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The role of technology in formative assessment with large classes

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Abstract

While the benefits and importance of formative assessment are well known, it can be challenging to incorporate formative assessment in large class teaching. This paper outlines how technology can be used to provide engaging, beneficial formative assessment for two cohorts of computer science students (n=138; 170). It provides an overview of the role of self-tests for students as an integral part of learning. They provide immediate feedback to students and also to the lecturer in what areas students need extra support. They are also a useful preparation tool for students in advance of assessment that contributes to their final mark. Student engagement with the self-tests is good, once they know they are available and there are no negative consequences for low scores. The upfront effort required to develop 100 and 150 words briefly specifying the focus and aims, the key findings and the implications or conclusions drawn.

Keywords: *Educational Technology; large classes; student engagement; formative assessment; assessment; feedback*

1. Introduction

Technology in education (or EdTech) has come to mean 'electronic technology', but technology has always been used in education - from the use of chalk, through to pencils and now to electronic devices. Often the focus of the use of technology in education (edtech) has been on teaching and learning, but in recent years, there has been a growing interest in the use of technology in assessment (Ward & Costello, 2016; Ward, 2021). This is a vast topic and ranges from the use of simple in-class quizzes to get a sense of students' understanding of a topic to sophisticated software and hardware for proctoring purposes. This paper explores how edtech can be used in engaging, beneficial formative assessment for students in a large class. It looks at the challenges around formative assessment including how to encourage students to actually participate when there are no marks associated with the assessment and how to provide timely feedback to students. It outlines an example of where self-tests (formative tests not carrying any marks) have worked well for both students and lecturers and provides some recommendations on adapting this approach

2. Description of the Teaching/Learning Context

The context in this paper relates to an introductory course on computer systems for beginner level first year computer science students. The class size ranges from 130-170 annually. The students have to learn specific skills in the module including conversion between different number systems (binary, octal, hexadecimal, and decimal), Boolean logic and data representation. These skills are procedural and students should be able to master these skills and become comfortable with these elements of computer systems (Luxon-Reilly et al., 2018). The module is 100% continuous assessment and consists of student artifacts (four artifacts worth 55% in total) and three in-class assessments (one each for number systems, Boolean logic and data representation, worth 45%). The steps involved in these topics are explained in class and students work out examples in class also. They have access to self-tests on sub-topics (detailed components) of each of these topics. These self-tests are purely optional and there are no contributory marks associated with them. The self-tests allow students to check their understanding and mastery of the sub-topic. There is also a special self-test for each of the assessments, prep quiz, which mirrors the format and level of difficulty of the actual mark-bearing assessments (i.e. preparation quiz). Some of the questions are basic with right/wrong answers, but others, particularly the ones that mirror the mark-bearing assessments, are more granular in nature. Figure 1 shows an example of a self-test question. The boxes with the arrows on the right-hand side provide students with options for the question, while in the box, the students should provide the correct answer. A less granular question would simply ask for the final

answer (i.e. what the hex number is in binary) without asking for values in each step of the conversion process.

These self-tests were developed over a number of years. There is an upfront cost in the development of the self-tests. Therefore, initially, there were only a few self-tests on selected topics, but students liked the self-tests and asked for more. The self-tests now cover all the quantitative aspects of the module.

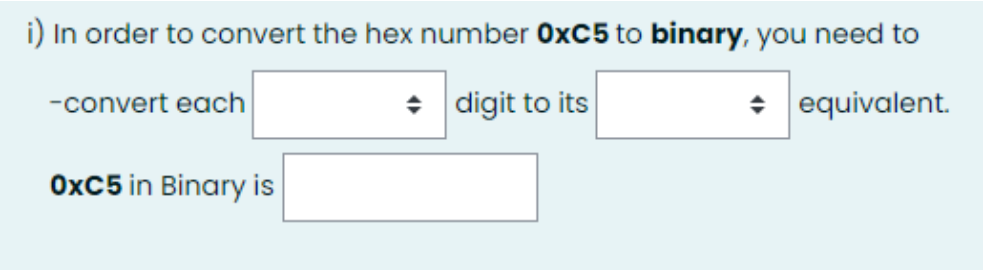

Figure 1. Screenshot of self-test question.

3. Literature Review

Assessment can make a positive contribution to student learning (Black & Wiliam 1998, 2006; Carless et al., 2006; Hattie & Timperley, 2007), although students may not often agree. If assessment is authentic, students can see a direct benefit from doing the assessment. However, this element of authenticity is sometimes lacking (Thompson et al., 2008). Sometimes the assessment and feedback is not clear, not perceived as relevant and may not be helpful for learning (Boud & Soler, 2016).

While an exact, agreed definition of formative assessment is hard to find, there are five key strategies pertaining to formative assessment (William & Thompson, 2008). These are Shared Learning Expectations, Questioning, Feedback, Self-Assessment and Peer-Assessment. Not all elements will be in every element of formative assessment and these are general, domain-independent ones. What formative assessments actually look like will vary depending on the domain and the context. Some researchers highlight feedback as one important element of formative assessment (Sadler, 1989; Juwah et al., 2004) and note that feedback should be timely (Wiggins, 2012). However, this can be difficult to do with large classes - individual, timely feedback that is helpful for learners is not easy to provide.

Another issue is student engagement - often students will not participate in optional formative assessment activities if there are no grade-bearing elements associated with them (Hornsby, 2020). Why would they do something if they are not going to get any marks for the work? Student engagement can be behavioural (participation), social (appeal) or cognitive (investment) (Fredricks et al., 2004) and it is important to take all three components into account. Positive student engagement can be beneficial for learning and availing of formative assessment opportunities can facilitate learning (Chen et al., 2021). The question is - how can students be encouraged to engage in formative assessments with no marks and how can educators provide these types of assessment, without excessive workload burdens?

4. Empirical Methodology/Data

The use of the self-tests by students in this module varies by year. In some years, the uptake is good, while in other years less so. Some of this variability can be explained by student awareness of the self-tests and the frequency of reminders about them to students.. In previous years (pre 2020), when the module had a terminal exam, students would use the self-tests before the in-class assessments and as a revision tool before the terminal exam. Now that the module is 100% continuous assessment, students will generally only use the self-tests before and leading up to a marked assessment, and the self-tests are used around 50% less. Table 1 shows the average number of self-tests per topic and the student engagement with them for 2020 (n=138) and 2021 (n=170). A '-' indicates that there was no self-test on that topic in that year. Note that some students retake the self-test several times - around 20% of students took the tests twice and approximately 2-3% took them more than twice.

5. Analysis of/Reflection on/Implications for Practice

The students actively use the self-tests, even though there are no marks associated with them. As mentioned above, there is an upfront cost in terms of the design and development of the self-tests. This was particularly true in the case of the prep quizzes, which had to mirror the actual tests and also be at the same level of difficulty. The prep quizzes are far more granular than the general self-tests and this provides students with detailed feedback on their submissions. One major advantage of the self-test and prep quizzes is that once they are developed, they can be used every year with students. The topics and sub-topics do not change, but a new cohort of students have to study and master them each year. The students use the self-tests as they find them helpful and beneficial for their learning. They are relatively easy to complete and align what is being covered in the lectures. There are no penalties and students can take the self-tests as often as they like. Some students retake the

self-test several times until they get full marks. The students also get timely feedback despite being in a large class and this is obviously beneficial for them.

There are three main recommendations to make in relation to the use of self-tests as formative assessment with large classes. Firstly, design and develop the resources gradually. This will allow modifications based on what works for students and acknowledges that time is required for self-test development. It is hard to state exactly how long it takes for each self-test - initially, a self-test may take a few hours to develop but later quizzes can be developed quicker. It is important to have a range of questions in each self-test to cater for the differing abilities in large classes. Secondly, the lecturer should review self-test usage regularly to monitor student progress and also to check if students are actually availing of the resources. It can be helpful to go through some of the self-tests in class so that students know who to do them. Thirdly, make students aware of the existence of, and the benefits of doing, the self-tests. They are an effective tool for learning, self-assessment and getting feedback on their knowledge. Technology facilitates assessment at scale and the benefits of technology for formative assessment have been realised in this module over several years.

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