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Advancing writing research:
an investigation of the effects
of web-based peer review on
second language writing

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# Advancing writing research: an investigation of the effects of web-based peer review on second language writing

University of Tartu, Institute of Estonian and General Linguistics

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# ABSTRACT

**Background.** Writing or text production is considered an inherent social activity, cognitively demanding, and genre specific and are, therefore, used as the framework to study second language writing in a higher educational establishment. The assumption is that providing students with a structure that will support social interaction, aid the cognitively demanding task by introducing them with a genre approach to writing will significantly aid in the learning of writing.

**Aims.** The main aim of this dissertation is to determine how the act of peer review (social interaction) influences text production (multiple drafts of essays) of students attending an English academic writing course using a web-based peer review system.

**Methods.** Machine Learning is used to test different models of effective peer feedback. These models contain multiple features identifying specific aspects believed to positively (or negatively) predict observable revisions in a subsequent draft.

**Results.** Two features were identified to positively predict revision in subsequent drafts: a feature identifying multiple reviewers commenting on the same aspect in the text that needs the writer's attention, and a feature indicating whether a peer review points to a specific (explicit) change that the writer of the text needs to make for the next draft.

**Discussion.** These results support the importance of motivation and multiple perspectives of peers identified in sociocultural theory, the cognitive process, and genre. It provides additional empirical evidence that can be verified in replication studies using the same methodological approach in studies altering slightly the study object.

# TABLE OF CONTENTS

# LIST OF PUBLICATIONS

Writing Context   Web-based peer review systems; Multiple anonymous peer review; Writing multiple drafts; L2 genre writing in the discipline; machine learning method.

Study I   Leijen, D. A. J. (2014). Applying machine learning techniques to investigate the influence of peer feedback on the writing process. In D. Knorr, C. Heine, & J. Engberg (Eds.), *Methods in Writing Process Research,* (pp. 167–183). Frankfurt am Main; New York: Peter Lang.

Study II   Leijen, D. A. J. & Leontjeva, A. (2012). Linguistic and review features of peer feedback and their effect on the implementation of changes in academic writing: A corpus based investigation. *Journal of Writing Research*, 4(3), pp.177–202.

Study III   Leijen, D. A. J. (forthcoming/2017) A novel approach to examine the impact of web-based peer review on the revisions of L2 writers. *Computers and Composition*.

# ACKNOWLEDGEMENTS

History and geography were my favorite subjects in school. If I had stuck to my first university study program, I would have been a human geographer today. A subject which I still hold dearly. However, it would not have led me to this instance now where I find myself writing an acknowledgment for my doctoral dissertation in the field of linguistics in Estonia. It seems only natural to take you by the hand on a journey where I introduce you to historic events and all the remarkable people that have made all this possible. The history and the geography of my journey in the field of writing.

It all started in 2009 when I was encouraged to pursue a PhD. And, no PhD without a supervisor. Drawing up the plans, I already knew who I wanted to be my tower of strength through these uncertain times that lay ahead. I can't recall how it happened, but in 2010 we embarked on this research project with high hopes and ambitions. Consequently, this thesis would not be here if it were not for my supervisor, Ilona Tragel. Ilona, you have been my greatest supporter even before I came to Estonia. You looked passed the photograph on my CV and took a chance to welcome me to the Language Centre. You cannot imagine how much of an impact you have had, and have, shaping me who I am today. Thank you!

Being a PhD student at the University of Tartu also means having to follow courses. At the time of my studies, there were not too many courses which were in English, but there was one course (USUS.03.096 Public Speaking) where 2 unlikely doctoral students met. Me from the department of general linguistics and Anna Leontjeva from the department of computer science. However unlikely it must seem, our paths had crossed before in a course that I taught myself (English for Academic Publishing). Without doubt, the impact that Anna has had on shaping my work has been enormous. Anna, thank you, for taking me by the hand and guiding me through the unchartered territory of machine learning. Without you introducing me to these methods, the world of writing research would have missed out. It might come as a surprise to you, but machine learning is shaping the future of writing research.

The following event on the time line occurred in March 2012, geographic location, University of Birmingham, United Kingdom. I knew that I needed an outsider who would provide the research with alternative stimuli. So, not entirely coincidental, I enrolled in a statistics workshop at the University of Birmingham. Not just a statistics workshop but the statistics for linguists with R workshop led by Stefan Th Gries. More importantly, I knew that the workshop was organized by Nicholas Groom, Senior Lecturer at the University of Birmingham, who I thoroughly investigated via the web. My plan, go to Birmingham, follow the workshop, but come home with Nick as my external supervisor. Once I met Nick in the UK, I knew my strategy worked out. Nick, I remember our lunch, discussing my first paper, and your enthusiasm. Your enthusiasm never faded, even when journals were hard to convince of the value of my work. Even when I spend day and night coding my data in the only month I was

in Birmingham working under your supervision. Your insights, feedback, encouragements have helped me endure the hardships of this PhD journey. Though most of the time geographically divided, you have always been there. Thank you, Nick.

I never thought I would find myself travelling to the USA, but when it comes to writing research, the US is the place to be. Writing research is a field of research in the US. Universities have professors in that field. Universities have departments which specialize in all aspects of writing, rhetoric and composition. Not surprising, Dartmouth College hosts an annual event called *the Dartmouth Summer Seminar for Writing Research*. It was no less in Dartmouth in 1966 where a group of scholars from the US and the UK gathered to discuss the future of writing in higher education. When I read the call, I thought it would be a wonderful experience working with some of the best researchers in the field, with colleagues doing the type of research I do. Where else would you find such a crowd of likeminded people? Never in my right mind did I think I would be selected, but I was. Not only was I selected once, but I was selected to return to the seminar in 2016 to take part of the 50th anniversary of the Dartmouth Institute and Conference. For the progression of my research, the dissemination of my theme, the broadening of perspectives, the scrutinizing of the current state, confirmations, and suggestions, from the words of wisdom of great people such as Charles Bazerman, Ellen Cushman, Sinfree Makoni, Clay Spinuzzi, Deborah Brandt, Cheryl Geisler, and David Galbraith to the discussions with colleagues, such as June Griffin, Darsie Bowen, Christine Rosalia, and all the other participants with who I shared inspirational discussions with, such as Anitha, Kelly, Pearl, Talinn, Ann, Sandra, Aimee, Dylan, Seán, Olga and everybody who was there.

There is, however, one person who deserves all the credit and gratitude for making this happen, for giving me a chance to travel to Dartmouth and meet such remarkable people: Christiane Donahue. Your tireless efforts to build bridges between continent, and bridges between research disciplines must be mentioned and recognized. This thesis is also a tribute to you, your passion, and to all those people working at the Dartmouth Institute making the seminar happen. You are an inspiration for everybody in the field of writing research and you have introduced me to those people that are travelling the same research route I am. Thank you, Christiane.

I remember being in Florida giving a presentation about the current state of my research and my last slide had a picture of a walnut. My message: I feel like a lone nut, and I am looking for others who share my ideas. I am not so sure if I found you, Joe, or if you found me, but thank you Joe Moxley. You heard my message loud and clear, and you are a pioneer in elevating our field of research. I am looking forward to continue our journey. Thank you, Joe, also for introducing me to Norbert who I am incredibly grateful for agreeing to review my work. I do hope we will meet soon. The one person missing in this remarkable lineup is Chris Anson. Chris, I have been an admirer of your work, your words, and your passion in the field of writing research from the first time I heard your

keynote speech delivered in a church in Paris. Thank you, Chris, for agreeing to be part of this incredible event.

This brings me closer to where we are today. And today is just like any other day. Work is ongoing, as it always is, and I am incredibly lucky for being able to share my work with my two AVOK partners Kristin and Anni. AVOK is beating strong primarily because of your dedication to the cause we know is worth caring and fighting for. Thank you both for putting up with me. Anni, Estonian writing depends on you! No pressure! I am also grateful for having met Roger. Roger, I am so glad you are taking up your project with such spirit. We will make sure you don't use the amount of time I needed.

I also want to thank my colleagues at the College of Foreign Languages and Cultures who have been with me from the first day I set foot in Estonia, especially I'd like to thank Ele Sepp for making me feel at home there. I would also like to express my gratitude to my colleagues and fellow PhD students from the Estonian language department. Many have come before and many more will follow. We all share that one question which we always never ask. I'd like to thank Anni and Riina Reinsalu for helping me out with the Estonian summary. Of the many skills that I did pick up, Estonian is not one of them, yet.

Mam, Pap, Pascal, en Xander jullie zullen altijd een deel uit maken van alles wat ik doe. Hoe ver we ook van elkaar zijn, hoe onze wegen zich splitsen in andere richtingen, jullie zijn nooit ver weg. Inge and Raul, you have always been here when I have not. Thank you for encouraging me, supporting me, and being there for me. Mairo and Egle, thank you for sharing your perspectives on all matters Estonian. There have been many times when your home and your garden have brought solace.

Finally, this story line end with those three individuals who never part from my side where ever I go and which every road I take. My two beautiful daughters, Kärt and Nora. I can always rely on you two reminding me about more pressing issues in life, such as My Little Pony, hobbies, ice-cream, and chocolate. I can always count on your hugs, big and small. Äli, this story started with you. You have always soared high during my journey and given me perspective. It was always you.

# PREFACE

This research developed mainly through my professional teaching experience at the Language Centre of the University of Tartu. Prior to my teaching in Tartu, I had been running academic writing courses at the Boswell Institute of the University of Utrecht. These courses were designed based on Feak and Swales' genre informed approach (Swales, 1990; Feak & Swales, 2004). Swales and Feak's handbook  Academic Writing for Graduate Students (AWG) (Swales & Feak, 2004) has been used in many higher educational contexts to instruct graduate students about the writing process. More specifically, it has been used, and is still used, extensively to support the growing community of second language writers in higher education. Second language writers are either the growing community of international students studying at English language universities or L2 writers who experience the need and demand in their local university for English academic writing. The handbook itself, therefore, has a dual purpose: firstly, to instruct students how to write academically, and secondly, to provide students with corpus informed English language use that applies in the context of academic writing.

The course that was taught at the Boswell institute had been running for a few years and the majority of students who took the course were doctoral students of the University of Utrecht. When I ran an adapted version of the course at the University of Tartu, I was surprised by the response of the students during the course. More specifically, the response students gave to a single aspect of the course: peer review. As the genre approach to teaching writing, as presented in Swales and Feak's AWG, is not only a handbook, but a complete pedagogical application how to teach writing in an academic setting, I had not considered peer review to have such profound effect on the participants attending the course. Although AWG does not suggest teachers of writing to use group discussion, peer review, or encourage revision, Swales' genre approach to writing places communication at the forefront. In other words, in the context of university writing, writing a text is understanding the needs of the readers of that text. As such, asking peers to confirm or reject the applicability of a specific aspect of writing becomes an integral part of the writing itself. As a learner, both my high school education and university education has always emphasized the importance of sharing writing with peers and asking feedback from others than your instructor. As such, as writing instructor, I never considered the teaching of writing to be purely content or final product oriented. The course I taught in Utrecht consisted of genre based instructions, discussions of examples from real example texts, the placement of these examples within students' own genre and writing context, and finally, the application through informed decision making what is considered applicable in the specific context of that text. As a result, students develop their knowledge of writing as writers and become more familiar how to improve texts in accordance to this knowledge. As writing becomes part of a student's 'daily' task, putting knowledge into practice will eventually lead students to enhance their skill as writers. This aspect has been demonstrate

in resent research observing a writer's transition from knowledge telling, to knowledge transforming, into the knowledge crafting phase (Kellogg, 2008), marking the difference between inexperienced writers (knowledge telling) and expert writers (knowledge crafting) (Van Waes, Leijten, & Van Weijen, 2009).

In the context of the course at the Language Centre, I realized that many of the students who attended the course, mainly PhD students and research staff, had not been exposed to such approach to writing. Now, after having taught writing for 8 years running, I know that, for the majority of students, writing has largely been about submitting a final written product at the end of the course. As a result, students encounter challenges when writing academic text. Specifically those academic text that aim to disseminate (or display) knowledge to a specific audience. In addition, students face the challenge, as graduate or post graduate students, that their highly specific domain has specific requirements. Challenged also by the fact that the writing is in a second language: English.

This personal professional experience has eventually led me to consider the importance of supporting academic writing of students through academic research. A specific area in the current writing research that requires further investigation concerns the influence communication has on student's writing. More specifically, with the current technological development, writers are exposed to a greater amount of review on their writing, and current pedagogical approaches support multiple peer review as a method that will help students to improve as writers.

# 1. GENERAL INTRODUCTION

## 1.1 Academic writing in the context of Estonia

Higher education in Estonia has gone through many changes after Estonia gained its independence from the Soviet Union. For higher education, the fall of the Soviet Union resulted in new ideas being introduced into the education system at a rapid pace. The former Soviet education systems rarely used writing as a form of assessment; therefore, the teaching of writing was relatively absent (Harbord, 2010). The newly introduced reforms in Estonian Higher Education and the introduction of the Bologna Process resulted in writing taking up a more prominent role (Bjork, Brauer, Rienecker, & Jorgensen, 2003; Kruse, 2013). The prominence of writing being introduced by the internationalization process of the Bologna Process lead, as in many other countries, to the adaptation of writing processes, methods, and studies from the US (Donahue, 2009). This is specifically true for writing in English, which, within the Estonian higher educational context is considered a second language for most university students.

In the current Estonian context, where education reform and internationalization has resulted in the university of Tartu establishing itself firmly in the top 500 world ranking universities according to the 2015 Times Higher Education World University Ranking ("Times Higher Education (THE)," 2015), writing is still not considered a skill one has to develop through continuous practice and support. Writing is primarily taught by enthusiasts, is not taught across all disciplines, and primarily product or text oriented (Leijen, Jürine, & Tragel, 2015b). Despite the position writing find itself in currently, research has been conducted to better understand the state of writing, whether writing in English or writing in Estonian. For example, Kärt Rummel's study investigating the needs of student creating coherent texts English as a foreign language (Rummel, 2010). According to Rummel's findings, students would benefit from discourse-oriented teaching of writing in English to improve the communicative quality of written text in general. In addition, she states that more research is needed in order to raise the awareness of students how they would best learn to write. In 2009, the university of Tartu launched a university wide survey to investigate the state of writing across the disciplines and to investigate the perspectives how writing should be taught and supported from students and instructors (Leijen, Jürine, & Tragel, 2015a). The most striking outcome of this survey is perhaps that writing is often confused with language. Students (and teachers) consider a good command of language (whether Estonian or English) to be a pre-requisite of good writing. As such, the type of support and teaching students receive, primarily focusses on the development of language or the correction thereoy. (Leijen et al., 2015, p. 7774). In addition, the results of the survey also indicated the lack of support or teaching across the disciplines or writing. A possible reason for this lack is, according to the survey, likely related to the large numbers of students enrolled in classes and the lack of time instructors have in providing feedback on writing. Furthermore, as Estonia has not gone

through a writing paradigm like the US or the UK, instructors often lack the competence to teach writing within their discipline as their focus is primarily on the content of their subject.

Other studies conducted in Estonia suggest that the lack of writing skills is caused by the lack of emphasis on writing in secondary education. Universities, generally, rely on secondary schools to teach writing, but if secondary school fail to instruct students about writing the burden of teaching and learning falls on the higher educational establishments. Students lack contact with written texts and as a result have poor writing skills (Ehala, Kerge, Lepajõe, & Sõrmus, 2010, 2015).

Writing in the current higher educational context in Estonia is becoming a topic of interest and a topic of research. The main focus of Estonian writing research has been on language (e.g. Ehala et al., 2010), a specific genre of writing called the *Kirjand* (a short essay written as a school exercise demonstrating good composition). which all high school students need to write (e.g. Lepajõe, 2011), and arguments in the *Kirjand* (e.g. Lepajõe, 2012). More recent efforts are shifting attention the writing process (e.g. Pastuhhova, 2015; Yallop, 2016). All these contributions make writing a discipline that matters in the local Estonian context.

## 1.2 Introduction to the dissertation

The original aim of my research was to determine the role of dialogue in the development of academic writing in the discipline. Although the research itself has diverted slightly from the original description, the aim, in essence, remained the same. The main aim of this dissertation is still to determine how peer communication influences the writing produced by students attending an English academic writing course using a web-based peer review system. The formulation of the main aim has changed to provide more focus. To better understand and to justify the alteration to the main aim, the following section provides a general overview of the diverse field of writing research applicable to the context of this study. The background section places the context of this study within a theoretical framework forming the backbone of the studies published in Article I, II, and III. Article I presents a literature review of web-based peer review systems and machine learning methods to investigate writing. Article I provides a strong argument, with examples, the advantages of both novel methods in writing research. Article II (pilot study) and Article III (main study) report on two separate studies using data obtained from web-based peer review systems and the analysis conducted using machine learning algorithms. In addition, a large part of the theoretical framework provides the justification for the application used to collect the data and the method used to analyze the data. Finally, the theoretical framework clarifies the implication the results have on the field of writing research.

# 2. BACKGROUND

The study of writing, also referred to as text production, is a relatively young field of research. The surge of research generated at the end of the 20th and beginning of the 21st century have resulted in the field becoming more widespread encompassing a diverse number of approaches, theories, and paradigms of writing (MacArthur, Graham, & Fitzgerald, 2008). The handbook of writing and text production (Jakobs & Perrin, 2014) provides a clear and detailed overview of the writing research discipline as it stands today. Historically, studies of writing are rooted in the fields of (general) linguistics, learning sciences, and semiotics. Writing studies in the field of linguistics have provided insights to the study of writing primarily through the studying of syntax, lexis, style and grammar, i.e. texts are the primary object of studies (Prior & Thorne, 2014).

Writing studies in the learning sciences are generally informed by disciplines such as psychology and the social sciences and are interested in the cognitive processes involved in text production (Prior & Thorne, 2014), such as how texts are socially constructed (i.e. how is text mediated by social conventions and part of a particular community of practice), how do individuals learn how to write (i.e. what external factors contribute to the learning process), how do we perceive text, and so forth. The object of research is most often the subject performing the text production.

Semiotics informed writing research is primarily interested in the artifacts that accompany texts (Prior, 2015). For example, images, animations, and other technological advanced means to further inform texts. Examples of such texts are produced in rich computer and/or web-based environments such as gaming, social networks, and so forth. This study does not incorporate semiotics into its study primarily as the setting where the writing takes place is in a higher education institute and in a learning and teaching context. The text production under investigation does not rely too much on additional artifacts. The writing under investigation in this dissertation primarily relies on linguistic and learning sciences as the main pillar used to construct the framework (see Figure 1).
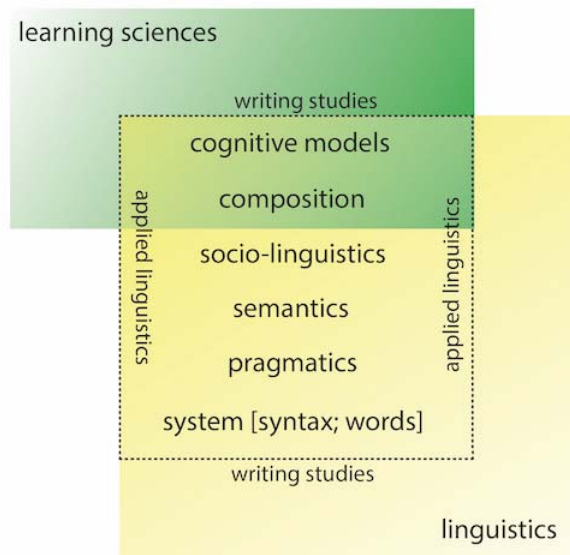
**Figure 1.** writing research domain.

In writing and text production studies, we often find that the domain of linguistics and the domain of learning sciences overlap (see Figure 1). The area where these two domains overlap is often referred to as the research domain of applied linguistics. As discussed earlier, linguistics informed writing studies are often interested in the form of writing or the product of writing, whereas writing studies in the learning sciences are often interested in the process of writing or the function of writing. The applied linguistic writing research domain investigates writing as form and function and the cognitive process involved when developing form and function (Prior & Thorne, 2014). Writing research, in other words, is where studies of cognitive modelling inform the linguistic domain and where the linguistic functions inform the cognitive models. Examples are the genre based studies of Swales (1990; 2004) and Hyland (2003, 2015). Often genre based studies rely on theories or research methods borrowed from corpus linguistics, socio-linguistics, and pragmatics, just to name a few, to construct a more holistic perspective of the complexity of writing.

Due to the complexity of the research space writing research fills, it is important, as writing researchers, to map the research within a clear framework including the object of inquiry, epistemological stance, theoretical framework, data collection, data analysis, and research presentation, as Prior and Thorne (2014) propose (see Table 1). The topics included in Table 1 provides researchers a clear structure how to proceed with the research and, more importantly, what is possible when placing it next to the research aim and object or question to be answered.

**Table 1.** A multidimensional mapping of writing research (Prior & Thorne, 2014).

| **Object of inquiry** |
| --- |
| Text/semiotic artefact (single, multiple, linked by genre, history or situation) |
| Person (individual, persons in context, categorical) |
| Activity (locally situated, dispersed, recurrent) |
| Mediation (technological means of production, distribution, reception; single modality or multiple modalities) |
| Society (social categorization of identity, a community, institution, or social group) |

| **Epistemological stance** |
| --- |
| Disinterested (aiming to describe writing in a basic science sense) |
| Interested (locating the value of research in relation to pedagogical, social, or disciplinary needs) |
| Participatory (researchers locating themselves in the object, e.g., teacher researcher) |
| Interventionist (researchers aiming to promote change through the research) |

| **Theoretical frameworks** |
| --- |
| Text linguistics |
| Semiotics |
| Cognitive science |
| Sociocultural theories of practice/activity |
| Critical, postmodern, feminist, critical race theories |
| Rhetoric and literary analysis |
| Other (e.g., psychoanalytic, rhizomatics) |

| **Data Collection** |
| --- |
| Collection of existing artefacts |
| Observation of existing practices |
| Interview or focus group (off-line interactional) |
| Text and artefact-based interviews |
| Response to scales or surveys |
| Autoethnographic participation |
| Elicited production of new artefacts |
| Elicited production of new performances |
| Observations of (re)designed practices (including experiments) |

| Data Analysis |
| --- |
| Categorization for parametric or nonparametric statistical analysis |
| Categorization of form or theme for descriptive statistics |
| Categorization of form or theme for qualitative account |
| Interdiscursive/intertextual analysis (ranging from categorical to particular) |
| Interpretative analysis (rhetorical or literary) |
| **Research Presentation** |
| Empirical research report genres |
| Interpretive research report genres |
| Experimental/creative representation of research |
| Multimedia representation of research |

I use Prior and Thorne's (2014) mapping to place this dissertation within a writing research framework. In addition, I will elaborate on the theoretical framework used to support the main studies carried out in Article II and Article III. Finally, I will present the aims and objectives of the study in line with both the writing research map, and theoretical framework.

**Table 2.** Mapping of research presented in this dissertation.

| Object of inquiry |
| --- |
| Text: drafts of argumentative essays in the field of chemistry |
| Person: University students |
| Activity: using multiple anonymous written peer feedback |
| Mediation: in a web-based peer review system |
| Society: students at the University of Tartu, Estonia. Second Language writers. |
| **Epistemological stance** |
| Interested (locating the value of research in relation to pedagogical, social, or disciplinary needs) |
| **Theoretical frameworks** |
| Cognitive science: Cognitive writing process model (Flower & Hayes, 1981) |
| Sociocultural theory of learning (Vygotsky, 1978) |
| Genre studies (Flowerdew, 2015; Hyland, 2003; Swales, 1990) |

| Data Collection |
|---|
| Peer review comments |
| Drafts of essays |
| **Data Analysis** |
| Data segmentation of peer reviews into meaning units |
| Comparison of students drafts |
| Predictive analysis of data using statistical machine learning |
| **Research Presentation** |
| Empirical research report genres |
| Interpretive research report genres |

As can be seen from Table 2, this dissertation uses a number of objects of inquiry specific to the context in which the writing takes place. The specificity of the context propels the other aspects specific to this research, such as the interested epistemological stance being a direct cause of the object of inquiry, the data collection being a direct result of the choice of mediation as well as the choice for data analysis and presentation. The most important part in this map is, perhaps, the underlying theoretical framework that is used to guide the research forward into new and compelling findings. As such, the following section further elaborates on the theoretical framework as presented in Table 2.

## 2.1 Sociocultural perspective on writing

The sociocultural theory has had a profound impact on our modern education system. Learning (and teaching) is inherently a social process. Interaction between individuals are fundamentally linked to a learner's cognitive development (Wells, 1999). As such, for the practice of learning to write, the inclusion of peer feedback, as a learning intervention supporting the general principle of interaction, have become common practice (MacArthur et al., 2008; Prior, 2006; Warschauer, 1997). The importance of the inclusion of sociocultural theory in this framework is primarily to include and justify the pedagogical principles guiding the writing instruction: primarily as the writing instructional approach used in the studies is the primary source for the data collected.

Two Vygotskian (Vygotsky, 1978) principles support this dissertation. The first principle relates to motivation and the context in which the writing takes place. For learner writers to learn how to write, the writing task and the written text need social context and real application. More specifically, when asking writers to write a text, learners are much more motivated to write when they know that they are writing for a 'real' audience. The second principle relates to

language. As the writers in the context of this dissertation are second language writers, the learning of a language for writing is an important aspect. According to the sociocultural perspective, exposure to real contexts of language application supports the learning of the language needed to 'write' in that context. The context for language learning is applied to the language needed in scientific writing and more specifically, within a specific discipline. Both principles are supported using a web-based peer review system supporting motivation and language learning specific for the group of learners represented in this dissertation.

As the sociocultural perspective influences education in general, it can, therefore, not be separated from the following two theories used to construct the framework: cognitive process theory, and genre theory. Sociocultural theory is an integral component of both theories which are more specific focused on writing and text production.

## 2.2 Cognitive process theory

Murray (1972) published a seminal paper entitled, "teach writing as a process not product". Writing had long been viewed and evaluated as products. Murray, and others with him (Murray, 1980; Sommers, 1980), however, prescribed that for students to learn to write they would do better if they followed 4 different stages of writing: pre-writing, drafting, revising, and editing. Today, this general process description is still used in many writing classes; however, more complex models have emerged as cognitive studies probed deeper into writers' minds whilst writing. The most well-known model is the Hayes-Flower model (see Figure 2). The Hayes-Flower model (Flower & Hayes, 1981) presented a slightly more complex writing process. The model took into consideration the writing task and the cognitive abilities of the writer performing that task. More recently, Hayes, updated the Hayes-Flower model (Hayes, 2012) as the previous model presented a fairly linear approach to the writing process, starting with pre-writing and ending with editing. The new model, Hayes' Model (see Figure 3), presents a three dimensional model of the writing process. The most notable change is found in the control level – the level that includes writing tasks such as revising, collaborating, summarizing, etc. (Hayes, 2012, p. 375). Based on empirical evidence, Hayes' model finds a prominent role of motivation. Motivation, according to Hayes, was left out in previous models, and, as he states "to account adequately for how people write, we have to learn how to combine motivation with cognitive processes in our model—something that I believe we have not yet adequately done" (Hayes, 2012, p. 372).
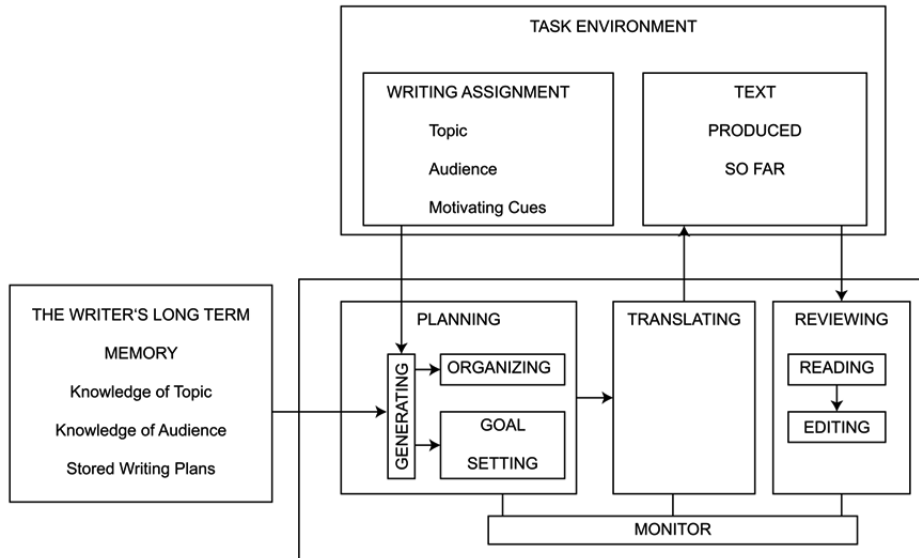
**Figure 2.** Hayes-Flower model (L Flower & Hayes, 1981, p. 370).

Studies addressed by Hayes, suggest that motivation is related to a person's willingness to engage in writing, the amount of text that gets produced, and the quality of the writing. In addition, motivation may also be related to a person's willingness to revise their text and engage in peer feedback, as also suggested by Nelson and Schunn (2009).

Another noticeable difference in Hayes' model is the exclusion of monitor. According to Hayes, monitor was an important aspect in the Hayes-Flower model as it distinguished individual differences (Hayes, 2012). These individual differences were indicative of the way students planned, revised, and so forth. It also included differences between novice and expert writers. In the new model, individual differences are primarily at the control level (the level that includes writing tasks such as revising, collaborating, summarizing, etc.) but, Hayes states that many of these differences are also stored in the long-term memory at the resource level. Generally, Hayes' model assumes individual differences and, therefore, the whole model modifies accordingly, depending on a person's experience with writing.

complex three-dimensional model replaces the original one-dimensional model

Transcription
as activity

Process
Level

Control
Level

Current Plan

Writing Schemas

Transcriber

Text-Written-
So-Far

Resource
Level

Long-Term
Memory

Reading

Evaluator

Translator

Goal Setting
Plan
write
revise

Attention

Working
Memory

Motivation

Transcribing
Technology

Task Materials,
Written Plans

Writing
Processes

Proposer

Collaborators
& Critics

Task
Environment

prominent role of
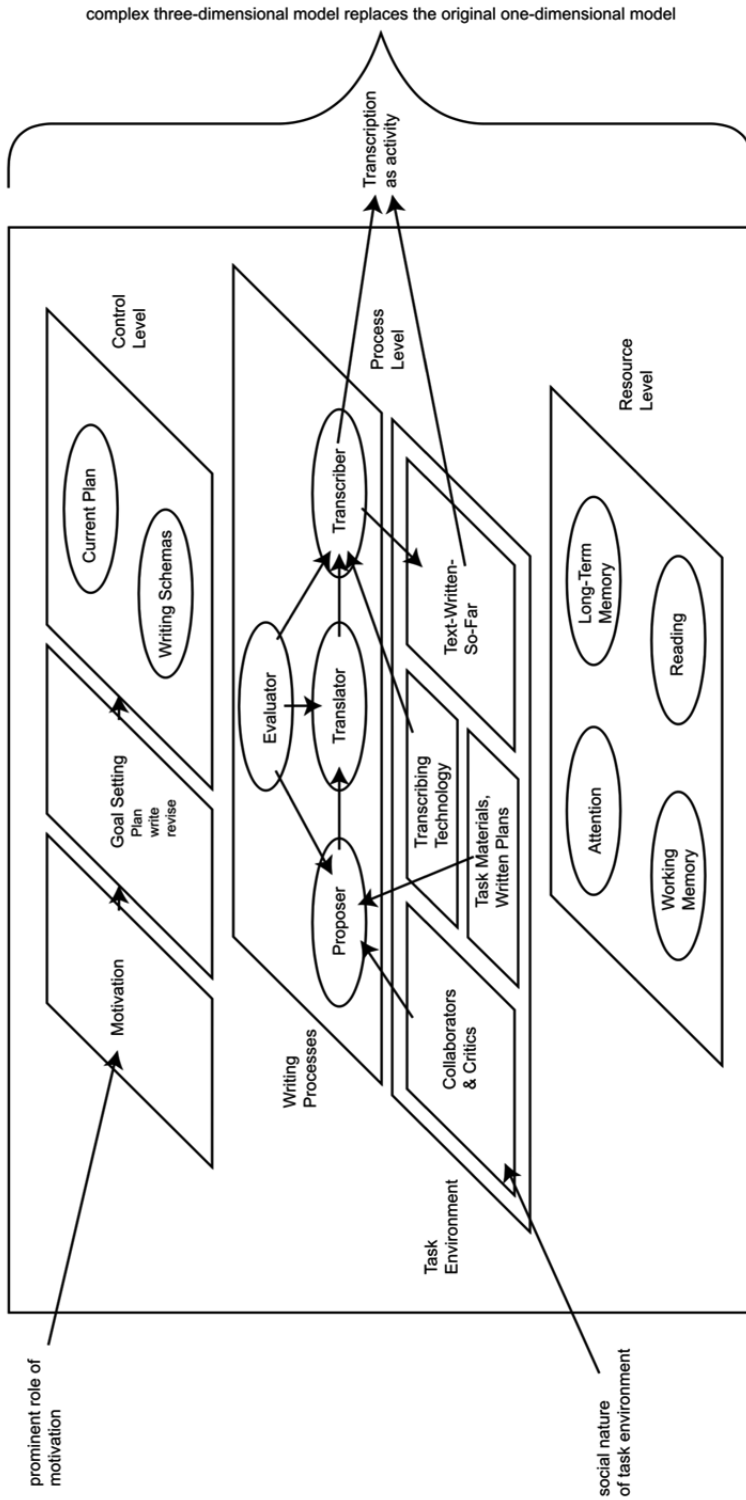motivation

social nature
of task environment

**Figure 3.** Hayes' model (Hayes, 2012, p. 371).

For this study, the Hayes' writing process model (Figure 3) is used as the underlying method for the teaching of writing to the students. Additionally, the model is used to justify the use of a web-based peer review system within this process to account for the importance of the process level, aided by collaborator and critics who support the writer during the revision process. The latter embedded in the sociocultural perspective on learning as presented earlier and labelled in the model as the social nature of the task environment. Finally, as there are aspects in the model that requires additional evidence, such as motivation and accounting for individual difference, the study aims to add to this need by looking at writers being the object of inquiry and not the text.

## 2.3 Genre theory

Genre theory (Bazerman, 1997; Swales, 1990), as presented here, is the theory in the framework that primarily focuses on the text itself. In other words, it proposes a somewhat product approach, as opposed to the process approach presented above. More precisely, genre theory focuses on the shared language used by writers and has therefore been incremental in writing instruction in English as a Foreign Language (EFL) courses (Flowerdew, 1993; Gee, 1997). Genre theory, within this context, is used to support the language learning process of writers who are second language writers (i.e. writing text in a language--English--which is not their native language). The application of genre theory in this study is twofold. First, genre is used to provide a model for learners. This model is representative of the writing task, e.g. an academic essay, or a lab report. The writing task presented in this dissertation is an academic essay within a specific disciplinary field. The model, that is supported by numerous studies and corpus analyses of these text types, is accompanied with learning material providing students with a clear representation of the text itself and a common understanding of the language used to compose the text and discuss the text. Developing a shared language to write and talk about writing is an integral component when developing genre knowledge (Callaghan, Knapp, & Noble, 2014). For the development of writing, writers are encouraged to enter a specific community of practice (Hyland, 2004; Swales, 2004). Consequently, the second application of genre in this study integrates the sociocultural approach presented earlier. As genre prepares students to enter a community of practice, the object of inquiry, as presented in Table 2, offers students multiple channels to enter this community. For example, by reading the text of others and evaluating these according to the required genre. Also, commenting on the text of others and offering suggestions puts students in the position to use genre specific language and build a common understanding of concepts appropriate for the genre they write in. Genre, therefore, is fundamental in the creation process of writing, i.e. the process of becoming a writer (cognitive process and sociocultural), and genre is fundamental to evaluating and developing an understanding of the product, i.e. the text itself.

In the 1990s, researches and instructors have viewed the process approach to writing and the genre approaches as opposing approaches (Badger & White, 2000; Hyland, 2003). The process approach emphasized the importance of linguistic skills, and not so much on linguistic knowledge. Linguistic skills translated to tasks related to planning, drafting, and so forth. From an educational perspective, instruction is primarily supportive and facilitative. The focus is on the act of writing. Consequently, by writing learners develop their writing skills. Genre approaches also emphasize the importance of linguistic skills, however, in comparison to the process approach it is the social context where writing occurs which informs the learners. In other words, text types (products) are regarded as essential component in the instruction to develop the skills of writing. In the 2000s, however, researchers have begun to see that both approaches are complementary (Badger & White, 2000). Specifically within the context of this study, a complementary approach is used as the writing is placed within a context where both learning to write is viewed as a skill to be obtained through endless practice, and endless practice being specified to a genre or discipline. This dissertation identifies new synergies between these approaches, and the social cultural theory provides a fundamental set of concepts that links process and genre together.

The general aims and objectives of this research emphasizes the importance of that synergy.

## 2.4 Aims and objectives of the research

The following points are the main aims and objectives presented in Article I, II, and III:

1) introduce web-based peer review systems as a method to collect large amounts of authentic student generated data (Article I)
2) introduce how Machine Learning can be used to analyze data collected from media such as web-based peer review systems to provide more insights into the writing process (Article I)
3) identify linguistic and general features of peer feedback generated in a web-based peer review system, and (Article II)
4) to determine which linguistic and/or general features affect student's revision (implementation/change) (Article II)
5) better understand how peer L2 writers conduct peer feedback activities by investigating the types and traits of the feedback they provide, and (Article III)
6) demonstrate how novel statistical data analysis (Machine Learning) provides new insights into the writing process, and (Article III)
7) provide suggestions for replication studies (Article III)

The aims and objectives presented above provides a clear position how this research contributes to the current state of research on writing, within the con-

text of Estonia, but also in a broader context of writing research in general. Prior and Thorne's (2014) overview (see Table 1) is again highlighted to clarify the current position of this research by focusing on the tensions and controversies writing research faces. According to Prior and Thorne, writing research in its current state faces three controversies present in the mapping of writing research they proposed (see Table 1). The first controversy is primarily related to the object of research. In other words, does the study investigate the text with the aim to understand objects that influence the process or production of these texts, such as persons, tools, etc.) or the other way around. Is the data collected related to person and mediation in order to understand the object under investigation: the text.

The second controversy, Prior and Thorne observe is whether the research object text itself can function as a unit of analysis. In other words, when analyzing the text itself, can we ignore all the features that play a part in the development of that object, which, as Prior and Thorne point out, are culturally defined. As such, considering which features are or can be considered important to include in the research object should be carefully considered. Moreover, every study on writing, thus, has its limitations set by these complexities.

The final controversy is related to language, culture, and traditions in which writing research is carried out and has been carried out. Historically, writing research has been strongly informed by the writing composition movement in the United States, the Writing in the Curriculum movement, and the Writing in the Discipline movement, not forgetting the contribution of writing center work. As a result, much of the research is embedded within these practices, language settings, and genre. Only recently are writing research conducted in different languages and on different languages and in different cultural settings being added to the field of writing research. Specifically, a lack of knowledge persists in the latter two and this bridge needs to be widened to better understand the multiplex of settings of writing and text production.

The three articles (Article I, II, and III), as well as the goals presented in this dissertation, and the method chosen to investigate the problems, all aim to contribute to the debate about these controversies. The aim of the first publication (Article I) was to describe two important methods that may help to broaden our understanding of different contexts in which writing takes place. It elaborates on web-based peer review systems as a means to collect large sets of authentic data for analysis related to the process of writing. Web-based peer review systems, as described in the article, allow for different objects of investigation to be collected. In addition, a web-based peer review system is easily implemented in a learning environment. As users progress through the stages of writing and feedback, the data is neatly collected in accessible formats for data analysis (see the section 3.1. for a more comprehensive overview of the system used to collect data). Using a web-based peer review system could offer a more holistic perspective on the first controversy, related to the unit of analysis. As web-based peer review systems collect data related to the process and the text itself, analyses can be carried out looking at it from either the process perspective or

the product perspective. Consequently, the data collected from web-based peer review systems could provide additional information about the second controversy, investigating additional factors influencing the development of the text. For example, the medium itself, the learning instruction, the cultural setting (additionally providing support for the third controversy).

The second aspect described in Article I elaborates on statistical machine learning as a method that can be used to systematically analyze the large sets of data collected from web-based peer review systems.  More specifically, it describes how machine learning can be used to broaden our understanding how multiple predetermined features may influence the writing process, if at all (see the section on machine learning for a more comprehensive overview). As the application of this method is novel in writing research, examples are provided of current and ongoing research how studies applying machine learning can support the complete spectrum highlighted in Table 1. In relation to the controversies, machine learning could provide to be a useful method to investigate multiple factors influencing the text, and therefore adding to the debate around the second controversy. In addition, as machine learning is presented here as a method for replication studies (Crossley, 2013), the method itself, when applied to different settings, ought to provide a broader perspective on writing in different languages, cultures, and traditions, as proposed in the third controversy.

The second article (Article II), published before (Article I), reports on the first study carried out using a web-based peer review system and statistical machine learning.  Data collected from a writing course using a web-based peer review system was coded and analyzed for a number of predetermined features by the first author. The co-author contributed with the machine learning analysis and three machine learning algorithms (Logistic Regression, Decision Tree, and Random Forest) were tested on the data to determine which algorithm best predicted the influence these selected features had on a measurable outcome of writing: observable revision. The main aim of this study was to determine whether machine learning is able to make prediction about the features that influence revision and to further explore which features most likely cause students to make revisions. In relation to the context in which this writing research takes place (Estonian higher education, second language writers in the discipline of chemistry), and the three controversies it wishes to address, this study is using mediation (a web-based peer review system) and predetermined features collected from the theoretical framework as means to measure writing, rather than the writing/text being used as the unit of analysis. As the objective of the study was to measure the process of writing, and applying the theoretical frameworks to do so, the unit of analysis would also help inform how different interventions influence the process of writing. The choice of this analysis and the context in which it falls directly addresses the second and the third controversy. The study takes place within a context where little or no attention has been paid to placing writing as an object of enquiry. No influence of writing movements nor language dominance. English as a second language is used to teach students the importance of learning to write. As such, questions concern-

ing the outside influence on the writing (or the process) are tested. In addition, comparisons are drawn to what we currently know about such influences (strongly informed by traditional writing research areas).

Article III uses the results obtained from the first study and takes the analysis further. More emphasis is placed on the features of analysis. This is primarily achieved by scaling up the research, improving the coding of the features, and applying additional types of methods to further understand how the results can be applied to inform our knowledge and application of writing within a context, and of whether and how this knowledge can be extended to different settings and different forms of pedagogic mediation. As such, the third study provides additional evidence addressing the three controversies in writing research. The evidence provided by these three studies should provide a compelling argument for replication studies using more advanced research methods in writing research. More specifically, new approaches may offer new understandings and solve certain aspects in the controversies causing a new paradigm shift in writing research.

Given the general aims of this study (presented at the beginning of this section), the above stated claim might seem bold. But, seeing how much an impact mediation (MOOCs, web-based peer review systems, Google Docs, and so forth) and methods (Analytics, Keystroke Logging, Eye tracking, Machine Learning, NLP) are already having on writing research from the beginning of this research to the present, such as the rise of MOOCs (Balfour, 2013; Comer, Clark, & Canelas, 2014), Automatic writing scoring systems (Valenti, Neri, & Cucchiarelli, 2003), Grammarly (Dianati & Cavaleri, 2015), WriteLab (Hewett, 2015), and so forth, the speed and extend to which data becomes available and the capacity to investigate this data are perhaps the biggest controversies in writing research.

### 2.4.1 The context of the writing course

The context reported in Article II and Article III is shortly generalized in this section to better understand how the context of these studies addresses the general context of writing research presented in the framework. As presented in Table 2, the context of this dissertation aims to address a number of controversies. Perhaps one of the most notable controversy is related to audience who are being addressed in both studies: second language writers following a course of English for Specific Purposes aiming primarily to teach the language through the intervention of academic writing. Consequently, the studies address writers who have not been taught how to write academically through the established traditions, such as those used in North America or the UK. This despite the fact that the second language which they are writing in is English. The consequence, as they are writing in English, is that the writers are adopting a specific genre (EAP) to write (an academic argumentative essay). Second language writers, and second language writing research, is often presented with a multitude of

research perspectives and different results, primarily as the context of these studies are highly contextual and influenced by factors related to culture, inexperience, language, and so forth (Matsuda & Silva, 2014).

The writing course was designed to accommodate for a number of factors: 1) students' second language level and English for Academic Purposes, 2) learner writers in English, 3) web-based instruction and writing using a web-based peer review system. The aim of the course was to instruct learners about the specific English language requirements for their own discipline through the application of writing an argumentative essay. The underlying principles and language instruction/materials use genre analysis as guiding principles (Hyland, 2009; Swales, 1990). As such, learners received instruction related to writing essays and language. These topics were used as feedback prompts when students engaged in the peer feedback activity in the web-based peer review system.

The web-based peer review system, SWoRD (Cho & Schunn, 2004), was used to support the writing process of students. Students were asked to upload drafts of their text in SWoRD. SWoRD would automatically assign multiple peer to provide peer feedback on the text using predetermined feedback prompts. The main goal using SWoRD was to give students an authentic platform and an authentic audience for their writing task. In addition, the tool was chosen as it provided a systematic organization of the writing and feedback tasks. Finally, SWoRD would collect all the data generated by students, such as drafts, feedback, feedback rating, and so forth. It allowed the instruction regarding writing and language to be concentrated during the course (or Moodle environment in case of Article III) and the task of writing in the SWoRD environment.

All these aspects were considered new and none of the students had, prior to these courses, worked with a web-based peer review system, gone through a genre informed course of EAP, nor learned how to write in a second language.

As the use of web-based peer review systems generated a large quantity of data, considerations were made what method could be applied to investigate the aims of the studies. The following section provides a detailed overview of web-based peer review systems, the data gathered from web-based peer review systems and the method used to investigate this data as applied in Article II and Article III.

# 3. METHOD

## 3.1 Web-based peer review systems

The rapid advancements in technology are causing huge shifts in all types of settings where writing occurs. The Internet, mobile devices, social media, and so forth are just a few obvious examples. More specific to written texts, the World Wide Web itself already contains a plethora of texts, and this collection of text production expands manifold day by day. For researchers of writing, this vast amount of text is a goldmine of information waiting to be tapped. However, the information is too vast and too unorganized for a systematic approach for analysis. The educational context, where writing research, writing instructors, writing tasks, and (learner) writers meet, provides an ideal environment to systematically collect authentic written data. In the pre-advanced technological age, this data was also collected, but, in most cases were considered products for grading, and much less so as products of investigation. If it was just as a product, it would be done on a small scale. As writing in higher education is primarily considered a skill one has or acquires through continued practice, the application of this skill is being supported by applications, whether computer supported or web-based, that aid in the production and submission. For example, course management systems such as Moodle, Google Docs, Word and Track Changes, and so forth. Currently, web-based peer review systems are being added to that list. Web-based peer review systems, however, are, in comparison to most of the other application, focused on visualizing and supporting students with the process of text production using a number of interventions which can be found in writing classrooms, such as peer review, rubric scoring and evaluation, writing guidelines, and back evaluations.

SWoRD was chosen as the object of data collection for this study as it supported the general theoretical framework of the investigation. Overall, the application can be implemented in any instructional setting where students are given a task to write a text over a period of time and with draft submissions. As such, the application itself follows a writing process format, can support a genre approach of teaching writing for an audience of L2 writers, and offers a socio-cultural learning experience.

In addition, the choice for a web-based peer review system, such as SWoRD, has a number of advantages. It is able to visualize how students react to the writing process, apply the acquired genre specific language, and respond to social interaction in their writing. Also, the results from studies using web-based peer review systems can be used, by means of replication studies, in follow up courses and studies to test and measure the effect it has on the student's writing performance. Finally, the system (and the courses created in the system) can be implemented in a wide array of settings (different genre, different writers, different cultural settings, and so forth). As such, the data it collects, can be analyzed and compared using computational methods, such as machine learning.

## 3.2 Machine Learning

The application of machine learning in writing research can be considered novel. However, the utility of machine learning in writing research will depend on how machine learning is defined and how it is applied (Crossley, 2013; Kellogg, Whiteford, & Quinlan, 2010). Also, the main aim of applying machine learning is to investigate whether it is a suitable method to investigate a large set of data, and whether the application is going to provide an added value to current knowledge and future research.

When designing a writing course for students, instructors use their experience and knowledge how best to organize the learning (writing) environment. Previously this learning environment may have been a classroom, for example. The available tools were pen and paper, typewriters, and basic computers.

Despite the changing environment, instructors and researchers are still interested in asking the same underlying questions. For example, do students learn from the feedback that I give them? Is peer feedback useful or are students not able to comment on each other's writing? Can I put novice with more experienced writers together in a writing group? Do students improve their text when being asked to write a number of drafts, and if they do, what do they improve, and if they do not, what is holding them back? Does a tool such as a web-based peer review system support the learning of writing? Is this the same in every context? How does a second language influence the improvement and feedback on writing? Is affective language use or "sugaring the pill" (or not sugaring the pill) important when students or teachers give feedback on writing? Do rubric guidelines or feedback prompts improve the uptake?

To some extent we do have the answers to many, if not most of these questions. However, the answer of these questions are as diverse as the settings writing takes place in (Goldin, Ashley, & Schunn, 2012). As such, researchers constantly tweak the environment, test different contexts, new tools etc., to seek more in-depth information regarding these questions. Every study adds a little bit more information, or makes the context more complex. Machine Learning in this context provides a method capable of extracting meaningful observation and information from complex sets of data.

Machine learning is a general term used to describe a method to extract meaningful patterns from large sets of data (Crossley, 2013; Leijen, 2014; Witten, Frank, & Hall, 2011). Essentially, machine learning uses large sets of data as samples from which to learn. The machine observes these patterns and constructs a model of predictable behavior. Once a model is constructed, machine learning will observe new data using this model and apply statistical analysis to predict whether the new data will behave the same as the data from which it has learned the behavior (Witten et al., 2011).

If we take an example of one the questions posted earlier, *Is affective language use or "sugaring the pill" (or the lack thereof) important when students or teachers give feedback on writing?,* we can start to construct a logical application of machine learning on the data. In order to answer this question, the

student or teacher feedback on writing is collected and segmented into meaning for units of analysis. Next, the feedback is coded for affective language. In order to do so, a taxonomy of affective language is applied. Once the data is coded, an output variable (importance) is coded. Similarly to the feature of affective language, importance needs to be measured and is therefore coded according to a form of measurement. Once the coding is complete, machine learning uses algorithms to process the data (different algorithms respond differently to different datasets) and build a model of affective feedback (see Figure 4).

This model is constructed on a set of data, referred to as the *training* set. Once the model has been constructed on the training data, the same model is tested on a yet unseen testing set, referred to as the *testing* set. The outcome of the training and testing procedure is a value indicating how strong or how weak the input variable (affective language) predict the output variable (importance). The model provides a predictive indication how affective language predicts importance. If there is a strong prediction, it basically means that there are clear patterns of affective language predicting importance. If the figure is weak, it would likely mean that the selected input variables do not predict how important affective language is. In order to improve the model, it would be possible to include and test more variables in the model. For example, for affective factors, including hedges and boosters might improve the model. Or features related to politeness could also be included. As such, a stronger more predictive model could be created. Furthermore, further statistical analysis could be included to better understand how the individual features in the model behave and predict.

The advantage of applying this method, is that the models which are constructed can be tested on new and unknown datasets. Within the context of using web-based peer review systems, a model developed from one set of data can be tested on another dataset. For example, data from a STEMS (Science, Technology, Engineering, and Mathematics) course could be compared to data from a humanities course. Or a model developed on native speakers, could be tested on second language writers.

In the context of this dissertation, statistical machine learning is used to predict a number of features on the writing process. The section below elaborates on the data, the collection procedure, the processing of the data, and the implications of the data in line with the dissertation.
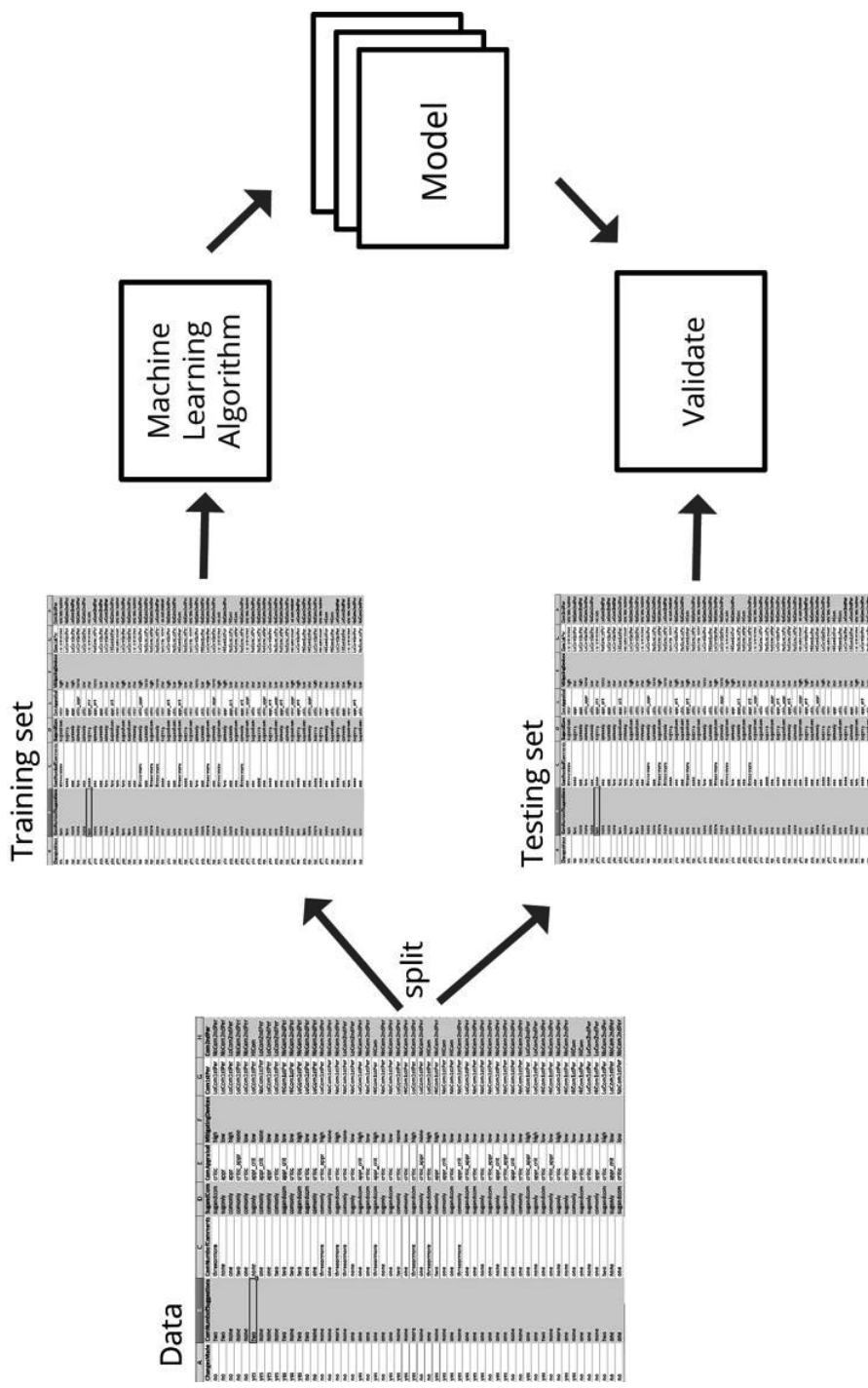
**Figure 4.** Approach to Machine Learning.

### 3.3 Data collection

To answer the research questions posted above, the following data was collected, segmented and coded.

### 3.3.1 Student interaction

To answer research questions three (identify linguistic and general features of peer feedback generated in a web-based peer review system) and five (better understand how peer L2 writers conduct peer feedback activities by investigating the types and traits of the feedback they provide), students peer reviews over a number of drafts are collected. In general, for the course, a student's review is prompted by the writing rubric provided by the web-based peer review system, focusing on specific aspects of the text that needs reviewing. For example, the prompts might instruct the reviewers to comment on the appropriateness of style within their discipline. In other cases, students are asked to comment on lower order concerns of the text, such as grammar and punctuation. The use of reviewing prompts is to support students learning by linking the course content to the written text. Additionally, the prompts and rubric guide students to provide uniform reviews on aspects they are applying in their text. Finally, as the writers are L2 writers, and they are attending a course focused on developing writing skills, in addition to language skills, the prompts and rubric should sufficiently support students not only to focus on aspects of language (lower order skills) but also on aspects of writing (higher order skills).

### 3.3.2 Student drafts

To answer research question four (to determine which linguistic and/or general features affect student's revision (implementation/change), students' draft versions of their text, and a comparison of these drafts are collected by the web-based peer review system. The text itself, or rather the observable changes (revision) from one draft to another, are used to determine how the features chosen in the student interaction effect writing. Revision is the measurable outcome of students making a change in a subsequent draft that can be linked to the peer feedback instance. Revision in the context of this study is understood as the act of altering something based on the feedback that has been provided by peers. Revision does not include the measurement of improvement.

### 3.3.3 Descriptive information

In addition to the information related to writing, descriptive statistics is also collected. For example, student background, language requirements, peer review evaluation, age, course information, course content, etc. Some of these

features are used to describe the context of the studies, and others are used as features in the model when predicting effectiveness using machine learning.

### 3.3.4 Processing of data

As mentioned earlier, an advantage of web-based peer review systems is that they make the process of data collection simple. At the end of the course, the data are collected in a manageable comma separated file format which allows for easy processing. Both the descriptive and numerical data (student anonymized names, peer reviews, usefulness ratings, etc.) are included in the file as well as the peer review and back evaluations. In addition, the different aspects provided in the prompts organized different comments related to that prompt to a different part in the data analysis. The object of the study and the method chosen to investigate the data meant that many different features were included; however, the data processing also meant excluding features which scored low in inter-coder reliability.

Article II and Article III extensively report on the data collection procedure and the challenges for each of the respective study.

# 4. RESULTS

The following section presents the main results of the two main studies presented in Article II and Article III. Article I, published after Article II, provided a literature overview and theoretical discussion about utilizing web-based peer review systems for systematic analysis of peer feedback data on writing. In addition, it provided a theoretical discussion and examples of current studies applying machine learning as a method to investigate such data. In other words, Article I provided a fundamental argument supporting Article II and Article II. As the results of Article I are integrated in the introduction and discussion of this dissertation, the results are not presented here, but provide support for the results presented in Article II and Article III. These results also answer the question whether machine learning is an applicable method to use when advancing the field of writing research, as is discussed in Article I. Overall, the main results and the implications of these are restricted to the context in which the study took place. Based on Table 1, the context applies to a medium (web-based peer review system), social interaction (peer review), and writing as a cognitive process (investigating how both the medium and the social interaction effects the writing process).

## 4.1 Article II

The main questions of this study (Article II) were:
1) identify linguistic and general features of peer feedback generated in a web-based peer review system, and
2) to determine which linguistic and/or general features affect student's revision (implementation/change)

After investigating what features previous studies have identified as influencing the effectiveness of peer review on writing, the following table of classified features were included in the study. Many of these features were adopted from Nelson and Schunn's study (Nelson & Schunn, 2009) investigating the nature of peer feedback and how different types of features affect writing performance. Their study resulted in a model of effective peer feedback within the context of their data (native speakers and students familiar with the needs and requirements of writing academically). The aim of the study presented in Article II was to duplicate some of the features they included in their study and include additional features that may provide further information about the communication process amongst peers and the effect it has on the writing performance (see Table 3). The features were classified in three categories: linguistic features, review features, and task features. The main aim of these classifications was to distinguish features that would allow automatic coding for larger datasets (linguistic features). The review features mainly set out to test current assumptions of effective peer review. The task feature mainly contained the outcome feature measuring the writing performance and hence the only feature related to the written draft.

**Table 3.** Features for analysis (Leijen & Leontjeva, 2012).

| Feature | | |
|---|---|---|
| Linguistic features | | |

| Code | Description | Example |
|---|---|---|
| SugType | Mitigation: to soften the strength of a given comment. Martínez-Flor's (Martínez Flor, 2005) taxonomy of linguistic realization of strategies concerning the act of suggesting was used to code the feedback instances as direct, conventionalized, or indirect. | *"There is a phrase many trends. It is quite hard to grasp the content. The author should at least bring some kind of examples of those trends."* – conventionalized using should |
| SugMark | Linguistic modality suggestion (modal) verbs | Modal verbs: *"may", "must", "would", "could", "should", "will", "can", "might", "need", "shall"* verbs indicating suggestions: e.g. *"suggest", "recommend", "advise", "encourage", "urge"* |
| PerPronoun | personal pronouns or nouns indicating person | *e.g.: "I", "me", "you", "author", or "none/ø".* |
| LOCmark | Location nouns and prepositions | *"on", "in", "page", "phrase", "paragraph", "sentence", "before", "after", etc.* |
| ERRmark | Error nouns | *"error", "mistake", "fault", "inaccuracy", "problem", "lack" etc.* |
| IDEmark | Idea verbs | *"consider", "use", "look at", "note", etc.* |
| NEGmark | Negative words | *"bad", "wrong", "poor", "hard", "difficult" etc.* |
| Review features | | |
| ComType | Feedback Type: directive, nondirective. The coding scheme developed by Cho et al. (2006) was applied for the coding of this feature. | Directive: *"The text doesn't really catch my attention. The author should try to make the research topic more interesting and give reasons why is this research new and special and what differentiates it from previous researches."* Indirective: *"There was some spelling mistakes."* |

| ComAppraisal | Appraisal, Criticism: Feedback instances could include praise, criticism, and praise and criticism | Praise and criticism: *"I like your introduction, but it is too short for this topic"* <br> Praise: *"It was clear and concise. I have no comments"* <br> Criticism: *"You should use a spelling checker to check your language"* |
|---|---|---|
| Others | Mentioned: This feature indicates whether other reviewers have also made a comment to the same aspect that needs a writer's consideration. | R1: *"Your thesis statement is too general. You should make it more narrow"* <br> R2: *"Perhaps the author should make the thesis statement narrower"* |
| Solution | Solution offered: This feature strictly indicates whether the peer feedback instance includes a concrete, explicit solution which can be directly applied to the text by the writer. | *"In the 5th line the sentence ..." subsequently it is quite little stories related about man and women". Perhaps a better wording would be: subsequently there are quite a few stories related to love between a man and a woman."* |
| Task features | | |
| Implemented | Feedback Implemented: Observable changes made in a subsequent draft. | |
| Length | Feedback length: short, medium, and long | |
| **FleschRead** | **Flesch reading ease: A score between 60 and 70 is considered as plain English; a score above 70 is regarded, on a scale, to be easier to read; a score below 60 is regarded, on a scale, more difficult to read.** | |

The classification of the features provided 3 comparative machine learning models determining firstly how well the selected learning algorithms (Random Forest, Decision Tree, and Logistic Regression) managed to process the dataset, and second, how well the included features in the model predict writing performance. The results are presented as ROC (Receiver Operator Characteristic) curves (see Figure 5).
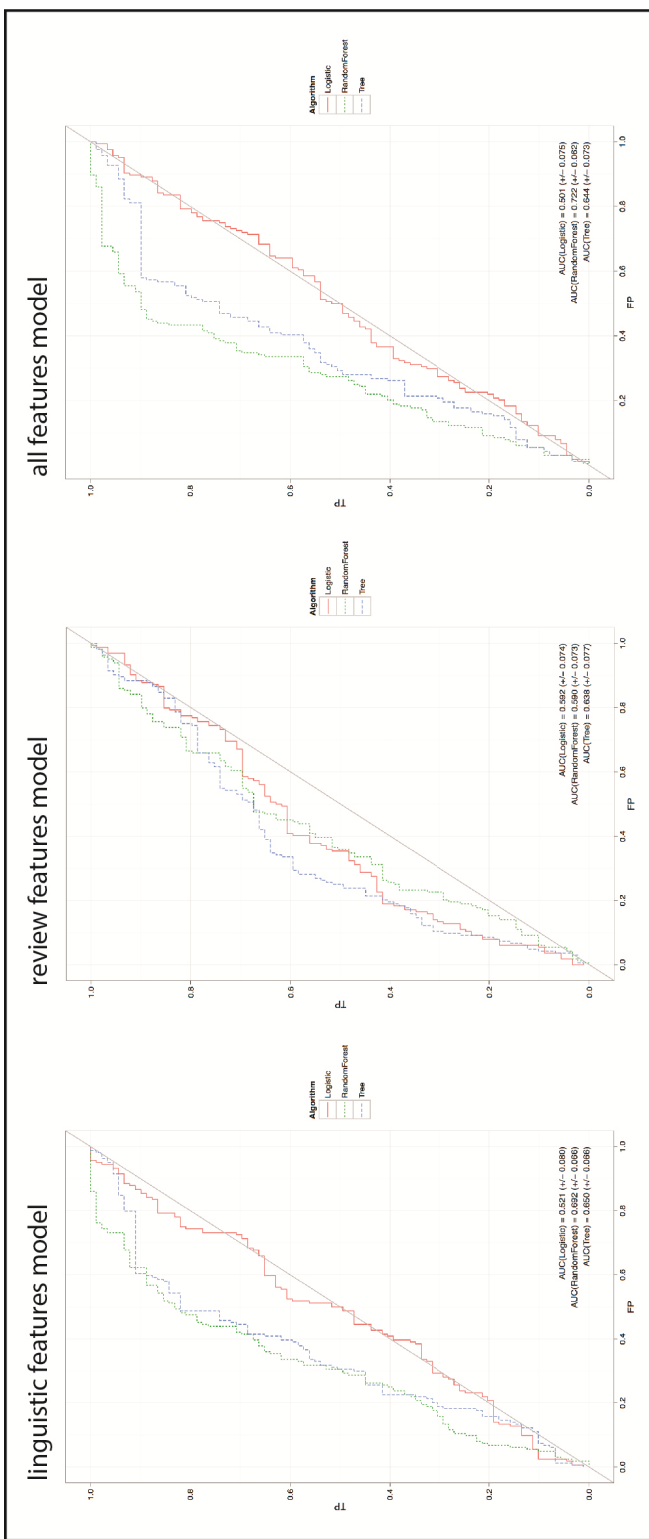
**Figure 5.** The performance of the three models (linguistic feature model, review feature model, and all feature model) and the three algorithms (Logistic regression, Random Forest, and Decision Tree) (Leijen & Leontjeva, 2012).

ROC curves generally present how accurately the included features in the model are able to predict the outcome and provide a simple visual representation. For this test, the presented ROC curves display the performances of the three different algorithms (Logistics Regression, Random Forest, and Decision Tree) in the 3 models (model containing linguistic features, model containing review features, and model containing both linguistic and review features) as AUC (Area under the curve) values. The Random Forest algorithm performed best across the three models with an AUC values slightly higher compared to Decision Tree and Logistic Regression, and the model containing all features came out as the best performing model with an AUC of 0.722 (+/- 0.082). What this means is that for this dataset, the Random Forest algorithm is able to predict observable changes in the text best and this prediction is most accurate in the model containing all the features. In other words, the models which contain only the linguistic features predicts less accurately observable changes in the subsequent draft and even less so the model containing the review features.

To determine, which of the features effect observable changes the most, a feature analysis was performed on the all features model (see Figure 6) – see article II for a more thorough description how the analysis was performed. The all feature analysis resulted in five features predicting the observable changes in a subsequent draft. Two of these features (*Others* and *Type*) stood out as strong predictors of observable changes. To test the validity of this result, the analysis was also carried out on the review features model (as *Others* and *Type* belonged to the review feature model) and an additional analysis with only the important features from the all feature model analysis. Both analyses confirmed the feature *Type* and *Others* being strong predictors of observable changes in a subsequent draft.

An additional analysis was required to determine whether the significance was towards one end of the feature or the other end. In the case of feature *Other*s (*Yes/No*) and feature *Type* (*Directive/Non-directive*), the review had a positive effect on the writing performance when two or more peers commented on the same aspect in the text (*Others>Yes*) and when the type of comments was *directive* (*Type>Directive*) (Leijen & Leontjeva, 2012, p. 195). Overall, this result is in line with other studies who claim that multiple peer feedback is effective (Cho, 2004; Cho, Chung, King, & Schunn, 2008; Cho & Schunn, 2007; Nicol, 2010) and directive comments are considered more useful (Pridemore & Klein, 1991).
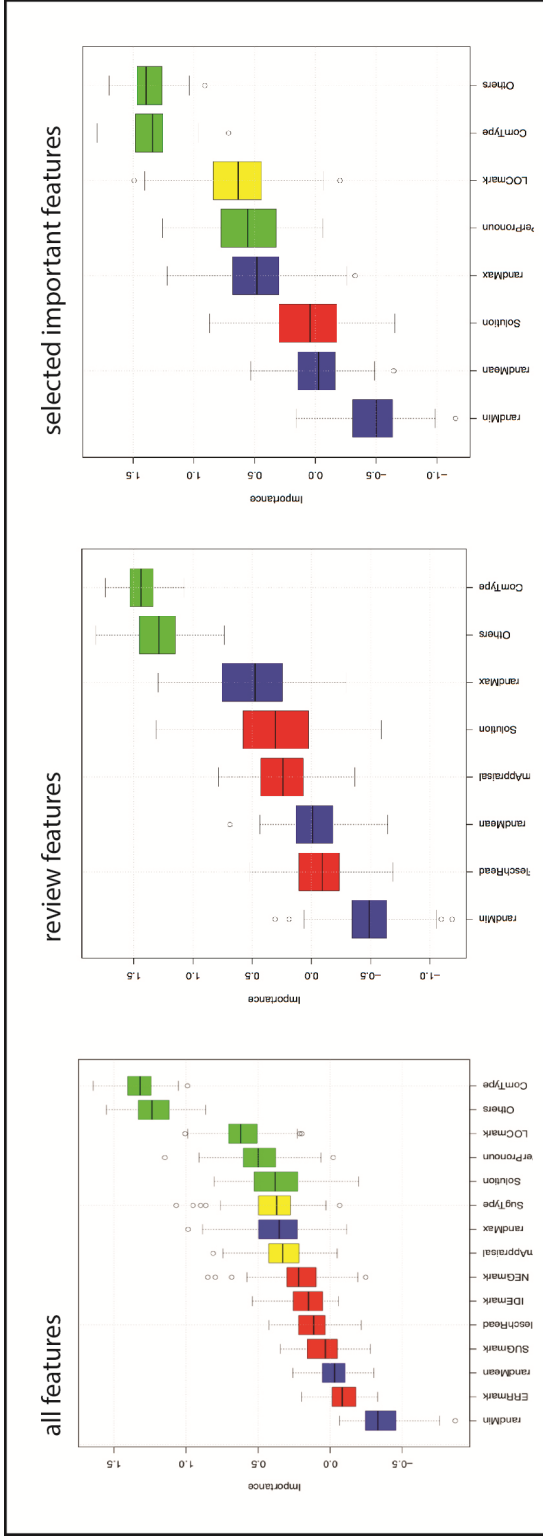
**Figure 6.** Box plots of feature importance.

## 4.2 Article III

The main questions of the second study (Article III) were:

1) better understand how peer L2 writers conduct peer feedback activities by investigating the types and traits of the feedback they provide, and
2) demonstrate how novel statistical data analysis (machine learning) provides new insights into the writing process, and
3) provide suggestions for replication studies.

In comparison to Article II, Article III is the main study primarily as the number of students participating in the study is nearly three times larger (15 students resulting in 253 instances of analysis in Article II versus 43 students resulting in 885 instances of analysis in Article III). The increased size should make the Machine Learning analysis more robust. In addition, as one of the general aims of this dissertation is to replicate studies using different datasets, selecting and coding features reliably is a necessary component. As some of the features in Article II did not provide any positive results, they were not included in the second study, or the feature had been re-assessed as a direct result of the larger number of feedback instances causing the reliable coding of the feature to be questionable. A good example is the feature *Type*, which in Article II was a good predictor for observable changes in a subsequent draft. Coding the larger set of data caused a greater amount of ambiguity amongst the coders and as a result the feature was abandoned and broken down into aspects referred to as *Identification, Justification, Alteration, and Area* (Leijen, 2017)*.* The following features (see Table 4) were used for Article III.

**Table 4.** Detailed description of the 8 selected peer feedback features, examples, and inter-rater reliability score.(Article III) (Leijen, 2017)

| **Feedback Type (modAll)** | |
| --- | --- |
| Predictor | *Identification*: Problem (PRB)/Action (ACT) |
| Description | *Identification* categorizes the feedback instances as either a Problem (PRB) or an Action (ACT). Problem statements tend to state that a part of the paper or sentence or word is incorrect, problematic, difficult to understand, misplaced, etc. In general, these instances identify themselves by their implicitness and indirectness. Action statements tend to give the receiver of the feedback a clear instruction or clear action to change a word, improve the spelling, alter the organization, include a phrase, etc. Generally, these instances identify themselves by their explicitness and directness. |

| | |
|---|---|
| Example | PROBLEM:<br>*"The text is too long for an introduction and over explained."*<br>*"The second part of the statement beginning with ..what are the main characteristics... doesn't suit there"*<br>*"I don't see a traditional structure of a paragraph which should begin with a general statement and end with a little conclusion."*<br>ACTION:<br>*"Maybe you could try to put the main subject clearly into one sentence."*<br>*"You should put in more discussion."*<br>*"Try to bring out more the pros and cons of steroid use/abuse."* |
| Additional information and references | In general, previous research is not conclusive about the explicit or implicitness or directness or indirectness of peer feedback. For example, directive feedback versus nondirective feedback provides different results, often culturally determined. In some studies directive feedback is considered more effective, whereas other studies consider nondirective more effective (Leijen & Leontjeva, 2012). Categorizing feedback instances to refer to a problem or state an action should be more definitive. |
| Predictor | *Justification*: Yes/No |
| Description | The feature *Justification* (feedback instance includes a justification or explanation yes/no) categorizes feedback instances that have either include or not included a justified (or explained) opinion in the feedback. This type of feedback characterizes itself by the added phrases or sentences to the identified issues that need to be address by the receiver of the feedback. A simple or complex explanation why as reviewer we think something needs to be changed, included, revised, reorganized, etc. |
| Example | Justification/Yes<br>*"I would suggest uniting short sentences into longer ones, <u>it would be easier to read</u>* (justification)*."*<br>*"You should make it more clear <u>because it took some time for me to really figure out what you want to write about</u>* (justification)*."*<br>*"The only mistake I found was the last word of the essay: don't. I'd use do not instead <u>to make it more formal</u>* (justification)*."* |
| Additional information and references | (Gielen, Peeters, Dochy, Onghena, & Struyven, 2010; Nelson & Schunn, 2009) |

| Predictor | *Alteration:* Yes/No |
|---|---|
| Description | Feedback that is more specific is considered to be more helpful in comparison to feedback that is more general. In the context of this study, *alteration* (adapted from Liu & Sadler, 2003) indicates whether a feedback instance points to a specific change. Alteration characterizes itself by phases such as, *for example*, or visual recasts, such as the incorrect word/phrase and the corrected word/phrase following. |
| Example | *The last sentence (I cannot…) I would rephrase for clarity. Maybe, <u>"So, why is it important"</u> (alteration) or something in those lines.* <br> *Little to primitive-> <u>A little toO primitive</u> (alteration)* <br> *"The first thing that caught my attention was the use of the wordpair rather that, which I think should be in this context rather than. The sentence is:Hydrocarbons rather that ethers can be used as a solvent."* <br> *"The spelling of the word fumingnation isn't correct, the right spelling is fumigation."* |
| Additional information and references | Ferris (1997) and Liu and Sadler (2003) |
| Predictor | *Area*: Local/Global |
| Description | Feedback instances refer to either *global* areas (e.g. audience and purpose, idea development, topic, logic and support, organization of writing, thesis statement) or *local* areas (e.g. wording, spelling, grammar, sentence structure, academic style, punctuation). |
| Example | Local: <br> *"I also found a spelling mistake. It should be mankind's instead of mankinds. And that's about it I could find. I had to whine about something;)"* <br> *"Also you already list too many notions that should be used in the main body instead."* <br> Global: <br> *"I think, you should support your ideas more. It is true, that no poison can kill you, if you take one molecule of it, but I think there are some, which can kill you after inhaling."* |
| Additional information and references | Liu and Sadler (2003) categorize global and local changes as an area and not as a type of feedback. As this study focuses on revision-oriented comments, area (global/local) is considered to be a type of feedback. |

**Feedback Trait (modTrait)**

| | |
|---|---|
| Predictor | *Question:* Yes/No |
| Description | Feedback instances can either include or not include a sentence, phrase or word formulating a *question*. As a feature, *question* does not need to be a direct question marked by a question mark, but can also include rhetorical questions, or statements which questions because there is doubt or confusion of something that is being referred to in the text or being stated by the reviewer. |
| Example | *Can this text be considered an essay?*<br>*Just wondering about the use of words here, it sounds like a specialized knowledge.* |
| Additional information and references | The nature of question statements in communication – often used to mitigate statements – is more often associated to negative effects (Ferris, 1997; Leijen & Leontjeva, 2012; Nelson & Schunn, 2009). |
| Predictor | *Point of View (POV)*: AUT/REV/NEU |
| Description | *Point of view* takes a more general perspective of the feedback instance. *POV* looks at who is the reporting subject in the feedback instance. Generally, POV can be found by identifying the subject of the sentence. In cases where there are more subjects, the most prominent subject represented in the feedback instance determines the POV, which can also be the implicit subject. |
| Example | *<u>The author</u> has to reformulate the second sentence in the $3^{rd}$ paragraph to include a … (AUT)*<br>*<u>I</u> strongly suggest that, the author has to reformulate … (REV)*<br>*Try to <u>think of a problem statement, what do you</u> want to discuss, argue about… (AUT)*<br>*As the topic was not given, it's hard to evaluate the execution of the overview properly (NEU)* |
| Additional information and references | The assumption with *POV* is that the perspective taken in the feedback comment refers to the distances reviewers take in their comments. Studies in computer mediated communication (CMC) report that communication in an online environment displays similar measures of distance, as would be in face to face communication (Morand & Ocker, 2003; Walther, 1992) which can be measured through specific features of politeness. |

| Predictor | *Recurring:* Yes/No |
|---|---|
| Description | Recurring (YES) indicates that another reviewer has mentioned the same topic highlighted in that instance. |
| Example | *Seems title is missing*<br>*I would suggest the author to include a title, as the task required a title to be included.* |
| Additional information and references | For example, two reviewers of the same paper can both comment (in different ways) that the text needs a title. Recurring is likely when multiple peer feedback is given. Research indicates the advantages of multiple peer feedback (Cho & Schunn, 2007). |
| Predictor | *Location (LOC)*: Yes/No |
| Description | Statements, words, phrases, which locate. Prepositions and nouns such as "on", "in", "page", "paragraph", "sentence", "phrase", "before", "after", "line", "beginning", "middle", "ending" etc.<br>*But also:* Instances which are on a more conceptual level, such as *in the introduction, in the discussion, in the text* |
| Example | *"The last sentence (I cannot...) I would rephrase for clarity. Maybe So, why is it important or something in those lines."*<br>*2nd paragraph, 2nd sentence - that?* |
| Additional information and references | Research suggests that an important characteristic of successful feedback (i.e. feedback that leads to implementation) is that it contains language features that explicitly locates the problem in question (Leijen & Leontjeva, 2012; Nelson & Schunn, 2009; Van der Pol, Admiraal, & Simons, 2006; Xiong, Litman, & Schunn, 2012). |

Revision in a subsequent draft

| (response variable) | *Revised:* Yes/No |
|---|---|
| Description | Revised is the measurable outcome of students making a change in a subsequent draft that can be linked to the peer feedback instance. Revised in the context of this study is understood as the act of altering something based on the feedback that has been provided by peers. Revised does not include the measurement of improvement. |
| Additional information and references | A feedback instance is regarded as having been revised when the changes in the revised text can be directly linked to the content of the feedback. Partial changes in revised texts and changes made in later revised versions of the text were also considered having been revised. |

Of these features, the feature *Agent* and *Object* had been excluded from the analysis due to low inter-rater reliability scoring. Comparable to study one, 3 models were created, model Type (*modType*), model Trait (*modTrait*), and an all feature model (*allMod*). Three algorithms (Random Forest, Logistic Regression, and Decision Tree) were compared for performances and, as expected, due to the size of the dataset, all algorithms returned comparable results. As such, Logistic Regression was selected as algorithm to further investigate the data.

The ROC curves, presented in Figure 7, give the overall performance of the three models: *modAll* containing all features, *modType* containing the type features, and *modTrait* containing the trait features. All three models performed similar, with the model containing all features being the best performing model and the trait model performing less well. A Logistic Regression feature analysis was conducted to determine which features in the model were the better predictors for observable changes in the model. The results of the Logistic Regression analysis indicated that two features were strong predictors of writing performance: *Alteration* (indicating a specific change) and *Recurring* (whether two or more peers commented on the same). A feedback instance including an *Alteration* affected the writing performance more than twice as likely than if it would not contain the feature. A feedback instance including *Recurring* affected the writing performance more than 3 times as likely. As these two features belonged to two different models, an interaction analysis was carried out to see whether these two features combined would increase effect on the writing performance. The inclusion of *Recurring* and *Alteration* in a model did not substantially improve the performance of the model (see Figure 8).
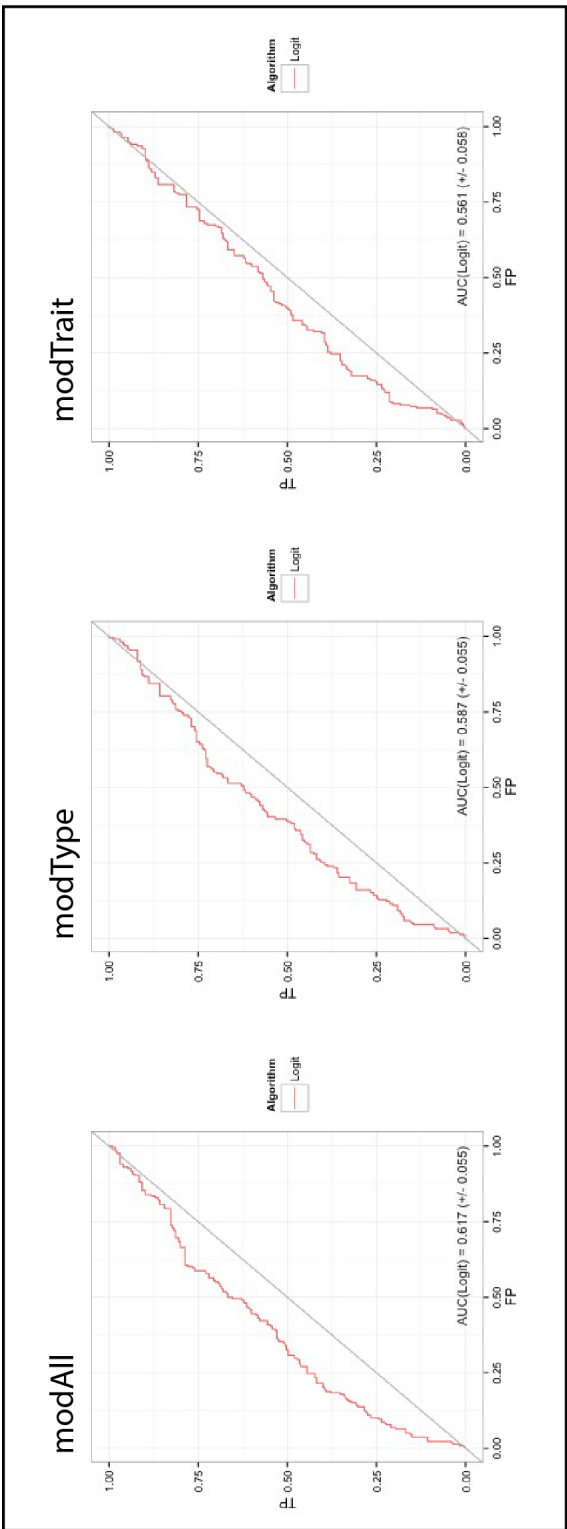
**Figure 7.** ROC curves for the logistic regression test with response feature *Revised*.
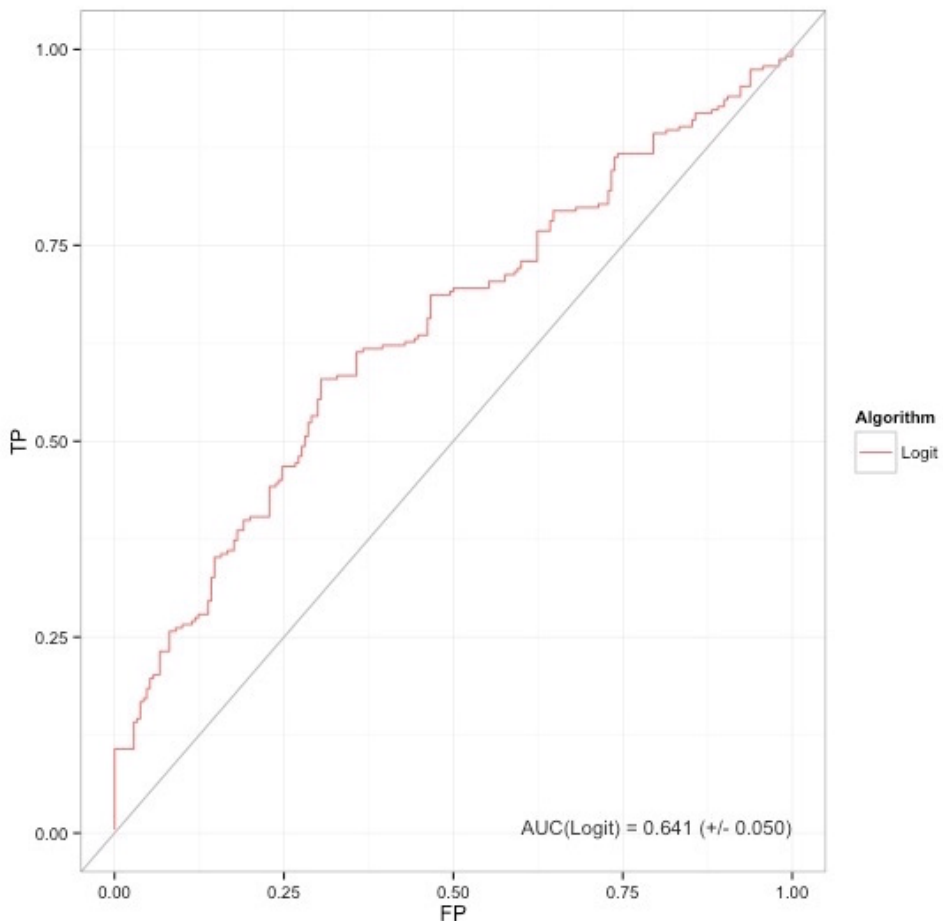
**Figure 8.** ROC curve model containing *Alteration* and *Recurring.*

There was no interaction effect between these two features, which also explains the comparable performance of the three models. As a result, interaction analyses were carried out on both features independently to see if other features interacted (positively or negatively) with *Recurring* and *Alteration*. *Recurring* as a feature had no interaction effect, positive or negative, with any of the other features in the models. *Alteration*, however, interacted with two features within the same *modType*: *Justification* and *Identification*. A feedback instance containing *Alteration* and *Justification* resulted in a three and half times increase for an observable change to happen in a subsequent draft. A feedback instance containing *Alteration* and *Identification*, on the other hand, had a negative effect on the writing performance.

Despite *Justification* having a positive interaction with *Alteration,* it was also a feature that negatively influenced the writing performance when interacting with two other features: *POV,* and *Area*. Feedback instances including a justification (including or not including an explanation/justification why the text needs revision) and written from the point of view (*POV*) of the text or commenting on a local aspect of the text negatively influenced observable changes. Similarly, feedback instances including a justification and commenting on local aspects of the text (grammar, spelling, punctuation) negatively influenced observable changes.

When comparing these results to the results obtained in the first study, a strong similarity can be observed: both studies provide evidence that recurring reviews (*Others* in Article II and *Recurring* in Article III) by two or more peers on the same aspect positively affected observable change in a subsequent draft. Another comparable result between Article II and Article III is with feature *Type - Directive/Nondirective* in Article II and the feature *Alteration - Yes/No* in Article III. As mentioned earlier, the feedback *Type* feature in Article II was changed for the study carried out in Article III. The distinction between *directive* (suggestion an alteration specific to the text) and *nondirective* (suggesting a change that applies to any text) comments caused ambiguity between coders in the larger dataset reported on in Article III. In Article II, *directive* comments came out as a strong predictor for observable changes in a subsequent draft. As such, the element *directive* was maintained in the study reported on in Article III and changed to the feature *Recurring* (pointing to a specific change in the text). The feature *Alteration* was adopted to match the feature description used by Liu and Sadler (2003). As such, pointing to an observable change specific to the text *Type – Directive* in Article II and *Recurring – Yes* in Article III are essentially the same.

The additional analysis performed in Article III highlights how features, despite positively influencing changes in a subsequent draft, can also negatively influence change in a subsequent draft. This is specifically the case with the feature *Justification*, which in combination with *Alteration* positively affected change in a subsequent draft, but in combination with the feature *Area* and *POV* negatively affected change in a subsequent draft. This result highlights that the how reviewers frame and formulate their review as well as the aspects of the text they comment on is a sensitive topic. Although no compelling evidence is provided by these results to support this claim directly, the general discussion below illustrates the importance of understanding the sociocultural aspects influencing the peer review process. Specifically as the learning to write principle applied in this context supports the writing process theory and the genre theory, more discussion is needed how the presented evidence is able to provide empirical support for aspects such as motivation and willingness included in the Hayes' cognitive process model (Donahue & Lillis, 2014; Hayes, 2012).

# 5. GENERAL DISCUSSION

Overall, the aim of this study was to investigate the role of dialogue on the writing process of students using a web-based peer review system. The underlying construct of the study is students communicating with each other about writing (genre and sociocultural), students are supported by a writing course teaching them aspects related to writing a specific genre in a second language English (genre), and they do so via a number of write and revise iterations (cognitive process writing). Machine learning is used as a novel method to investigate the large amount of data generated from the web-based peer review system to classify a number of identified features that might influence the writing performance by measuring observable changes in subsequent drafts. Sociocultural theory, the cognitive process theory, and genre are used to understand and interpret the writing performance, and explain the importance of the social process and motivation involved when commenting on multiple submitted drafts using a web-based peer review system and receiving multiple peer reviews on one's submitted text.

The results are presented in three published articles. The first article (Article I) generally explores the use of web-based peer review systems and Machine Learning as methods to investigate the writing process (and more specifically revision within that process) of students. Article II and Article III both used data generated from a web-based peer review system and statistical Machine Learning method to investigate the identified features for these studies. Article III is, in essence, a replication study of Article II. The web-based peer review system, SWoRD, chosen for these studies was effective to the extent that it provided a well-structured set of data, including peer review comments, review-usefulness ratings, and drafts that could easily be used for coding, segmentation, and analysis. Given the context where the writing has taken place (Higher Education, Estonia, EFL and second language writing, learning to write, specified discipline, etc.), the tool itself has been used as a means to gather data for a more thorough analysis. The results of Article II and Article III should be placed within the context of writers using SWoRD web-based peer review system. The similar results obtained in Article II and Article III are being generalized to apply to a larger context or different web-based peer review systems.

The research presented in Article II and III generally investigates how the identified features predict revision (observable change in a subsequent draft), and if so, which of the features most strongly influences the writing performance. Despite the relatively small data sample used in the second study (Article II) for machine learning, the results are comparable to some studies in terms of peer review effectiveness (Kaufman & Schunn, 2011; Nelson & Schunn, 2009). The importance of these results become more significant considering the results obtained in Article III. The comparability of the results is noteworthy as it emphasizes the importance of the feature *Recurring*/*Other* and *Alteration*/*Directive* within the context of multiple peer review with in a web-based environment. In terms of the outcome on the writing performance itself,

and with the larger aim of this study, the results might be somewhat less significant. Applied in the learning to write context as proposed by the cognitive process theory of writing, one of the two important features highlighted in this dissertation: a feature identifying multiple reviewers commenting on the same aspect in the text that needs the writer's attention (*Others* – Article II and *Recurring* – Article III), does somewhat support the sociocultural approach to learning: multiple perspectives of peers offer a convincing argument only when two or more of these peers agree on the aspect that needs attention. Regarding the other feature, the feature indicating whether a peer review points to a specific (explicit) change that the writer of the text needs to make for the next draft (*Type/Directive* – Article II and *Alteration* – Article III), specifically within higher education, the aim of the instructor is to support self-directed learning and critical thinking. However, the results seem to suggest that comments positively affect the writing performance when an explicit suggestion is provided by a peer. There seems to be no evidence that the writing performance is positively affected (nor negatively) when students are provided with implicit comments (comment not including a Directive/Alteration). In other words, students would prefer to choose to carry out revisions in their subsequent draft when the solutions have been explicitly presented to them.

The most striking result obtained from the study presented in Article III is related to the feature *Justification*. *Justification* measures comments for the inclusion or exclusion of justifications/explanations regarding the comment which has been given. In other words, comments include arguments why the author should consider (or not consider) reviewing and/or revising their text for the next draft. The feature *Justification* has a positive interaction with the feature *Alteration*: the feature which in Article II came out as a predictor of revision. In other word, if the reviewer provides a clear solution in the comment and gives a justification for this solution, the recipient of the review is more likely to make a revision in their subsequent draft. However, the reverse is the case when the reviewer writes a comment which includes *Justification* and comments focusing on lower order concerns, such as spelling and grammar. The same negative interaction is the case when the comment includes *Justification* and the comment is written is from the perspective of the text (the text functions as the subject of the comment). The following examples illustrate how the constructions differ and demonstrates both the positive interaction with *Alteration* and the negative interaction with Low Order concern and *POV*/text.

**Table 5.** Interaction Justification.

| Example | Interaction | Comment |
|---|---|---|
| In a formal essay nobody should be referred to directly, *i.e. constructions like "you could" should not be used* | Justification – Lower Order: negative interaction | |
| *The exact methods and history of genetic engineering deserves a separate paragraph, the introduction should only give the most basic information and perhaps a few examples on the topic at hand.* | Justification – Text: negative interaction | The comment is written from the perspective of the text. *The exact methods* and *the introduction.* |
| ***In the second sentence I would write …as ammonia, bleaches and so on… because without …and so on… I felt this sentence was unfinished.*** | **Alteration – Justification: positive interaction** | |

These examples, despite all containing a justification, clearly show how different the justification translates the message to the author. An explicit change and a justification of that change leaves a positive impression. In the case of the other two examples, when a justification is given about suggestions which are implicit (no clear suggestion) and about a lower order concern, the impression seems to be much more biased, teacher like, instructive. As such, the author could interpret the comment negatively, or simply disagree more easily. As is the case when the implicit comment has no "reviewer" or "author" ownership, as in the example provided above: *"The exact methods and history of genetic engineering deserves a separate paragraph…",* the comment itself becomes distant and no ownership or responsibility is expressed, as the following altered version demonstrates: *"*[I think that] *The exact methods and history of genetic engineering deserves a separate paragraph…"* or "[You should] *create a separate paragraph for the exact methods and the history of history of genetic engineering"* (changes made by author). These interpretations regarding implicitness related to these comments are to a degree speculative. However, the evidence seems to indicate, as have other studies (Shea et al., 2010; Yallop, 2016), that the complex act of communication between the students certainly affects their learning and their writing performance. Furthermore, it seems that if students adopt a socially inappropriate communication style, e.g. as a teacher, rather than a student, peers are more likely to reject or ignore the comment. This would be further evidence supporting the importance of sociocultural factors in this process. This is also evident from the study presented in Article II with the feature personal pronoun. Although the feature did not come out as a strong predictor, it did come out as a predictor in 2 models. Models of affective peer feedback on writing have previously taken affective factors into consideration

(Nelson & Schunn, 2009). However, large scale studies have yet to confirm how affective factors, or more importantly, which aspects of affective factors influence the writing performance when students are engaged in peer review.

When applying these findings to the context of the theoretical framework, Hayes revised cognitive writing model (Hayes, 2012) supports the complex notion of affective factors when he added motivation to the model. According to Hayes, motivation affects writing much more than we currently know or current studies demonstrate as motivation has not been integrated into the cognitive process (Hayes, 2012). Previous studies have indicated that different types of writers (students with different writing experience or ability) have varying degrees of motivation. More experienced writers tend to be more motivated to engage in the writing process than novice writers (Hayes, Schriver, Hill, & Hatch, 1990). Hayes claims, however, that the representation of motivation in the model does not completely represent how and where motivation affects the cognitive writing process. Clearly, the contribution of this study, and future replication studies using the same approach, are able to more clearly determine how, by measuring affective factors on large sets of student generated date, at which levels motivation to write, review, and revise influences the writing performance.

Being able to measure the extend different type of factors affect the writing performance can be applied in different contexts. The most practical context is the context of writing instruction itself. Specifically if the writing instruction takes the sociocultural approach to learning and incorporates peer review in the writing process. It is known from literature, that peer review training (Lundstrom & Baker, 2009; Min, 2006) is an important component of improving the effect of peer review. Making students understand what is expected from them during the peer review process might improve the effectiveness of peer review on the writing performance. In addition, making distinctions between different type of writers (novice, expert, second language, etc.) might help in addressing issues related to motivation and, as a result, support those students more who struggle with writing, rather than support those who already are motivated to improve.

In addition to the context of writing instruction itself, the development of web-based systems that support writing are currently ongoing. Web-based peer review systems are already making an impact on writing instruction and writing support across the curriculum. Web-based systems, such as SWoRD (rebranded Peerceptiv) and MyReviewers are already integrating 'smarter' technology, such as natural language processing (NLP), machine learning, and learner analytics, to support and visualize the writing process for students and instructors. Other systems, such as WriteLab are already making use of machine learning to help provide students with feedback on the text production. Within the scope of this research, the text product has largely been used to measure the writing performance after peer interaction on the writing process. However, in accordance with the genre approach to writing, measuring the effect on the written product

should be explored more thoroughly. For example, measuring if the writing performance has improved or not improved can be included in the analysis.

Overall, the main contribution this research makes in the field of writing research, is a recipe for future research to replicate this approach to studying writing in as many different settings as possible. The validity of the outcome of these studies will increase the importance of the findings, specifically if the same features are measured. It opens up a new dimension to measuring writing, using taxonomies classifying different aspects related to the sociocultural theory, such as politeness (Brown & Levinson, 1987) or motivation, such as social presence (Shea et al., 2010; Yallop, 2016), or revision of students writing (Faigley & Witte, 1981). Efforts should be made to automate the coding of such taxonomies via NLP or semantic parsing (SP). In this context, genre theory provides a strong framework for measuring the written products, if these fit within a specific framework. In all cases, the application reaches further beyond only the framework as is presented here. For example, Thesis Writer (Rapp & Kruse, 2016) is an application which strongly draws from genre theory and process writing and applies it to a system aiming to support students how to write specific texts. Through the integration of additional features, such as peer or teacher, or even computer generated feedback, will further support students learning to write. The amount of data about writing is growing, exponentially in different contexts, research methods investigating writing need to accommodate for such growth and test, replicate, and validate what we currently know about writing. Writing has always been multidisciplinary. This is equally the case for the methods that can be applied to investigating writing.

# SUMMARY IN ENGLISH

The study of writing, also referred to as text production, is a relatively young field of research. The surge of research generated at the end of the 20th and beginning of the 21st century have resulted in the field becoming more wide-spread, encompassing a diverse number of approaches, theories and paradigms of writing. The handbook of writing and text production (Jakobs & Perrin, 2014) provides a clear and detailed overview of the writing research discipline as it stands today. Historically, studies of writing are rooted in the fields of (general) linguistics and learning sciences. Consequently, the field of linguistics has offered insights to the study of writing by studying the system (syntax, lexis, style and grammar) of texts themselves. Within that context, texts are primarily the object of study in the linguistic subfields, such as pragmatics, semantics, and sociolinguistic inquiry (Prior & Thorne, 2014). Linguistics informed writing studies are generally interested in what texts do, what the style of a text looks like, how the rhetoric in a specific text is used, what common language is used, what mistakes are made, and so forth. The learning sciences are generally informed by disciplines such as psychology and the social sciences and are interested in the cognitive processes involved in text production (Prior & Thorne, 2014), such as how texts are socially constructed (i.e. how is text mediated by social conventions and part of a particular community of practice), how do individuals learn how to write (i.e. what external factors contribute to the learning process), how do we perceive and read text, and so forth. The object of research is most often the subject performing the text production. This dissertation find itself nestled in both fields: linguistics and learning sciences, further referred to as applied linguistics.

The main aim of this dissertation is to determine how the act of peer review (social interaction) influences text production (multiple drafts of essays) of students attending an English academic writing course using a web-based peer review system. As the field of writing research is a diverse field of research, positioning the context is essential to better understand the implications of the outcomes.

Prior and Thorne's (2014) guideline is applied to map the context of writing research as presented in this dissertation. The guideline distinguished six dimensions: the object of inquiry, the epistemological stance, the theoretical frameworks, data collection, data analysis, and research presentation. The object of inquiry primarily seeks to clarify what aspect of writing is under investigation. For example, does the study investigate a specific text type, who is or are the writer(s) of the text, how is it produced (under what circumstances), is there a specific mediation (technology) involved (i.e. hand written or typed, etc.), and so forth. The diversity of these settings and the practical application of these generally informs the epistemological stance of the object. In other words, what does the study aim to achieve and add to our understanding of writing. For example, do we wish to understand the writer, text production, or the application of writing within a specific context, such as learning and teaching. What

theoretical framework or frameworks is/are used to question and support and contribute to the epistemological stance. The theories used informs the type of data collections needed to answer the questions that arise, and of course the method used to analyze the collected data.

Using Prior and Thorne's guideline (2014), this dissertation is mapped according to the following points. The object of inquiry looks at bachelor's and master's students' essay drafts written in English (as a second language) in their specified disciplinary field. These essays are written using multiple peer review through an anonymized web-based peer review system. The epistemological stance locates the value of the research in relation to pedagogical, social, and disciplinary needs. The theoretical framework used to support the inquiry and stance is sociocultural theory (Vygotsky, 1978), cognitive process theory of writing (Flower & Hayes, 1981; John R. Hayes, 2012), and genre (Bazerman, 1997; Swales, 1990). As a result, the following data is collected: (text) multiple drafts of students' essays and (act of communication) multiple peer feedback on the drafts. The data analysis comprises of segmentation of the students' peer feedback into meaningful units and coded for multiple features. The drafts are compared and coded for revision. Machine Learning algorithms are used to predict the effectiveness of different models of peer feedback by analyzing observable changes in subsequent drafts. The aim is to offer empirical evidence to the existing body of research on peer feedback and writing in higher education, to provide a working method for future replication studies on the vast amount of data currently available to writing researchers, and to inform instructors and writers which features in communication affects the writing performance.

The inclusion of sociocultural theory (Vygotsky, 1978) and writing research are nowadays viewed as inseparable. This is certainly the case within the context of this dissertation where both text and communication are used for data analysis. Two sociocultural principle form part of the framework for this dissertation: the first primarily relates to real social context the writers occupy. The writers are learner writers who need to be supported in several ways, one of them being motivation to learn and motivation to write. Providing a real social context where learning takes place should contribute to this aspect. The second principle relates to language. As the object of inquiry are English as a second language users, the social context of applying real language supports both the development of writing and the development of communication about the writing. Considering the main aim of this dissertation, sociocultural theory trickles down in the other two principles in the framework: cognitive process theory of writing and genre theory.

The cognitive process theory of writing has recently seen a long standing writing process model, Hayes-Flower model (Flower & Hayes, 1981), revised. Hayes' model (Hayes, 2012) transforms the process model, which was primarily a linear model of writing, into a more complex three dimensional model of writing. Besides the transformation of viewing writing in a three dimensional space, one aspect has been given a more prominent position: the

inclusion of motivation and the exclusion of monitor, which encountered for individual differences. According to Hayes, (Hayes, 2012) motivation is an essential component in the cognitive process model of writing. There is some evidence that motivation accounts for the way writing tasks are carried out, influencing both the process and the product (Duijnhouwer, 2010; Hidi & Boscolo, 2006). The absence of monitor, in the new model, is somewhat related to motivation. According to Hayes, the model does not include individual differences as a separate component, individual differences are to be taken into account when applying the model. Motivation, expert and novice writers, language skills, and so forth are individual. The application of the model has to support these differences when applying the process into a writing context.

Finally, genre (Bazerman, 1997; Swales, 1990) theory is used to construct the context of writing in this study. As the context is a learning environment, genre is applied to support both the product and the process. The product, the essay, uses genre specific guidelines which have been developed using corpus analyses of existing examples. As such, a working model is presented to the writers. In addition, as genre is, nowadays, strongly influenced by the socio-cultural theory, the working model of the product is accompanied by creating a community of practice. Learners are introduced to the language required to both discuss writing and evaluate (read) writing. The genre approach, as a result, invites learners to understand and create a text which meets the genre require-ments as well as develop a common language that allows them to socially enter a community of academic writers.

The two main studies reported on in Article II and Article III apply Machine Learning as method to investigate the main aim. Different features, identified and coded from the principles and theories related to the theoretical framework, were used to create different models. For example, Article II tests the effective-ness of a linguistic features model, a review features model, and an all feature model. Article III, being a replication study of the study presented in Article II, tests the effectiveness of two altered feature models containing a feedback type model, a feedback trait model, and an all feature model. The main purpose of testing the effectiveness of these models is to identify what type of feedback influences observable changes in a subsequent draft of a student. This is achieved by predicting how well a model predicts observable revision in subse-quent drafts. Based on the performance of the model, a more thorough analysis is made of the models to determine 1) which specific feature(s) predict revision the most, 2) how does the feature affect revision, and 3) are there positive and/or negative interactions between features in relation to observable revision in subsequent drafts.

The results of the studies primarily show that two features in both studies come out as strong predictor of revision: 1) a feature identifying multiple reviewers commenting on the same aspect in the text that needs the writer's attention (*Others* – Article II and *Recurring* – Article III), 2) a feature indicating whether a peer review points to a specific (explicit) change that the writer of the text needs to make for the next draft. The first feature confirms studies which

support the need for multiple peer review on drafts. The power that multiple perspectives (on the same problem) have on the text is significant specifically when we utilize peers as assessors of the quality of a text. Peers, within this context might lack the authoritarian stance an instructor has, but this is compensated by the number of peers that comment. The second feature highlights the importance of identifying explicitly what the problem is and at the same time offer a solution. It seems, within this context, that student writer is not always able to make a change, if an example of that change is not provided. It offers added evidence for genre and the sociocultural theory that being able to formulate and talk about writing both in respect of the product and of the process aids in building a common understanding of what is needed to revise a text.

The results of the studies reported on in Article II and III also show negative interaction between features. Negative interaction generally indicates that a combination of features negatively affects observable changes. In other words, receivers of specific types of comments are less likely to carry out revision in subsequent draft. Interestingly, a negative interaction was observed with the features that indicates whether a peer review points to a specific (explicit) change that the writer of the text needs to make for the next draft and the change being at a lower order concern. In other words, if a reviewer indicates that the spelling or punctuation is wrong in a sentence and provides the solution leads to fewer observable changes in the next draft. The reason might be related to the object of inquire, second language writers and the act of this type of communication. Being told by a peer that spelling or punctuation is wrong could result in a comment being too directive or making one feel 'stupid' for not knowing the rules of language. This in turn has an impact on motivation, lowering the willingness to further attend to changes in a draft. Another negative interaction is found between the feature that identifies feedback instances to include or not include justified (or explained) opinions why something for the next draft needs the writer's attention and the comment being written from the perspective of the text (i.e. the text is the object of change, rather than the reviewer or the author being the instigators of change). It seems that the neutral (or distant) tone of these reviews do not leave a positive mood for change. Perhaps the tone of voice is not personal enough or too generic puts writers in a position where they can easily neglect such comments. The neutrality might not convey a message of importance.

Overall, the results of these studies presented here imply that features related to sociocultural theory play a significant role in the process of revision in subsequent drafts within the context of this study. In addition, the evidence provided by these studies seem to suggest that motivation plays a crucial role. Although motivation is difficult to measure using the method presented here, Hayes' model, sociocultural theory, and genre suggest the importance, although lack empirical evidence to support it. The method used, Machine Learning, identified specific features in feature models that predict revision and seems to be able to identify features that implicitly are related to motivational factors. In addition, the result reported on in this dissertation provide a strong foundation

for future replication studies to be carried out in order to obtain more empirical evidence. These replication studies should alter the object of inquiry but use the same methodological approach to the data collection and data analysis. Additional theoretical frameworks can be introduced to develop alternative models to study.

# SUMMARY IN ESTONIAN

## Kaasõppija tagasiside kui akadeemiliste tekstide kvaliteeti mõjutav tegur

Kirjutamise ehk tekstiloome uurimine on võrdlemisi uus uurimissuund. 20. sajandi lõpus ja 21. sajandi alguses kasvas uurimuste arv sel alal järsult ning see tõi kaasa distsipliini laiema leviku ja edasise arengu. Selle arengu käigus kujunes tekstiloome uurimises välja eri suundi, teooriaid ja paradigmasid. Uurimissuuna praegusest seisust annab hea ülevaate Jakobsi ja Perrini (2014) käsiraamat.

Ajalooliselt on tekstiloome uurimine välja kasvanud ühelt poolt keeleteadusest ja teiselt poolt haridusteadustest. Keeleteaduses on tekstiloome seisukohalt enim huvi pakkunud kirjutamise keeleline pool (sõnavara, lausestus jms). Pragmaatikas, semantikas, sotsiolingvistikas ja teistes aladistsipliinides on vaatluse alla võetud eelkõige tekst tervikuna ja tekstiloome (Prior & Thorne, 2014). Keeleteaduslikud tekstiloomeuurimused puudutavad eeskätt seda, mida tekstid teevad: missugust stiili ja retoorikat kasutatakse, mis keeles tekst on kirjutatud, mis vead tekstis esinevad jne. Psühholoogiale ja sotsiaalteadustele tugineva haridusteadusliku käsitlusviisi korral huvitutakse enam sellest, millised kognitiivsed protsessid tekstiloomet mõjutavad (Prior & Thorne, 2014), näiteks kuidas on tekstid sotsiaalselt konstrueeritud, kuidas õpitakse teksti looma (millised välised tegurid kujundavad õppeprotsessi), kuidas võetakse kirjutatud tekst vastu. Uurimisobjekt on sageli teksti looja ehk autor. Siinses väitekirjas on ühendatud nii keele- kui ka haridusteaduslik vaatepunkt.

Väitekirja peamine eesmärk on teha kindlaks, kuidas mõjutab tekstiloomet kollegiaalne tagasiside (*peer review*). Selleks analüüsitakse üliõpilasesseede mustandeid, mis on koostatud veebipõhist tagasisidesüsteemi kasutava akadeemilise väljendusoskuse kursuse raames. Kuna tekstiloome uurimine hõlmab mitmeid käsitlusviise, on väga tähtis selgitada üksikasjalikult uurija teoreetilist lähtekohta. Sellest oleneb ka tulemuste ja järelduste tõlgendamine.

Väitekirja eesmärki, lähtekohti ja järeldusi selgitatakse Priori ja Thorne'i (2014) mudeli abil. Mudel sisaldab kuut dimensiooni, milleks on uurimisobjekt, epistemoloogiline hoiak, teoreetiline taust, andmete kogumine, andmeanalüüs ja tulemuste esitamine. Uurimisobjekt osutab, millist tekstiloome aspekti uuritakse, näiteks žanri, autorit, teksti koostamise tingimusi ja vahendeid (tehnoloogiline aspekt). Uurimisobjektist oleneb ka episteemiline hoiak ehk see, mida soovitakse uurimusega saavutada, näiteks saada lisateadmisi autori või tekstiloome kohta või otsida vastust küsimusele, kuidas õpetada ja õppida kirjutamist. Selleks tuleb aga valida sobiv teoreetiline taust, millest omakorda sõltub andmete iseloom ja kogumise viis ning uurimismeetodid.

Tuginedes Priori ja Thorne'i (2014) mudelile, on siinse väitekirja uurimisobjektiks valitud bakalaureuseastme üliõpilaste esseede mustandid (nende eri valmidusastmes versioonid). Uuritavad tekstid on kirjutatud inglise keeles ning kuuluvad temaatiliselt eri valdkondadesse. Tekstid esitati ja neid tagasisidestati veebipõhises tagasisidesüsteemis. Tagasiside oli anonüümne ja korraldatud

selliselt, et iga autor sai tagasisidet mitmelt kaasõppijalt. Sellisena vastab uurimus pedagoogilistele, sotsiaalsetele ja erialast lähtuvatele vajadustele.

Uurimuse teoreetilise tausta moodustavad sotsiokultuuriline teooria (Vygotsky, 1978), kognitiivse kirjutamisprotsessi teooria (Flower & Hayes, 1981; Hayes, 2012) ja žanriteooria (Bazerman, 1997; Swales, 1990). Seetõttu võeti siinses väitekirjas vaatluse alla materjal, mis koosnes üliõpilasesseede eri valmidusastmes mustanditest ja nendele antud tagasisidest. Materjal segmenteeriti lõikudeks ning kodeeriti mitmeid asjakohaseid faktoreid silmas pidades. Seejuures võrreldi ka mustandite eri valmidusastmes versioone ja kodeeriti ka neis tehtud muudatused. Tagasisidemudeleid ja nende efektiivsust hinnati masinõppe algoritmide abil, analüüsides mustandites tehtud muudatusi. Eesmärk oli pakkuda empiirilisel analüüsil põhinevaid lisateadmisi akadeemiliste tekstide kirjutamisest ja tagasisidestamisest kõrghariduses, töötada välja meetod võimalike tulevaste uuringute tarbeks ning selgitada välja, kuidas tagasiside mõjutab tekstiloomet.

Sotsiokultuuriline teooria (Vygotsky, 1978) on tänapäeval tekstiloome uurimise lahutamatu osa. Sellel on kindel koht ka siinses uurimuses, kus analüüsitakse nii teksti kui ka suhtlust (tagasisidet). Lähtekohaks on kaks sotsiokultuurilise teooria olulist põhimõtet, millest esimene on seotud autorite sotsiaalse kontekstiga ning käsitleb teksti loojaid kui õppijaid, keda tuleb toetada, pakkudes neile motivatsiooni õppida ja kirjutada. Teisisõnu, neile tuleb tagada õige sotsiaalne kontekst. Teine põhimõte on seotud keelega. Kuna uuritavad on inglise keele kui võõrkeele õppijad, pakub sotsiaalne kontekst, mis toetab selles keeles suhtlemist, võimalust nii tekstiloomeks kui ka tekstide tagasisidestamiseks. Võttes arvesse siinse väitekirja põhieesmärki, seostub sotsiokultuuriline teooria ka kahe teise mainitud teooriaga.

Kognitiivse kirjutamisprotsessi teoorias oli pikka aega keskel kohal Floweri ja Hayesi (1981) kirjutamisprotsessi mudel. Hiljuti täiendas seda mudelit John R. Hayes (2012), kes esitas seni lineaarsena kujutatud mudeli keerukama, kolmedimensioonilise mudelina. Peale kolmanda dimensiooni lisamise tehti mudelis kaks olulist muudatust: sinna lisati motivatsioon ja arvati välja vaatleja, sest vaatlejat mõjutab tema individuaalne eripära. John R. Hayesi (2012) järgi on motivatsioon kirjutamisprotsessi mudeli oluline komponent. Leidub tõendeid, et motivatsioonist sõltub see, kuidas tekstiloome ülesandele lähenetakse, see aga mõjutab nii kirjutamisprotsessi kui ka lõpptulemust. Vaatleja puudumine Hayesi (2012) viimasest mudelist on mõnevõrra seotud motivatsiooniga. Hayesi järgi ei ole individuaalsed erinevused eraldi komponent, kuid neid tuleb komponendi rakendamisel arvesse võtta. Kuna motivatsioon, autori kogemuste pagas, keeleoskus jms on individuaalsed, on vaja nendega mudeli rakendamisel arvestada.

Kolmanda teoreetilise lähtekohana kasutatakse töös žanriteooriat (Bazerman, 1997; Swales, 1990). Kuna töö seisukohalt on oluline õppekeskkond, oleneb žanrist nii lõpptulemus kui ka kirjutamisprotsess. Lõpptulemus (essee) kuulub kindlasse žanri, mille tunnused on leitud korpusanalüüsi meetodil, uurides samasse tekstitüüpi kuuluvaid olemasolevaid tekste. Kuna žanr sõltub täna-

päeval oluliselt sotsiokultuurilisest teooriast, lisandub etteantud mudelile ka kuulumine praktikakogukonda. Õppijatele tutvustatakse keelevahendeid, mis aitavad neil tekste analüüsida ja hinnata ning tagasisidestada. Seega õpetab žanriteoreetiline käsitlusviis õppijatele, kuidas mõista ja luua teksti, mis vastab teatud žanri kriteeriumidele, ning aitab neil leida võimalusi moodustada akadeemiliste tekstide kirjutajate kogukond.

Väitekirja teine ja kolmas artikkel kajastavad uurimistulemusi, mis on saadud masinõppe meetodil. Materjalis on kodeeritud tunnused, mis tuginevad ülal mainitud teoreetilisele raamistikule. Nende tunnuste põhjal on loodud mudelid, mille efektiivsust mõõdetaksegi masinõppe kaudu. Teises artiklis mõõdetakse, kui efektiivne on keeleliste tunnuste mudel, tagasiside mudel ning kõikide tunnuste mudel. Nende mudelite hindamisega soovitakse selgitada välja, kuidas eri tüüpi tagasiside kajastub mustandite versioonides. Mudeleid hinnatakse selle alusel, kui täpselt need ennustavad ühest mustandi versioonist teise tehtavaid muudatusi. Sellele järgneb mudelite põhjalikum analüüs, et selgitada välja, millised konkreetsed tunnused ennustavad muudatusi kõige täpsemalt ning kas tunnuste vahel esineb vastastikmõju, mis on seotud vaadeldavate muudatustega mustandites.

Teises ja kolmandas artiklis esitatud tulemused näitavad, et muudatustega on seotud eelkõige kaks tunnust. Esiteks, muudatusi soodustab peamiselt selline tagasiside, mis tagasisidestajate kommentaarides kordub (tunnus „Teised" ('Others') teises artiklis ja „Korduv" ('Recurring') kolmandas artiklis). Teiseks, muudatusi toob esile konkreetne tagasiside, st kommentaar, mis viitab konkreetsele muudatusele, mida autor peaks tegema. Esimene tulemus kinnitab varasemates uurimustes esitatud järeldust, et mustandeid peaks tagasisidestama mitu korda. Kuigi tagasisidestajatel ei ole akadeemilise väljendusoskuse kursuse raames antava tagasiside puhul autoritaarset positsiooni, st neil puudub näiteks voli tööd tagasi lükata, tagab tagasiside kvaliteedi tagasisidestajate hulk. Teine tulemus, mille kohaselt on efektiivsemad just konkreetsed kommentaarid, näitab, et teksti parendamiseks tuleb selgelt osutada, millise kohaga on probleem seotud ja mis on võimalik lahendus. Tundub, et üliõpilased ei ole ise alati võimelised tekstis muudatust tegema, kui soovitatavat muudatust ei ole kommentaaris näitlikustatud. See kinnitab sotsiokultuurilises lähenemises ja žanriteoorias levinud arusaama, et oskus rääkida loodavast tekstist nii kirjutamisprotsessi kui ka selle tulemuse aspektist aitab kujundada ühtset arusaama sellest, mida tuleb teksti parendamiseks ette võtta.

Teises ja kolmandas artiklis esitatud tulemused näitavad, et mõningatel tunnuste kombinatsioonidel on muudatuste tegemisele negatiivne mõju. Teisisõnu, autorid, kes saavad oma mustanditele teatud tüüpi kommentaare või kommentaaride kooslusi, teevad tekstis muudatusi väiksema tõenäosusega. Näiteks ilmnes, et kuigi konkreetsemalt sõnastatud kommentaarides soovitatud parandusi tehakse üldjuhul suure tõenäosusega, on selliste paranduste tegemine vähem tõenäoline, kui kommentaar puudutab vähem olulisi tekstiloome aspekte. Seega kui kaasõppija viitab oma kommentaaris mõnele õigekeelsusprobleemile ning pakub sellele ka lahenduse, on vähetõenäoline, et autor arvestab seda

kommentaari ja teeb mustandi järgmisse versiooni paranduse. See võib tuleneda uurimisobjektist (tekstiloome võõrkeeles) ja konkreetsest suhtlussituatsioonist. Kui kaasõppija viitab puudujääkidele autori keeleoskuses, võib autor seda kommentaari tõlgendada liiga direktiivsena ning see võib panna teda ennast rumalana tundma. See omakorda vähendab autori motivatsiooni teha soovitatud muudatusi.

Teise koosluse, millel on teksti muutmisele pigem negatiivne mõju, moodustavad kommentaarid, mis sisaldavad õigustatud (või vähemalt selgitatud) muudatusi ja mis on samal ajal sõnastatud viisil, mis loob ettekujutuse tekstist kui subjektist, mitte muudatuste objektist (*Teksti keel vajab parandamist* vs. *Ma arvan, et sa peaks teksti keeleliselt parandama*). Näib, et seesugused kommentaarid loovad tagasiside saaja ja autori vahele distantsi ning ei motiveeri autorit parandusi tegema. Ilmselt mõjuvad seda tüüpi kommentaarid liiga geneerilisena, soodustades omakorda kommentaaride ignoreerimist, sest neutraalse sõnastuse tõttu ei pruugi autor tajuda nende kommentaaride olulisust.

Kokkuvõttes näitavad väitekirjas esitatud tulemused, et sotsiokultuurilise teooria vaatepunktist olulised tunnused avaldavad suurt mõju kirjutamisprotsessi käigus loodavate mustandite parandamisele. Peale selle osutavad tulemused, et selles protsessis on tähtsal kohal ka motivatsioon. Kuigi motivatsiooni on siinses töös kasutatud meetodiga raske mõõta, viitavad selle olulisusele Hayesi mudel, sotsiokultuuriline teooria ja žanriteooria. Töös kasutatud masinõppe meetodiga tuvastati, millised kommentaarid soodustavad muudatuste tegemist mustandites ning mis näivad seostuvat motivatsiooniga. Lisaks loovad väitekirjas esitatud tulemused tugeva põhja tulevastele empiirilistele uuringutele. Töös välja töötatud metodoloogiat saab kasutada andmete edasiseks kogumiseks ja analüüsimiseks. Tulevastes uurimustes võiks kaasata ka teisi teoreetilisi raamistikke ning testida muid mudeleid.

# ABBREVIATIONS

EFL          English as a foreign language. Students studying English in a country where English is not an official language.

L2 writers   Second language writers. Writers who are writing in another language (English) other than their native language.

Predictor    Independent variable

Response     Dependent variable

EAP          English for Academic Purposes

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# CURRICULUM VITAE

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## Education

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2000        University of Wolverhampton, England and Amsterdam University of Applied Sciences, Holland, English and Education Studies, BA (honours), HBO grade 2 teaching degree in English, and TESOL certificate.
2004        University of Twente (the Netherlands), Education Training and Systems Design, MSc.

## Professional employment

2000–2001   Language Programme Coordinator. CHEER, Peking, PRC.
2001–2001   Education Programme Coordinator CHEER, Peking, PRC.
2004–2005   English language teacher. College de Brink, Laren, the Netherlands.
2002–2008   Freelance English language trainer. Amersfoort, the Netherlands.
2005–2008   English language teacher. RSG Slingerbos/Levant, Zeewolde, the Netherlands.
2007–2008   Lecturer. Boswell College, University of Utrecht, Utrecht, the Netherlands.
2008– ...    Lecturer of English. University of Tartu, Estonia.
2011– ...    Head of the Centre for Academic Writing and Communication. University of Tartu, Estonia.

## Scientific activities

### List of publications

Leijen, D. A. J.; Leontjeva, A. (2012). Linguistic and review features of peer feedback and their effect on implementation of changes in academic writing: A corpus based investigation. Journal of Writing Research, 4(2), 177–202.

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Leijen, D. A.J. (2013). Academic Writing Guideline for Writing in English.

**Projects**
2015    Norplus Project: Network of Nordic and Baltic Writing Centres
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**Conference presentations**
Leijen, D. A. J. (2015) Investigating the revision process in a web-based peer review system using machine learning. EDULEARN. Barcelona, Spain.

Jürine, A.; Leijen, D. A. J. (2015) Academic writing practice at the University of Tartu: A multifaceted perspective on language, teaching, and tradition. Writing groups supporting Estonian doctoral student writers. European Association of the Teaching of Academic Writing 2015, Tallinn, Estonia

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Leijen, D. A. J. (2011). Supporting students and teachers with the academic writing process. http://primus.archimedes.ee/conference2011 Tartu, Estonia

Leijen, D. A. J. (2011). Surveying needs and requirements: what does it tell us and how does it help us when establishing an academic writing centre? http://www.eataw.eu/conferences/ Coventry, UK

Leijen, D. A. J. (2011). Word level specificity in peer feedback and its effect on changes made in academic writing: a corpus based investigation. http://www.eataw.eu/conferences/ Coventry, UK

Leijen, D. A. J. (2010). Introducing process writing using SWoRD (Scaffolded Writing and Reviewing in the Discipline) in an English academic writing course for informatics students: a pilot study. Academic Writing from Bachelor to PhD: Interdisciplinary Conference at Solstrand Fjord Hotel. http://www.uib.no/iped/43870/academic-writing-bachelor-phd Bergen, Norway

Leijen, D. A. J.; Ojava, L. (2010). Investigating needs and requirements to establish a writing center at the University of Tartu, Estonia. In: Grossing national boundaries and linguistic borders: (Re)Thinking and (re)situating the writing center and WAC connection in Europe and Beyond: European Writing Centers Association conference 2010; Paris, France

Leijen, D.A.J. (2009). EAP (English for academic purpose) for lecturers and doctoral students at the University of Tartu. Tartu, Estonia

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**Publikatsioonide loetelu**

Leijen, D. A. J.; Leontjeva, A. (2012). Linguistic and review features of peer feedback and their effect on implementation of changes in academic writing: A corpus based investigation. Journal of Writing Research, 4(2), 177–202.

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Leijen, D. A.J. (2013). Academic Writing Guideline for Writing in English.

**Toetused uurimisprojektide raames**

2015    Norplus Project: Network of Nordic and Baltic Writing Centres
2015    COST Project: Advancing effective institutional models towards cohesive teaching, learning, research and writing development (WeRELaTE)

**Muu teaduslik organisatsiooniline ja erialane tegevu**s (konverentside ette-kanded, osalemine erialastes seltsides, seadusloome jms.)

**Ettekanded konverentsidel**

Leijen, D. A. J. (2015) Investigating the revision process in a web-based peer review system using machine learning. EDULEARN. Barcelona, Spain.

Jürine, A.; Leijen, D. A. J. (2015) Academic writing practice at the University of Tartu: A multifaceted perspective on language, teaching, and tradition. Writing groups supporting Estonian doctoral student writers. European Association of the Teaching of Academic Writing 2015, Tallinn, Estonia

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Leijen, D. A. J. (2014). How can we establish a good cooperation between academic writing centers, libraries and academic staff? http://sosek.b.uib.no/ nasjonalt-seminar-2014/ Oslo, Norway

Leijen, D. A. J. (2014). Linguistic features of peer feedback influencing the reviewing process of L2 academic writers. http://conference2014.fr/ wrab_accueil_en.php Paris, France

Leijen, D. A. J. (2013). Applying Machine Learning Techniques and Corpus Based Methods to Investigate the Influence of Peer Feedback on the Writing

Process. http://www.universitaetskolleg.uni-hamburg.de/de/projekte/tp05/ tp05berichte/tp05-tagungen/2013-02-15-x-prowitec-symposion-schreibprozessforschung.html Hamburg, Germany

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