Bedfordshire

Centre for Learning Excellence

Adaptive Learning Program for Developing Employability Skills

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The paper aims to demonstrate the benefits of adaptive learning technologies as a viable alternative to time consuming tutor led individual support. It proposes to reveal how adaptive learning interventions can be effective in enriching student learning while targeting precise areas of development.

This review will compile evidence on the nature and extent of Adaptive Learning tools used to develop employability skills among Higher Education institutions. This will be specifically for students undergoing studies at the graduate level. Given the short time available, a scoping study framework will be used to examine the scope of carrying out a full systematic review or identifying gaps in existing literature (Arksey and O'Malley, 2005).

This design follows the general principles of a systematic review by following pre-specified methods to reduce the risk of bias by selecting favourable studies, and extracting and analysing data that backs a particular hypothesis. That is, the methods are determined a priori, and are transparent and replicable.

Keywords: adaptive learning, learning interventions, scoping, employability, systematic review.

Introduction
Policy makers are increasingly faced with the question of how to develop employability skills among University graduates. Given a global competitive labour market, educators recognise that the scope of teaching has increased beyond delivering specific knowledge and vocational skills.

Adaptive learning, also known as adaptive teaching, is an educational method which uses computers as interactive teaching devices. It is also used to orchestrate the allocation of human and mediated resources according to the unique needs of each learner. For the purposes of this study adaptive learning tools are defined as: 'any web based technology platform providing real-time feedback to the student in his/her learning process.'

In the UK, over 12% of young people (18-24 years old) are unemployed with double the number of applicants for every job vacancy (ONS 2017). With increased numbers graduating out of the universities, only 44% of graduates find jobs with long-term contracts (HESA 2016). The majority of the graduates favour jobs with a large corporate against employment opportunities with small and medium enterprises as they perceive better career prospects at the larger companies (Hart, 2009). Universities may still not be preparing graduates with the right skills and knowledge for future employment. Programs aimed at enhancing professional skills and experiences of graduates play an important role in equipping the graduates for employment (Pefanis Schlee and Harich, 2010). In this hyper competitive environment, universities require more insights into the knowledge and skill requirement of different groups within the industry. To ensure the success of their graduates in the market place, universities need to understand the specific skills required by large and small organisations (Cheng et al., 2016).

Successful employability programs are the ones that have close links and participation from the employers (UK Commission for Employment and Skills, 2009). Creating an ecology of students, teachers and employers to nurture employability skills is resource intensive. Given the resource constraints, there are growing calls to explore alternative options to the conventional method of delivering employability skills. Moreover, the dynamic nature of employability skills necessitates quick response to constant changes in the emerging skill sets that are required to participate in the contemporary workplace. A solution to this problem lies in new types of learning technologies. There is an increased focus on technologies that provide a rounded learning experience. Recent developments in adaptive learning technologies provide a viable alternative to resource intensive face-to-face teaching. Adaptive learning technologies are easily scalable to meet the increasing demand.

However, there is limited published evidence-based summaries of the research literature on adaptive learning and employability skills to inform policy decisions. Scoping studies are popular for reviewing research evidence. Scoping studies are useful in answering a specific research question by exploring the current state of knowledge and identifying the areas sufficiently explored as well as areas where there is limited information. This is then interpreted within the policy and practice context (Levac et al., 2010). This scoping study involves an in-depth literature review that investigates how to identify the conceptual underpinning of adaptive technologies used in developing employability skills in pre-existing research outputs. It examines research gaps relating to the use of adaptive tools to deliver employability skills and specifically addresses the issue of identifying the research gaps in adaptive learning and employability skills. In this way, this study summarises the emerging themes in current research then identifies areas that require further insights by zeroing in on the gaps in research and exploring research priorities to advance policy and practice.

This report presents the findings on 'Adaptive Learning Programs for Employability Skills' among undergraduates. Scoping studies are finding increased use among researchers and there are a number of frameworks available for conducting scoping studies. For this study the authors have chosen to use the framework recommended by Levac, Colquhoun and O'Brien (Levac et al., 2010). This framework provides a detailed list of steps at each stage of the review process that enhances the clarity and rigor of the review process. Using this framework, the following steps were followed in carrying out the review. Stage 1: articulate the rationale and the research question and link the same to the purpose of the study. Stage 2: explore the right balance between the breath of available studies and the required comprehensiveness of the review process through the research design. Stage 3: discuss the iterative approach used to select the relevant studies for the review process and data extraction. Stage 4: present the numerical data as visual charts and also discuss the themes emerging from the selected studies. Stage 5: reflect on the whole process and present the conclusion and the implication for further practice or research.

Rationale

Adaptive learning technologies respond to student interactions in real-time, providing a viable alternative to expensive tutor led individual support (Guest, 2016). Adaptive learning interventions can be effective in enriching student learning while targeting precise areas of development (Christina, 2011). At the same time, there is a growing demand of Higher Education institutions to prepare their graduates for a smooth transition into the world of work. Policy makers are of the view that Higher Education institutions must play a proactive role in the community by promoting sustainable growth and job creation (Suleman, 2016a).

Employability has become a key factor for students while making a decision to join a particular program of study. With an increasing number of students graduating every year, there is huge pressure on jobs. The supply side has not kept up with the increased demand for jobs. In this highly competitive market the differentiating factor is transferable skills (Simatele, 2015). Given this intense competition, a number of universities have already begun experimenting by supplementing the conventional classroom instructions with adaptive learning tools to provide students with an opportunity to enhance their transferable skills (Tan and Neo, 2015).

One of the major elements of adaptive learning is personalisation. This brings a specific challenge of addressing ethical and social issues that will arise through personalisation. A design to address these issues will require appropriate technology and user training. Moreover, there is very little evidence on the issues of ethics and personalisation in learning. This in itself will require further research (Ashman et al., 2014a).

The current public debate on reduced educational funding and student employability provides an encouraging platform to implement an effective adaptive learning system with an objective to enhance student employability skills. There is strong emphasis on teachers around the world to use differentiated pathways for their students. In this regard, it is pertinent to understand the effectiveness of adaptive learning tools for successful implementation (Guest, 2016).

This review will compile evidence on the nature and extent of Adaptive Learning tools used to develop employability skills among Higher Education institutions. Specifically, students undergoing studies at the graduate level. Given the short time available a scoping study framework will be used. Scoping studies are widely used to examine the scope of carrying out a full systematic review or identifying gaps in existing literature (Arksey and O'Malley, 2005).

Research Question

The purpose of the scoping study is to answer the following research question: What is the extent and nature of published research literature on Adaptive Learning programs for developing employability skills?

Research design: This design follows the general principles of a systematic review by following pre-specified methods (detailed below) to reduce the risk of bias by selecting favourable studies, and extracting and analysing data that back a particular hypothesis. That is, the methods are determined a

priori, and are transparent and replicable. The label 'scoping' indicates that the methods are adapted to meet the limitation of time and resources available.

As such, compared to a full in-depth systematic review, the search process is less sensitive (e.g., minimal grey literature searches), the inclusion criteria are more narrow (e.g., English-language publications only; Under Graduate Students; restricted date range), and the inter-rater reliability processes are truncated (i.e., no double-screening and double-data extraction).

A scoping study involves rapidly mapping key concepts supporting the research area (Arksey and O'Malley, 2005). Scoping studies are suitable for broad research questions by involving a range of research and non-research material to provide clarity for the concepts studied about a specific topic (Davis et al., 2009).

The scoping review involved compiling the information collected from the title, abstract and full text studies. The information was collated from the records identified through searches of bibliographic databases.

Inclusion and exclusion criteria
Based on the research question, the following list was considered relevant to this scoping exercise. Records of research evidence had to meet the following criteria:
- Studies published during the last 16 years (2000 onwards)
- Abstracts in the English language
- Adaptive learning tools are the central component of the study to develop employability skills (i.e. research which used adaptive learning tool to develop employability skills)
- And one of the following criteria holds :
    - Studies reporting the impact of adaptive learning tools on employability skills and other social outcomes (outcome evaluations), or
    - Reported student's experiences of using adaptive learning tools (process evaluations), or
    - Provided access to the views and experiences of students on the use of adaptive learning tools where individuals or groups sampled in the studies should be students undergoing an undergraduate program in a university.

Research methodology - information retrieval
The following methods were used to retrieve information on published research. Published research evidence was identified by using an iterative process. For the purpose of this study, three popular databases were selected: Science Direct, Ebsco Host & Proquest. All three databases were searched for published research on adaptive learning and employability skills. The search results were limited to all published work from the year 2000 to 2016. Using an iterative process, a search strategy was developed using the online search tools associated with the databases. The search was optimised for relevant studies by a combination of strings using Boolean operators. This strategy used different indexing terms available in the databases to locate specific information in the three databases. A full copy of this and other search strategies is provided in appendix A.

Findings
A specific data charting form to extract data from selected studies was designed especially for this scoping study (appendix A).

Bibliographic search: The searches of bibliographic databases resulted in the identification of 307 records (appendix B) with abstracts. After screening these against the inclusion criteria the authors found that 33 individual studies were eligible for inclusion.
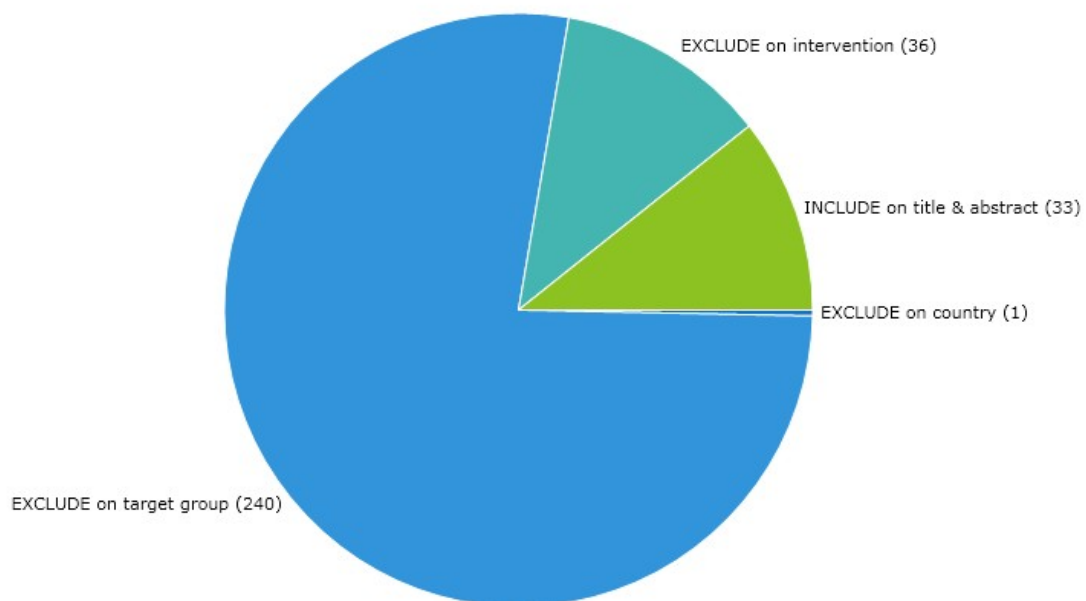
**Figure 1. Bibliographic search**

The analysis presented here is based on coding of information available in the title and abstracts for the 33 studies. (Appendix B contains a list of all 33 included reports of research.)

Full text screening: After screening the abstracts, 13 studies were selected to be included in the final analysis (based on the inclusion criteria).
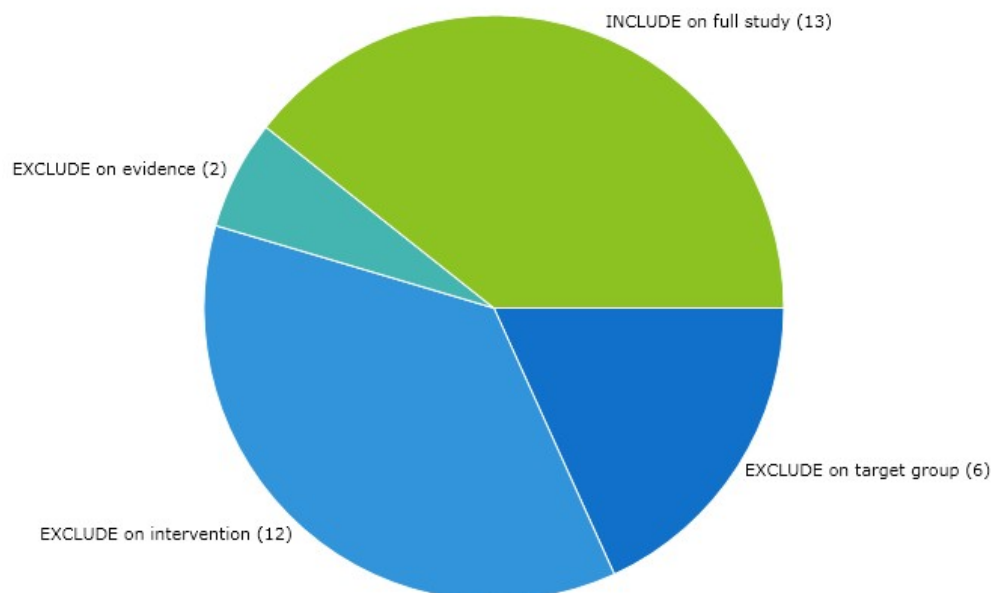

Figure 2. Full text screening

Country of Origin: Of the 13 studies, only 5 were conducted in the UK, 2 were conducted in Australia, and one each in Netherlands, Portugal, Malaysia, South Africa and India.
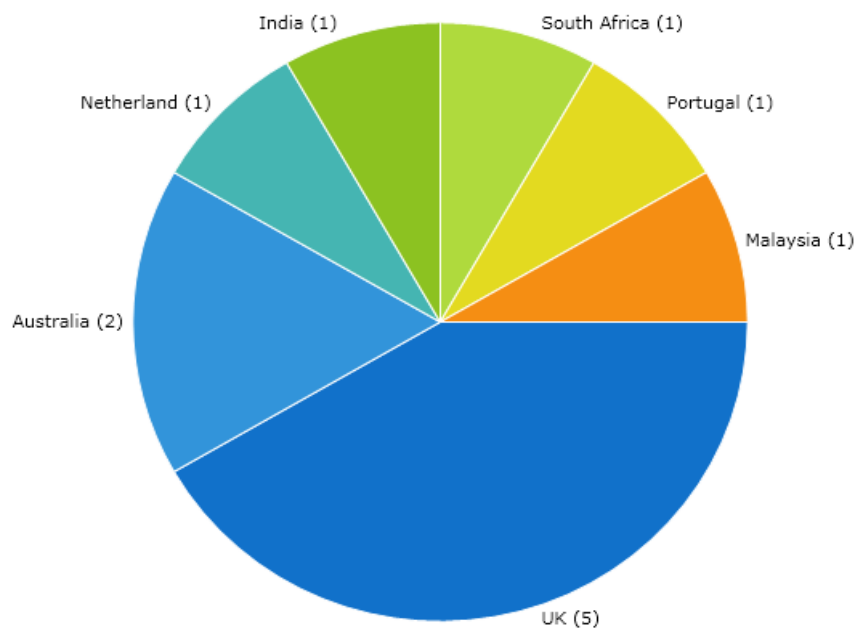
Figure 3. Country of Origin

Sample Population: In terms of the populations targeted by the interventions, all the studies were limited to undergraduate students. Nine studies targeted both male and female students, while three studies reported no information. Some studies provided more descriptive details of the sample population. A range of groups were represented: business students, computer science students, bio medical students and psychology students.
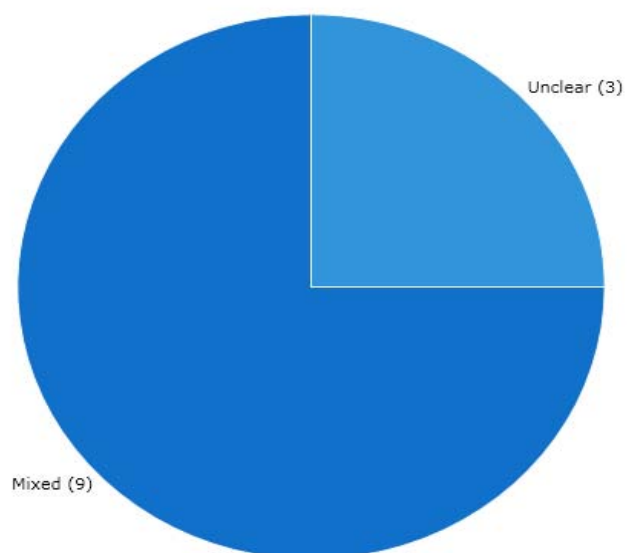

Figure 4. Gender

Computer Literacy: Nine studies reported a high level of computer proficiency among the sample population. Only one study reported limited computer proficiency.
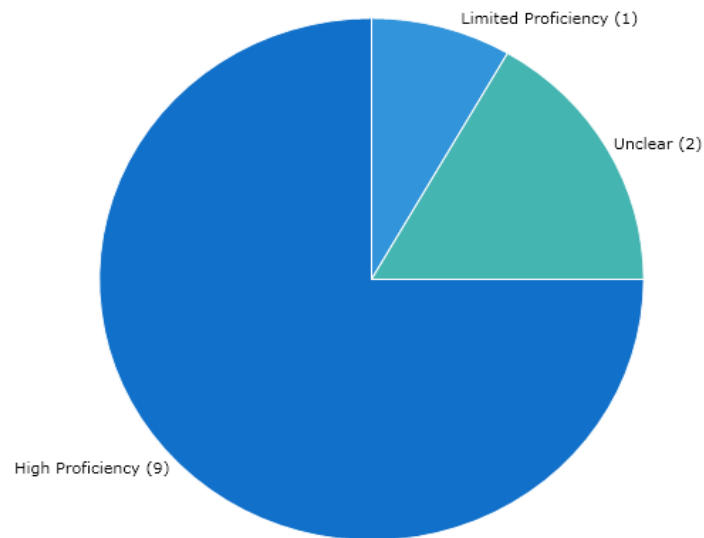

Figure 5. Computer Literacy

Type of Adaptive learning system: Studies used different types of self-paced e-learning delivery systems that can be broadly divided into linear, macro-adaptive and micro-adaptive. Four studies reported results for linear e-learning systems (which deliver the same content in the same predetermined sequence to each learner). Three studies used macro adaptive systems to deliver the content (which make a pre assessment of the leaners skills to tailor the program). Two studies reported using micro adaptive systems (which are highly customisable systems that react to leaners needs dynamically and in whicha high level of personalisation is possible). Three of the studies did not specify the type of technology used to deliver content.
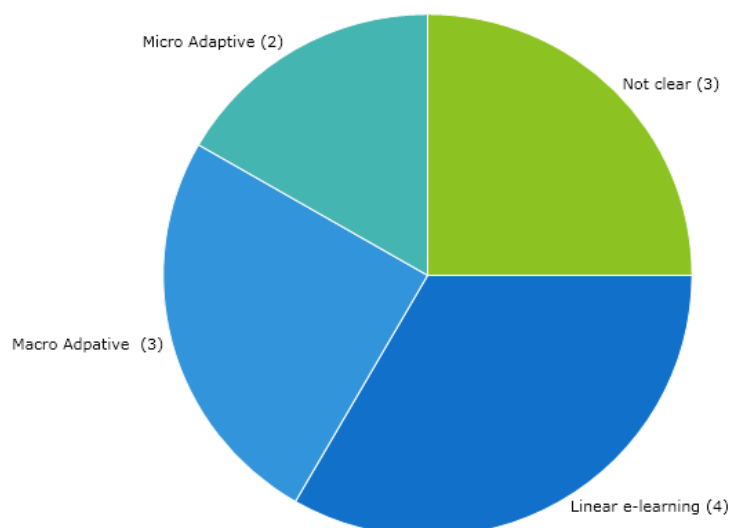

Figure 6. Type of Adaptive learning system

Content delivery: Four studies used a preference based approach to deliver the content (in which the system records user preferences and then delivers content based on the user's preferences). One study reported the use of data driven algorithms to identify the learning path for each individual learner. The majority of the studies reported no specific design for the delivery of content or personalisation.
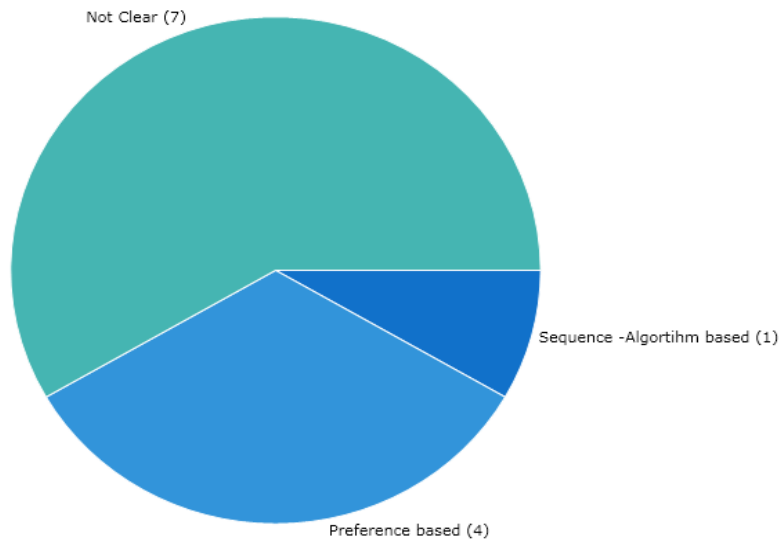

Figure 7. Content delivery

Employability Skills: The data presented here is based on the 13 studies. The studies focused on a wide range of employability issues and outcomes, with many having more than one focus. The types of employability skills these studies focused on can be categorised as relating to Communication, Planning and Organising, Teamwork, Problem solving, Initiative and enterprise.
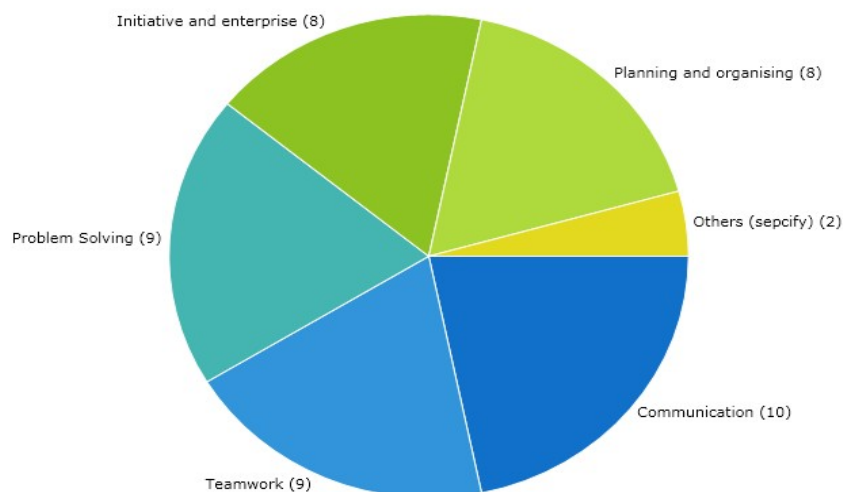
Figure 8. Employability Skills

Sampling: Eleven of the 13 studies used convenience sampling to collect the primary data. Only one study used a randomised sample. Only one study reported a nationally representative sample.
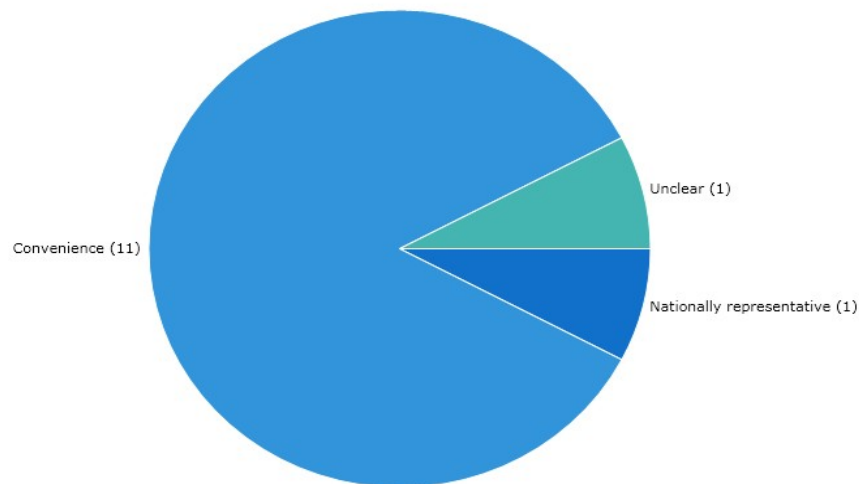
Figure 9. Sampling

Reliability Statistics: Only two out of the 13 studies reported reliability statistics. Both the studies reported an alpha co-efficient of over .80.

Data Analysis: Five studies used quantitative data to report the findings, three studies used qualitative data from focus studies to report the findings, while four studies made use of case studies to report the findings.
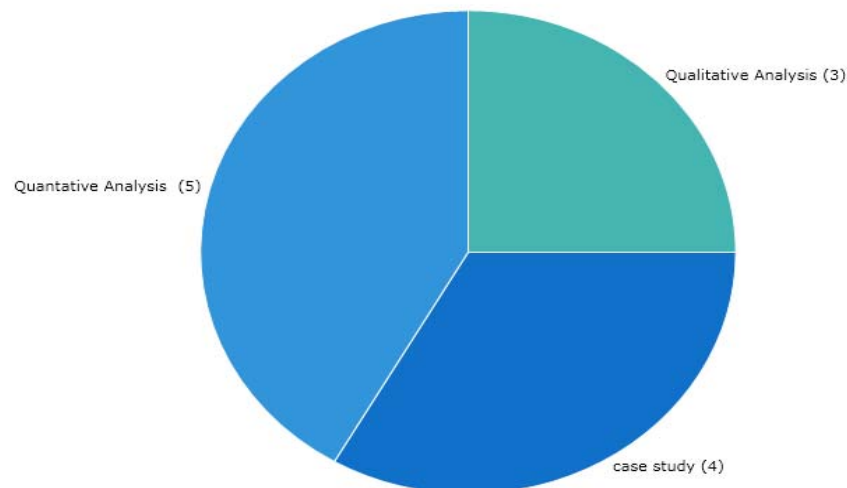
Figure 10. Data analysis

Classification: Of the 13 studies, 10 were classified as outcome evaluations. Of these, three were randomised controlled trials (RCTs), two were non-randomised controlled trials, three were single group pre-test post-test studies, and the design of five was unclear. There was one potential systematic review. Two surveys were included.
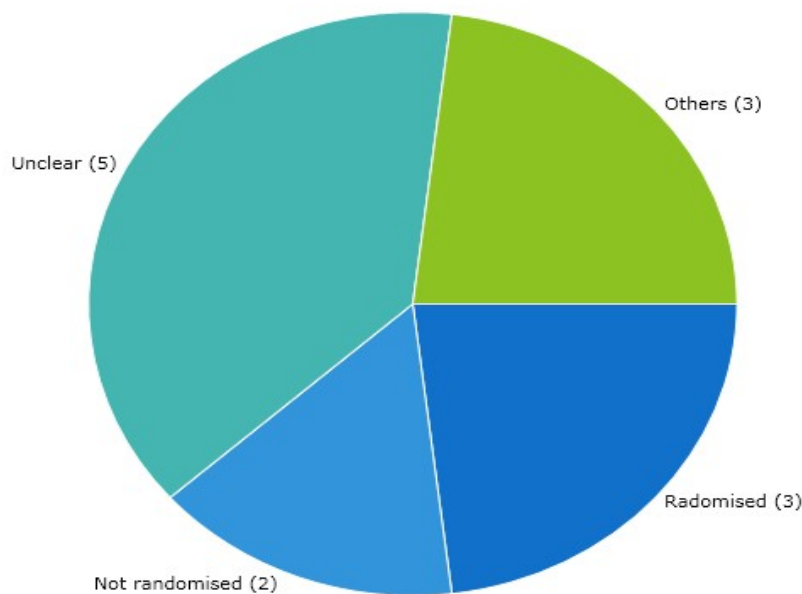
Figure 11. Research design

Discussion

Use of adaptive learning tools to enhance employability skills is expanding and is reflected in the number of recent studies selected in the scoping study that explore the use of adaptive learning programs for teaching employability skills. Adaptive learning interventions have several benefits over the conventional classroom teaching methods. Adaptive learning tools are available at any time of the day unlike conventional classroom settings with predetermined hours of operation. Adaptive learning tools are not constrained by geographic location of the learner. They are cost effective and can be configured to reach a larger group of learners. In addition, they give users the choice to learn at their own pace and time while also giving them the option to work from familiar settings.

Adaptive learning tools have many advantages but there are some key concerns surrounding data protection and limiting the scope for face to face interaction (which is a clear disadvantage compared to the conventional classroom learning environment).

The scoping review focused on the use of adaptive learning tools to develop employability skills and found varying degrees of quality and evidence to support the efficacy of using adaptive learning tools. Only 3 studies of the 13 studies included in the review used Random Controlled trials to evaluate the efficacy of the program.

The results of the scoping review point towards research evidence in the area of adaptive learning for developing employability skills among graduate students. The search results were negative for existing systematic reviews with a focus towards the use of adaptive learning tools to develop employability skills. The majority of the full text studies identified may not be found suitable for a systematic review on the basis of their research design or the quality of data and reporting. The results of the scoping exercise highlight the limited body of research evidence in the area of adaptive learning tools to develop a range of employability skills among graduates.

Thematic Analysis

Thematic analysis of adaptive learning programs to develop employability skills included in the review revealed the following themes: employer involvement, background characteristics, embedded curriculum, data protection, technology and learning strategy.

Employer Involvement

Universities report positive experiences from creating systems that include interaction with the world of employment. In cases where companies were involved the design of the employability program, the students benefited from ongoing advice and later thinking. This has also helped perceptions usually associated with semester schedules and other course management issues. More over, accumulated projects provide a source of support and insight into practical issues. Adaptive systems that encourage employer participation offer the opportunity for more rounded and employable skills relevant to the job market (Holmes and Miller, 2000).

The changing nature of employability skills are best served by involving industry in defining the relevant skills. There is general perception among the employers that the graduates do not engage sufficiently in honing employability skills (Jackson, 2012).

Background characteristics

Adaptive learning tools used in the acquisition of employability skills find background characteristics make a significant contribution towards the final outcome. Specially examining gender, pre education and industrial training were found to have significant relationships among different academic disciplines and the employability skills, and there was a strong correlation between previous industrial training and higher employability skills. However, there was no significant relationship between employability skills and gender (Boahin and Hofman, 2013).

Embedded curriculum

Embedding employability skills within the curriculum is beneficial but it is not without resistance. The majority of students consider employability skills as soft skills and feel it should not be part of the curriculum. They are concerned that these topics are not subject specific and do not have a place in the curriculum. Surprisingly, the majority of institutions involved with employability skills also hold this view and are not willing to compromise teaching time for employability skills. Thus it is very critical to engage students and listen to their views throughout the development process (Fitzgerald, 2015).

Employers appear to have reasonable certainty of the skills required for employability but research questions these assumptions and shows there are clear uncertainties among the different employers and, moreover, there is no agreed set of employability skills that are common across the broad spectrum. Literature in the area of employability skills highlight the fact that there is no one specific skill that makes graduates more employable. This diversity in skills has its own challenges for the educators. Additionally, the level of skills required for each workplace varied and required a narrow or a broad focused educational objective. The skills demanded by the job market set the tone for managing the skills mismatch but managing this complexity is a challenge for educators (Suleman, 2016b).

Researchers report varying levels of student engagement with adaptive learning tools. Lack of clarity or a clear set of objectives for using the virtual environment is one of the causes for the low level of engagement. Often there is also no clear understanding among the teaching teams about how the tools should be used and monitored. Consequently, the success of adaptive learning tools requires teacher engagement combined with regular encouragement to increase student engagement (Viol, 2015).

Data protection

Adaptive learning systems have potential promise but at the same time, there are real concerns around the use of personalisation. Problems are anticipated based on the authors experience with personalisation in non-educational systems. Concerns around privacy, unintended discovery and reduced skills pose a problem for the individual and the larger society. However, given that adaptive learning systems are still evolving, there is increased scope to model systems that consider the constraints to evolve a more robust adaptive learning system (Ashman et al., 2014b).

Technology

Kruse, R., Gebhardt, J.E., Klowon, F., (1994) suggest that fuzzy systems are more adept at finding the right person for the job in a simple and effective manner. The complexity of educational requirement and personal attributes are manipulated to arrive at a range of employability skills from low to high. These systems can be configured to select appropriate candidates based on a set of rules evolved by the employers (Kumari et al., 2015).

Learning strategy
Adaptive learning tools are a good platform for the transferability of employability skills. These systems offer a greater level of engagement and more scope for active learning. Apart from the cognitive learning, these systems offer a platform for students to plan and display their own career development through a process of reflection that evidences their technical and soft skills that are a norm in today's work place. These systems are found to be beneficial when they are embedded in the curriculum as opposed to a stand-alone approach to teaching employability skills (Simatele, 2015).

Incorporating extra-curricular opportunities and work based diaries in Adaptive learning tools, that provide opportunities for reflection and transfer of knowledge across contexts, significantly contribute towards the employability of the students (Watson, 2011).

The challenge of preparing graduates for the workplace is complicated by the need to prepare graduates for progression, if that is their option. Research suggests that there is demonstrable evidence linking beneficial outcomes with early introduction of employability skills (Rutt et al., 2013). Simulating the work place in the learning process provides the opportunity for graduates to explore practical application of the theory and also exposes them to the skills gap in their repertoire, thus providing an opportunity to develop appropriate skills and learning strategically (McKinnon and McCrae, 2012). Universities in Malaysia have been experimenting with adaptive learning tools for delivering employability skills but find the problem of employability still persists. The authors recommend a more comprehensive model of including adaptive tools and face-to-face learning, and focus on learning principles that are suitable for specific environments. Adaptive tools combined with conventional learning environments provide better opportunities for increasing employability among graduates (Tan and Neo, 2015).

This scoping exercise provides an initial guide of the likely size and scope of the available research literature on the use of adaptive learning tools for developing employability skills. The main benefit of this scoping exercise was that it highlights the salient issues and was completed in short period of time.

Limitation
The scoping review uses the methods followed in a systematic review but these are limited in scope. Because of this limited scope the findings and recommendations should be used as indicators for further research and should not be seen as firm recommendations for developing policy or practice. The approach used for this study is replicable, transparent and follows an agreed framework but there are some major differences when compared to a full systematic review.

Some of the limitations of this scoping study are listed below.

1) The search was limited to three popular databases.
2) Grey literature was not included in the study.
3) No contact was made with any of the authors for further information.
4) The inclusion and exclusion criteria was decided keeping in mind the limitation of available time.
5) There was no attempt to evaluate the quality of individual studies.
6) The findings were highlighted as broad themes; there was no effort to synthesis the results.
7) The authors were the only people involved in data extraction so there is no scope for secondary opinion.

One of the recommended criteria for an effective scoping study is the process of consultation. In this study there was no scope for stakeholder consultation. The consultation process would have

increased the methodological rigor. There is a possibility that consultation would have given a different perspective and meaning to the scoping study.

Conclusion
The authors interest in systematic review and scoping review started with a project at the UCL EPPI centre. The experience gained during this project and subsequent readings furthered the knowledge of systematic reviews. The authors chose the research question from a list of issues concerning their practice as academic teachers. Employability skills is top of the list within their department and is discussed at different forums. Given the general interest, the authors were enthusiastic to explore the evidence. During discussions with practitioners, it was identified that one of the most common obstacles encountered in developing effective employability skills was the availability of sufficient resources. Teaching time is a premium in most British universities and adding additional workload is normally opposed. Given the authors' interest in learning technologies they started focusing on adapting learning tools as an alternative to conventional face-to-face teaching. They started with the premise that, if there is sufficient evidence to prove that adaptive learning tools can be effective in delivering employability skills, then there was an increased potential of finding a solution to the problem of resource constraints and teaching time. The scoping review is a popular methodology among researchers exploring evidence in a particular context. Also scoping reviews are very useful in informing policy and practice.

Considering this, the authors choose to undertake a scoping review to explore the extent and nature of published research literature on 'Adaptive Learning programs' for developing employability skills. In the last decade, there are over 30,000 published research papers on adaptive learning but only one percent of these papers have specially focused on adaptive learning tools for developing employability skills. The scoping review listed evidence of the use of adaptive learning tools for imparting employability skills, and the thematic analysis highlighted the areas of focus for creating an effective adaptive learning environment.

From the perspective of answering the research question, the extent of published work on adaptive learning has seen a marked increase. For example, in the last decade over 30,000 research articles were published and it is set to increase in the coming years : in recent years, a large number of Universities and Charities have invested in infrastructure for promoting adaptive learning.

Currently, use of adaptive learning tools in developing employability skills is limited, but with more and more universities realising the importance of developing employability skills among their students for their long-term growth, there is increasing potential for using adaptive learning tools to develop employability. Adaptive learning tools offer many potential advantages over conventional face-to-face programs, beginning with accessibility; these tools can be accessed anytime and gives the leaner the flexibility of learning at his/her own time and pace. Moreover, it is potentially a more time efficient option to deliver employability skills.

The thematic analysis provide insight into the areas that require further research. One of the key themes is on embedding skills development into the curriculum. There is also need to understand the issues with using technology to deliver the curriculum. Another area of focus is understanding the mechanics of involving employers, building the appropriate technology infrastructure to collaboratively deliver employability programs on an adaptive learning platform.

There is increased focus on the issues of personalisation and the use of data. Adaptive learning tools store large quantities of data. The majority of this data will contain personal information. This data can be used to accurately model individual personality and must be used with caution. More research is necessary to understand issues around safeguarding data. Moreover, there is need for research around students spending the majority of their time in a virtual world. Employability skills by their dynamic nature will need different teaching strategies and this is one area where we need more research information. Historically, there was a clear understanding of the skills required for the work place but with today's fast changing technologies bring about a certain amount of ambiguity. It is very difficult to forecast the jobs of tomorrow and so there is limited information relating to skill sets required for the future jobs.

A full systematic review will provide an opportunity to explore in-depth the advantages and the disadvantages around the use of adaptive learning tools to develop employability skills. A full systematic review will provide an opportunity to explore in-depth the various issues of technology and skills relevant to policy makers and practitioners, while recommending an appropriate adaptive learning system design for implementing a program to enhance the employability skills among the students.

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