

Engaging large cohorts of students in online formative assessment to reinforce essential learning for summative assessment.

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Abstract

Assessing large numbers of students is a challenging prospect for educators; they must identify suitable assessment methods to establish that students have achieved the desired learning outcomes, but must also meet tight deadlines for marking, moderating and submitting results. In view of this we developed a new assessment strategy with the aim of replacing a paper-based quiz with online formative and summative quizzes. The rationale for introducing these quizzes is outlined together with a description of the planning, development and implementation process. The advantages of this innovation are discussed in light of relevant literature. The changes made allow a more flexible, student centred approach that fosters student engagement, reinforces essential learning, eliminates errors in marking, and reduces the resources and time required to run the assessment. This strategy to use online quizzes with structured for both formative and summative assessment is pedagogically sound and offers many benefits that stimulate learning and student engagement.

Keywords: feedback, formative assessment, online quizzes, student engagement, summative assessment.

1. Introduction.

A common feature of modern university life is ever-increasing class sizes. While this increase in student numbers, and the accompanying tuition fees, undoubtedly benefits the broad mission of the university, it also creates challenges for students and lecturers alike. For the student, large class sizes can limit student-lecturer and student-student interaction, internal

motivation to learn and classroom engagement. This may lead to feelings of isolation and insecurity, which in turn can negatively affect learning outcomes, grades and student progression (Cuseo 2007; Leufer 2007; Hornsby & Osman 2014; Prosser & Trigwell, 2014; Snowball 2014).

For lecturers, large class sizes may impact the quality and quantity of curriculum coverage (Maringe & Sing, 2014; Giannakis & Bullivant, 2016), impede pedagogical approach (Prosser and Trigwell. 2014; Snowball 2014), decrease insight into students' understanding of material (Arvanitakaitis, 2014), and affect the assessment methodology (Snowball, 2014). Indeed, setting and correcting assessments for large cohorts is a challenging prospect for educators, particularly in relation to the quality and content of feedback (Y1 Feedback 2016) which may lead to increased pressure and stress (Allan et al. 2013; Snowball 2014).

Despite the potential negative effect of large class sizes, it appears that this is a feature of modern university life that is here to stay (Arvanitakaitis, 2014; Horsby & Osman 2014). It is therefore incumbent on educators to reconceive their approach to teaching, learning, assessment and feedback. A potential solution may be the use of educational technology.

1.1. Background.

While there is no one accepted definition of 'large class' (Maringe & Sing 2014), it is generally accepted that classes of over 150 students are considered 'very large' (Mateo & Fernandez, 1996). One programme in our university that consistently attracts large class sizes is our undergraduate nursing degree programme. This BSc (Honours) in Nursing programme has an annual intake of 232 students across the four distinct pathways of General Nursing, Mental Health Nursing, Intellectual Disability Nursing, and the General and Children's Nursing programmes. These degree programmes consist of a combination of academic study, simulated clinical practice in the university, and clinical placement in partner healthcare settings. In first year students from all pathways undertake a common module that provides the foundation on which their nursing practice is built. This module prepares students for their initial clinical placements, thus providing them with the foundation on which they will develop their psychomotor nursing competencies over the following years of training. As such this is a high stakes module.

Traditionally, part of this module was assessed using a paper-based quiz which accounted for 20% of the overall module marks. Each student was required to complete two 10-item

questionnaires; one on drug calculations, the other on manual handling. The students were split into groups of 20-25 with each group being allocated a specific date and time to attend for assessment. There were many problems and challenges with this assessment which will be discussed later. These problems prompted us to review alternative options and ultimately develop a novel online assessment strategy by replacing part of the existing paper-based assessment with an online assessment. This innovation was first implemented during the 2013-2014 academic year with a cohort of 217 students.

2. Methodology.

Our concerns with the existing method of assessment prompted us to seek an alternative method to assess this aspect of the module. This was a challenge as the large numbers of students to be assessed within a limited timeframe restricted the options available. Furthermore, we had to ensure that the method used was appropriate for the module content and that it established that the students had achieved the required learning outcomes.

Having reviewed the options available we decided that an online quiz was appropriate. This new approach simply transferred the quizzes to an online environment which allowed us to take advantage of several features available in the university Learning Management System (LMS) to expand the range of topics assessed and how the assessment was administered.

- a. We were able to introduce formative assessments which were not previously an option.
- b. We could assess aspects of all of the topics covered in the module which was not feasible with the paper-based format.
- c. It also allowed us to double the marks allocated for the quiz in keeping with the increased number of questions being asked.

These changes allowed a more flexible, student-centred approach that was more efficient for educators and fostered student engagement and learning.

Having identified an appropriate assessment methodology, we then devised an implementation timeline. The semester was 12 weeks long, starting at the end of September and finishing just before Christmas (Table 1).

Before Semester started	Reviewed the module content and learning outcomes. Identified areas appropriate to assessment using an online quiz. Started creating a bank of online quiz questions.
Week 1	Gave students a brief overview of the assessment format during the orientation to the module. Explained that more detailed information would be provided in week 4 when they had completed some module content and were more familiar with the university LMS
Week 4	Gave detailed information about the assessment. Opened a trial quiz with general knowledge questions to allow students to familiarise themselves with online quizzes.
Weeks 4 - 10	Started opening online formative quizzes on a phased basis.
Week 10	All formative quizzes opened.
Week 11	Mock exam opened for two days.
Week 12	Online summative quiz opened for 12 hours on the second last day of semester. Results and feedback available immediately on closure of the quiz.

Table 1: Timeline

Having reviewed the module content and learning outcomes, we devised over 200 questions. These were aligned to the learning outcomes of the module and focussed on the 'need to know' content of the course, for example 'What is the ratio of compressions to breaths in adult cardiopulmonary resuscitation (CPR)?' Devising questions and constructing the quizzes on the LMS was time consuming but this was a once-off time investment as the quizzes now carry forward each year, and only the opening and closing dates need to be changed. The questions are reviewed each year to ensure that they still reflect current best practice. For

example, updated CPR guidelines are published by the American Heart Association (AHA) every five years. The original bank of questions on this topic was based on the 2010 guidelines (AHA, 2010) so these were checked to ensure that they were still pertinent to the 2015 guidelines (AHA, 2015).

As we completed delivery of each topic in the module, a related online formative assessment quiz was made available to students. There was no time limit on these formative assessments; this allowed students time to look up answers they were unsure of as they completed the quizzes. When students submitted each formative assessment it was automatically graded online and they received immediate feedback telling them which answers were correct and incorrect. They were not given the answers to incorrect questions in order to stimulate self-direction and a sense of autonomy and shared responsibility for learning. Once a quiz was opened students could access it for the rest of the semester and could do it as often as they wished. The week before the summative assessment a 'mock' exam was made available to allow students to become familiar with the format of the summative assessment. It also guided us as to the appropriate time limit for the summative assessment, 40 minutes being determined as a time limit that was challenging but achievable, and reflective of students' retention of essential information.

On the second last day of semester students completed the summative assessment. They answered questions that totalled 40 marks; these questions were randomly selected from the bank of questions used in the formative assessments. They could undertake their assessment at any time from any location between the hours of 8am and 8pm. If students did not complete the quiz within the time allowed their attempt was automatically submitted. They were allowed two attempts at the exam and their best score was counted. The questions were randomly chosen for both attempts so they could get completely different questions on their second attempt. Once the quiz closed at 8pm it was automatically graded online and immediate feedback given which included the mark and correct answer for each question.

2.1 Assessment challenges addressed.

There were a number of challenges with the old paper-based assessment that were resolved with the implementation of the online assessment.

- Once the first group of students had completed their paper-based assessment they told later students what was on the paper. This gave the second and subsequent

groups of students an advantage. This issue was eliminated with the new assessment method as all students had access to all of the questions during the formative assessments. If they had attempted all of the quizzes, then they already knew all of the questions that could come up in their exam.

- We were restricted in the topics that could be examined with the original format. The potential volume of work did not permit the delivery of large quiz-based exams in terms of accommodating students to sit them, and the subsequent marking, collating and entering of results within the timeframes required. With the online format we were no longer restricted to assessing two topics and were able to develop a question bank that covered every topic in the module.
- The paper-based quizzes were marked manually so feedback was not immediately available. Students could make an appointment with the module coordinator to receive feedback but very few did. This meant that a valuable learning opportunity was missed and, more importantly, mistakes and errors were not corrected. In contrast feedback was given immediately on submission of formative assessments and immediately after the exam closed for the summative assessment. Students did not have to make an appointment to receive feedback and as a result enjoyed the benefits of timely, actionable feedback.
- The paper-based quizzes offered no flexibility for students. They had just one opportunity to do the quiz at a specific time on a specific date. The online summative assessment offers much more flexibility to students. They no longer have to be available at a specific date and time. They can attempt the quiz at any time in a 12-hour period from any location that suits them on the appointed day. Furthermore, they have two attempts at the assessment so are not relying on a single performance to demonstrate their knowledge.
- It was the norm to have 7 – 10 days to assess, correct, and submit results which was a very tight deadline for such a large group. As the online quizzes were automatically marked on submission and the results uploaded to the students' gradebook this tight deadline was no longer a concern.
- It was very time consuming to photocopy quiz papers, to manually mark over 4000 questions, and to collate and enter the results on the computer. The online format eliminated all of this.

- Manual marking of paper-based quizzes left the potential for errors both in marking the papers and subsequently uploading the results to the computer system. Automated marking of online quizzes eliminated this risk.
- Large quantities of paper were needed for the paper-based method which was environmentally unfriendly but also led to issues in relation to storage and retrieval of papers. No paper is used for the online assessments so stationary requirements are eliminated making it more environmentally friendly. Results are kept online which means there are no issues with the storage and retrieval of papers.

In addition to addressing the problems identified with paper-based assessments, the online assessments offer many advantages and benefits. These will now be discussed in light of relevant literature which suggests that our strategy to use online quizzes with structured questions for both formative and summative assessment is pedagogically sound and offers many benefits including increased efficiency, reliability and accuracy, and timely feedback that stimulates learning.

3. Discussion.

3.1 Questions / Multiple Choice Questions (MCQs).

The vast majority of questions in the online quiz were MCQs. These are difficult to construct (Piontek 2008; Simbak et al. 2014; Pugh et al. 2016) however, there is plenty of guidance available on how to develop and write effective MCQs (Braddom 1997; Jennings 2012). Where MCQs were unsuitable, structured questions such as true-false, matching, and cloze questions were used. These types of questions can provide a focused assessment of students' knowledge (Morrison & Walsh-Free 2001; Piontek 2008). It is argued that MCQ type questions foster surface learning rather than in depth processing of ideas (Maringe & Sing 2014). However, well-written, skillfully designed questions can enhance learning (JISC,2010) and contribute to higher-order thinking including comprehension, application, and analysis (Morrison & Walsh-Free 2001; Kominski 2012).

Begum (2012) argues that MCQs “*inhibit students from expressing creativity or demonstrating original thinking*” (p. 159). However, much of the content of this module is ‘need to know’ factual information. As such the online quiz with structured questions is an appropriate assessment method for the module content and learning outcomes (Burton et al., 1991; Kominski, 2012). Once students know and understand this material they can then go on to construct higher level knowledge facilitated by their lecturers. For example, the principles of infection control are facts that are not open to interpretation or discussion. Students learn these in first year and must know and understand them. As they progress through their training they will be required to demonstrate their knowledge and understanding of the principles of infection control by applying them in different situations. For this reason, online quizzes are an attractive and appropriate option for this large cohort of first year student nurses learning the essential basics of nursing.

3.2 Formative Assessment.

Prior to the implementation of this initiative, all assessment in this module was summative. Summative assessment is also known as assessment ‘of’ learning and its main purpose is to grade and certify the student’s level of achievement after a designated period of learning (McNulty et al., 2015; National Forum for the Enhancement of Teaching and Learning in Higher Education (NFETL) 2017a).

The [UK] Quality Assurance Agency for Higher Education (2007) state that assessment ‘for’ learning, or formative assessment, is also important to support students and help them advance their learning. The objective of formative assessment is to enhance learning by helping students to identify the gap between what they do know and what they need to know (Black & William, 1998a; Sadler, 1998). As such, formative assessments offer many benefits to both students and educators. These include the identification of errors and ambiguities in questions, monitoring student’s progress towards the achievement of module learning outcomes, the early identification of students that may be encountering problems, and fostering student engagement. Indeed NFETL (2017b) argues that assessment for learning is particularly important in first year, to “*ensure students begin to develop their self-monitoring and self-regulating skills*” (pg. 2).

The transition to online quizzes allowed us to make formative assessments available to students. This was not possible with the previous paper-based format due to the volume of work it would have created; if each student did each quiz only once it would have meant in

excess of 43,000 questions to be marked with results to be fed back to students. If students did quizzes more than once the demands on educators would increase exponentially. Time and resources simply did not permit this. However, the automated marking and feedback offered by the LMS revolutionised this aspect of the module.

It is widely acknowledged that assessment drives learning (McCoubrie, 2004). The questions in the summative assessment are randomly selected from the questions in the formative assessments so students know in advance all of the questions that might be asked in the exam. It is in their interest to complete the formative assessments so they can learn the course content to achieve a high mark. This directs and drives their learning encouraging and motivating them to learn the 'need to know' content of the module. As such, this combination of formative and summative assessment fosters student engagement and 'drives' students to learn the essential basics of nursing.

The quiz questions are aligned to the learning outcomes of the module; they serve to measure the degree to which students are achieving these learning outcomes which in turn allows early intervention by educators to guide and direct areas of study. The formative assessments allow verification and correction of students understanding of what is being asked. They also allow identification of errors and ambiguities in the questions prior to them being used in the high stakes summative assessment (McNulty et al., 2015). Monitoring the results of formative assessments allows evaluation of student progress and facilitates the identification of students who may be struggling thus allowing early intervention (Azzi et al., 2015; Zhang & Henderson, 2015; Kiersey et al., 2018)

The formative assessments also facilitate self-directed learning by helping students to identify their own strengths and weaknesses (Black & William 1998b; Krasne et al. 2006, Sullivan, 2016), monitor improvements in their own learning (Sadler, 1989; Leaf et al., 2009), identify areas where further study is required (McDaniel et al., 2012; Boud & Molloy, 2013; McNulty, 2015) and achieve a deeper understanding of subject matter (Sullivan 2016). This empowerment can stimulate students to take control of, and responsibility for, their own learning (Mitra & Barua, 2015). This is supported by Ramsaran-Fowdar et al. (2011) who suggest that regular online quizzes motivate students to participate in regular study, whilst Logan et al. (2011) believe that repeated knowledge tests enhance retention of material to be learned.

There is evidence to suggest that online formative assessment enhances summative

assessment results (Bouwmeester et al., 2013). Both Kibble (2011) and Wilson et al. (2011) found that students who engaged with formative quizzes scored better than those who didn't; in Kibble's (2011) study the average difference was 13% whilst in Wilson et al.'s (2011) Canadian study the average improvement was equivalent to three letter grades. McDaniel et al. (2012) using a strategy similar to ours found that "*quizzes with questions identical to those on the exam can provide robust gains on unit exams relative to reading or studying the content*" (p. 23).

Regardless of the benefits of participation in voluntary formative assessments, there is evidence that some students decide not to complete them (Olson & McDonald, 2004; Johnson, 2006; Kibble, 2007; Carrillo-de-la-Pena et al., 2009). Research suggests that these students are at risk of poor academic performance (Kibble, 2011). Therefore, monitoring participation in formative assessments could help identify students to be targeted for intervention (Angus & Watson, 2009).

3.3 Feedback.

Feedback helps students close the gap between what they do know and what they should know (Nicol & MacFarlane-Dick, 2006; Leflay & Groves, 2013; NFETL .2017a) and as such, is an essential element of formative assessment (Sadler, 1989; Rushton, 2005) The importance of timely, understandable, actionable feedback is repeatedly acknowledged in educational literature (Gaytan, 2005; Gaytan & McEwen, 2007; Nicol, 2007a; Bunmie et al., 2014; NFETL, 2017a). Indeed 81% of respondents in the Y1 Feedback (2016) agreed that timely feedback is valued by learners. It is recommended that corrective feedback should be given as close as possible to the assessment (Hattie & Timperely, 2007).

Formative assessments with immediate feedback are valuable to students because they enhance self-insight, relative performance indication, the correction of misconceptions, and direction towards areas for improvement (De Kleijn et al., 2013; Snowball, 2014; Lull & Mathews, 2016; Carroll et al., 2016; NFETL, 2016; Mahon et al., 2018). In the online formative assessments in this module the quizzes are marked and feedback is given immediately on submission of each attempt. Students are told which answers are correct and incorrect but are not given the answers to incorrect questions; they have to ascertain this information themselves. This can engage students and stimulate learning by highlighting knowledge gaps, by helping students to identify their learning needs, and by empowering them to become independent, autonomous, self-regulated learners who take responsibility for their own

learning (Buchanan, 2000; O'Neill & McMahon, 2005; Nicol, 2007a; Carless et al., 2011; NFETL, 2017a). Indeed, Boud and Molloy (2013) argue that it is what the students do with feedback, rather than how the teacher provides it, which is crucial. Immediate feedback that can be repeatedly and easily accessed (Carless & Boud, 2018) is more beneficial to students than delayed, once-off feedback, as was the case with our traditional approach to assessment.

3.4 Flexibility.

Our online formative assessments provide an “*anytime, anywhere*” (Higher Education Funding Council for England 2010, p. 4) learning experience whereby students can choose to complete the quizzes at their own pace and in their own place (Peat et al, 2005; Angus & Watson, 2009; Ramsaran-Fowdar et al., 2011; Snowball, 2014; Lull & Mathews, 2016). Such an approach also offers an additional degree of psychological safety and fosters a private, non-threatening learning environment where errors are permitted and can be learnt from (Scott & MacLean, 2008; Velan et al., 2008). There is no restriction on how often students attempt the quizzes or how long they spend doing them, further enhancing the student experience and engagement (Butler et al., 2008). Indeed, authors such as Evans and Culp (2015) and Fisher and Hageman (2016, p. 1) argue that this type of “*distributed practice*” is superior to “*cramming*” as it facilitates mastery of the subject matter by allowing students time to reflect on what they are learning and to correct mistakes and misperceptions. This results in them accumulating the information required to successfully answer specific quiz questions which is rewarded with a better score. Having the flexibility to do these formative assessments at any time from any location and receive instant feedback is of huge advantage to learners (Peat et al., 2005; Balter et al., 2013).

3.5 Efficiency and effectiveness.

Online assessments offer increased efficiency and effectiveness over paper based alternatives (NFETL, 2018). They are easily administered and reduce assessment workload by eliminating the need for educators to mark, report and analyze results, and deliver feedback (Nicol, 2007b; Piontek, 2008; Snowball, 2014; Kiersey et al., 2018). This frees up time which can be dedicated to other educational activities (McDanie et al., 2012). The variety of question formats used permit reliable objective testing of large numbers of students on a large amount of the course content with minimal input required from educators (Merrel et al.,

2015; Pugh et al., 2016). The automated grading of the assessments and provision of feedback reduces workload and eliminates the risk of errors both marking papers and recording results (Burton et al., 1991; Snowball, 2014; Varble, 2014; NFETL, 2018). The reduction in human and material resource requirements means that the online quizzes also contribute to reducing administrative costs (Angus & Watson, 2009; McDaniel et al., 2012; Varble, 2014).

3.6 Security and cheating.

Concern has been expressed about security and cheating in online exams (Crisp, 2011; Kominski 2012) particularly in relation to verifying the identity of the students undertaking summative exams (Lilley et al., 2016) It has been suggested that asynchronous, online exams have “*immense potential for cheating*” (Sullivan, 2016; pg. 204). Potential solutions include remote live invigilation, use of biometrics, computer testing centres in the university, and making cheating impractical (Ladyshevsky, 2015; Lilley et al., 2016; Sullivan, 2016; NFETL, 2018).

The use of remote live invigilation and biometrics are however costly, difficult to implement, and may present data protection issues (Lilley et al., 2016; Sullivan, 2016). In addition, the benefits have not been proven and such technology would have to be decided at institutional level. Setting up computer testing centres may be costly and requires availability of an invigilator. Furthermore, it is not an enabling process as it requires students to travel to the centre on a specific date and time and prevents them using their own devices thus negating much of the convenience of our online assessment format (Ladyshevsky, 2015; NFETL, 2018)

However, making cheating impractical (Sullivan, 2016) is within our scope and we have taken steps to do this including randomizing questions, regulating the duration of the test, shuffling questions and answers, using a question bank to generate a different exam for each student so that no two students receive the same set of questions in the same sequence, using a variety of question formats, and allowing multiple attempts with the best score counting (Sullivan, 2016). In addition, the formative assessments allow students to confirm their knowledge level and identify areas for improvement thus reducing anxiety which is often a trigger for cheating (Sullivan, 2016). Some writers suggest that it can also be effective to remind students at the start of the exam about the institutional guidelines and regulations in relation to academic integrity and the consequences of cheating (Varble, 2014; Ladyshevsky,

2015; Sullivan, 2016).

Cheaters will always find a way to cheat (Dillé, 2011) and as such, this is a concern that is not solely associated with online assessment but with all types of assessment (Lilley et al., 2016). Indeed, Ladyshevsky (2015) asserts that concerns expressed about cheating in online exams are not supported.

4. Reflections on implementation.

The development and implementation of this project was challenging as much of the work was time-sensitive and front-loaded. We had a tight window in which to populate the question bank and set up quizzes that ascertained that essential learning was achieved and learning outcomes were met. In addition, this aspect of the LMS was new to us so we had to embrace the technology and embark on a steep learning curve. However, we met these challenges and this online assessment is now firmly embedded in the module and runs smoothly every year. The 'roll-over' from year to year requires minimal updating mainly focussing on opening and closing dates for quizzes. The nature of the questions means that whilst they are reviewed each year very few changes or updates are needed. The analytics available in the LMS have allowed us to examine the facility and discriminative indices and adjust questions accordingly bearing in mind that a large number of correct responses is not necessarily a problem when addressing need-to-know information that is core to safe nursing practice (Ladyshevsky, 2015).

4.1. Plans for the future.

The online formative and summative assessments have been used in this module for the last five academic years. They are now well and truly embedded in the module and roll out seamlessly year on year. We are now looking at further developments including:

- a. The introduction of a 'Progress Bar'; this is a feature on the LMS that allows students to see how they are progressing. It can also be programmed to allow students see how they compare to other students.
- b. We are considering opening the quizzes to students from the start of the academic year before the topics are delivered in class. Assessment of students' prior knowledge

could stimulate learning by alerting them to information they don't know and need to pay attention to. It would also allow us to monitor the effectiveness of teaching; a downward or static trend could suggest that students were not learning in class and a review of teaching methods would be indicated.

- c. We now have a rich bank of data gathered over the last five years which we plan to analyse from a number of perspectives particularly with a view to examining the effect of student engagement with formative assessments on summative results.

4.2 Conclusion

We have outlined and discussed the planning, development and implementation of an online assessment strategy that is pedagogically sound. This development was prompted by the difficulties we faced assessing large cohorts of students and turning in results in a limited period of time. The original assessment method was described, and the difficulties experienced with it discussed. The new online assessment method addressed all of the problems identified and gave additional benefits. This online assessment is appropriate to the module content and is closely aligned to the module learning outcomes. The combination of formative assessments, flexibility in submission of summative assessments, and prompt feedback ensure a student-centred approach that encourages autonomous learning and helps students engage with the module and acquire the knowledge to succeed. The benefits to staff of increased flexibility, reduced workload and more efficient use of time are a welcome bonus.

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5. References

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