

## The potential for artificial intelligence in the educational sector: Service automation of assessment at Copenhagen Business School

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Artificial intelligence is revolutionizing the way in which technology is conceived in society. While previously, its purpose was to simplify rule-based activities, it is nowadays a mean to aid humans in complex and unstructured data intensive decisions. The process of assessment in higher education, for instance, is an activity that can be improved through artificial intelligence as it consists of data intensive decisions, and at the same time, requires the teacher to focus on the performance of each student's writing, thinking and knowledge of a topic.

This research uses a case study approach to look at the opportunity for Automated Essay Scoring (AES). As the current literature on AES has focused on primary and secondary education, the paper aims to expand the topic to higher education. The paper draws on a case study from Copenhagen Business School which analyses current resources and the experience of stakeholders (teaching staff, students and university management). The theoretical framework adopts a Service Dominant Logic and a human centred design approach to investigate the jobs, gains and pains of introducing AES. The research identifies a clear need from teachers and students for improvements in assessment feedback and the benefits and drawbacks of AES are outlined.

### Introduction

In the education sector today, class enrolments are on the rise. Since the mid 1990's it has been observed that occupational satisfaction rates of academics are decreasing (Ramsden, 1996), in part because of increased time preparing for classes and examining assignments. In addition, governments are cutting budgets on public expenses, including the education sector. With these dynamics in place, the impact on the quality of higher education is negatively affected. Students have become pre-occupied with advancing their grades rather than mastering the content of the subject matter (Ramsden, 2003) and there is a questioning of what learning is – both from the teacher and for students.

Assessment plays a central part in the quality of learning (Boud & Associates, 2010) and the distinction between how students learn and the teacher's perspective is critical. Students' perceptions of the education system are based on three main criteria: the curricula, teaching methods, and assessment procedures. Rowntree (1977, p.1) states, "if we wish to discover the truth about an educational system, we must look into its assessment procedures". According to Ramsden (1996), assessments are: a method to help students learn, a method to analyse students' progress, and a method for teachers to alter ways of teaching to better assist students. In order to help students to learn and evaluate their progress, there is an inevitable link between the two forms of assessments: formative and summative. Furthermore, assessments are defined as the activity of collecting information on the knowledge depth of a student that has attended an educative and formative course. This process is carried out by examiners and entails the evaluation of the learner's performance and instructional outcomes. However, at the end of each formative and summative assessment, students should receive feedback in order to improve their performances and to better appreciate why they received a specific score or evaluation. Feedback has a twofold purpose: it is the consequence of performance and, at the same time, it is an integral part of learning. Feedback is a constructive and valuable comment that, if provided with responsiveness, has the capability of helping an individual to correct their mistakes or increase their skills in performing a specific action (Boud, 2007). Moreover, feedback is said to support learning, instead of merely giving a final score on the performance and indicating what is right and wrong, by focusing on explaining to the student the what, the how and the why of their mistakes and poor performances (Evans, 2013).



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## Automated Essay Scoring

Currently, AI in education is implemented and focused on the purpose of freeing academics from routine-based activities. This can reflect tasks such as the marking process, to let teachers focus on more valuable and productive activities like teaching, researching and assisting in individual students' needs. In 1966, even before the time when the concept of AI was first introduced, and even before students used computers to write essays, such a solution as Automated Essay Scoring (AES) was already being tested by Ellis B. Page (Potts, 2005).

Page (1966) came up with the idea of using a computer program to examine essays, as he realized that there was a lack of English writing evaluation in essays. He believed teachers were not promoting writing quality, instead focusing on the subject's learning objectives. He was reflecting on the multiple-choice test, a popular way of testing subject-matter knowledge in a cheaper and more objective way than essays. It was, however, a weak knowledge test as it only implied the recognition of information by the student and, as Page (1966) argued, could not test the ability of students to synthesize theories in their own words and analyse facts. To address the sceptical comments of other colleagues on letting a machine correct essays, Page responded that his solution was "a way to measure essay quality with the same reliability, validity and generalizability - with the same "objectivity" - which they enjoy in multiple-choice items" (Page, 1966, p. 239).

Today, AES tools are computer programs that are able to analyse the text of an essay on the basis of several writing qualities and content variables that are defined a-priori by a human rater. AES tools are already implemented in the examination of high-stakes written tests. In addition to examining summative assessments, they are also used in formative assessments and, as an instructional tool that is able to provide feedback to students (Nathawitharana et al, 2017). These tools are typically web-based and include two components: an electronic portfolio and an AES engine. The electronic portfolio component is the platform and graphical interface where students assess essay prompts, use specific writing tools, upload their essays and receive feedback. The feedback they receive are in two forms: qualitative and quantitative. Qualitative feedback is given as suggestions to the students regarding improvements of their writing and in order to meet specific writing qualities. Quantitative feedback, on the other hand, either takes the form of a single numeric score, or of different scores that rate the essay on specific writing traits such as content, creativity, style, mechanics (spelling, capital letters and punctuation) and organization (essay structure quality) (Shermis, 2010). The AES engine is the component that scans the essays and uses statistical algorithms that are built on the concepts of Machine Learning (ML) and Natural Language Processing (NLP) and then evaluates them.

Having touched on the research field of AES, it is important to analyse the potential of AI opportunities for institutions. In this paper we use a case study of the Copenhagen Business School (CBS) to explore the potential benefits and issues associated with adopting AI as part of the assessment system.

## Theoretical framework

As the basis for undertaking this research, a Service Dominant Logic (SDL) and Value Proposition Design (VPD) approach was used to provide a framework to explore the use of AI on written examinations. It is believed this approach will assist in analysing the service proposition and value obtained by the stakeholders involved in the process.

The emergence and evolution of a SDL perspective was introduced in 2004 by Vargo and Lusch (2004) who based it on the idea of the role of service in regard to exchange and value creation. For decades, the dominant logic was based on the exchange within a Goods Dominant Logic (GDL) view, focusing on tangible resources, embedded value, and transactions, predominantly of manufactured goods (Vargo & Lusch, 2004). However, Vargo and Lusch argued for a new perspective that focused on the economic exchange of more service-oriented offerings, that are embedded within intangible resources, the co-creation of value, and relationships (Vargo & Lusch, 2004). Although the perspective has emerged from Vargo and Lusch's work, the importance of services in the marketing literature has existed for over two decades (Gummesson, 1995).

As the world economy has shifted to a service orientation view, Constantin and Lusch (1994) classified two types of resources: operand and operant resources. Operand resources are those resources that have been produced through an operation or act, such as a physical tangible good. Whereas, operant resources are often invisible and intangible. Action is normally taken to create operant resources such as using the skills and knowledge of teachers. In a GDL centred view, operand resources are the primary source of factors of production. In contrast, in a SDL centred view, operant resources are the primary source of producing effects which are then used by students for their own value creation. This creates a world in which humans can create

additional operant resources, by adding value to the natural resources (Vargo & Lusch, 2004). As a result, a market that is customer-centric involves collaboration with customers (Sheth, Sisodia, & Sharama, 2000). This reflects back to the world being more customized and personalized for individuals, in order to create additional value.

The VPD canvas, developed by Osterwalder et al (2014), is a theory that is used in human-centred innovation processes for improving or developing new products and services. Its main contribution lies within the idea that an organization can create real value only after understanding the individuals to whom they are offering a unique solution. This is accomplished by creating a solution that fits perfectly with their profile. The framework consists of two distinct parts: the customer profile and the value map. These parts have to be mapped out for every distinct customer segment that an organization or firm wants to serve. The mapping process provides insights into the customer's needs that can then be used in any service design.

## Value Proposition Design Canvas

The VPD framework was used in this research as a way to understand the two most important stakeholders of the assessment process, teachers and students, and to identify a solution that incorporates the two. As teachers and students have very different needs and experiences, the value creation process started with mapping out two different customer profiles, one for each stakeholder. Even though the two different customer profiles are created separately, it can be observed that both of the stakeholders, students and teachers participate in the assessment process: teachers as “active” users; as they are the ones that evaluate the performance, and students as “passive” users; as they receive the grade and feedback. Therefore, a single value proposition can be examined by looking at the interconnection between these two different stakeholders.

The goal of mapping out the value proposition canvas is to guide the creation of value as a response to the customer profile. As a result, the entries of the value map are named “gain” creators, “pain” relievers and “product and services”. Pain relievers explain how the product or service solution aims at resolving and reducing specific customer pains. Gain creators, on the other hand, tackle the outcomes that are already mentioned in the gains part of the customer profile that a customer will get out of the solution offered. Lastly, the product and services section helps to disclose the final solution and it includes all of the different products and/or services that are included within the entire value proposition.

The last stage is to find a “fit”. Osterwalder et al (2014) suggests that there are three stages of fit that are related to the level of maturity of the solution from prototype to final product/service: problem-solution fit, product-market fit and business model fit. Problem-solution fit is achieved when it is proven that customers' most relevant jobs, pains and gains are the ones tackled by the solution, even though at this stage it is not yet proven that they will in fact use the solution. Product-market fit is created when customers start showing interest in using and buying the designated solution and see the real value they can get out of it. The final stage of success is then reached when the solution has a business model fit and, hence, when it is proven that there is a stable business model that can be profitably sold, in a sustainable way.

When looking at a SDL approach, for the purpose of this research, it was important to understand this view in a customer centric world. In order to do so, the selection of the VPD canvas was chosen to analyse the nature of the process of the innovation that is being created- in this case the assessment system is seen as a service. The process of assessments has been, so far, an extremely human related activity that has always been a subjective process for the experts performing the task and the different performances of students. Furthermore, as each educational institution has a different approach to undertaking assessment and as CBS has been selected as the case study of this paper, prior to this research, it was not clear how CBS academics carried out the activity. Consequently, there was a need to find a framework that could be used to gather an in-depth understanding of the specific customer segment, aligning it with the service era of today's education sector.

## Introduction to the CBS case study

Established in 1917, CBS is an international business school teaching over 21,000 students and employing 1,500 employees. Since 1917 until 1971, there were no standard marking schemes, thus individual departments created their own. Introduced in 1971, a 00 to 13 grading scale was used, whereby grades could be placed within 4 different groups according to the performance of students; (1) where 13,11,10 are excellent (2) 9,8,7 are average (3) 6 are just acceptable and (4) 5, 03, 00 are marginal or fail. Then, in August 2007, Denmark enforced a new 7-step grading scale, to create more compatibility within an international context, specifically the European Credit Transfer System (ECTS) grading scale (Eng.uvm.dk, 2018). This 7-point scale is based on the overall

performance of a student and on the academic requirements. The grade of 02 is the lowest used in order for a pass. Students are graded at the end of each course through oral and written exams. Written exams can either be sit-in-exams where the student has to write an exam at the university, take-home exams where the student has a limited period to write the exam outside of the university (24, 48 or 72 hours) and projects where the student works individually or in groups on a theoretical problem (Copenhagen Business School, 2018). In total it is estimated that over 30% of the Schools resources are dedicated to the process of setting and marking assignments and exams. Subsequently, some observers believe there is potential for AI to take some of this burden and reallocate resources which would provide more consistency and provide a better experience for students.

After reviewing the relevant literature, it became apparent that research in the field of AI and education have yet to adopt a SDL approach. Thus, based on the research question: *What is the potential for AI to be used for feedback and grading at CBS?* the research method of a single case study was adopted. As identified by Yin (2013), a case study examines an existing experience whereby the analysis of a real-life context is conducted in order to identify and analyse the knowledge gaps that are unexplored, with no clear evidence. Qualitative research was undertaken in order to obtain an insight into the examination process of exams at CBS. As Kvale (2007) explains, qualitative research helps to understand the views and experiences of the stakeholders of the social phenomena studied in their natural context. The collection of stakeholders' insights was carried out by conducting 29 face-to-face interviews with AI experts, university management, teachers and students. This process is supported by the premise that interviews are an effective way to appreciate personal insights of the subjects interviewed, as interviewees have the possibility to explain their own experience and opinions in their own words. Most interviews were conducted face-to-face, to create a more personal dialogue, but also to observe the interview in a different perspective by respondents' body language and emotions throughout the responses.

The interviews consisted of a list of open questions regarding the examination topic, and, depending on the insights that the interviewee introduced, further follow-up questions were asked during the interview (Kvale, 2007). When talking to students, a short dialogue was held using an unstructured interview model based on their experiences concerning their satisfaction (or dissatisfaction) with different aspects of CBS while observing their behaviours when talking to gain answers in divergent ways. This was done in order to obtain both a factual and meaning (Kvale, 2007). The factual level was achieved when the students talked about something that had happened and what they thought about a specific topic. The meaning level, on the other hand, consisted of the researchers probing for further explanation and detail (Kvale, 2007).

## Findings from the interviews

The insights from the interviews with teaching staff and students have then been analysed and grouped by using the customer profile canvas (Osterwalder et al, 2014). It has to be noted that only the insights that were mostly recurrent among teachers and students are represented. As shown in Figure 1 and Figure 2, there are two patterns that connect the pains, gains and jobs of students with the ones of teaching staff. These patterns are time and feedback. From the teacher perspective, the lack of time and management is a major issue as it dictates their availability in being part of determined activities, such as teaching. From the teaching staff interviews the lack of time seems to be connected with the fact that there are some repetitive and time-consuming activities, such as administrative tasks and marking. This lack of time is echoed by the students, as having to wait one month to receive a grade was considered a "pain". The lack of time also triggers the pain of students of not receiving any feedback or explanation for their final performances (assessments), which ultimately results in a decrease in teaching quality. This pain is also reflected in the teachers' profile as they feel they are not being respectful towards students by not providing students with prompt feedback. Even though teachers admit that, according to the university rules, they have to be open to providing feedback at any time it is requested by a student. However, teachers state that they are not given an allocated time for this activity and this leads to arbitrary decisions as to whether, and to what extent, feedback is provided. Referring back to the literature review for this study and looking at the data from the interviews with teachers and students, it is evident that CBS is missing an important part of the learning process by not providing feedback as a support for learning (Evans, 2013).

By looking closely at the teaching staff profile (Figure 1), some additional considerations can be observed. A common point in the customer job section was of "creating an exam format that allows other teachers to grade the exam". This is mentioned by 5 out of 13 teachers who report that, in some cases, they have to either create a solution guide to the exam so that it can be graded by another teacher (or external examiner) and to collaborate with other teachers with whom they teach in the same course on how to grade the exam in a consistent manner.

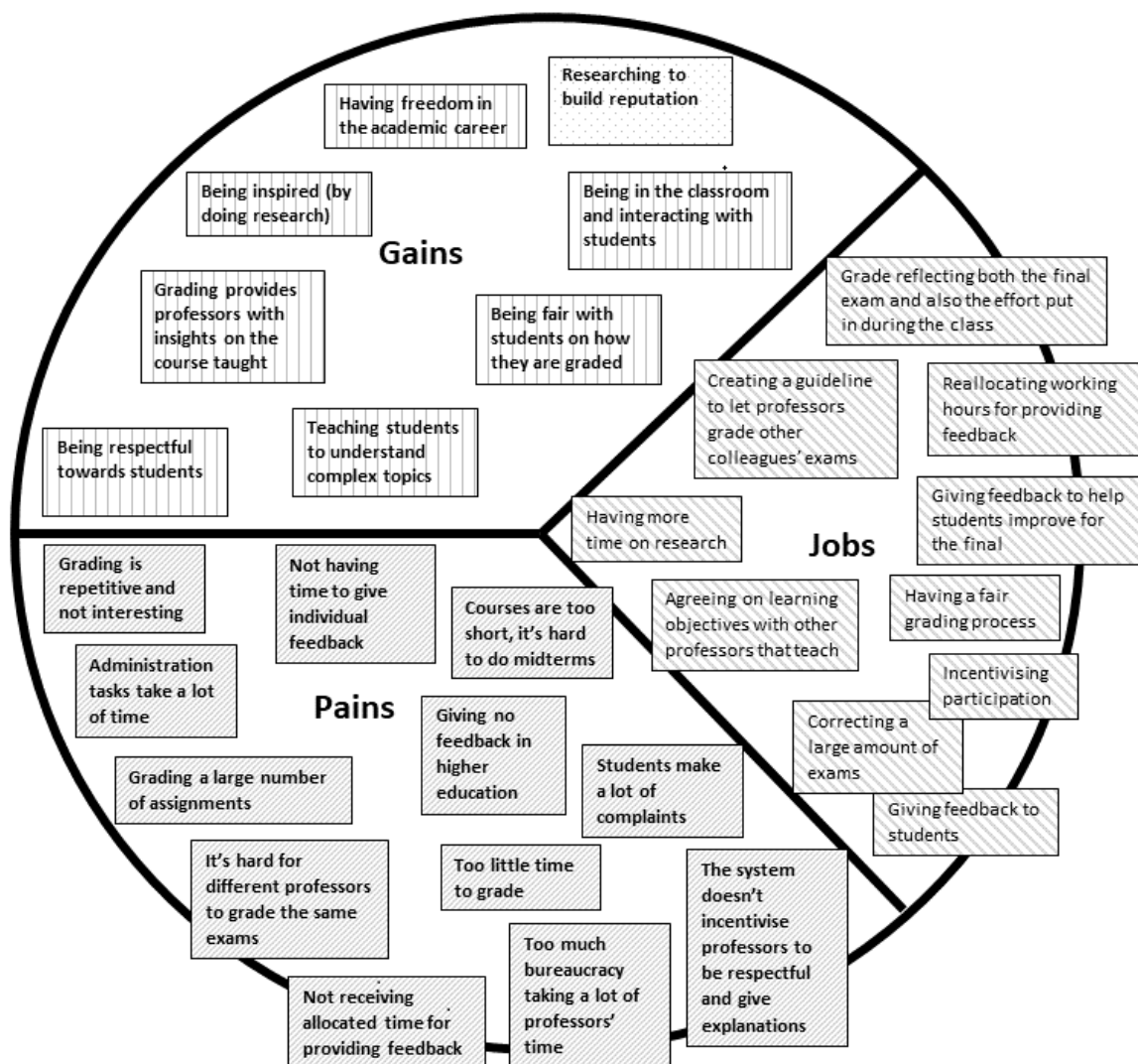
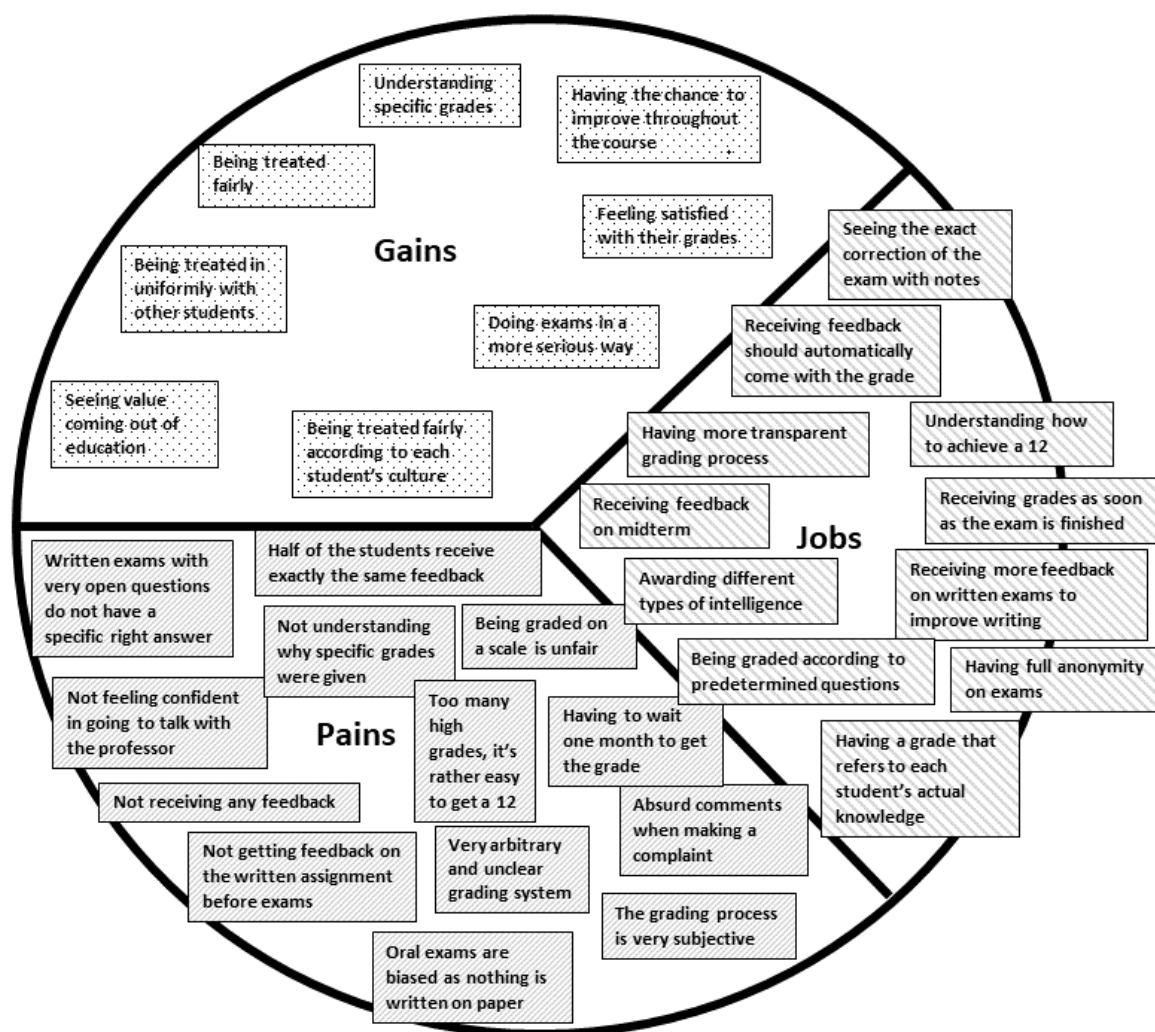


Figure 1: Value proposition Design Canvas: Teaching staff profile

It follows that, even though the examination activity of teachers is very subjective, according to the teachers, there is an expectation that exams are designed so that they can be graded in an objective way. In addition, “incentivizing in-class participation” was also a shared customer job for 6 out of 13 teaching staff. Some said they would like to have a percentage of the final grade based on student participation.

Moving to the students’ profile (Figure 2), besides receiving prompt feedback, a shared request was having a more transparent examination process that is based on answers that are partially decided a- priori even for essay-based assessments, as standardized solutions are already being used for quantitative exams. This would mean that when a grade is received, it would be easier for a student to understand how different their answers are in comparison to what the teacher is looking for. Related to this point is the need for more standardization of the exam for the teachers. Another relevant observation was the desire for students to have an examination process that can consider the different cultural and educational background of each student. For instance, according to one respondent, Danish students are very good at presentations and oral exams, as they are taught public speaking and argumentation techniques from the beginning of their education, while in other countries the knowledge and depth of understanding of the student are considered more important.



**Figure 2: Value Proposition Design Canvas: Student profile**

A common point that emerged from teachers and students' discussions was the inconsistency that resulted from the newly introduced 7-point Danish grading scale. From the teachers' side, it was felt the scale does not allow them to award a grade of excellence, which was previously possible with the grade of 13 in the previous scale. The scale was also considered a pain for teachers when having to decide between the grades 4 or 7 and 7 or 10. The large gap that these new marks represented was thought to provide a poor differentiator between students with very different performance levels (for instance a very poor 7 and a very high 7) receive the same grade. This is one reason why students made complaints, as they feel their better performance is not awarded fairly compared to others. Additionally, as one teacher explained referring to essay exams, this type of grading scale does not allow exceptions and students' extra effort or knowledge to be rewarded. According to the grade descriptions in the scale, teachers have to look for how many mistakes the students made in order to decide on the grade. This makes the examination process an activity that is based more on negative scanning of exams than looking for positive points. Similarly, from the students' perspective, the scale divides the students into good and bad performance with low grades seen as having a more negative impact than a high one for the final GPA.

## Discussion

Based on the data collected in this study and a review of the value proposition canvas' for the teaching and student profiles it would appear implementing AES would allow CBS to increase efficiency in the examination system, however it is acknowledged there are drawbacks to such implementation.

From the interviews with teachers, it was revealed that many teachers did not do formative assignments because they felt there was no time available to mark them. At the same time, however, it has resulted in some

departments starting to look for new ways to increase the use of formative assessments as a “pass or fail” or requiring the student to send a minimum number of completed assessment in order to be admitted to the final exam. Additionally, as one teacher explained, the university has a contract with the Ministry of Higher Education that aims at increasing the study intensity of students as they believed to show a low study effort during classes. By cutting out time spent on examinations, teachers will have the opportunity to dedicate their time to more valuable activities like teaching and researching. Reflecting on the literature from higher education and the students’ gains pinpointed in the canvas as “seeing value come out of education”, this will have a positive impact on the quality of teaching (Ramsden, 2003). From the extra time saved from marking, teachers will be able to add additional valuable lectures that would incentivize students’ participation. For instance, in-class participation can be stimulated by following Säljö (1979)’s view that creating more in class students’ discussions that incentivize students to compare different types of learning and assigning in-class practical or case study exercises to make students interpret knowledge and understand reality in a different way.

The other important point to note is that these tools will allow students to receive rapid feedback on formative assignments so that they have time to improve their knowledge in advance of the final exam. Besides feedback on formative assessments they will also be able to get feedback on their final exams which is one of the “jobs” that students want from the examination system.

By using AES, the examination process will become more standardized as teachers will have to design their assignments by developing a standard solution beforehand or a specific rubric on which the software will be trained to grade the exam and provide feedback. In relation to this, the examination process will become more objective. Having a more objective examination process will enhance transparency and fairness of the examination method as students will be able to work toward consistent predetermined assessment criteria.

AES will also provide feedback to each single student, as well as provide a general overview of the students’ performances and knowledge level to the teacher. This will help the teacher investigate whether there are topics that have to be explained further during the rest of the course, and at the end, after the final exam, understand whether their teaching requires improvement or changes.

There are some potential drawbacks that might result as a consequence of the implementation of AES, some concerning the assessment process itself and others concerning ethical matters. The first is that students, after learning how to use these tools and knowing what these tools are looking for when assessing, may figure out how to deceive the system in order to receive a higher grade. Another point that requires consideration is the legality of using AES and to ensure that in the formal examination process teachers will still have the role of signing off on the grades and acknowledging that the software is only an aid and not replace the teacher (Ministry of Higher Education 2018). A further concern would be if teachers do not read all of the written assignments which students are required to submit to CBS as a part of their preparation for the oral discussion. When oral examinations are used the teacher usually starts by asking questions related to the students’ written production and that requires the student to further reflect on what they have written. On the basis of the students’ answers, the teacher will then move to other topics in the syllabus. When a written production is assessed by an AES tool, it may be harder for the teacher to come up with questions that are related to the student’s paper as they were not able to read it fully. A further concern is the amount of work required in order to train the software for different courses. Teachers will need to put time in, firstly, finding out the content on which to train the software and, secondly, developing the solutions that they want their students to come up with together with listing predictable mistakes in the system.

Issues may also arise when students get low grades through AES. As, Wind (2018), co-founder and CEO of Peergrade, states, such a new technology will take time to meet the trust of students and hence students might be very satisfied when they get a good grade but feel angry and not treated fairly when they get a low grade. This trust issue means that students may end up questioning their machine marked grades than the ones provided by a teacher. In such a case, the teacher will have to come into place to evaluate the complaint and establish whether the grade given was the right one.

One of the ethical concerns has to do with the difference between humans and machines. By reflecting on the use of AES, a teacher brought up the “pain” of facing the trade-off of having to give up authenticity in order to achieve standardization. This is because, on the one hand, AES would increase the fairness and objectivity of examinations creating an important benefit to the students that feel that they are not treated equally with respect to the others and on the other hand, it will decrease the value of authenticity. Three teaching professors during the interviews said that, even though examining more than 100 papers is a struggle, they actually learn new things from what the students write in their papers and this is something that amuse and excite them. Writing

essays that have to be graded by a scoring engine might turn out as a low value activity for students as there will no longer be a human behind the process that would be able to appreciate the pieces of writing. In relation to this, Yonck (2017) said that no matter how much human-like these tools become, the question will still be on how authentic its thinking processes and responses will be.

Notwithstanding the ethical drawback raised by teachers, it is important here to consider that the value of education is not lost. While students will be graded by a machine, as already stated among the benefits of AES, teachers will spend more time in class interacting with them through engaging exercises where the students have to bring in their own perspectives and thoughts. It can be argued that, with AES, the value of education and teaching will shift from the moment after the final exam and after receiving the grade to the moment in which the class is actually being taught. If students were to see this value added throughout the course of a class, they would be more incentivized to participate and, by actually participating, might increase the chances of getting a higher grade in the final exam.

In looking to the future, the research has revealed some additional features necessary for AES to be valued for formative and summative assessment. One feature is the ability to test the content and validity of the points made by the student in written papers. Even though ML and AI capabilities are increasing, it is important to be able to predict new content that may be introduced by the student. Finally, in relation to the future of AI where emotional intelligence will be eventually reproduced by machines (Yonck, 2017), AES will have to be able to understand the tone of writing in order to better analyse whether the arguments that are made are logical and have valid reasoning. An analysis of teachers and student's contributions, benefits and drawbacks of an AES solution are summarized in Table 1.

## Limitations and recommendations for future work

This research was based on a single case study of a Danish Business School, CBS. It is important for future research to analyse other educational systems before directly applying it to other learning realities. In addition to consideration of the feedback system, it is believed that future research should include consideration of the customs of other countries and how feedback is provided. Consideration should also be given to differences in course levels. This is because master's students tend to be more experienced in academic writing than bachelor's students and, assessments might require different weights for the writing abilities and styles of students.

**Table 1: Benefits and drawbacks of an AES solution**

Benefits	Drawbacks
<ul style="list-style-type: none"> <li>• Less time spent on examining</li> <li>• Less time for students to receive a grade</li> <li>• Possibility of doing both formative and summative assessments</li> <li>• Increasing students' study effort during courses by using formative assessments</li> <li>• More time for teachers for focusing on teaching and researching</li> <li>• Students will receive feedback both on summative and formative assessments</li> <li>• Standardized and objective examination process</li> <li>• More transparent and fair examination process</li> <li>• The teacher will have an overview of the level of the entire class</li> </ul>	<ul style="list-style-type: none"> <li>• Students might learn how to deceive the system to get higher grades</li> <li>• Teachers have to trust the software giving the grades to students</li> <li>• The teacher will not be able to know enough about the students' written composition that is prepared for the oral examination</li> <li>• Teachers need to spend time on setting up the software</li> <li>• Students not trusting the grades that were given through automatic examining and filing more complaints</li> <li>• Losing human authenticity</li> <li>• Losing the value of written composition</li> </ul>

## Conclusion

AI is considered one of the major breakthroughs of the Content - Centric Era (2005-2025) where technology is said to be conceived to enhance customization of products and services (Willcocks & Lacity, 2016). Having an assessment tool that functions as a service for teachers and students, implies a standardization of the examination process. By observing the EU context, in line with The Bologna Accord (2005) which aims at standardizing the educational system of all the different EU countries, AES, if implemented, would help achieve



harmonization between different higher education systems and make it easier for a member country's student to move from one system to another while having the same examination process.

Our research contributes to a gap in the literature of AES in the specific context of higher education. Moreover, by interviewing stakeholders of the process, we have adopted an innovative approach. This consisted of applying human centred design through the value proposition design framework (Osterwalder et al, 2014) and by investigating knowledge and value creation with a service dominant logic approach of serving the examination process (Vargo & Lusch, 2004).

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