Yano, Y, Long, M., & Ross, S. (1994). Effects of simplified and elaborated texts on foreign language reading comprehension. *Language Learning, 44*, 189-219.
- Yin, R. K. (2013). *Case study research: Design and methods*. Thousand Oaks, CA: Sage publications.
- Young, D. (2000). An investigation into the relationship between L2 reading anxiety and L2 reading comprehension, and self-reported level of comprehension, topic familiarity, features of an L2 text and reading ability in the L1 and L2. *Current Research on the Acquisition of Spanish*, 15-33.
- Young, D. N. (1999). Linguistic simplification of SL reading material: effective instructional practice? *The Modern Language Journal, 83*(3), 350-366.
- Younger, K., Gascoine, L., Menzies, V., & Torgerson, C. (2019). A systematic review of evidence on the effectiveness of interventions and strategies for widening participation in Higher Education. *Journal of Further and Higher Education, 43*(6), 742-773.
- Yuan, R. (2020). Promoting EMI teacher development in EFL higher education contexts: A teacher educator's reflections. *RELC Journal, 51*(2), 309-317.
- Zhang, X., Tlili, A., Nascimbeni, F., Burgos, D., Huang, R., Chang, T. W., ... & Khribi, M. K. (2020). Accessibility within Open Educational Resources and practices for disabled learners: A systematic literature review. *Smart Learning Environments, 7*(1), 1.

Appendix 1: Study 2 and Study 4 ethical approval

Human Research Ethics Committee (HREC)



From Dr Duncan Banks
The Open University Human Research Ethics Committee

Email duncan.banks@open.ac.uk
Extension (6) 59198

To Irina Rets, WELS

Project title: Processing of authentic and non-authentic
simplified texts in L2 among English language
learners: evidence from eye-tracking.

Memorandum

HREC ref **HREC/2018/2774/Rets**

Date application submitted: 12/01/18 (Study 2) / 16/09/19 (Study 4)

Date of HREC response: 08/02/18 (Study 2) / 19/09/19 (Study 4)

This memorandum is to confirm that the research protocol for the above-named research project, as submitted for ethics review, has been given a favourable opinion by Chair's action by the Open University Human Research Ethics Committee.

Please note the following:

1. You are responsible for notifying the HREC immediately of any information received by you, or of which you become aware which would cast doubt on, or alter, any information contained in the original application, or a later amendment which would raise questions about the safety and/or continued conduct of the research.
2. It is essential that any proposed amendments to the research are sent to the HREC for review, so they can be recorded and where required, a favourable opinion given prior to any changes being implemented (except only in cases of emergency when the welfare of the participant or researcher is or may be affected).
3. Please include your HREC reference number in any documents or correspondence. It is essential that it is included in any publicity related to your research, e.g. when seeking participants or advertising your research so it is clear that it has been reviewed by HREC and adheres to OU ethics review processes.
4. You are authorised to present this memorandum to outside bodies such as NHS Research Ethics Committees in support of any application for future research clearance. Also, where there is an external ethics review, a copy of the application and outcome should be sent to the HREC.
5. OU research ethics review procedures are fully compliant with the majority of grant awarding bodies and where they exist, their frameworks for research ethics.
6. At the end of your project, you are required to assess your research for ethics related issues and/or major changes. Where these have occurred you will need to provide the Committee with a HREC final report to reflect how these were dealt with using the final report template on the research ethics website - http://www.open.ac.uk/research/ethics/human-research/full-review-process-and-proforma#final_report

Best regards

Dr Duncan Banks

The Open University Human Research Ethics Committee

www.open.ac.uk/research/ethics/

Appendix 2: Study 3 ethical approval

Human Research Ethics Committee (HREC)

From Prof Louise Westmarland
The Open University Human Research Ethics Committee



Email research-rec-review@open.ac.uk

Extension (6) 59198

To Irina Rets, WELS

Project title: Processing of authentic and non-authentic

Memorandum

simplified texts in L2 among English language

learners: evidence from eye-tracking.

HREC ref **HREC/3046/RETS**

Date application submitted: 12/10/2018

Date of HREC response: 09/11/2018

This memorandum is to confirm that the research protocol for the above-named research project, as submitted for ethics review, has been given a favourable opinion by Chair's action by the Open University Human Research Ethics Committee. Please note the following:

As part of your favourable opinion, it is essential that you are aware of and comply with the following:

1. You are responsible for notifying the HREC immediately of any information received by you, or of which you become aware which would cast doubt on, or alter, information in your original application, in order to ensure your continued safety and the good conduct of the research.
2. It is essential that you contact the HREC with any proposed amendments to your research, for example - a change in location or participants. HREC agreement needs to be in place before any changes are implemented, except only in cases of emergency when the welfare of the participant or researcher is or may be affected.
3. Your HREC reference number has to be included in any publicity or correspondence related to your research, e.g. when seeking participants or advertising your research, so it is clear that it has been agreed by the HREC and adheres to OU ethics review processes.
4. Researchers should have discussed any project-related risks with their Line Manager and/or Supervisor, to ensure that all the relevant checks have been made and permissions are in place, prior to a project commencing, for example compliance with IT security and Data protection regulations.
5. Researchers need to have read and adhere to relevant OU policies and guidance, in particular the Ethics Principles for Research involving Human Participants and the Code of Practice for Research - <http://www.open.ac.uk/research/ethics/>
6. The Open University's research ethics review procedures are fully compliant with the majority of research council, professional organisations and grant awarding bodies research ethics guidelines. Where required, this message is evidence of OU HREC support and can be included in an external research ethics review application. The HREC should be sent a copy of any external applications, and their outcome, so we have a full ethics review record.
7. At the end of your project you are required to assess your research for ethics related issues and/or any major changes. Where these have occurred, you will need to provide the Committee with a HREC final report to reflect how these were dealt with using the template on the research ethics website - <http://www.open.ac.uk/research/ethics/human-research/full-review-process> (HREC Final Report form)

Sent on behalf of the Human Research Ethics Committee

Professor Louise Westmarland

Dr Duncan Banks

Dr Claire Hewson

Chair

Deputy Chair

Deputy Chair

Human Research Ethics Committee

The Open University, Walton Hall, Milton Keynes, MK7 6AA

<http://www.open.ac.uk/research/ethics>

Appendix 2: Study 3 participant recruitment advertisement

Making English texts more accessible to English learners



To find out more about text simplification strategies for English learners, we are conducting a research study at the Open University. We would like to ask you for your co-operation in this research*.

We are looking for English teachers who

- speak Spanish / Russian / Chinese as their mother tongue;
- have minimum 5 years of experience of teaching English.

*approved by Open University ethics committee - HREC/3046/RETS

If you wish to participate, please, access the texts and project-related documents at

<https://openuniversity.onlinesurveys.ac.uk/simplification-study-with-english-teachers-2>

By participating in this research project, you will make an important contribution to making learning through English more accessible for English learners.

If you wish to participate in a Skype interview following the text simplification you will carry out, we will be able to reward you for your time in the form of an **Amazon voucher**.

Please, e-mail the main researcher, Irina Rets, for any queries at irina.rets@open.ac.uk

Appendix 3: Study 3 texts for the online text simplification task

OER texts used in Study 2 as part of the online text simplification task

Text 1. Introduction to vitamins and why we need them

Before the 19th century, one of the hazards of long sea voyages was a condition called scurvy, whose symptoms were loss of hair and teeth, bleeding gums, very slow healing of wounds, and eventually death. Hundreds of sailors and explorers died from scurvy until a Scottish physician, James Lind, in the 1750s discovered that adding a daily portion of citrus fruit to the rations of those at sea could prevent the condition, whereas adding cider, vinegar or various other substances that he tested, could not. In those days, it was considered that a disease was caused by something bad in the diet, or in the air, but not by the absence of something good, so despite Lind's evidence, his ideas were not accepted by his fellow physicians. Additionally, he was unable to confirm his work by experiments on land since, although he tried to restrict the types of food eaten by a group of volunteers to attempt to produce scurvy in them, he was unable to do so, probably because it can take several months for the condition to develop, and in that time his volunteers occasionally cheated on their diet. However, though he died disillusioned, Lind had actually discovered the importance and source of vitamin C.

Before their detailed chemical structures were known, vitamins were named by being given a letter. They are generally still referred to by that letter, as well as by their chemical name; for example, vitamin C or ascorbic acid. There are two main groups of vitamins: fat-soluble vitamins and water-soluble vitamins. The body can store fat-soluble vitamins, but any excess water-soluble vitamins are easily removed from the body in the urine, so regular intake is necessary. Vitamins are, however, needed in only very small quantities.

Text 2. Complex issues: social work, risk and the media

It can be argued that, on many occasions, social workers engage with some of society's most complex issues, often being called on to intervene alongside other professionals or when a series of interventions have not been effective enough to keep a service user supported or safe. For example, many young people coming to the attention of social workers may already be known to teachers, school counsellors, health professionals or others, before their situation arrives at the point of needing social work action.

At this point, social workers do not make decisions about how to respond to perceived risks alone. Their judgements are made in conjunction with service users, their kin and networks, and in discussion with other significant professional people – for example, doctors, teachers, other health workers, lawyers and the police. These professionals will have important information that needs to be considered. Also, social workers can only act where the law permits. They do, however, have significant power given to them by law, and this has to be exercised ethically.

It can be argued that politicians and especially the media – in the shape of newspapers, radio and television – demonstrate little understanding of the complexity of the social work task. There often seems to be an unrealistic expectation of omniscience, when in fact social workers can only work with the information and resources available to them.

When social workers are blamed for 'failures' in particular circumstances, there may be some errors of social work practice to learn from, but it is also important to consider the complexity of the wider picture and the way in which a 'blame culture' is not helpful to the profession.

Appendix 4: Study 3 typological differences between participants' mother tongues

Some key typological differences between Spanish, Chinese and Russian

Typology	Study 2 participants' mother tongues		
	Spanish	Mandarin Chinese	Russian
Language family	Indo-European/Romance	Sino-Tibetan/Sinitic	Indo-European/Slavic
Tone and stress	<ul style="list-style-type: none"> • stress language uses stress to distinguish words; • syllable-timed no vowel reduction 	<ul style="list-style-type: none"> • tone language uses tone to distinguish words 	<ul style="list-style-type: none"> • stress language; • stress-timed vowel reduction
Morphological typology	<ul style="list-style-type: none"> • Inflecting uses a single suffix in order to express the grammatical functions; • medium degree of inflection 	<ul style="list-style-type: none"> • Isolating/analytic expresses the connection among words mainly through their order in the sentence 	<ul style="list-style-type: none"> • Inflecting • high degree of inflection
Syntactical Typology	<ul style="list-style-type: none"> • preferred word order: subject (S)-verb (V)-object (O); • noun (N)-adjective (A) order: N-A 	<ul style="list-style-type: none"> • preferred word order: SVO; • N-A order: A-N 	<ul style="list-style-type: none"> • preferred word order: SVO; • N-A order: A-N
Script	alphabetic/Latin	logographic	alphabetic/Cyrillic

(Based on Comrie, 1989; Ramat, 2011)

Appendix 5: Study 3 interview questions

Part 1.

1. Tell a little bit about yourself – where do you teach, type of students, their proficiency level.
2. Do you simplify original texts that you bring to your classroom? Why/Why not?
- 3a. When you simplify texts for your learners, does your mother tongue influence how you simplify it?
- 3b. If you don't simplify – what the potential influence of your mother tongue might be on this practice?

Part 2.

The interviewer goes through each change identified prior to the interview in the two simplified texts and asks the interviewee why a particular instance was simplified / replaced / removed / changed in the original text.

Appendix 6: Study 4 participant recruitment advertisement

Making English texts more accessible to English learners



To find out more about how English non-native speakers read in English, we are conducting an eye-tracking research study at the Open University. We would like to ask you for your co-operation in this research*.

We are looking for English non-native speakers who

- haven't reached the highest level of English language proficiency;
- have good / corrected to normal eyesight to be able to take part in the eye-tracking

If you are interested to take part, or if you have any queries – please, e-mail the main researcher, Irina Rets, irina.rets@open.ac.uk

If you wish to participate, we can arrange your visit to the Open University campus/visit your campus at a time convenient for you. You will complete a few short tests, and read one text from the computer screen while the eye-tracker* records the movements of your eyes. Participation should not take more than 90 minutes.

We will be able to reward you for your time in the form of an **Amazon voucher**.

By participating in this research project, you will not only make an important contribution to research, but this will also visualise the reading process for you. It will help you self-reflect more on how you read.



*approved by Open University ethics committee - HREC/2018/2774/Rets

* Eye-tracking is non-invasive (you do not have to wear special kit or get linked up to any instruments), it records gaze-direction while the person looks at a computer screen

Appendix 7: Study 4 texts with the list of the text simplification changes

Text 1 Authentic	Text 1 Simplified
<p>Introduction to vitamins and why we need them</p> <p>Before the 19th century, one of the hazards¹ of long sea² voyages³ was a condition⁴ called scurvy,⁵ whose symptoms⁶ were loss⁸ of hair and teeth, bleeding gums⁹, very slow healing of wounds¹⁰, and eventually¹¹ death¹². Hundreds of sailors and explorers died from scurvy¹³ until a Scottish physician, James Lind, in the 1750s discovered that adding a daily portion¹⁶ of citrus fruit to the rations¹⁷ of those at sea¹⁸ could prevent the condition¹⁹, whereas²⁰ adding cider, vinegar or various other substances that he tested²³, could not²⁴. In those days, it was considered²⁵ that a disease was caused by something bad in the diet, or in the air, but not by the absence²⁶ of something good,²⁷ so despite Lind's evidence, his ideas²⁹ were not accepted³⁰ by his fellow physicians³¹. Additionally, he was unable³² to confirm his work by experiments on land³³ since³⁴, although he tried to restrict³⁵ the types of food eaten³⁶ by a group of volunteers to attempt³⁷ to produce scurvy in them, he was unable to do so³⁸, probably³⁹ because it⁴⁰ can take several months for the condition to develop⁴¹, and in that time his volunteers occasionally cheated on their diet. However, though⁴² he⁴³ died disillusioned⁴⁴, Lind had actually discovered the importance and source of vitamin C.</p> <p>Before their⁴⁵ detailed chemical structures were known⁴⁶, vitamins were named⁴⁷ by being given⁴⁸ a letter. They are generally still referred⁴⁹ to by that letter, as well as by their chemical name; for example, vitamin C or ascorbic acid. There are two main groups of vitamins: fat-soluble vitamins and water-soluble vitamins. The body can store fat-soluble vitamins, but any excess⁵⁰ water-soluble vitamins are easily removed from the body in the urine,⁵¹ so regular intake is necessary. Vitamins are, however⁵⁴, needed⁵⁵ in only very small quantities⁵⁶.</p>	<p>Introduction to vitamins and why we need them</p> <p>Before the 19th century, one of the dangers of long journeys at sea was a disease called scurvy. People who suffered⁷ from this disease gradually lost their hair and teeth, their gums bled, wounds healed very slowly, and they died in the end. Hundreds of sailors and explorers died from scurvy. Then¹⁴, in the 1750s¹⁵, a Scottish physician James Lind, discovered that adding a daily amount of citrus fruit to the food supply of sailors could prevent the disease. He also discovered²¹ that adding other substances²² like cider or vinegar did not help. In those days, people thought that a disease was caused by something bad in the diet, or in the air, but not by the lack of something good. So, despite Lind's evidence, his colleagues at the time²⁸ did not believe his ideas. Additionally, he couldn't confirm his work by experiments on land. Although he tried to produce scurvy in a group of volunteers by restricting the types of food they ate, he failed. Probably because scurvy can take several months to develop, and in that time his volunteers occasionally cheated on their diet. However, although Lind died disappointed, he had actually discovered the importance and source of vitamin C.</p> <p>Before the detailed chemical structures of vitamins were discovered, vitamins had names of letters. They are generally still known by these letters, as well as by their chemical name: for example, 'vitamin C' or 'ascorbic acid'. There are two main groups of vitamins: fat-soluble vitamins and water-soluble vitamins. The body can store fat-soluble vitamins, but water-soluble vitamins are easily removed from the body in the urine. Although⁵² regular intake of vitamins⁵³ is necessary, people need vitamins in only very small amounts⁵⁷.</p>
<p>16 text simplification strategies as identified in Study 3 (see Section 6.3.1) Approach: surface-level modifications Change word frequency</p>	

1 ('hazards' vs. 'dangers'); 3 ('voyages' vs. 'journeys'); 4;19 ('condition' vs. 'disease'); 11 ('eventually' vs. 'in the end'); 16 ('portion' vs. 'amount'); 17 ('rations' vs. 'food supply'); 26 ('absence' vs. 'lack'); 30 ('accepted' vs. 'believed'); 32 ('unable' vs. 'couldn't'); 37 ('attempt' vs. 'tried'); 42 ('though' vs. 'although'); 44 ('disillusioned' vs. 'disappointed'); 49 ('referred' vs. 'known'); 56 ('quantities' vs. 'amounts')

Convert into SVO order

9 ('bleeding gums' vs. 'their gums bled'); 10 ('very slow healing of wounds' vs. 'wounds healed very slowly'); 12 ('eventually death' vs. 'they died in the end'); 41 ('it can take ...for the condition to develop' vs. 'scurvy can take several months to develop')

Split sentence

5; 13; 20; 27; 33; 39; 51

Convert passive into active

25 ('it was considered' vs. 'people thought'); 29 ('his ideas were not accepted' vs. 'his colleagues ... did not believe his ideas'); 36 ('food eaten by a group of volunteers' vs. 'food they ate'); 47 ('vitamins were named' vs. 'vitamins had names'); 55 ('Vitamins are ... needed' vs. 'people need vitamins')

Convert noun into verb

8 ('loss' vs. 'lost')

Approach: content modifications

Cut information

20 ('whereas'); 23 ('that he tested'); 34 ('since'); 48 ('by being given'); 50 ('any excess'); 54 ('however')

Add clarification

6 ('People who suffered from this disease gradually' added to simplification); 21 ('He also discovered'); 22 ('other substances'); 24 ('did not help'); 46 ('known' vs. 'discovered')

Compress meaning

31 ('fellow physicians' vs. 'his colleagues'); 38 ('he was unable to do so' vs. 'he failed')

Add emotional emphasiser

7 ('suffered' added to simplification);

Add time references

28 ('at the time' added to simplification)

Approach: discourse features modifications

Add logical connectives

14 ('then' added to simplification); 52 ('although')

Break the noun phrase

2 ('sea voyages' vs. 'journeys at sea')

Change order of ideas

15 ('until a Scottish physician, James Lind, in the 1750s' vs. 'then, in the 1750s, a Scottish physician James Lind'); 35 ('tried to restrict the types to attempt to produce scurvy in them' vs. 'tried to produce scurvy ... by restricting')

Resolve pronoun

18 ('those at sea' vs. 'sailors'); 40 ('it' vs. 'scurvy'); 43 ('he' vs. 'Lind'); 45 ('their' vs. 'vitamins'); 53 ('of vitamins' added)

Combine sentences

57 ('so regular intake is necessary. Vitamins are, however, needed in only very small quantities' vs. 'Although regular intake of vitamins is necessary, people need vitamins in only very small amounts')

Text 2 Authentic	Text 2 Simplified
<p>Complex issues: social work, risk and the media</p> <p>It can be argued that, on many occasions¹, social workers engage with² some of society's³ most complex issues^{4,5} often being⁶ called on to⁷ intervene⁸ alongside⁹ other professionals or when a series of interventions¹⁰ have not been effective enough to keep a service user¹² supported or safe. For example, many young people coming to the attention of¹³ social workers may already be known to teachers, school counsellors, health professionals or others, before their situation arrives at the point of needing¹⁵ social work action¹⁶.</p> <p>At this point¹⁷, they⁵⁰ do not make decisions about how to respond to¹⁸ perceived¹⁹ risks alone²⁰. Their judgements are made²¹ in conjunction with²² service users²³, their kin²⁴ and networks^{25,26} and in discussion with²⁷ other significant²⁹ professional people – for example, doctors, teachers, other³⁰ health workers, lawyers and the police. These professionals³¹ will have important information that needs to be considered³². Also, social workers can only act where the law permits³³. They do, however, have significant power given to them by law³⁴, and this has to be³⁷ exercised³⁸ ethically.</p> <p>It can be argued that politicians and especially the media – in the shape of³⁹ newspapers, radio and television – demonstrate little understanding⁴⁰ of the complexity of the social work task. There often seems to be⁴¹ an unrealistic expectation⁴² of omniscience⁴³, when in fact social workers can only work with the information and resources available to them.</p> <p>Social workers are blamed for 'failures' in particular circumstances⁴⁴. There⁵² may be some errors⁴⁵ of social work practice to learn from,⁴⁶ but it is also important to consider⁴⁷ the complexity of the wider picture and the way in which⁴⁸ a 'blame culture' is not helpful⁴⁹ to the profession.</p>	<p>Complex issues: social work, risk, and the media</p> <p>It can be argued that social workers very often deal with some of the most complex problems in society. They often act together with other professionals or when a series of services offered to the person in need¹¹ before haven't been effective enough to keep him/her supported or safe. For example, many young people who need social work service¹⁴ may already be known to teachers, school counsellors, health professionals or others, before social workers start working with them.</p> <p>When action is needed¹⁸, social workers do not make decisions alone about how to deal with the potential risks. They work closely with the person, their relatives, and friends. Social workers also discuss the situation²⁸ with other important professional people – for example, doctors, teachers, health workers, lawyers, and the police. All these people will have important information to consider. Also, social workers can only act where the law allows it. Of course³⁴, the law gives them some³⁵ significant power, but³⁶ they always⁵¹ have to use it ethically.</p> <p>It can be argued that politicians and especially the media – newspapers, radio, and television – seem to understand little about the complexity of the social work task. It is unrealistic to expect that social workers can know everything, when in fact they can only work with the information and resources available to them.</p> <p>When social workers are blamed for 'failures' in certain situations, there may be some mistakes of social work practice to learn from. However, it is also important to see the complexity of the wider picture and that a 'blame culture' doesn't help the profession.</p>

Approach: surface-level modifications
Change word frequency

1 ('on many occasions' vs. 'very often'); 2 ('engage with vs. 'deal with'); 4 ('issues' vs. 'problems'); 8 ('intervene' vs. 'act'); 9 ('alongside' vs. 'with'); 10 ('interventions' vs. 'services'); 18 ('respond' vs. 'deal'); 19 ('perceived' vs. 'potential'); 22 ('in conjunction with' vs. 'closely with'); 23 ('service users' vs 'the person'); 24 ('kin' vs. 'relatives'); 25 ('networks' vs. 'friends'); 29 ('significant' vs. 'important'); 31 ('professionals' vs. 'people'); 33 ('permits' vs. 'allows'); 38 ('exercised' vs. 'use'); 44 ('circumstances' vs. 'situations'); 45 ('errors' vs. 'mistakes'); 47 ('consider' vs. 'see')

Convert into SVO order

27 ('and in discussion with' vs. 'Social workers also discuss'); 34 ('given to them by law' vs. 'the law gives them'); 37 ('this has to be exercised' vs. 'they have to use it'); 42 ('There often seems to be' vs. 'It is unrealistic to expect'); 49 ('is not helpful' vs. 'doesn't help')

Split sentence and Split paragraph

5; 26; 46

Convert passive into active

6 ('often being called on to' vs. 'They often act'); 21 ('Their judgements are made' vs. 'They work closely with')

Approach: content modifications

Cut information

7 ('often being called on to intervene'); 12 ('service user'); 15 ('before their situation arrives at the point of needing'); 17 ('At this point'); 30 ('other'); 39 ('in the shape of'); 41 ('seems to be'); 48 ('the way in which')

Add clarification

11 ('offered to the person in need'); 14 ('social work service'); 28 ('the situation' added); 35 ('some'); 43 ('social workers can know everything')

Compress meaning

13 ('coming to the attention of' vs. 'who need'); 16 ('before their situation arrives at the point of needing social work action' vs. 'before social workers start working with them'); 32 ('that needs to be considered' vs. 'to consider')

Add emotional emphasiser

34 ('of course' added)

Add time references

51 ('always' added)

Approach: discourse features modifications

Add logical connectives

18 ('When action is needed'); 36 ('but')

Convert noun into verb

40 ('little understanding' vs. 'understand little'); 42 ('expectation' vs. 'to expect')

Break the noun phrase

3 ('society's most complex issues' vs. 'most complex problems in society')

Change order of ideas

20 ('do not make decisions about... alone' vs. 'do not make decisions alone about')

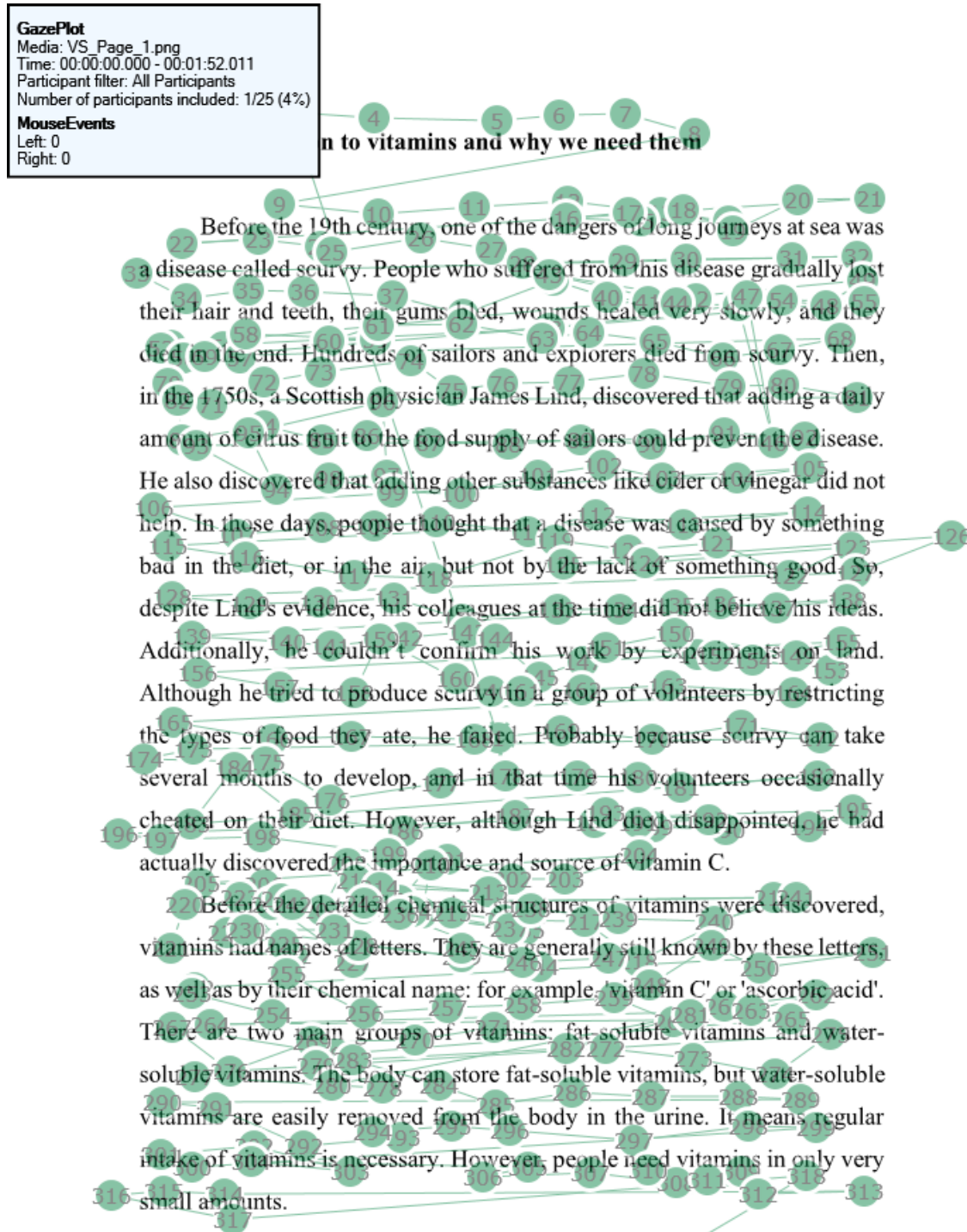
Resolve pronoun

50 ('they' vs. 'social workers')

Combine sentences: 52

Appendix 8: Study 4 sample gaze plot

Text 1, simplified



Appendix 9: Study 4 language proficiency test

For the questions below, please circle one best option to complete the sentence or conversation. The first five questions refer to a conversation between two people.

1. Person A: Can I park here?

- a) Person B: Sorry, I did that.
- b) Person B: It's the same place.
- c) Person B: please, check the building regulations.
- d) Person B: Only for half an hour.

2. Person A: What colour will you paint the children's bedroom?

- a) Person B: I hope it was right.
- b) Person B: We can't decide.
- c) Person B: It wasn't very difficult.
- d) Person B: the living room will be in light blue.

3. Person A: I can't understand this email.

- a) Person B: Would you like some help?
- b) Person B: Don't you know?
- c) Person B: I suppose you can.
- d) Person B: what a shame!

4. Person A: I'd like two tickets for tomorrow night.

- a) Person B: How much did you pay?
- b) Person B: Afternoon and evening.
- c) Person B: I'll just check for you.
- d) Person B: Good idea, why not?

5. Person A: Shall we go to the gym now?

- a) Person B: It's very good.
- b) Person B: Not at all.
- c) Person B: I'm not sure I want to study.
- d) Person B: I'm too tired.

6. His eyes were bad that he couldn't read the number plate of the car in front.

- a) such
- b) too
- c) so
- d) very

7. The company needs to decide and for all what its position is on this point.

- a) here
- b) once
- c) first
- d) finally

8. Don't put your cup on the of the table – someone will knock it off.

- a) outside
- b) edge

- c) boundary
- d) border

9. I'm sorry - I didn't to disturb you.

- a) hope
- b) think
- c) mean
- d) suppose

10. The singer ended the concert her most popular song.

- a) by
- b) with
- c) in
- d) as

11. Would you mind these plates a wipe before putting them in the cupboard?

- a) making
- b) doing
- c) getting
- d) giving

12. I was looking forward at the new restaurant, but it was closed.

- a) to eat
- b) to have eaten
- c) to eating
- d) eating

13. tired Melissa is when she gets home from work, she always makes time to say goodnight to the children.

- a) Whatever
- b) No matter how
- c) However much
- d) Although

14. It was only ten days ago she started her new job.

- a) then
- b) since
- c) after
- d) that

15. The shop didn't have the shoes I wanted, but they've a pair specially for me.

- a) booked
- b) ordered
- c) commanded
- d) asked

16. Have you got time to discuss your work now or are you to leave?

- a) thinking
- b) round
- c) planned
- d) about

17. She came to live here a month ago.

- a) quite
- b) beyond
- c) already
- d) almost

18. Once the plane is in the air, you can your seat belts if you wish.

- a) undress
- b) unfasten
- c) unlock
- d) untie

19. I left my last job because I had no to travel.

- a) place
- b) position
- c) opportunity
- d) possibility

20. It wasn't a bad crash and damage was done to my car.

- a) little
- b) small
- c) light
- d) mere

21. I'd rather you to her why we can't go.

- a) would explain
- b) explained
- c) to explain
- d) will explain

22. Before making a decision, the leader considered all of the argument.

- a) sides
- b) features
- c) perspectives
- d) shades

23. This new printer is recommended as being reliable.

- a) greatly
- b) highly
- c) strongly
- d) readily

24. When I realised I had dropped my gloves, I decided to my steps.

- a) retrace
- b) regress
- c) resume
- d) return

25. Anne's house is somewhere in the of the railway station.

- a) region
- b) quarter
- c) vicinity
- d) district

Appendix 10: Study 4 background knowledge questionnaire

Please, circle one answer in each point about how familiar you were with the topic of the text you have just read:

1. I didn't have a clear idea about this topic before reading the text

- a) strongly disagree b) disagree c) somewhat disagree d) not sure e) somewhat agree f) agree g) strongly agree

2. It will be easy to respond to the questions about this topic

- a) strongly disagree b) disagree c) somewhat disagree d) not sure e) somewhat agree f) agree g) strongly agree

3. I knew a lot about this topic before reading the text, i.e., I had more than enough ideas to talk about this topic

- a) strongly disagree b) disagree c) somewhat disagree d) not sure e) somewhat agree f) agree g) strongly agree

4. It would be easy for me to produce enough ideas for this topic from memory

- a) strongly disagree b) disagree c) somewhat disagree d) not sure e) somewhat agree f) agree g) strongly agree

5. If I were to talk about this topic in my first language, I would have more ideas to talk about

- a) strongly disagree b) disagree c) somewhat disagree d) not sure e) somewhat agree f) agree g) strongly agree

Appendix 11: Study 4 topic interest questionnaire

Next to each adjective, please, circle the correct answer about how you felt when reading the text you have just finished:

While reading the text I felt

1. "stimulated"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

2. "engaged"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

3. "bored"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

4. "interested"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

To me personally, the topic is

5. "meaningful"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

6. "useful"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

7. "worthless"

a) completely disagree b) disagree c) slightly disagree d) neutral e) slightly agree f) agree g) strongly agree

Appendix 12: Study 4 multiple-choice comprehension tests for Texts 1 and 2

Please, complete the following comprehension test in accordance with what you have read in the text. Please, circle only one answer in each point.

Text 1.

1. According to the text, which of the following was a symptom of scurvy?

- a) high fever
- b) chest pain
- c) numbing of limbs
- d) slow closing of wounds

2. Who suffered the most from scurvy in the past?

- a) sailors
- b) physicians
- c) James Lind
- d) villagers

3. Where was James Lind originally from?

- a) Ireland
- b) Scotland
- c) U.S.
- d) France

4. What could help fight scurvy, according to James Lind's discovery?

- a) restricting the diet
- b) adding cider and vinegar to the diet
- c) adding stone fruit to the diet
- d) adding lemons to the diet

5. Why did James Lind's colleagues not believe that he had found a solution for scurvy?

- a) they already knew enough about vitamins
- b) James Lind did not discover anything new
- c) they could not imagine a lack of vitamins could cause a disease
- d) James Lind died before he finished his experiments

6. What did James Lind do to try and prove his solution for scurvy?

- a) he studied samples of lost hair
- b) he restricted his own diet
- c) he tried to develop scurvy symptoms in a group of volunteers
- d) he added cider and vinegar to the diet of those on land

7. How did James Lind feel about his work before he died?

- a) happy
- b) disappointed
- c) envious
- d) thankful

8. Why were vitamins named using just a single letter in the past?

- a) because it is shorter
- b) because physicians could not agree on the names of the vitamins
- c) because there had been very few vitamins discovered by that time
- d) because the chemical formulas of vitamins had not been discovered yet

9. What type of vitamins are not stored in the body?

- a) fat-soluble
- b) water-soluble
- c) vitamin E
- d) all of the above

10. How much of each vitamin do people need to take?

- a) very little
- b) in big quantities
- c) people need mainly fat-soluble vitamins
- d) people need mainly water-soluble vitamins

Text 2.

1. According to the text, what do social workers do?

- a) provide support and help to the people in need
- b) keep other professionals safe
- c) solve society's complex problems
- d) help with the school administration

2. Which of the following specialists do the people in need not contact before social workers start working with them?

- a) doctors
- b) teachers
- c) school counsellors
- d) career advisors

3. Which of the following groups of people do social workers not seek advice from?

- a) other professionals
- b) families of the people in need
- c) friends of the people in need
- d) other people in need who receive help from social workers

4. Why don't social workers make decisions on their own?

- a) because it is not ethical
- b) because the information shared by other professionals might help to understand the situation better
- c) because they need to ask the permission of the families of the people in need first
- d) because social workers might fail alone

5. Why do social workers have the right to interfere?

- a) because they are authorised by the school administration
- b) because they are authorised by the people in need themselves

- c) because they are authorised by law
- d) because they are authorised by the police

6. According to the text, which of the following underestimates, specifically, the work of social workers?

- a) the media
- b) lawyers
- c) the families of the people in need
- d) social workers themselves

7. What is one unrealistic expectation about social workers?

- a) that they can provide the necessary support to the people in need
- b) that they know everything
- c) that they can cope with the risk and danger they face
- d) that they can act without consulting anyone

8. Why are social workers sometimes 'blamed' for failures?

- a) because of sometimes poor working practices
- b) because it is believed they do not work hard enough
- c) because they do not show enough empathy to the people in need
- d) because social workers often do not like their job

9. Why should we not 'blame' social workers for failures?

- a) because this creates a stressful environment
- b) because it damages their reputation
- c) because the scope of the social problems they face is wide and very complex
- d) because they do not have enough funding to do a better job

10. What is a 'blame culture', in the context of this text?

- a) a culture in the geographic region of Blame
- b) a culture where it is usual to find a group of responsible people guilty
- c) a culture where blaming your neighbour is accepted
- d) a culture that blames the victim