Evaluating the Potential Impact of Online Assessment on Students' Academic Performance

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Abstract

Purpose

With the outbreak of COVID-19 pandemic, online assessment has become the dominant mode of examination in higher education institutions. However, there are contradictory findings on how students perceive online assessment and its impact on their academic performance. Thus, the purpose of this study is to evaluate the potential impact of online assessment on students' academic performance.

Design/methodology/approach

This study proposes a research model based on the task-technology fit theory and empirically validates the model using a survey from students in the UK. In addition, the study conducted four experiments based on paper-based and online assessments and analysed the data using paired sample t-test and structural equation modelling.

Findings

The findings show that the use of online assessment has a positive impact on students' academic performance. Similarly, the results from the experiment also indicate that students perform better using online assessments than paper-based assessments.

Practical implications

The findings provide crucial evidence needed to shape policy towards institutionalising online assessment. In addition, the findings provide assurance to students, academics, administrators, and policymakers that carefully designed online assessments can improve students' academic performance. Moreover, the study also provides important insights for curriculum redesign towards transitioning to online assessment in higher education institutions.

Originality/Value

This study advances research by offering a more nuanced understanding of online assessment on students' academic performance since the majority of previous studies have offered contradictory findings. In addition, the study moves beyond existing research by complementing assessment results with the views of students in evaluating the impact of online assessment on their academic performance. Second, the study develops and validates a research model that explains how the fits between technology and assessment tasks influence students' academic performance. Lastly, the study provides evidence to support the wide use of online assessment in higher education.

Keywords: Online Assessment; Students' Performance; Task-Technology Fit Theory; Higher Education; Technology Enabled Assessment

1. Introduction

The changing nature of education has resulted in the transformation of assessment. Generally, assessment refers to a means of evaluating the progress of learning (Spivey and McMillan, 2014. In the online environment, assessment refers to the use of digital technology for the evaluation, design, feedback and storage of results (Bahar and Asil, 2018). In recent times, online assessment has become prominent in higher education (Clariana and Wallace, 2002) Indeed, the recent COVID-19 outbreak has meant that, in order to facilitate continuous learning and assessment, higher education has been pressured into adopting online teaching, learning and assessment methods (Eaton, 2020; Kawaguchi-Suzuki et al., 2020). Subsequently, most assessments have been moved online. Prior to the pandemic, some aspects of online assessments were touted to offer numerous benefits such as interactivity and instant feedback (Debuse and Lawley, 2016; Thelwall, 2000). However, there were equally potential challenges such as security risk, technical malfunctions and impersonation (Baró-Solé et al., 2018; Timmis et al., 2016). Although online assessment systems can be stand-alone technologies, some are usually embedded in learning management systems. For instance, learning management systems such as Moodle, Blackboard, and Sakai all have capabilities for online assessments. Given that most higher education institutions use learning management systems, there has been a trend of increased use of online assessments.

Despite the growing research and practical interests, there have been limited studies on the impact of online assessment on students' academic performance. Majority of the studies, with a few exceptions (e.g., Ashworth et al, 2021; Elmehdi & Ibrahem, 2019; Sánchez-Cabrero et al., 2021; Spivey and McMillan, 2014) are focused on adoption and perception (e.g., Nikou & Economides, 2016; Or & Chapman, 2022), students' experiences (e.g., Mafenya, 2016; Soffer et al., 2017), feedback (e.g., Cutumisu, 2018; Van Der Kleij, Eggen, Timmers, & Veldkamp,

2012), and engagement (e.g., Alavi & Gallupe, 2003; Browne et al., 2006). The few studies that have evaluated the impact of online assessment on students' performance show contradictory findings. For instance, Spivey and McMillan (2014) show that there are no significant differences between online and paper-based assessments in students' academic performance. On the contrary, Flannery et al. (2013) find that paper-based assessment was more effective compared to online assessment. Recent studies also remain inconclusive. Sánchez-Cabrero et al. (2021) show that online assessments led to a 10% increase in performance while Ashworth et al. (2021) find no performance differences between online and paper-based assessments. Given the contradictory findings of existing literature, there is currently inconclusive evidence on the impact of online assessment on students' academic performance. Moreover, studies (e.g., Ashworth et al, 2021; Sánchez-Cabrero et al., 2021; Spivey and McMillan 2014) that evaluate the impact of online assessment have largely relied on assessment results without complementing these with the views of students. Given that students' opinions matter regarding how they are assessed, it is important to evaluate if there is divergence in students' views and their performance to advance the ongoing debate on online and paper-based assessments.

Considering these limitations, this study is motivated to address the following research questions: 1) *what is the impact of online assessment on students' academic performance*? *and 2) how do students perceive the impact of online assessment on their academic performance?* By addressing these questions, this study makes three main contributions. First, it advances research on online assessment by offering a more nuanced understanding of students' perception of technology on their academic performance. Second, the study develops and validates a research model that explains how the fits between technology and assessment tasks

influence students' academic performance. Lastly, the study provides appropriate evidence needed to support the wide use of online assessment in higher education.

The rest of the study is organised as follows. Section 2 develops the theoretical background research model and hypothesis. Section 3 explains the research methodology while Section 4 presents the results. Section 5 focuses on discussions, theoretical, practical and policy implications of the findings with limitations and directions for future studies. Section 6 draws conclusions.

2. Theoretical Background, Model and Hypothesis Development

2.1 Impact of online assessments

Traditionally, assessments used to be largely paper based. However, with technological advancement, online assessments have gradually been included in the range of students' assessments (Ali et al., 2018). Synthesising emerging literature on the positive and negative impacts of online assessment, over the last two decades, reveal three main themes: (1) assessment and performance, (2) curriculum design, and (3) student engagement as outlined in Table 1.

Table 1: Selected studies on the impact of online assessment

Themes	Focus	Positives	Negatives	Sample References
Assessment and Performance	Viability and possibility of online assessment to improve students' performance	Instant Feedback, Fairness, Saves Time, etc.,	Technology Reliability, Unsuitable for some assessments, etc.	Ashworth et al. (2021); Elmehdi & Ibrahem (2019), Sánchez-Cabrero et al. (2021); Spivey & McMillan (2014)

Curriculum Design	Possibility of integrating online assessment into curriculum design	Reduced workload for teachers, etc	Limited physical interaction, susceptible to cheating, etc.	Holmes (2015); Llamas-Nistal et al. (2013); Mellar et al. (2018)
Student Engagement	Possibility of using online assessment to drive students' engagement	Remote access, increased interactivity, opportunity for repeated practice, etc.,	Absenteeism, difficult for students with disability, etc.	Alavi & Gallupe, (2003); Browne et al., (2006); Hakimi (2021); Jordan (2012); Nguyen et al. (2017)

Studies within the assessment and performance theme focus on whether online assessment leads to better academic performance. This is motivated by the changing nature of students' examination processes. Traditionally, students' assessments have been conducted using pen, pencil and paper. With online assessment, examinations are carried out using electronic learning management systems such as Moodle, Sakai, Blackboard, etc. (Ali et al., 2018). Some studies on the impact of online assessment explore the viability of online approaches for both formative and summative assessments in so doing highlight the positive and negative issues. In the extant literature, the majority of the studies assert that online assessment can be applied to both formative and summative assessments. However, earlier assertions perceived online assessments as being more suitable for summative assessment due to the widespread existence of more summative assessment tools compared to formative ones (Gikandi et al., 2011). In addition, other studies explore students' experiences to determine if online assessment is efficient for formative or summative assessments (Mafenya, 2016). For instance, Soffer et al., (2017) investigate students' perspectives of online assessments and found that there was a low perception of workload but a high overall learning experience. Furthermore, studies (e.g., Van Der Kleij, Eggen, Timmers, & Veldkamp, 2012) also evaluate the impact of online assessments on providing appropriate feedback to students. From the literature (e.g., Cutumisu, 2018; Van

Der Kleij, Eggen, Timmers, & Veldkamp, 2012), there is large support that online assessment tends to improve assessment feedback due to the capability of instant feedback and other response mechanisms (Helfaya, 2019). For instance, the use of traditional pen and paper sometimes result in assessment feedback delays whereas by using online assessment, students can, for example, receive instant feedback in objective tests. As such, both students and lecturers are highly in favour of the use of online assessments for feedback.

While the majority of prior studies in this theme focus on implementation (e.g., Singh & Wassermann, 2016), adoption and continuous intention to use (e.g., Terzis et al., 2013) as well as design of technical solutions (e.g., Kuo & Wu, 2013) of online assessment, a few studies (e.g., Ashworth et al, 2021; Elmehdi & Ibrahem, 2019; Sánchez-Cabrero et al., 2021; Spivey and McMillan, 2014) investigate the differences in students' performance. Notwithstanding the contributions of these studies, there are contradictory findings on the use of paper-based and online assessments. For instance, Elmehdi and Ibrahem (2019) assess the impact of online and traditional in-class paper and pen exams on students' performance. The study finds no significant difference between performances of the two modes of assessments, a finding consistent with some extant studies (e.g., Spivey and McMillan, 2014). On the contrary, Sánchez-Cabrero et al., (2021) find that students perform better using online assessment compared to traditional paper-based assessment. These contradictory findings in the literature justify the need for more studies, a gap this study seeks to address.

Studies in the second theme examine the impact of online assessment on curriculum design. These studies focus on restructuring teaching and learning practices to fit the digital environment (e.g., Llamas-Nistal et al., 2013; Mellar et al., 2018). In terms of restructuring,

the literature points to making online assessment central to curriculum design as this is essential for students to take ownership of the learning process towards successful outcomes (Llamas-Nistal et al., 2013). While integrating online assessment in curriculum design offers several benefits such as reduced workload for teachers due to limited requirements for marking, there is a downside of students' being able to cheat. For example, when online assessment is not well planned and integrated into the curriculum design, problems such as academic dishonesty are bound to occur (Holmes, 2015). Academic dishonesty in the form of cheating is one key issue of online assessment. As such, studies on the impact of online assessment on curriculum design point to mechanisms to address cheating. Though techniques such as question shuffling and the use of similarity detection tools (e.g., Turnitin) have been somewhat useful, there is a need for more holistic approaches to reduce the propensity of cheating in online assessments. For instance, Mellar et al. (2018) investigate how cheating can be addressed in online assessment by proposing the use of student authentication and authorship systems and their impact on assessment practice. The findings show that building sanctions policy into curriculum and online assessment is one of the ways of addressing cheating.

Lastly, the third theme of research focuses on the impact of online assessment on student engagement. Studies (e.g., Alavi & Gallupe, 2003; Browne et al., 2006) in this theme investigate students' engagement in using online assessment and whether or not they had pleasant experiences. Largely, the literature points to mixed experiences by students in the use of online assessment. Jordan (2012) investigates student engagement with online assessment and found that students are engaged because of the interactivity of the technology. Similarly, Nguyen et al. (2017) explore the design of online assessment and its impact on students' engagement and found that the use of a variety of strategies such as consistent workload by educators can result in student engagement. On the other hand, Hakami (2021) shows that

learning environment can lead to absenteeism, which in turn affects academic performance. In spite of the inconsistencies in the extant literature, online assessment can be a useful medium for student engagement (Mafenya, 2016; Soffer et al., 2017). As the popularity of online assessment is increasing and could be a viable alternative to paper-based assessment, there is a need for a holistic understanding of students' perception and its impact on their academic performance.

2.2 Research model and hypothesis

To investigate students' perception of online assessment on their performance, this study adopts the Task-technology fit theory (Goodhue and Thompson, 1995; Howard and Rose, 2019). Task-technology fit theory was developed by Goodhue and Thompson (1995) to explain the relationship between technology, task, performance impacts and utilisation of the technology. The theory holds that technology is able to produce positive impact on individuals' performance and can be used if capability of the technology matches the task an individual wants to perform (Goodhue, 1995). We consider the task-technology fit theory suitable since it supports the analysis of the effect of technology on individuals' performance. In addition, the theory explains how fit between task and technology influences performance (Adya and Phillips-Wren, 2019). Given the aim of this study is to predict if the use of online assessment has a positive impact on students' academic performance, we deemed the task-technology fit theory an appropriate theoretical lens.

In the extant literature, the Task-technology fit theory has been used to evaluate and study a wide range of information systems (Adya and Phillips-Wren, 2019). In addition, the theory has been combined with others such as Technology Acceptance Models (e.g., Larsen et al., 2009; Park et al., 2019) and Unified Theory of Technology Acceptance and Use (e.g., McGill &

Klobas, 2009), as well as Social Capital Theory (e.g., Lu & Yang, 2014). In the educational technology context, the Task-technology fit theory has been used to investigate behavioural intention to use MOOCs (Wu and Chen, 2017), learning management systems (McGill and Klobas, 2009) and adoption of multimedia technology for learning (Park et al., 2019). As such, the use of the theory has been limited in other contexts such as the impact of online assessment. In fact, some extant studies (e.g., Lu & Yang, 2014, Wu & Chen, 2017) assert that there is a need for further studies and validation of the Task-technology fit theory across different contexts. In response to these calls and limited applications of the Task-technology fit theory in online assessment literature, this study attempts to fill this gap.

Drawing on the Task-technology theory, we present our research model and hypotheses to predict the impact of online assessment on students' academic performance. As presented in Figure 1, our research model comprises four constructs, namely task characteristics, technology characteristics, task-technology-fit and students' academic performance. In the ensuing discussion, we present hypotheses underpinning the various constructs.

Figure 1 Research Model

2.2.1 Task characteristics

Tasks refer to actions performed by individuals that transforms inputs into outputs (Goodhue and Thompson, 1995). While some tasks can be simple as clicking a button, others can be complex such as programming computer systems. Tasks can be defined by their attributes,

referred to as characteristics such as being routine, structured, interdependent or vice versa (Dishaw and Strong, 1999). In the context of this study, tasks for students entail undertaking online assessments. Hence, tasks characteristics represent attributes of actions students need to perform when undertaking online assessments. In prior studies (e.g., Dishaw & Strong, 1999; Lu & Yang, 2014), tasks characteristics have been identified as a significant construct in the fit between task and technology. For instance, in investigating behavioural intention to use social networking sites, Lu and Yang (2014) find that task characteristics significantly affect task-technology fit. Given that online assessments have characteristics that might influence the fit between the task and technology used as well as students' academic performance, we deemed it appropriate to investigate this relationship. Therefore, this study hypothesises that:

H1. Task characteristics positively influence task-technology fit in the use of online assessment.

2.2.2 Technology characteristics

Technology refers to computer systems including hardware and software as well as associated support services that enable users to accomplish tasks (Goodhue and Thompson, 1995). Like tasks, technologies can be simple as well as complex. Similarly, technologies can be defined by their characteristics such as availability, capabilities, and relevance (Dishaw and Strong, 1999). For example, in the context of online assessments, students are sometimes required to use technology systems to undertake their quizzes. As such, there is a tightly coupled relationship between technologies and their characteristics and the task of undertaking quizzes. Without technologies, it will not be possible for students to undertake online assessments. Therefore, technology characteristics are essential in the fit between task and technology. Indeed, the extant literature acknowledges the significance of technology characteristics in task-technology fit (Lu and Yang, 2014). Following the extant literature, this study examines

the relationship between technology characteristics from the perspective of online assessment system capabilities. Given that technology characteristics have an impact on task-technology fit, this study hypothesises that:

H2. Technology characteristics positively influence task-technology fit in the use of online assessment.

2.2.3 Task-technology fit

Task-technology fit represents how technology supports users to accomplish their tasks (Goodhue and Thompson, 1995; Howard and Rose, 2019). Task-technology fit occurs through interactions between task, technology and an individual (Park et al., 2019). According to Goodhue and Thompson (1995), when there is a task-technology fit, this can lead to utilisation of the technology as well as performance impacts. Thus, matching the capabilities of technology to tasks is critical to achieving performance impact. In previous studies (e.g., Dishaw & Strong, 1999; Park et al., 2019; Wu & Chen, 2017), the significance of task-technology fit has been established. However, the majority of the studies (e.g., Park et al., 2019; Wu & Chen, 2017) tend to focus on the relationship between task-technology fit and intention to utilise a technology. As such, there is limited validation of the relationship between task-technology fit and performance. In the context of this study, the focus is on understanding the relationship between task-technology fit and students' academic performance. Given that there is limited understanding currently from this perspective, it is important to establish this relationship. Thus, this study hypothesises that:

H3. Task-technology fit positively influence students' academic performance in the use of online assessment.

3. Methodology

3.1 Research design

Given the dual aim of this study to investigate students' perception of online assessment on their performance and conduct an evaluation to validate the results, there was the need to adopt a two-phase research design. As such, a quantitative research design comprising a survey and an experiment were adopted. The survey supported the collection and analysis of quantitative data (e.g., Senyo & Osabutey, 2020) to evaluate students' perception of online assessment while the experiment helped to assess the performance of students in both online and paper-based assessments (e.g., Nikou & Economides, 2016). Moreover, this study seeks to address "what" research questions, which demanded a quantitative research approach. Thus, we deemed the choice of a quantitative approach to be appropriate for the study. In line with these methodological choices, a two-phase research approach was used. In the first phase, the study conducted four different experiments involving two online and two paper-based assessments to determine students' academic performance. For the experiments, two sets of assessments were conducted in the first time period (T1) and followed by another two sets of assessments in the second time period (T2). The experiments were conducted in a university computer laboratory to ensure all students have access to the same computing software (Blackboard) and hardware (Desktop computers) to control for technology infrastructure issues that might impact the study. The allocated time and sample set of students were the same for all experiments. In the second phase, we conducted an online survey based on a questionnaire designed in line with the research model in Figure 1 to examine students' perception of online assessment on their academic performance. While the experiments were actual class assessments for the module, which contributed to students' final mark, the survey about their perception of online assessment was voluntary. Participants for this study were second year business and management students enrolled in a UK university. The sample for the experiments consisted

of 63 males (60%) and 42 females (40%) while the survey participants consisted of 39 males (53.4%) and 34 females (46.6%). In the ensuing subsections, the study presents discussions on instruments, and data analysis.

3.2 Instruments

For the experiments, the students were asked to undertake assessment tasks (see Appendix A and B). Each quiz comprised of multiple-choice, true or false and fill-in-the-blank questions. To ensure consistency, the quizzes were moderated by two members of staff for the level of difficulty and clarity. Based on their feedback, some questions were revised before the final quizzes were undertaken. For the survey, a two-part online questionnaire (see Appendix C) was designed to evaluate students' perception of online assessment on their academic performance. The first part of the questionnaire focused on students' demographic characteristics such as gender, age, highest educational level, experience, competence and duration of using online assessments. The second part of the questionnaire was based on variables in the research model. Questions measuring each variable were adapted from prior validated instruments based on the Task-technology fit theory. Items measuring task characteristics, technology characteristics, task-technology fit and students' academic performance were adapted from prior studies (e.g., Dishaw & Strong, 1999; Goodhue, 1995; Goodhue & Thompson, 1995; Lu & Yang, 2014; Wu & Chen, 2017). Like the experiments, the questionnaire was also pilot tested by two staff members for face value consistency and clarity.

3.3 Data analysis

As two data sets were collected from the experiments and the online survey, the study also performed two different data analysis. For the experiment data, the study performed paired

sample t-test to determine if there is a significant difference between students' grades on the two sets of paper-based and online assessments. In prior studies (e.g., Nikou & Economides, 2016), the paired sample t-test analysis was used to determine the difference between pre-and post-test regarding students' motivation and problem-solving performance respectively. Given the aim of the study to determine if there is a difference between students' academic performance in paper-based and online assessment, we consider the pair sample t-test a suitable analytic technique. Based on the result of paired sample t-test analysis, the study was able to address the first research question.

In terms of the survey data analysis, the study used the structural equation modelling (Kapo et al., 2020). Specifically, the study used partial least square structural equation modelling (PLS-SEM) (Hair et al., 2013). As a second-generation statistical data analysis technique, PLS-SEM supports analysis of complex relationships between variables even with small samples as compared with other techniques such as AMOS, EQS and LISREL (Chin, 1998; Hair et al., 2013). For this analysis, the PLS-SEM is used for evaluation of the measurement and structural model analysis to address the second research question. Given that the sample for the study is relatively small but representative of the students who participated in the study and as PLS-SEM support small samples, we deemed this choice appropriate.

4. Results

4.1 Impact of online assessment on students' academic performance

As presented in Table 2, we find that there is significant difference between grades obtained by students in both online and paper-based assessments. In the first time period (T1 – Pair 1), the online assessment recorded a mean of 9.54 and a standard deviation of 2.41. On the contrary, the paper-based assessment recorded a mean of 6.61 and a standard deviation of

1.784. Similarly, in the second time period (T2 – Pair 2), we find that the online assessment recorded a mean of 7.37 and a standard deviation of 2.187 while the paper-based assessment recorded a mean and standard deviation of 4.48 and 1.379 respectively. These results indicate that students perform better in online assessment compared to paper-based assessment.

Table 2 Paired sample statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Test 1 (online)	9.54	105	2.418	.236
	Test 2 (paper-based)	6.61	105	1.784	.174
Pair 2	Test 4 (online)	7.37	105	2.187	.213
	Test 3 (paper-based)	4.48	105	1.379	.135

Further results as presented in Table 3 shows significant differences in both time periods. We find that there is a mean increase of 2.933 in time period T1 with a 95% confidence interval ranging between 2.504 and 3.363 as well as a t-value of 13.540 and $p<0.000$ (two-tailed). Again, for the time period T2, we find a mean increase of 2.895 with a 95% confidence interval ranging between 2.419 and 3.371 as well as t-value of 12.060 and $p<0.000$ (two-tailed). Based on these results, we can conclude that students perform better in online assessments than paper-based assessments.

Table 3 Paired sample test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	**Std. Deviation**	**Std. Error Mean**	**Lower**	**Upper**	t	**df**	**Sig. (2 – tailed)**
Pair 1	Test 1 (online) - Test 2 (paper-based)	2.933	2.220	.217	2.504	3.363	13.540	104	0.000
Pair 2	Test 4 (online) - Test 3 (paper-based)	2.895	2.460	.240	2.419	3.371	12.060	104	0.000

4.2 Measurement model evaluation

For this analysis, three main criteria were used to estimate the fit between the data and the research model. Specifically, the analysis focused on factor loadings, convergent and discriminant validity. As presented in Figure 2, factor loadings of all the variables in the research model ranges between 0.817 and 0.937. As the factor loading of all the indicators are above the recommended threshold of 0.70 (Hair et al., 2013), we concur that there is a good fit between the data and the research model.

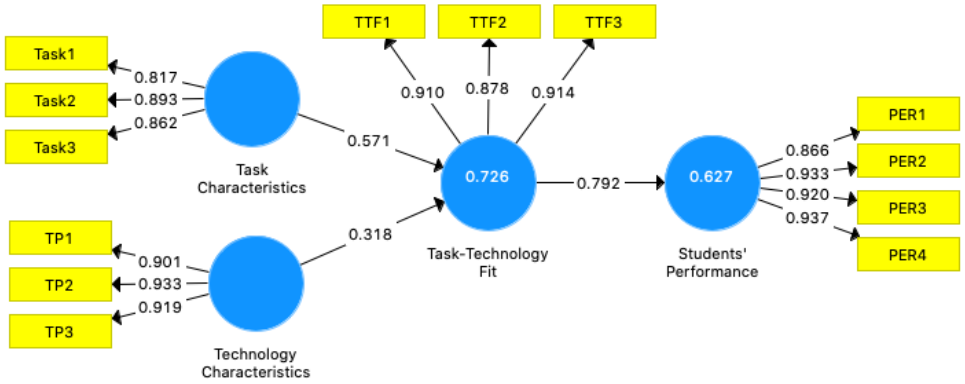

Figure 2 Factor loadings

In terms of convergent validity, average variance extracted (AVE) criterion, which measures the amount of variances constructs that a research model explains, was used (Kapo et al., 2020). As presented in Table 4, the AVE values are between 0.819 and 0.934, indicating good convergent validity; since these values are above the recommended 0.50 threshold (Hair et al., 2013). Also, the Cronbach's alpha results ranging between 0.819 and 0.934 demonstrates a good internal consistency between items used to measure each variable in the model; since the values are above the recommended threshold of 0.70 (Chin, 1998). Similarly, the composite reliability values ranging between 0.893 and 0.953 also attest to the good internal consistency of the data collection instrument and as such as good fit with the research model.

Table 4 Construct Reliability and Validity

Constructs	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Students' Performance	0.934	0.953	0.836
Task Characteristics	0.819	0.893	0.736
Task-Technology Fit	0.884	0.928	0.811
Technology Characteristics	0.906	0.941	0.842

Lastly, we performed discriminant validity using the Fornell and Larcker (1981) criterion to determine how distinct the variables are from each other. As presented in Table 5, the diagonal values ranging between 0.858 to 0.918 exceed the square root of the bivariate correlations between the other constructs, indicating that there is discriminant validity between the variables in the research model (Fornell and Larcker, 1981). Given that results from the three measurement criteria meet all the thresholds, we conclude that there is a good fit between the research model and the data (Kapo et al., 2020).

Table 5 Discriminant Validity

Constructs	Students' Performance	Task Characteristics	Task-Technology Fit	Technology Characteristics
Students' Performance	**0.914**			
Task Characteristics	0.716	**0.858**		
Task-Technology Fit	0.792	0.833	**0.901**	
Technology Characteristics	0.729	0.824	0.788	**0.918**

4.3 Structural model evaluation

To examine the path significance, effect of each hypothesised relationship and the explanatory power of our research model, we conducted structural model evaluation. As presented in Table 6, all the three hypotheses (H1, H2 and H3) were confirmed. From the results, it is evident that there is a positive relationship between task characteristics ($\beta = 0.571$; $p < 0.000$) on task-technology fits. Similarly, the result also indicates that technology characteristics ($\beta = 0.318$; $p < 0.006$) has a positive effect on task-technology fit. Furthermore, the result confirms that task-

technology-fit (β= 0.792; p < 0.000) also has a positive effect on students' academic performance. Moreover, the result also indicates that our model explains 63% of students' academic performance. In a nutshell, the structural model confirms all the three hypotheses in our research model.

Table 6 Hypotheses Testing

Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Interpretation
Task Characteristics → Task-Technology Fit (H1)	0.571	0.565	0.108	5.303	**0.000**	**Accepted**
Technology Characteristics → Task-Technology Fit (H2)	0.318	0.320	0.116	2.750	**0.006**	**Accepted**
Task-Technology Fit → Students' Performance (H3)	0.792	0.791	0.051	15.449	**0.000**	**Accepted**

5. Discussion

The aim of this study was to understand students' perception and the impact of online assessment on their academic performance. Specifically, the study endeavoured to answer the following research questions: 1) *what is the impact of online assessment on students' academic performance*? *and 2) how do students perceive the impact of online assessment on their academic performance?* In addressing these research questions, the study conducted four experiments comprised of two sets of paper-based and online assessment as well as developed a research model based on the Task-technology fit theory. From our findings, we derived the following insights. First, our findings show that there is a significant difference between students' academic performance on paper-based and online assessments. We find that students perform better on the online assessments as compared to paper-based assessments in the four experiments. This insight suggests that online assessment may be a better alternative to paper-based assessment since it increases student performance (Nguyen, et al., 2017; Soffer et al., 2017) and does not make students worse off in their academic attainment. Given the

contradictory findings in existing literature, our findings provide critical evidence to settle this debate.

Second, we find that students have a positive perception of the impact of online assessment on their academic performance. It is reassuring that the student perceptions align with the findings from the experiments. This emphasises that the use of online assessment will lead to better academic performance. However, for a positive performance impact, there needs to be a fit between assessment task and technology characteristics (Adya and Phillips-Wren, 2019). Consistent with the extant literature (e.g. Dishaw & Strong, 1999; Lu & Yang, 2014), we find that task characteristics and technology characteristics have a positive relationship with task-technology fit in using online assessment. Therefore, the more aligned online assessment tasks are with the technology used, the better the fit between task and technology which in turn leads to better students' academic performance. In addition, we find that task characteristics are more critical than technology characteristics in achieving a fit between task and technology. This finding fits well and supports existing notion (see Lu and Yang, 2014). Therefore, more attention needs to be paid to task characteristics in the use of online assessment. Because the more aligned the task characteristics, the better there is task-technology fit since technologies used for online assessments are mostly off the shelf solutions. Most often, these technologies are designed for use by many higher education institutions, therefore, the responsibility is on individual institutions to ensure online assessment task characteristics are appropriately designed to align perfectly with existing technology characteristics.

5.1 Theoretical implications

Theoretically, this study advances research on online assessment in three main ways. First, this study offers a more nuanced understanding of online assessment on students' academic

performance since the majority of previous studies (e.g., Macedo-Rouet et al., 2009; McGill & Klobas, 2009) did not complement assessment results with student perceptions or views. In addition, studies that sought to evaluate students' perception and impact of online assessment on their performance (e.g., Elmehdi & Ibrahem, 2019) measured performance by overall class pass grade percentage and cumulative averages. Our experimental approach using specifically designed similar type online and paper-based questions provide a unique and important perspective. In addition, extant studies are mostly focused on adoption, motivation and intention to use online assessment (see e.g., Lu & Yang, 2014; Park et al., 2019; Wu & Chen, 2017) while limited understanding exists on students' perception and the ultimate impact of the technology on their performance. Similarly, other studies have focused on the impact of online assessment on students' experiences (e.g., Mafenya, 2016; Soffer et al., 2017), feedback (e.g., Cutumisu, 2018; Van Der Kleij, Eggen, Timmers, & Veldkamp, 2012), engagement (e.g., Alavi & Gallupe, 2003; Browne et al., 2006) and motivation to use technology (e.g., Nikou & Economides, 2016). To the best of our knowledge, this may be the first study or among a few studies to investigate both students' perception and impact of online assessment on their performance which draws results from a survey and experiment. As such, the study makes a significant contribution to the online assessment literature by offering conclusive evidence to the contradictory results in the extant literature.

Second, this study contributes by developing and validating a research model that explains how the fits between technology and assessment influence students' academic performance. Although some previous studies draw on the Task-technology fit lens, the theory is either combined with others such as Technology Acceptance Model (e.g., Larsen et al., 2009; Park et al., 2019) and Unified Theory of Technology Acceptance and Use (e.g., McGill & Klobas, 2009), as well as Social Capital Theory (e.g., Lu & Yang, 2014). In the educational context,

the Task-technology fit theory has been used to investigate behavioural intention to use MOOCs (Wu and Chen, 2017), learning management systems (McGill and Klobas, 2009) and adoption of multimedia technology for learning (Park et al., 2019). Thus far, there has been limited attempt to utilise the Task-technology fit theory to explain how interactions between assessment and technology impact students' academic performance. By drawing on the Task-technology fit theory, in the educational technology context, the study provides an alternative lens to evaluate the impact of online assessment on students' academic performance. Therefore, the current study makes a significant contribution to both Task-technology fit theory and online assessment and will serve as a good foundation for future studies.

Lastly, the study contributes to online assessment literature by demonstrating the differences between students' academic performance on both paper-based and online assessments. While some extant research attempted to demonstrate the difference between paper-based and online assessment, these studies (see, e.g., Macedo-Rouet et al., 2009; Nikou & Economides, 2016) tend to conduct pre-and post-experiments without evaluating both types of assessment concurrently, leading to time-lag biases. In most cases, existing studies (e.g., Nikou & Economides, 2016) tend to only use the results from a single time period for analysis. However, this study conducted four experiments consisting of two sets of paper-based and online assessments which were undertaken at the same time, thereby eliminating time-lag biases as well as revalidating the results to draw a more definitive conclusion. Hence, this study provides a more robust and clearer difference between the impact of paper-based and online assessments on students' academic performance.

5.2 Practical and policy implications

In terms of practical and policy implications, this study provides two contributions. First, the findings in the study present evidence to support the wide use of online assessment. In addition to the benefits of online assessment (Timmis et al., 2016) such as time, convenience and cost-saving, this study also points to students performing better in online assessments compared with paper-based assessments. This study also highlights the importance of task characteristics fitting technology characteristics to elicit required improved performance. This raises very important questions about which types of courses, tasks and related learning outcomes will be suitable for online assessments. Another pertinent dimension is the need to examine which elements of assessments, in line with fulfilling learning outcomes could be examined through online assessments. The findings from the study also provide important implications for curriculum design. Thus, the findings from this study provide an important implication for educators and policymakers. There is the need for careful evaluation of the extent to which online assessment is institutionalised across subjects (courses) and programmes if the aim is to achieve learning outcomes and as improve students' performance at the same time. Therefore, in practical classroom settings lecturers and policymakers will need to intrinsically examine which elements of the learning outcomes could be examined through online assessment. This means that, depending on the subject and expected learning outcomes, lecturers and policymakers can redesign their curriculum to incorporate more online assessment rather than the traditional paper-based assessment. Therefore, this study contributes the needed practical evidence to shape policy and practice required in transitioning to online assessments. Finally, the findings could also bring assurance to higher education providers who were forced to move provision, delivery, and assessment online because of COVID-19. In particular, worries of the impact on the performance of students as a result of online assessments may be far-fetched. It is important for academics to note though that task-

technology fit is crucial to ensure that student performance is maintained and improved. In other words, it is important to ensure a fit between the assessment characteristics and the technology. Where paper-based assessments are being adapted for online assessments, it is important to ensure task-technology fit for better student performance.

5.3 Limitations and future research directions

Despite the contributions, this study has limitations. First, this study focuses on students from a UK university in one discipline, limiting wider generalisation of the results. Nevertheless, the results advance our understanding of the impact of online assessment on students' academic performance. Thus, future studies may conduct cross-university multiple discipline investigations for better generalisation. Second, this study is limited to students' performance, as a result, other aspects of online assessment such as implementation processes, accessibility and systems analysis and design are not covered. Again, contextual idiosyncrasies (Senyo et al., 2016) such as culture, technology infrastructure development, and demographic characteristics such as students' age, level of study, etc may influence the study. Therefore, future studies may consider investigating these other aspects of online assessment. In addition, how online teaching relates to online assessment and the resulting performance is a key area of enquiry that requires attention. Third, this study used quizzes so future studies could explore how paper-based written exams compare with reports submitted online, etc. Fourth, the study is limited by the use of the quantitative methodology. There may be qualitative factors that might not be captured using the quantitative research approach. Again, future studies may conduct qualitative investigations into the impact of online assessment on students' academic performance. Finally, the data for this study was collected in the pre-COVID-19 era. There would be the need to conduct studies that evaluate online assessments before, during and after COVID-19 to guide the formulation of long-term assessment policies and practices. In a wider

context, this study also elicits the need for further research on the effects of online teaching and learning on academics, students, and the wider Higher Education ecosystem.

6. Conclusion

The interest in online teaching and learning, as well as related assessments in academic and further education institutions, has been on an upsurge. However, studies that examine the impact of online assessments on academic performance remain relatively limited. Existing studies do not sufficiently incorporate both assessment results and student perceptions to evaluate performance. We contribute to the literature by combining experiment and survey results to examine the impact of online assessment on students' academic performance. We extend the literature by adopting the task-technology fit theory to particularly demonstrate how the fit between the technology and assessment task influences students' academic performance.

Overall, our findings suggest that online assessments improve student outcomes. We show that task-technology fit is crucial to ensure that student performance is maintained and improved. It is important to ensure a fit between the assessment characteristics and the technology. We emphasise that task characteristics take precedence over technology characteristics in determining the extent to which academic performance improvement can be achieved. Particularly when adapting hitherto paper-based assessments into online assessments it is crucial to ensure task-technology fit to achieve improved student performance. This shows that the design of the assessment needs to take into consideration how it aligns with the available technologies. Pertinently, the design of online assessments must start from the module design to ensure proper alignment of the learning outcomes with the assessments. This emphasises that to improve and sustain student performance there needs to be congruence between curriculum and module design, teaching and learning on the one hand with the characteristics

of the online assessment task on the other hand. The evidence presents advantages for both students and educators alike and therefore bodes well for teaching and learning.

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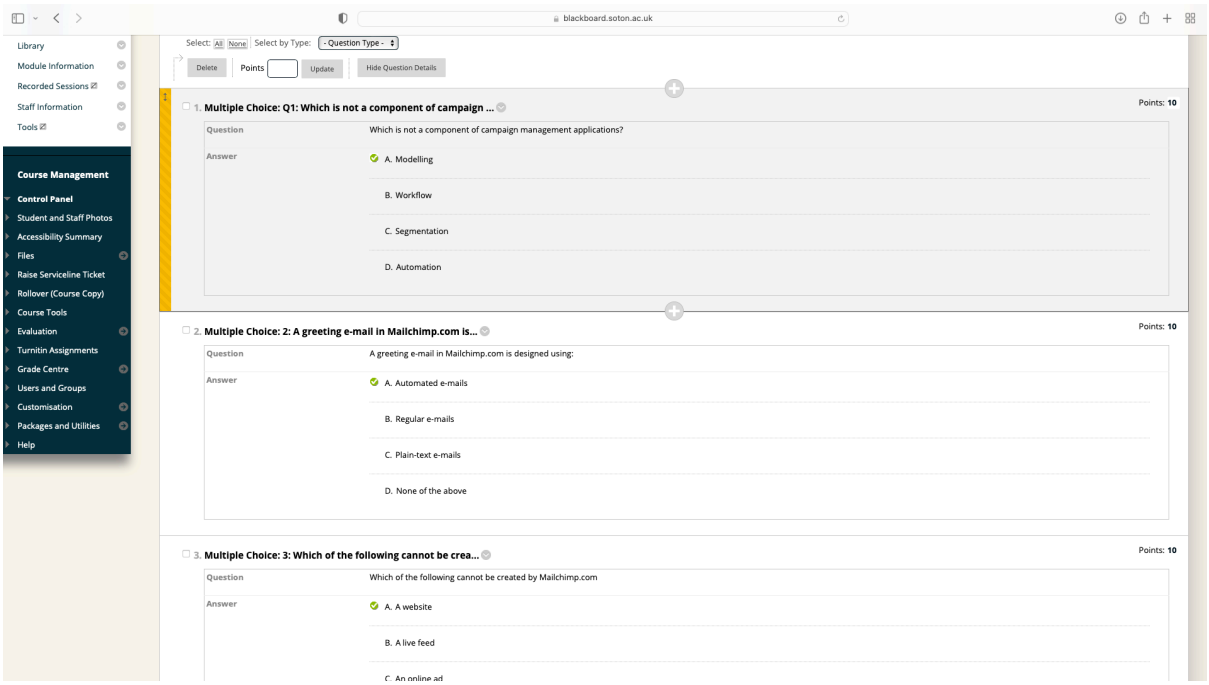
Appendices

Appendix A: Online Assessment



Appendix B: Paper-Based Assessment

Student ID_____

1. _____is a benefit from customer retention.

2. Customer centricity requires a
    a. CLT
    b. KPI
    c. SVOC
    d. CLV

3. In which Zoho CRM module you are required to estimate the number of responses:
    a. Leads
    b. Contacts
    c. Deals
    d. Campaigns

4. _____ is the second phase of the customer lifecycle

5. In Zoho CRM, what is the earliest stage of a deal?
    a. Needs Analysis
    b. Id. Decision Makers
    c. Qualification
    d. Negotiation/Review

6. Customer development strategies include ....
    a. Lead generation
    b. First closed sale
    c. Assimilation
    d. Cross-selling

7. _____ is one of the core functionalities of service automation.

8. _____ is a KPI for customer retention.

Appendix C: Survey data collection instrument

Q1. Gender
[ ] Male [ ] Female

Q2. What is your year of birth? [ ]

Q3. Highest educational level
[ ] High School [ ] Professional Certificate [ ] First Degree (Bachelors)

Q4. Have you ever used online assessment?
[ ] Yes [ ] No [If No, go to Part B]

Q5. Which online assessment have you used? Please, select as many as possible
[ ] Moodle [ ] Blackboard [ ] Saki [ ] Others……

Q6. How frequently do you use online assessment systems?
[ ] Always [ ] Frequently [ ] Occasionally [ ] Rarely [ ] Never

Q7. How would you rate your competency in using online assessment technology?
[ ] Not good [ ] Fairly good [ ] Averagely good [ ] Very good [ ] Extremely good

Q8. How long have you been using online assessment?
[ ] 1-3 Months [ ] 6month [ ] 6-12 months [ ] 1-3 years [ ] 3-5 years [ ] Over 5 years

Section B

Below are statements regarding using online assessment systems. Please read each statement and indicate to what extent you disagree or agree based on these ranges strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree, strongly agree.

Constructs	Items (measured using 7-point Likert scale)
Task Characteristics	I prefer online assessment to paper based assessment
	I will use online assessment for formative test
	I find online assessment appropriate for university tests
Technology Characteristics	Computer based assessment systems allow me to take tests
	Computer based assessment technology has interactive feature which help me take tests
	I can interact with online assessment technology to undertake tests
Students' Academic Performance	Online assessment helps me to obtain good grades
	Online assessment helps me to improve my academic performance
	Online assessment helps me to be productive
	Online assessment is important in my academic performance
Task-Technology Fit	Online assessment is a viable alternative to paper-based assessment
	Online assessment is easier to use than paper-based assessment
	It is easier to use online assessment to complete tests than paper-based assessment