Students' Acceptance Of Digital Exams: A Case Study In A Swedish University

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Abstract: In this paper we present the results of a case study in a Swedish university regarding students' acceptance of digital exams. Technology Acceptance Model (TAM), which has been widely used in research concerning technology acceptance, was used to measure the level of students' acceptance of digital exams. The aim of the study is to investigate students' acceptance of digital exams and if there are any factors that are responsible for this behavior. A survey based on the two main factors of TAM, perceived ease of use and perceived usefulness, was conducted. The survey was targeting the degree of acceptance along with students' demographic characteristics. The results showed that the students demonstrated a high degree of acceptance of digital exams, with students in their second and third year having a more positive perception rather than students in their first year. However, other factors, such as gender, subject, and age did not appear to have a strong impact on the overall acceptance of digital exams but did show a moderate impact on external factors such as perceived accessibility and computer self-efficacy, which work as predictors for perceived ease of use for a system. Overall, the knowledge about the level of acceptance of the students is valuable since we can highlight strengths and weaknesses associated with digital exams. This can be a useful tool in deciding upon a suitable digital solution for digital exams, as well as in learning how to increase the level of acceptance among the students in the future.

Keywords: Technological Acceptance, Digital Exams, Technology Acceptance Model (TAM), Higher Education

1. Introduction

Coronavirus pandemic has brought with it a tremendous shift in how learning, assessments, and examinations take place in the field of higher education. Restrictions concerning in-person activities have forced educational institutions to shift to a primarily digital, or digital-only, approach. Many universities introduced taking digital exams at home as an alternative campus-based exams (Liebherr et al., 2022). Digital exams offer some advantages over traditional methods, such as increased accessibility, faster feedback, and flexible scheduling (Dreher et al., 2011). Despite these advantages, there are still reservations among teachers towards the concept of digital exams, both concerning academic dishonesty (Eltahir et al., 2022) as well as the well-being of students (Dayananda et al., 2021). Therefore, given the current context, it is likely that digital exams will remain an option at many universities in the future.

In this paper we present the results of a case study in a Swedish university regarding students' acceptance of digital exams and if there are any factors that are responsible for this behavior. For that reason, the results are oriented along with students' demographic characteristics. The knowledge about the level of acceptance of the students is valuable and it can be a useful tool in deciding upon a suitable digital solution for digital exams, especially on emergency situations, such as pandemics. It also can be helpful in learning how to increase the level of acceptance among the students in the future solutions and in choosing the right solution for our students. In particular, from our study we learned that "older" students demonstrated a high degree of acceptance of digital exams in comparison with "younger" students which did not have such positive perception towards digital exams.

To measure the level of students' acceptance of digital exams, we have used Technology Acceptance Model (TAM). TAM has been widely used in research concerning technology acceptance. For this study, we focused on the two main factors of TAM, perceived ease of use and perceived usefulness. Towards that direction we have conducted a survey targeting the degree of acceptance along with students' demographic characteristics.

The remainder of the paper is structured as follows: Section 2 provides an outline of the related work. Section 3 provides a brief description of the theoretical framework that was used in the study. Section 4 presents the research methodology of our work. Section 5 presents the results of the analysis. Finally, in Section 6 discussion and conclusions are provided.

2. Background

Digital exams are administered electronically, typically through a computer, tablet, or other electronic device. They may involve a combination of assorted questions including multiple choice, true or false, matching, arrangement, fill in the blank, or essay questions. They typically require students to type or select their answers, and those answers are then graded and scored manually or automatically, depending on the type of assessment. According to Awad Ahmed et al. (2021), digital exams enable the provision of new kinds of questions with the use of multimedia as well as easy ways to gather feedback, instant support, assistance, aid during the examination, distribution of results, easy use of data, and flexibility of examination timing.

2.1 Benefits:

Digital exams provide a number of benefits, both for the teachers as well as the students; it constitutes a fully integrated system, which increases the validity of its evaluations (Alsalhi et al., 2019); it improves the reliability of the performance and the robustness of the test, as well as providing quicker feedback (Dreher et al., 2011); it decreases the workload of teachers, and significantly reduces the burden of monitoring while examining bigger student populations (Hodgson and Pang, 2012); as well as being cheaper as it saves effort, time, money, and can be more environmentally friendly (James, 2016). Additionally, Eltahir et al. (2022) states that studies have shown that digital exams improve learning amongst students when compared to paper exams. Studies show that students seem to prefer digital exams over traditional exams because they have the choice of where to take it, can obtain feedback and results quicker, are quick and easy to use, saves time, and are more environmentally friendly (Alyahya and Almutairi, 2019; Challis et al., 2004; Uchenna, 2021). Ryan et al. (2014) summarises digital exams in comparison to traditional paper-based examinations as possessing six characteristics: interactivity, instant feedback, flexibility, timesaving, recordkeeping, and reduced resource use.

2.2 Challenges:

However, there are reported some challenges regarding digital exams. According to Eltahir et al. (2022) five categories of challenges with implementing digital exams have been identified. These are: (1) *risks of technical failure*, where potential problems can arise from insufficient servers or lack of internet connection amongst faculty members and students (2) *academic student dishonesty*, which refers to the risk of plagiarism and cheating connected with digital exams (3) *ensuring fairness*, which refers to the various working conditions on an individual level amongst students when taking a digital exam, since they do not offer the same environment for every student, while on-campus exams do (4) *assessing practical skills, and knowledge*, which refers which refer to the problem of not being able to evaluate a student's practical ability to complete a certain task and (5) *lack of experience amongst undergraduate students in regard to digital exams* which highlights the problem of insufficient knowledge of how digital exams are performed and thus the need of familiarising undergraduate students with digital exams and how they are done so that they can perform them on their own.

The COVID-19 pandemic has caused an unprecedented crisis. Worldwide, teachers in all educational levels were invited to develop the students' learning experience in a new digital environment for their teaching (Lavidas et al, 2022, a)). Empirical studies have been conducted to investigate the potential effects of social desirability on students' self-reports in different social contexts (Lavidas et al, 2022, b)). Towards to that direction, we have noticed that in the last decade, there has been increased use of eLearning tools. Platforms and ecosystems supporting digital learning generate a vast amount of data and information in various forms and formats (Papadakis et al, 2022). Overall, the knowledge about the level of acceptance of the students is valuable since we can highlight strengths and weaknesses associated with digital exams, but also to choose the best digital tool for our students.

3. Theoretical Framework

Technology Acceptance Model (TAM) (Salloum et al., 2019) is widely used to measure the level of acceptance of technologies. In our case we used TAM to measure the level of students' acceptance of digital exams. In TAM (Figure 1, Salloum et al., 2019) there are two main factors that contribute to the level of acceptance concerning technologies. These are *perceived ease of use* and *perceived usefulness*. As a result of these two factors an attitude towards use of the specific technology is created which in turn showcases the behavioural intent to use the technology which ultimately predicts the actual use of the technology.

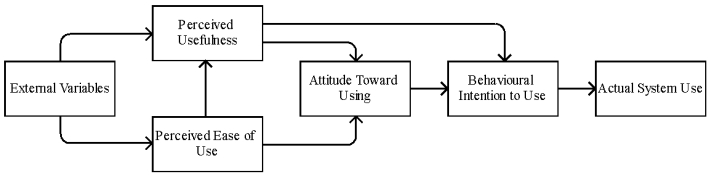

Figure 1: Technology Acceptance Model (TAM)

TAM (Figure 1) has been proven to be effective in measuring technology acceptance when it was compared with other similar models. However, when it comes to applying TAM in the context of digital exams and e-learning, a new comprehensive version of TAM (Figure 2) has been created which further describes the external variables that affect *perceived ease of use* and the *perceived usefulness*. These factors have been identified into two categories: *System Characteristics* (which contain system, content, and information quality) and *Individual Factors* (which contain computer self-efficacy, subjective norm, perceived enjoyment, perceived accessibility, and computer playfulness) (Salloum et al., 2019). Table 1 contains all the TAM specific constructs, System Characteristics, and Individual Factors with their acronyms and a short term (Salloum et al., 2019), as they were used in this work.

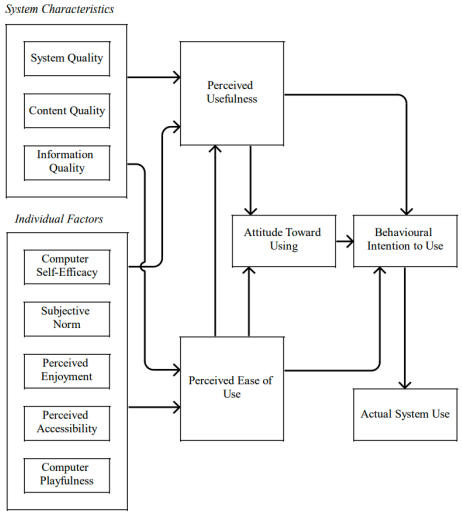

Figure 2: Comprehensive TAM

Table 1

TAM specific constructs		
PU	Perceived usefulness	The degree of belief that implementation of a new technology can enhance work performance amongst individuals
PEOU	Perceived ease of use	The level of how uncomplicated a system is to use, according to an individual
ATT	Attitude towards use	The level of negative or positive feelings an individual internalises in regard to an e-learning system, i.e., digital exams
BIU	Behavioural intention to use	The intent a user has regarding the use of an e-learning system
System characteristics		
CQ	Content quality	The depth of the content as well as the frequency at which it is updated
IQ	Information quality	The degree to which a user receives precise, well-timed, and complete information
SQ	System quality	Refers to the system characteristics such as adaptability, availability, usability and reliability and how they affect the view users have of the system in question
Individual factors		
CP	Computer playfulness	Refers to the degree of cognitive spontaneity in interacting with a system
AC	Accessibility	Describes how easy it is for users to use and access information from the system
CSE	Computer self-efficacy	Refers to an individual's confidence in their ability to take steps needed to deal with future situations.
PE	Perceived enjoyment	Is described as the enjoyment that comes from using a system, rather than from the enjoyment that manifests itself because of the intended system outcome
SN	Subjective/social norm	Refers to the social pressure an individual perceives when it comes to engaging or not engaging in a certain type of behaviour

4. Research Methodology

4.1 Research Euestion

Our work is driven by the following research questions:

RQ1: To what degree do students accept digital exams as a viable option?

RQ2: Is the degree of acceptance of digital exams affected by the students' demographic characteristics i.e., age, academic year, subject or gender?

4.2 Survey Design

The questionnaire consisted of 15 closed-ended Likert scale questions. The questions are referred to as Q1-Q15 and are available in Table 2. The questionnaire contained three sections targeting TAM specific constructs, System Characteristics, and Individual Factors (Table 1). The overview of the questionnaire is available in Figure 3 and Table 2. For collecting our data, we have used the *Simple Random Sampling* technique. The simple random sample means that every case of the population has an equal probability of inclusion in sample. (Taherdoost, 2016).

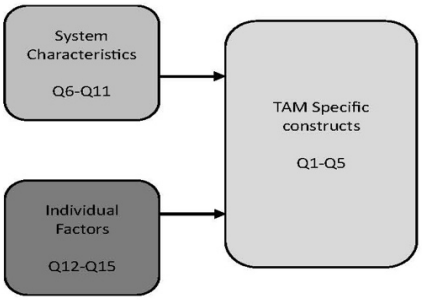

Figure 3: Overview of the questionnaire

Table 2: The questionnaire questions

	Questions
Q1	I find it to be easy to reach the digital exams
Q2	I like using digital exam tools
Q3	I use digital exam tools without issues
Q4	I think digital exam tools are easy to use
Q5	I think digital exam tools are a good replacement for written classroom exams
Q6	The digital exam tool provides me with the information I need
Q7	Information on digital exams is current
Q8	I am satisfied with my interaction with digital exam tools
Q9	Digital exams provide me with clear information
Q10	I am satisfied with the functions that digital exam tools offer
Q11	I trust digital exam tools to give me information that is true
Q12	I find it more comfortable to use a digital tool than to take a written classroom exam
Q13	Digital exams were accessible according to my own capabilities
Q14	I feel I have enough knowledge to use digital exam tools
Q15	I feel confident in my use of digital exam tools, even when there is no one nearby to help me

4.3 Description of the Data Set

The data were gathered from a Swedish University in particular, from the Business school. We evaluated the effect of the digital exams though a survey. We performed the survey under the academical year 2022 where the students still used digital exams for the examination of all their courses. In total we collected 103 responses from the survey.

Regarding the demographic characteristics of the students, we took into consideration 4 different factors: The subject of their study, the age, the gender, and the semester study. Since the survey was conducted to a business school, the students came from 4 different subjects: civil economics (36%), economics (21%), informatics (40%) and only 1% came from statistics, an expected result since the statistic department in the university were the survey was conducted, has a few number of students. Regarding the age of the students, most of the students (74%) are between 20-24 years old. 16% are between 25-29 years old, where almost 10% was over 30 years old. Regarding gender, the sample was equally distributed with 50% male and 50% female students. Furthermore, regarding the semester the are studying, only 2% were new students (1st semester), 9% from 2nd semester, 16,5% from 3rd semester, 20% from 4th semester, 32 from 5th semester, 10% from 6th semester and a 10% were in order semester than 6th.

4.4 Data Analysis

In order to identify to what degree, do students accept digital exams as a viable option (RQ1), we used descriptive measurements. The descriptive measurements we used were Mean value and Standard Deviation. Moreover, to investigate the degree of acceptance of digital exams and if it is affected by the students' demographic characteristics i.e., age, academic year, subject or gender (RQ2), we used the Chi-Square Test of Association. The Chi-Square Test of Association determines whether there is an association between categorical variables (i.e., whether the variables are independent or related) and it is a nonparametric test. To examine the strength of associations we use Cramer's V test. Cramer's V is a measure of the strength of association of a nominal-by-nominal relationship. Cramer's V ranges in value from 0 to +1 with a value of 0 indicating no association to a value of 1 indicating complete association. Cohen (1988) suggested the following guidelines for interpreting Cramer's V: describes the association as weak for values from 0.1 to 0.3, moderate for values from 0.3 to 0.5 and strong for values over 0.5.

Finding an association, however, did not provide us with further details about this association (e.g., which cases are 'responsible' for this association). Therefore, following up our statistically significant results, we performed post hoc testing using adjusted standardized residuals (Agresti 2013), (Siegel and Castellan, 1988). By analysing these values, we had a cell-by-cell comparison of the expected versus observed frequencies which helped us understand which cases were deviated from the independence. We consider an adjusted residual significant if the absolute value is above 1.96, as suggested by Agresti, (2013). The analysis was conducted in the statistical package SPSS.

4.5 Validity Threats

The population under study, i.e., students at the Business school, is large and highly heterogeneous. Consequently, we assume that the size of the population could be regarded as infinite. Under these circumstances, the importance of determining the appropriate sample size for our study is dwarfed by the importance of selecting a representative sample. Our survey was not designed to make strong quantitative conclusions about all the students belonging to the Business school, but rather to identify larger trends.

Next we discuss four aspects of validity according to (Runeson and Höst, 2009):

Construct validity reflects the extent to which the operational measures represent study subject. All our data were quantitative responses of the students, thus representing objective measures. No subjective measures were used, such as data through interviews.

Internal validity refers to the examination of causal relations. In our study, we focused on descriptive statistics and on the preliminary results from the differences between the demographic characteristics of the students. Our results are preliminary and further study of potential impact factors is needed to build the resulting prediction model.

Regarding *external validity*, the study is empirical and by no means can the findings be generalized to an isolated department or university.

Regarding *reliability*, this aspect is concerned with to what extent the data and the analysis are dependent on the specific researchers. Again, the data gathered are quantitative and independent from the influence of different research subjects or researchers' interpretation.

5. Results

5.1 Descriptive Results

Regarding RQ1, we wanted to identify to what degree do students accept digital exams as a viable option. To answer this RQ we used a descriptive measurement and calculated the mean value of the responses. The mean value of all the 15 questions is quite high i.e., 4.3 which indicates that the students showed a very high level of acceptance of digital exams. From Table 3 we can claim that the questions related to System Characteristics and Individual factors tend to attract very higher values from the students (mean value: 4.32/5), in addition, the questions related to TAM Specific constructs seem to attract again high values (mean value: 4.32/5).

Taking into consideration the different question items we can claim that Q11 ("*I trust digital exam tools to give me information that is true*") and Q14 ("*I feel I have enough knowledge to use digital exam tools"*) have the highest mean values (4.62 and 4.61 accordingly). This indicates that computer self-efficacy and information quality are highly rated, which according to the comprehensive TAM model, are both strong predictors for perceived ease of use.

Q13 ("*Digital exams were accessible according to my own capabilities*") attracted also a very high score (4.53). This indicates that the perceived accessibility of the system is highly valued, which works as a predictor for both perceived usefulness as well as perceived ease of use, with a slight leaning toward perceived usefulness. Q6 ("*The digital exam tool provides me with the information I need*") and Q3("I *use digital exam tools without issues*") were again rated high, with the respective mean values of 4.43 and 4.40. This confirms previous findings that perceived accessibility and information quality are important constructs for the acceptance of e-exams.

Q1 ("*I find it to be easy to reach the digital exams*") was rated again very high (4.35), which furthermore expounds on the importance of perceived accessibility. Q7, Q8 and Q9 were rated quite high. These questions refer to the quality of a specific part of the implementation and to the quality of the system, which predicts perceived ease of use. Q2 ('*I like using digital exam tools*) received the lowest mean (3.93). However, even though this question has the lowest score it is still regarded as a high score, indicating that the students, in general, accept digital exams as a viable solution.

Table 3: Descriptive results for RQ1

TAM Specific constructs	
Question	**Mean**
Q1	4.35
Q2	3.93
Q3	4.43
Q4	4.39
Q5	4.24
Mean:	**4.23**

System characteristics	
Question	**Mean**
Q6	4.40
Q7	4.24
Q8	4.28
Q9	4.22
Q10	4.17
Q11	4.62
Mean:	**4.32**

Individual factors	
Question	**Mean**
Q12	4.03
Q13	4.53
Q14	4.61
Q15	4.12
Mean:	**4.32**

5.2 Validity of Association

Regarding RQ2, we were interesting into investigating the degree of acceptance of digital exams affected by the students' demographic characteristics i.e., age, academic year, subject or gender. Thus, after the descriptive statistics, a chi-square test of independence was conducted between the mean score of each question and the 4 demographic characteristics of the students, i.e., age, gender, study subject and academic semester. The null and the alternative hypothesis of our study were:

Ho: There is no association between Q1-Q15 and demographic characteristics, and

H1: There is an association between Q1-Q15 and demographic characteristics.

The Chi-Square test of association provides further evidence against the null hypothesis (i.e., the p-value for this test describes the strength of evidence against the null hypothesis of independence). We used this result to determine whether there is an association between our variables. We have found a number of statistically significant associations and we tested also the strength of the association with Cramer's V. However, to test which categories, deviate from independence, we follow up our statistically significant results with Post hoc testing using Adjusted Standardized Residuals. The results are available in Table 4 where we report the p-value of the test for each question along with the Cramer's V results. The questions with significant differences (p-value<0.05) are written in bold.

Q	Age	Gender	Subject	Semester
	Sig (Cramer's V)	**Sig (Cramer's V)**	**Sig (Cramer's V)**	**Sig (Cramer's V)**
Q1	0.441 (0.198)	0.387 (0.203)	0.544 (0.187)	**0.006 (0.331)**
Q2	0.056 (0.250)	**<0.001 (0.435)**	0.145 (0.235)	0.238 (0.263)
Q3	**<0.001 (0.408)**	**0.007 (0.298)**	**0.002 (0.317)**	**<0.001 (0.404)**
Q4	**0.005 (0.302)**	0.100 (0.218)	0.072 (0.226)	**0.009 (0.338)**
Q5	0.387 (0.203)	**<0.001 (0.427)**	**0.015 (0.285)**	0.064 (0.293)
Q6	0.091 (0.247)	0.730 (0.141)	0.063 (0.229)	**<0.001 (0.392)**
Q7	**0.029 (0.288)**	0.404 (0.173)	0.686 (0.138)	0.115 (0.296)
Q8	0.062 (0.269)	0.507 (0.160)	0.472 (0.165)	**0.045 (0.322)**
Q9	**<0.001 (0.408)**	**0.006 (0.274)**	**0.039 (0.239)**	**0.038 (0.311)**
Q10	0.105 (0.244)	0.263 (0.190)	**0.045 (0.236)**	**0.040 (0.310)**
Q11	**0.002 (0.320)**	**0.001 (0.299)**	0.550 (0.159)	**<0.001 (0.388)**
Q12	0.425 (0.200)	0.292 (0.214)	0.486 (0.193)	0.174 (0.271)
Q13	**0.004 (0.332)**	0.104 (0.226)	0.085 (0.232)	**0.002 (0.386)**
Q14	**0.004 (0.306)**	0.270 (0.189)	**<0.001 (0.318)**	**<0.001 (0.490)**
Q15	0.236 (0.218)	**0.043 (0.264)**	0.315 (0.211)	**0.006 (0.330)**

Age seems to pay a significant role related to constructs of perceived accessibility and information quality (Q13, Q14 and Q7, Q9). In order to identify which age categories of the students, deviate from independence, we follow up our statistically significant results with post hoc testing and the results revealed that the students aged 20-24 were more in favour of digital exams, displaying a significantly higher perceived ease of use of the technology than students aged 30 and higher.

Regarding gender, a statistically significant association was found for many of the questions that are related with TAM specific constrains and more specifically towards perceived usefulness and information quality. The questions concerning information quality show a significant difference between men and women, where male respondents tend to be more neutral while female respondents are more positive. However, both groups lean towards a positive sentiment.

Regarding subject, again the results showed that there is a statistically significant association with the questions that are related with TAM specific constrains and more specifically towards perceived usefulness and information quality. However, from the post hoc test, no important deviations were found between the students from different departments.

Finally, regarding semester, many of the questions related with System characteristics and individual factors were found to have statistical difference in relation to the semester the students were. The post hoc results indicate that students in their second to third academic year were more in favour of digital exams.

6. Discussion and Conclusions

According to our RQ1, our study aimed to investigate to what degree do the students accept digital exams as a viable solution. Thus, we aimed to determine the level of acceptance of digital exams among undergraduate students at a Swedish University. The results on the degree of acceptance of digital exams indicate that, from purely the students' own perspective, the degree of acceptance of digital exams was at a very high level, with a general mean of 4.304/5. This result might indicate that the majority of the students have accepted the implementation of digital exams, while only a small minority of students still prefer traditional paper-based examinations. Moreover, it is noted that some of their responses indicated positive attitudes towards the implementation of digital exams, particularly regarding Q2. The reason for this might be a perceived ease of use and a perceived usability as indicated by the results of the questionnaire, as well as other factors inherent to digital exams, such as quicker feedback, saving time and money, being environmentally friendly, being more accessible and clearer, and giving students the ability to take exam wherever they want.

Furthermore, regarding our RQ2, we were interested into investigating if the degree of acceptance of digital exams is affected by the students' demographic characteristics. The results showed that the demographic characteristics of the students seems to also affect their acceptance of the digital exams. Younger students seem to be keener to digital exams, rather than older students. On the other hand, students on the later exams seem to be more acceptive towards digital exams. In any case, those results by no means can be generalized and further research is necessary to understand the factors contributing to these variations and to determine if similar patterns of acceptance exist at other universities.

As mentioned before, one difficulty with implementing digital exams is the lack of experience and familiarisation among undergraduate students when it comes to how digital exams are conducted. This lack of familiarisation and experience makes it more difficult for students to perform digital exams on their own which potentially affects the grade of acceptance of digital exams among the students. The results showed that undergraduate students in their second to third academic year had the highest level of acceptance for digital exams. One potential reason behind this is the need for more experience and familiarisation with digital exams. According to Bashitialshaaer et al. (2021), studies have shown that a resistance or unwillingness to accept a more digital learning environment might stem from a familiarity with traditional education and learning systems. Thus, according to Liu et al. (2015), unfamiliarity with e-exams may indicate a resistance to change. A possible implication of this is that universities should aim to introduce digital exams early, to garner familiarity with digital exams faster in order to increase the likelihood of a higher acceptance.

The results of this study cannot be applied to create new insight into the difficulties with implementing digital exams, aside from the lack of experience and familiarisation regarding digital exams, as this study has not focused on cheating, environmental factors, technical difficulties, or anxiety levels connected to e-exams. These difficulties are essential to take into consideration when considering digital exams as a viable solution in situations that require it, such as a pandemic.

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