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ABSTRACT

In the last two decades online computer-marked assignments (CMAs) have been widely used in accounting education. Although there is a growing body of research on this form of online assessment, most of the previous studies relied on small samples of respondents or focused on student self-report using survey methods. This exploratory mixed-method study aims to combine a quantitative analysis of learners' academic performance on an online Financial Accounting course with a more in-depth exploration of learner experiences using qualitative methods. The quantitative findings suggest that student previous educational qualifications, age and experience of studying a similar subject are strongly associated with CMA completion, which is also linked to scores on other pieces of assessed work. The qualitative results show that from the learners' perspective, diversifying assessment methods, introducing low-stakes assessment activities and creating opportunities for situational interest are viewed as key aspects of online CMA design. The paper concludes with discussing the implications of the study for designing and delivering online courses in accounting, particularly in the light of the growing popularity of massive open online courses (MOOCs).

Keywords: online tests, computer-marked assignments, accounting education

In the field of accounting education, there is a growing body of research on the use of online computer-marked tests that highlights the significance of computer-marked assignments (CMAs) for motivating learners, communicating assessment requirements (Marriott & Lau, 2008; Aisbitt & Sangster, 2005) and shaping skills of self-regulation (Becker, 2013). However, there is less clarity as to which pedagogical principles should underpin the design of these online tests, particularly in the context of purely online open-access courses. Evidence relating to the impact of CMA on student assessment scores and on the relationships between learner characteristics and their CMA scores also seem to be mixed. This exploratory study investigates the effects of innovative uses of CMAs in an online professionally accredited course in Financial Accounting at a distance-learning university in the UK. The design of the course under study required relatively low levels of interaction between instructors and students, and so CMAs were designed in the form of instructional scaffolds that increased in difficulty and helped to reinforce the knowledge of accounting concepts through feedback. This study explores two key facets of learner experiences with CMAs– relationships between learner characteristics, their CMA scores and scores on other forms of assessment; and learner perspectives on CMA design. The study combines the analysis of secondary quantitative data on academic performance with the collection of primary qualitative data in the form of semi-structured interviews.

The results of the quantitative data analysis suggest that CMA completion is a strong predictor of student progress, as students who completed the three summative CMAs were much more likely to both take and pass the final examination, and the students who did not complete the CMAs, did not manage to pass the course. In addition, the significant effects of previous educational experiences, particularly study in the related subject area, and of age on CMA performance were observed. The qualitative results show that students viewed CMAs as one of the key components of course design, as they provided low-stakes opportunities for

self-assessment, contributed to a variety of assessment methods and helped to generate situational interest in learning. Given the growing popularity of MOOC courses, which are often designed using similar principles to those described in this study, the results presented in this paper can be generalizable to a wide range of online learning settings both in the field of accounting education and in other disciplinary areas.

The remainder of the paper describes each stage of the study in more detail and is organized into five sections. The first two sections – the literature review and the aims and methods – set the scene for the study and describe its key objectives and research methodology. The key findings of data analysis are presented in the quantitative and qualitative results sections. The paper concludes with a discussion of the implications of the findings for advancing knowledge on online testing in the field of accounting education.

LITERATURE REVIEW

With the rapid technological advances of the 1990s and early 2000s, online computer-marked testing has been increasingly used to support in teaching and learning across several academic disciplines, including accounting. Today, computer-marked tests are commonly used for the assessment of student learning in the field of accounting both at university level and in professional exams. This growth in online tests has led to a growing body of research on their use in accounting education.

Two Waves of CMA Research

From an historical perspective, there is a distinction between the accounting education studies of the 1990s and early 2000s and the research at the end of the first and second decades of the 21st century. The focus of the first wave of research was on creating conceptual underpinnings for integrating web-based technologies into instruction, exploring the nature of institutional constraints and staff resistance to their wider adoption. For

example, early in the first decade of the 21st century, Dunbar (2004) considered the pedagogical implications of course redesign in the light of online delivery through embedding synchronous and asynchronous components into assessment. Cleaveland & Larkins (2004) and Rebele et al. (1998) explored methods of integrating online technologies into assessment practice. Aisbitt & Sangster (2005) discussed the challenges that the delivery of a purely online distance course faced due to a lack of adequate resourcing and technical support at the institutional level. In line with developments in other disciplinary areas (e.g., Rovai, 2000), comparative studies investigated the differences between more traditional paper-based and online modes of test administration (e.g., Green, Reinstein & McWilliams 2000; Gujarathi & McQuade, 1998). Another research stream examined relationships between learner characteristics, their attitudes towards and preferences for computer-based testing (Fogarty, Goldwater & Lopez, 1996; McCourt & Radcliffe, 2000; Paterson & Reider, 2002).

During the second half of the first and second decades of this century, as web-based technologies grew in sophistication and incorporated facilities for interactivity, individualization and adaptivity, accounting education research embraced more nuanced explorations of learner experiences. For example, later CMA research saw more in-depth studies of affordances for Web-based assessment within online systems (Apostoulou, Blue & Daigle, 2009; Einig, 2013; Potter & Johnston, 2006), web-based homework (Khanlarian & Singh, 2015; Phillips & Johnson, 2011) and online tutoring software (Jackson & Cossitt, 2015). Other salient research in this period included the examination of the effects of various types of online tests (Camp, Earley & Morse, 2015), such as multiple-choice questions (Einig, 2013; Simkin, Keuchler, Savage & Stiver, 2011) on student learning.

CMA Use and Academic Performance

Given the growing importance of online testing in the accounting field, it is not surprising that studies into the effectiveness of this type of assessment form a salient research strand. Most contributions relating to effectiveness of CMAs reported strong relationships between scores on summative or formative continuous assessment and on final examinations results. For example, drawing on the analysis of online summative assessment scores on an introductory first-year accounting course, Marriott and Lau (2008) noted an improvement in overall student performance compared to student cohorts who had not been exposed to online testing. Baxter and Thibodeau (2011), Brink (2013), Einig (2013), Kanapathippillai et al. (2012), Perera et al. (2014) concurred that there was a positive impact of CMAs on student learning and found positive relationships between scores on online computer-marked assessment and exam scores. Gaffney et al. (2015) explored the effects of using online homework management software, which included facilities for online testing on an introductory accounting course.

While generally agreeing with previous studies on the benefits of online testing – in terms of provision of instant feedback and help with structuring study problems – the authors reported no significant differences on the final examination scores of students exposed to online assessment compared to the control group, who were not using the homework management system. However, students who were assessed online scored higher on some of the tasks that constituted part of the continuous assessment. Morris, Burnett, Skousen and Akaaboune (2015) and Khanlarian et al. (2015) concluded that the use of online technology led to the improvement of student scores over several cycles of final assessment. In contrast, Khanlarian and Singh (2015) found that variables related to student perceptions or experiences with online technologies were not linked to their scores on the final examination. Drawing on evidence from an intermediate accounting course, Fatemi, Marquis and Fasan

(2014) suggested that students who submitted their homework using pen and paper, gained better scores than students who were tested online. Hahn, Fairchild and Dowis (2013) reported no advantages in relation to the use of an online homework management system on an introductory Financial Accounting course. The system incorporated a facility for online testing, compared to more conventional paper methods, but no differences were observed on the final examination performance across the experimental and control groups.

One limitation in the research of the relationships between CMA scores and other indicators of student performance was that few studies accounted for the effects of student characteristics or considered differences in performance across various demographic groups. Guney (2009) analyzed the effects of learner characteristics on academic performance amongst second- and third-year undergraduate accounting students at a UK university. The study found significant effects in relation to previous studies, age and work experience on academic performance but none in relation to gender. Byrne and Flood (2008) explored data on academic performance amongst first-year accounting students at Dublin City University, finding highly significant effects of previous education, prior knowledge of accounting but no effects of gender. Perera et al.'s (2014) study reported a mixed picture of gender differences in academic performance on an undergraduate Finance course, as female students performed better in tutorial-based formative assignments, but male students fared better in the final examination.

Benefits of Online CMAs

Whilst studies exploring the effectiveness of CMAs mostly relied on the analysis of quantitative data, several other studies considered CMA use in more detail by collecting qualitative data in the form of interviews with students. One of the major themes that reoccurred in these studies were the benefits that the online mode of test administration

offered to students. For example, CMA use was reported to contribute to consolidating learning (Aisbitt & Sangster, 2005), improving financial knowledge (Baxter & Thibodeau, 2015; Gikandi et al., 2011) and highlighting areas of improvement (Einig, 2013; Marriott & Lau, 2008). From the motivational perspective, computer-marked assessment aided learners in maintaining engagement (Potter & Johnston, 2006) and persevering with their studies (Khanlarian, Shough & Singh, 2015). In addition, online CMAs were seen to contribute to forming skills of self-regulation by helping student pace their studies (Marriott & Lau, 2008), impose discipline (Aisbitt & Sangster, 2005; Gaffney, Ryan & Wurst, 2015) and develop skills of reflection (Marriott & Lau, 2008). Although these studies explored student views on CMA use, they typically focused on the advantages of new technological affordances and learner reactions to these. Furthermore, these studies were carried out in higher education contexts, where entry requirements were in place.

Assessment Design in The Light of Novice Student Experiences

Previous research has also shown that students starting their first accounting courses face a number of specific challenges. For example, Becker (2013) noted low levels of self-monitoring amongst new accounting students, where insufficient ability to self-evaluate led to students' incorrect assessment of their levels of expertise and consequently to low levels of academic performance. Duff's (2004) study of learning strategies of first-year Economics and Accounting students at a Scottish university elucidated the challenges of delivering courses to students following an open-access route to higher education. According to the author, a considerable proportion of learners displayed characteristics of an 'ineffective learner' (423) and students' level of previous academic achievement was a strong indicator of their likelihood of successfully coping with study demands. In Nicol's view (2009) assessment design can be an important aspect in helping learners to overcome some of the

challenges of learning in technology-rich environments, particularly when learners are new to higher education. Using Nicol and McFarlane-Dick's (2006) principles of good feedback practice (see Figure 1), Nicol (2009) demonstrates how assessment redesign of first-year courses in Psychology and French at a Scottish university has led to substantial improvement in student satisfaction scores and retention rates. This study noted a lack of research in relation to the principles of assessment design in technology-rich contexts of novice higher education learners and highlighted a need for more research on assessment attitudes and preferences from the perspective of the learners (Watty et al., 2010).

Gaps in Knowledge and Research Questions

There is a substantial body of research on online computer-marked testing in the field of accounting education. Although more nuanced explorations of integrating CMAs into teaching and learning are starting to emerge, much of the previous research has focused on the benefits of this form of assessment. Some of the previous studies have explored links between aspects of teaching, the learning context or instructional interventions and student performance. However, the relationships between student self-reporting on their learning experiences and actual performance outcomes were not examined (Apostolou, Dorminey, Hassell, & Watson, 2013), particularly considering student demographic characteristics, such as gender, previous level of education, experience of online studies or study in a specific disciplinary area. Furthermore, most of the previous research was either conducted in the context of traditional classrooms, where online tests are used in addition to face-to-face delivery or in a blended mode, where students have regular face-to-face contact with their instructor and with other students in addition to online interaction. In the context of purely online courses, research on online testing has been scarce (Apostolou et al., 2013),) and there

is a lack of studies in relation to the design of online assessment from the learners' perspective. Thus, this study was driven by two key research questions:

a) What are the relationships between CMA scores and scores on forms of assessment and the effects of student characteristics on CMA scores? (RQ1)
b) Which features of the design of online assessments tasks were perceived to foster student engagement? (RQ2).

METHODS AND CONTEXT

This study employed a mixed-method approach to research design that combined the analysis of qualitative and quantitative data in order to achieve methodological triangulation (Denzin, 1978). Quantitative data was collected from secondary sources in the form of data on student characteristics and academic performance. The quantitative analysis focused on relationships between learner characteristics, their CMA scores and on associations between CMA scores and scores on other pieces of assessment. Chi-squared tests, correlation analysis and univariate (ANOVA) and multivariate (MANOVA) analysis of variance and co-variance were employed to analyze quantitative data. The results of the quantitative data analysis underpinned the sampling for the interviews, using a stratified sampling approach (Trost, 1986), where equal proportions of potential interviewees, from demographic groups that showed significant differences in CMA scores were invited to take part. The qualitative data collection and analysis focused on learner's views on the design of online tests through a series of semi-structured interviews.

The population of this study were undergraduate students studying a distance-learning second-year (referred to as Level 2 in this paper) financial accounting course at a UK university. On successful completion, students gained exemption from some examinations of professional accounting bodies, such as the Chartered Institute of Management Accountants.

Students completed the course over a six-month period and focused on independent study of learning material that required satisfactory completion of various problems, exercises and cases. Students mostly contacted their instructors remotely, via electronic conferencing and email. Additional contact (6% of the total study time) was provided in regular face-to-face tutorials, each lasting between three and six hours, which were not compulsory. According to the typology suggested in Arbaugh (2014), the course under study can be described as being taught online, since more than 80 percent of its content and activities were delivered online.

The assessment design was comprised of a continuous assessment component and a closed-book written examination; both had to be passed at a threshold of 40% for successful completion of the course. The continuous assessment involved three online open-book CMAs and two open-book instructor-marked assignments (IMAs). Each CMA was completed online and had a predetermined submission date and time. No one question in any set of five was significantly harder or easier than other questions in the same set. The innovative nature of CMAs in this context was that online CMAs took a 'scaffolding' (Beaumont, Moscrop & Canning, 2016, 1) approach to the design of tasks, which increased in technical complexity to match with the increase in technical complexity of the accounting content. In addition, question types were varied. While the first of the CMAs (CMA01) contained 70% of preselected response questions (such as multiple choice and 'drag and drop' questions) relating to theoretical concepts and principles covered in the first units of the course, the later CMAs contained more constructed-response questions. For example, in CMA03 70% of the questions required a constructed response and commentary and relied on the analysis of financial statements from more challenging and detailed case studies or situations. Since 50% of marks in the final examination were allocated to constructing and interpreting data from financial statements, completion of CMA03 served as preparation for the final examination. Like other previous studies (e.g., Hernandez, 2012; Perera et al., 2014; Voelkel, 2013), the

design of CMAs combined formative and summative assessment components, in so far as student marks and feedback provided an evaluation of student achievement at different stages of their studies, but also highlighted areas of improvement in the light of future assessment tasks.

Closer analysis of assessment design on the course in question showed that it followed five out of seven of Nicol and MacFarlane-Dick's (2006) principles of good feedback practice (see Figure 1), that is:

a) Principle 1 – detailed information on assessment requirements and standards for different levels of performance were provided in the assessment guide and marking guidelines for the course.
b) Principle 2 – in addition to longer pieces of work in the form of IMAs, students were encouraged to assess their knowledge of course material through CMAs.
c) Principle 3 – students were provided with detailed and extensive feedback on their assessed pieces of work by their instructor, whose comments incorporated analyses of strengths and weaknesses in their work.
d) Principle 4 – instructor comments on student work were written in a friendly, accessible manner and students were encouraged to ask additional questions by email or phone if necessary, to continue dialogue about their learning. There were also opportunities for peer dialogue using the online course forums.
e) Principle 6 – some tasks and topics (e.g., creating financial statements and discussing issues in corporate governance) were provided in a repeated cycle. In addition, one of the tasks in a second IMA specifically asked learners to discuss their use of instructor feedback from the first IMA.

RESULTS: QUANTITATIVE ANALYSIS

Descriptive Statistics and Differences in Academic Performance on CMAs

A total of 1,127 students were registered for two presentations of the course considered in this study. Some of their key demographic characteristics are summarized in Table 1. Overall, the student population had a higher proportion of male students, similar proportions of students in different age groups and a relatively even spread of students with previous higher educational qualifications, though with a plurality studying up to A-levels, which are advanced secondary school qualifications in the UK (Peers & Johnston, 1994). Around a third of students had a higher educational qualification equivalent to an undergraduate degree or above, and between 28.5 and 35.1% provided no information on their higher educational qualifications.

[Table 1 about here]

Although some of the data relating to educational qualifications might have been missing, it is plausible that in most cases students either had qualifications below two A-levels or were originally admitted with no formal education under the university's open admissions policy. A little less than 80% of students were new to distance learning and more than 20% were continuing their distance studies with the same institution. Both employment/ career and personal development were major reasons for studying financial accounting and between 30 and 40% of students had previously completed a distance-learning course in bookkeeping. To explore the effects of student characteristics on CMA scores, a series of multivariate analysis of variance (MANOVA) tests were performed. The tests were carried out using a demographic characteristic (gender, age group, highest previous educational qualifications,

nature of motivation for studying the course, ethnic background, whether students were new to the university in question or continuing and whether they had previously completed an introductory bookkeeping, mathematics or a Level 2 course) referred to in Table 1 as independent variables, and scores on CMA01, CMA02 and CMA03 as the dependent variables. Due to the low numbers of ethnic minority students the sample was split into two groups by ethnicity – white UK and other students, most of whom belonged to ethnic minorities, such as Black or Asian.

The MANOVA results showed that learner characteristics had an overall multivariate effect on their CMA scores ($F_{(3,542)} = 1124.05$, $p < 0.001$). However, when the multivariate test results by each student groupings were explored in more depth, only some of the predictors were related to CMA scores (see Table 2 for more detail). More specifically, there were statistically significant differences across gender, age and ethnic groups, as well as groups with different levels of previous education and experience of studying in a related subject area. Interestingly, prior experience of study with the university in question, such as by completing a mathematics or a Level 2 course, did not affect student CMA scores. However, completion of a relatively short introductory course in bookkeeping, which also used self-check quizzes, had a positive effect on student CMA performance. The analysis of univariate tests for individual CMAs showed that, while for CMA01 the differences between those who have completed an introductory bookkeeping course were at the .05 level of significance ($F_{(1, 544)} = 5.04$, $p = .025$), they were at the .001 level of significance for CMA02 ($F_{(1, 544)} = 23.48$, $p < .001$) and CMA03 ($F_{(1, 544)} = 19.029$, $p < .001$). In other words, the initial advantage that students with previous experience of study in a related subject area did not diminish, as students progressed through their studies. The analysis of univariate tests showed a somewhat similar pattern for other groupings (i.e., by age, ethnicity and previous educational qualifications), as differences in CMA scores did not decrease towards the end of

the course. Students with higher educational qualifications (i.e., those who had previously completed an undergraduate as well as a postgraduate degree), older students (students in their 40s and 50s compared to younger students) and white UK students tended to fare better on all three CMAs. The only exception to this tendency were gender differences, where male students outperformed female students on CMA01 ($F_{(1, 544)} = 7.38$, $p = .007$), but there were no statistically significant differences between gender groups on CMA02 ($F_{(1, 544)} = 0.61$, $p = .059$.) and CMA03 ($F_{(1, 544)} = .01$, $p = .280$).

[Table 2 about here].

It should be noted, that the interpretation of these results was not straightforward, due to the association between some of the variables. For example, older students tended to have higher levels of educational qualifications ($\chi^2 = 70.99$, d.f. = 12, $p < .001$) and were more likely to study for either personal or personal and career reasons ($\chi^2 = 27.152$, d.f. = 12, $p = .007$). In a similar way, those who had completed the introductory bookkeeping course were less likely to be uncertain about their motivations for study and more likely to study for personal and career-related reasons ($\chi^2=19.80$, d.f. = 3, $p < .001$). Interactions between other demographic variables were not significant.

CMA Completion Rates and Associations between Assessment Tasks

Student performance was also examined by analyzing patterns of CMA completion by various student groupings. In total 967 students (or 85% of those initially registered) completed at least one assessment task during the course. Closer inspection of the data on CMA completion showed that any student who missed CMA01 did not complete any other assessment. Amongst other students who did not complete all three CMAs, students either missed both CMA02 and CMA03 (74 students or 7.6% of the sample) or missed CMA03 (260 students or 23.1% of the sample) only. Analysis of data on CMA completion presented

in Table 3 showed that it was closely associated with data on differences in CMA performance; for example, older students, students with higher educational qualifications and white UK students were more likely to complete all three CMAs and performed better on these tests. Two notable exceptions to this pattern involved comparisons across gender groups, where no significant differences in CMA completion rate were reported, and differences between new and continuing students, where despite no significant differences in mean CMA scores, continuing students were more likely to attempt all three CMAs (see Table 3).

[Table 3 about here].

Analysis of CMA completion across groups of students by level and subject of previous study at the university in question helped to shed more light on student use of online tests. Students who had previously completed a bookkeeping, a mathematics or a Level 2 course were more likely to complete all three CMAs. Nonetheless, it was only students with previous experience of studying bookkeeping who reported higher CMA scores than those who did not. In other words, prior study experience enabled students to attempt the online tests, but it was previous study in the related subject area (rather than previous experience of studying a quantitative discipline, such as mathematics, or another Level 2 course) which led both to a higher rate of CMA completion and to higher scores on these online tests. When CMA completion rates by individual CMAs were considered, patterns in their completion were very similar to data on completion or non-completion of all three CMAs. The only notable difference was CMA03, which had more complex tasks, and older students (χ^2 = 11.41, d.f. = 4, p = .022), UK white students (χ^2 = 5.14, d.f. = 4, p = .023) and students who had previously completed a mathematics course (χ^2 = 5.57, d.f. = 1, p = .018) were more likely to attempt it, while differences in completion rates of CMAs 01 and 02 by demographic grouping were not significant. However, yet again a higher rate of completion did not

necessarily lead to better performance – while students who had completed a Math course performed better ($F_{(1, 604)} = 8.30$, $p = .025$) than those who had not, differences in academic performance on CMA 03 across two ethnic groups ($F_{(1, 604)} = 0.75$, $p = .388$) and students with higher educational qualifications ($F_{(4,623)} = 2.29$, $p = .059$) were not statistically significant.

When associations between CMA completion and scores on other assessment tasks were examined, it appeared that completing all three CMAs had a strong effect on the likelihood of completing the examination, as 88% of students who completed all CMAs sat the final examination, compared to 20% of those who had missed at least one CMA. Pearson's chi-square test confirmed strong associations between completing the CMAs and sitting the examination ($\chi^2 = 442$, d.f. = 1, $p < .001$). In addition, students who completed all three CMAs had significantly higher scores on both IMAs and the examination, compared with students who missed one or more (see Table 4).

[Table 4 about here]

Finally, to analyze the relationships between different assessment tasks correlation analysis was performed. Using Cohen's (1988) guidelines, most of the correlations between three types of assessment tasks (CMAs, IMAs and the final examination) can be described as large (=0.5) or very large (see Table 5). In other words, student performance on CMAs was strongly associated with performance on IMAs and the final examination. The only exception to this pattern were correlations of CMA01 with the other assessment tasks, which fall between large and medium size. This was due to clustering of high scores on CMA01, which decreased the predictive power of those scores. Consistent with this, the average CMA score decreased from CMA 01 to CMA03, as the technical complexity of each CMA increased.

[Table 5 about here].

Results: Interview Data Analysis

A total of 200 students received an email invitation to participate in the interviews and 15 of them (or 7.5% percent) agreed to participate in the study and were interviewed by phone by one of the project team members. Table 6 compares the characteristics of students in the interview sample with those of student populations on spring and autumn presentations of the course. The following groups of participants were overrepresented in the interview sample: female students, students aged between 25 and 39 years of age, white UK students, students studying for both personal interest and for career or employment reasons, and those who had completed an introductory bookkeeping course. However, the standard of academic achievement in the interview sample was fairly similar to average scores across both presentations of the course; therefore, despite a certain degree of bias, the views of interviewees can be described as illustrative of student perspectives on CMA use in this context.

[Table 6 about here]

Interview data was transcribed and analyzed, using a thematic approach (Boyatzis, 1998), where the themes that emerged in respondent accounts were developed based on the list of codes in the text of the interview. Both the themes associated with the interview questions and those generated by the interviewees were considered. The interviewees referred to several characteristics of assessment design, described in Nicol and MacFarlane-Dick (2006) (see Diagram 1), as principles of good feedback practice. For example, they helped to facilitate the development of self-assessment in learning and provided opportunities for closing the gaps between current and desired performance. However, there were other aspects of assessment design that the respondents viewed as being conducive to their engagement with studies on this course can be grouped into three categories: *diversifying assessment*

methods, generating situational interest and low-stakes nature of initial assessment activities. These three themes are discussed in more detail below.

The interviews confirmed the findings of the quantitative data analysis, which showed that learners on this course came from a wide range of backgrounds in terms of their age, previous educational qualifications and motivations for study. They also revealed that many of the interviewees had been out of formal education for a significant period and so were initially lacking confidence in their academic ability to study in a disciplinary area, which was new to most learners. CMAs were the first assessment tasks that learners encountered on this course, and in line with Meer and Chapman's (2014) low-stakes approach to assessment design, were introduced early in the course and were relatively straightforward and accounted for a very small proportion of marks for the course. For example, CMA 01 accounted for only 2% of the overall grade for the course. The interviewees found CMA 01 to be a useful method for checking their understanding of the learning material and building confidence without the risk of failing.

> "… You get these little puzzles and you keep looking through them, you keep working through them, I think they're very positive … revision wise to go back to make sure that you're on track on learning at each stage … And they don't count so much to the end of marks, do they? But what it's very good at is the little small building blocks so the little small problems that it's asking you it makes you think. And I think they're quite challenging and I had to put a lot of work in to get good results. And I think they make you more secure when you're going to do a bigger project." (Respondent A)

The diversity of learners studying on an introductory open-access course was also reflected in the different approaches to studying, such as the strategies of organizing time and study environment, and their preferences in the forms of assessment. The fact that CMAs

were designed in the form of online quizzes helped to achieve more variety in presentation of the content than relying solely on text format, be it in the form of a printed textbook or the website material. The interview accounts echoed concerns in higher education research (e.g., Gibbs, 2006; Rust, 2004), suggesting that traditional forms of assessment only test a narrow range of skills and so introducing a variety of assessment methods can help to foster student motivation and interest.

> "So yes, the CMAs were kind of light relief ... Because you know you've got to test yourself. You don't know if you're just reading, and it's just some words on a page. So, it was a nicer way to be tested. You could almost have more of them, I don't know how other people think, but you could almost have more of them (CMAs) […] A CMA … it's like a pop quiz, isn't it?" (Respondent B)

One aspect of fostering student engagement involves creating instructional activities that trigger situational interest. Situational interest can be described as an "an emotional state aroused by specific features of an activity or a task" (Eccles & Wigfield, 2002, 14), which is essential to learners forming an intrinsic desire to engage in a subject matter. Some of the respondents in this study used emotional language and reported heighted emotional states during completion of CMAs, thus showing how triggering their interest in the task created opportunities for a closer engagement with learning.

> *"You know, if there were more formative learning opportunities which were computer based, I think I'd enjoy that even more, you know … If there was a little computer quiz as well, that might be quite good fun. Doing the ICMAs, it was all right, I found it quite enjoyable, and it's nice to be challenged from time to time, rather than just sitting looking at a screen."* (Respondent C)

DISCUSSION AND IMPLICATIONS

Limitations

The limitations of this study derive both from its approach to research design and from the nature of the interview sample. Although a mix of methods was envisioned as an appropriate approach to research design, a true blend of quantitative and qualitative methods was difficult to achieve since assessment results were released towards the end of the course, thus selecting a sample that was truly representative of the student population was challenging. Reliance on volunteer participation led to a sample of 15 interview respondents, where some demographic groups were overrepresented, such as female, older students and students with higher CMA scores. Due to their higher CMA scores, the interview participants might have held more positive views of their learning experience compared to other students, and this might have influenced their perceptions of CMA use.

Implications for Research on Assessment in Online Open-Access Contexts

This exploratory study considers the implications of innovation at a distance-learning university in the UK by examining online computer-marked tests on an online undergraduate Level 2 Financial Accounting course. Drawing on the analysis of qualitative and quantitative data, the study offers new insights into learner experiences and approaches to designing online CMAs in accounting education, especially in contexts where the focus is on independent study and where there are few barriers to entry. The results are of relevance in the light of wide proliferation of MOOCs, which today attract millions of learners from virtually every corner of the globe. MOOCs follow a similar approach to course design to the one considered in this study, that is learners are offered a reasonably open-access route to

entry, assume a large degree of independence in learning and may use online test facilities to obtain feedback on their progress. Although evaluation of student learning remains one of the key challenges in the design of MOOCs (Hew & Cheung, 2014), online formative tests remain a salient feature of different types of open online courses (Hayes, 2015) and contribute a significant proportion of marks to the final grade.

We observe that CMA performance is strongly related to the successful completion of the course and academic achievement in other assessment tasks, which confirmed the findings of previous studies that established links between completing online computer-marked tests and the results of final assessment (Baxter & Thibodeau, 2011; Einig, 2013; Gaffney et al., 2015; Phillips & Johnson, 2011; Potter & Johnston, 2006). In agreement with Byrne and Flood (2009) and Guney (2009), a higher level of previous educational qualifications and age are associated with better scores on all types of assessment, including CMAs. In addition, the findings of this study underscore the importance of previous study experience in a similar subject area (in this case through completing a bookkeeping course), which in this instance was linked student performance on CMAs to a greater degree than previous studies in a quantitative discipline or previous study at the same level.

A closer analysis of student scores by individual CMA shows that patterns of relationships between scores on other assessment tasks (such as the IMAs) and demographic characteristics of student and their CMAs are slightly different for a less challenging CMA01 compared to a more complex CMA02 or CMA03. In fact, student scores on CMA 03 were one of the best predictors of successful completion of the final examination; thus, showing the importance of more challenging CMA tasks for preparing students for the final examination. In agreement with studies in other disciplines (e.g., Angus & Watson, 2009), a lack of student engagement with CMAs was indicative of negative trends in student engagement, as no student who missed all three CMAs, sat the final examination. Thus, for

online courses that follow an open-access admissions policy, CMA completion can be used as the screening tool to identify learners who fail to engage early in their studies, and thus are at risk of dropping out. As online courses, including MOOCs, have traditionally been associated with high attrition rates (Kember, 1989; Woodley, 2004), incorporating elements of online formative testing early in the course can be one of the key attributes of course design.

The findings of the qualitative data analysis render further support for introducing CMAs early in the course, and they shed more light on the nature of these early online assessment tasks. As many of the studied learners were new to higher education study and its requirements, one of the students during the interview raised the theme of the "low-stakes" (Meer & Chapman, 2014, 186) nature of early assessment tasks. As the first CMA accounted for 2% of the total grade, online learners were able take it without the risk of losing a high proportion of marks, which helped to build their confidence and check their understanding of the learning material. The interview data also brings two other aspects of assessment design to the fore, which were also viewed by students as being key to their engagement with online CMAs, such as diversifying assessment tasks and generating situational interest. On the one hand, as most of the assessment tasks on the course were comprised of preparation, analysis of financial statements and writing essays, online testing helped to introduce variety to the assessment. On the other hand, in line with de Barba et al.'s (2016) conclusion on the salience of MOOCs, the study highlights the importance of the affective dimensions of online learning, particularly in contexts where learners assume a high degree of independence and where the degree of personal interaction with instructors and other students is limited. Thus, the design of online open-access courses in Accounting in the future could consider both integrating elements of "assessment for confidence" (Meer & Chapman, 2014, 186) and interventions aiming to generate situational interest.

Conclusions and Areas of Further Research

To sum up, this study presents evidence of an innovative use of computer-marked tests on an online open-access course in Financial Accounting. The course was enriched by relatively small, frequent online tests that were introduced in the first few weeks and increased in difficulty as students progressed through their studies. Further research in the field of accounting education might focus on exploring relationships between CMA completion and student learning beyond their demographic characteristics and self-reported data on motivations. For example, further studies could usefully explore links between student metacognitive skills in relation to time management and CMA performance in purely online learning settings. More comparative research with other academic disciplines, both in the wider field of business and management and in other fields, might help to elucidate the impact of the disciplinary effects on the student experience of online testing and the challenges that accounting education students face. In addition, designing interventions, where CMAs are used for screening and identifying student groups who do not engage early in their distance learning studies, with a view to providing more individualized support for these groups might be plausible. As this study mostly relied on the analysis of secondary data on student performance and primary data of self-report interviews, further studies might aim to employ multiple data sources, including learning analytics data that is widely available through virtual learning environments today.

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TABLES AND FIGURES

Table 1. Demographic characteristics of student population.

Demographic characteristics	Presentations	
	Spring	Autumn
Total number	607	520
Gender (%)		
• Male	61.0	62.5
• Female	39.0	37.5
New to continuing (%)	79.1/20.9	79.6/20.4
Age group (%)		
• Up to 25	19.3	21.7
• 26-29	25.0	20.4
• 30-39	27.5	27.7
• 40-49	19.4	22.9
• Over 50	8.5	7.3
Motivations (%)		
• Employment/ career and personal development	54.2	45.6
• Mostly employment	29.0	26.3
• Mostly personal development	10.2	11.5
• Missing/ no information	6.6	16.5
Highest previous qualifications (%)		
• No information	35.1	28.5
• A-levels or equivalent	37.1	42.7
• HE qualification	22.9	24.8
• Postgraduate qualification	4.9	4.0
Ethnic group (%)		
• White	86.5	84.2
• Black	6.1	5.6
• Asian	4.8	5.6
• Mixed	1.3	2.1
• Other or no info	1.4	2.5
Students previously completing (%)		
• Introductory bookkeeping course	37.4	33.1
• Math course	12.2	15.4
• Level 2 course	19.8	28.1

Table 2. MANOVA results on group differences on CMA scores.

Demographic group	Pillai's trace (V)	F	d.f.
Gender	.015	2.77*	3, 542
New or continuing	.007	1.26	3, 542
Age group	.060	3.19**	12, 1884
Motivation	.007	0.67	6, 1086
Highest previous education	.058	4.13**	9, 1887
Ethnic group	.054	10.29**	3, 542
Completed introductory bookkeeping course	.04	8.6**	3, 629
Completed a math course	.011	2.05	3, 542
Completed a level 2 course	.002	0.21	3, 542

* $p < .05$

* $p < .001$

Table 3. CMA completion by group**.**

	Were all three CMA completed? (%)		d.f.	Pearson's χ^2
	Yes	No		
Gender			1	.364
• Male	57.9	42.1		
• Female	55.1	44.9		
New or continuing			1	8.68*
• New	47.6	52.4		
• Continuing	58.4	41.6		
Age group			4	11.42*
• Up to 25	48.3	51.7		
• 26-29	56.6	43.4		
• 30-39	55.6	44.4		
• 40-49	63.7	36.3		
• Over 50	57.1	42.9		
Motivations			2	.358
• Employment/ career and personal development	58.0	42.0		
• Mostly employment/career	53.4	46.6		
• Mostly personal development	59.0	41.0		
Highest qualifications			3	34.52**
• No information	44.0	56.0		
• A-levels or equivalent	59.7	41.3		
• HE qualification	63.8	36.2		
• Postgraduate qualification	70.6	29.4		
Ethnic group			2	5.14*
• White UK	57.6	42.4		
• Other	47.6	52.4		
Students previously completing				
• Introductory bookkeeping course (yes/no)	67.9/ 49.7	32.1/50.3	1	34.66**
• Math course (yes/no)	64.9/54.8	35.1/45.2	1	5.57*
• Level 2 course(yes/no)	68.4/52.4	31.6/47.6	1	21.24**

Table 4. Difference in mean scores between those completing all CMAs and those not.

Other assessment	Increase in average % score when completing all CMAs	t	d.f.
IMA01	16.0	13.4*	542, 2^
IMA02	17.3	7.4*	130, 0^
Examination	7.6	3.3**	835

* $p < .001$
** $p = .001$
^Equality of variances not assumed for these tests – Levene's test was significant

Table 5. Correlations between key assessment tasks*.

	CMA01	CMA02	CMA03	IMA01	IMA02
CMA01					
CMA02	.470				
CMA03	.417	.641			
IMA01	.480	.600	.642		
IMA02	.409	.575	.667	.642	
Examination	.400	.553	.587	.559	.643

* All 15 pairs of correlations are significant at the .001 level. Pearson's r is used. Correlations are calculated pairwise.

Table 6. Interview sample characteristics in comparison to cohort results.

		Interview Sample	Proportion of population
Gender (%)	Male	13	38.3
	Female	87	61.7
Age group (%)	< 25	26.7	20.4
	25-29	6.7	22.9
	30-39	13.3	27.6
	40-49	33.3	21.0
	50 <	20.0	8.1
Ethnicity (%)	White	93.4	85.4
	Black	6.6	5.9
Educational qualifications (%)	2 A-levels or less	20.0	32.0
	3 A-levels or more	46.7	39.7
	HE qualification	20.0	23.8
	Postgraduate qualification	14.3	4.5
Motivation (%)	Main personal	0	10.8
	Mainly employment or career	28.6	27.8
	Both personal and employment important	71.4	50.2
Mean IMA score		67.4	66.7
Mean CMA score		80.3	72.00
Introductory bookkeeping course (%)	Yes/ no	60/ 40	35.4/ 64.6

Figure 1. Nicol and MacFarlane-Dick's principles of good feedback practice.

Good feedback practice:

1. helps clarify what good performance is (goals, criteria, expected standards);

2. facilitates the development of self-assessment (reflection) in learning;

3. delivers high quality information to students about their learning;

4. encourages teacher and peer dialogue around learning;

5. encourages positive motivational beliefs and self-esteem;

6. provides opportunities to close the gap between current and desired performance;

7. provides information to teachers that can be used to help shape the teaching.