CREATING CONDITIONS FOR STUDENT SUCCESS

**Social justice
perspectives from a
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USING AUDIENCE RESPONSE TECHNOLOGY TO ENHANCE THE EDUCATOR-LEARNER RELATIONSHIP

A CASE STUDY APPROACH

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INTRODUCTION

The capabilities and functionings of one human being often affect the capabilities and functionings of another human being (Nussbaum 2011). This is especially true in the educational context. Learner capabilities can be enhanced by the functionings of lecturers such as their teaching methods, but the effectiveness of these methods is in turn influenced by the participatory capabilities of the learners.

Ongoing research into improving the learning process has resulted in several new pedagogical approaches, such as active learning, to enhance the two-way relationship between educators and learners (Barnett 2006; Cutts, Kennedy, Mitchell & Draper 2004; Draper & Brown 2004; Kane 2004). The introduction of audience response technology to enhance active learning is one such approach (Caldwell 2007; DeBourgh 2008; Dori & Belcher 2005; Harper 2009; Hoffman & Goodwin 2006; Martyn, 2007; McClanahan & McClanahan 2002; Oakes & DeMaio 2013). The aim of this chapter is to examine, in five case studies, how the educator-learner relationship is influenced by the use of audience response technology.

CAPABILITIES, SOCIAL CONSTRUCTIVISM AND ACTIVE LEARNING

The capabilities approach considers the well-being of individuals and the ability of individuals to do things that will improve their quality of life. This approach not only considers capability, but also what individuals deem important to enhance their quality of life (Nussbaum 2011; Sen 1999, 2004). This includes agency, i.e. the freedom of the individual to make choices. In his *Development as Freedom*, Amartya Sen calls the freedoms of individuals “basic building blocks” (Sen 2001:18). He argues that “capabilities can be enhanced by public policy, but also, on the other side, the direction of public policy can be influenced by the effective participatory

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capabilities by the public” (Sen 2001:18). He calls this a two-way relationship. This two-way relationship is also prevalent in education. According to Nussbaum (2011:152) the importance of education has been at the heart of the capabilities approach since its inception. On the one hand this approach values the right of the individual to education, while on the other hand it appreciates how education enables various capabilities and functionings.

In spite of the value that education can add by enabling individuals’ capabilities and functionings, traditional teaching and learning methods are often widely criticised and held responsible for learners’ inability to learn (Campbell & Monk 2015:27; Mader & Bry 2019:117; Scholten & Dubois 2017:1684). New learning approaches to improve pedagogical effectiveness, amongst other things, have focused on giving learners more agency in their own learning process (Moore, Fowler & Watson 2007:47). A number of these approaches are based on social constructivism, a theory grounded in the work of Lev Vygotsky (1896-1934) (Vygotsky 1978). This theory redefines the learning process as a social and cultural process directed by the learner, shifting the focus from the educator as the primary source of information to the learner, and posits that if learners are given more agency in their learning process, then the learners’ capability to learn is enhanced (Dignath & Büttner 2008; Sitzmann & Ely 2011; Zimmerman 2008; Zimmerman & Bandura 1994).

Numerous research studies have been conducted in order to improve teaching and learning practices, several of which focus on improving the quality of undergraduate teaching and learning (Braxton, Eimers & Bayer 1996; Chickering & Gamson 1987; Fernandez, Simo & Sallan 2009; Kuh 2001, 2003; Pascarella 2001; Zhao & Kuh 2004; Zhao, Kuh & Carini 2005). One such study, conducted in the late eighties by Chickering and Gamson, resulted in the development of the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamson 1987). This study highlighted the importance of collaboration, active learning and feedback, amongst other things, for student learning. Other studies that were conducted at the turn of the century by Kuh (2001, 2003) also identified the importance of collaboration and active learning. Active learning gives students more agency in the learning process in that it allows the learner to be actively involved in the learning process instead of being a passive recipient of knowledge (Kane 2004).

FACILITATING ACTIVE LEARNING THROUGH AUDIENCE RESPONSE TECHNOLOGY

Developments in the field of technology have opened up new possibilities for active learning and made it possible to introduce innovative pedagogical approaches such

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as MOOCs, digital storytelling, videos and animation. One such technological resource is audience response technology. Kay and LeSage (2009:235) explain audience response technology as follows: “An audience response system (ARS) allows students to respond to multiple choice questions using a remote control device. After students click in their responses, the results are instantly amalgamated and displayed in chart form. More often than not, responses are anonymous, but can be linked to specific students for evaluation purposes.”

The use of audience response technology in classroom instruction was initially made popular by Mazur, who used it as part of peer learning in physics education (Crouch & Mazur 2001:970). Since 2001, several researchers have reported on initiatives that successfully integrated audience response activities to promote active learning (Caldwell 2007; DeBourgh 2008; Dori & Belcher 2005; Harper 2009; Martyn 2007; McClanahan & McClanahan 2002; Remón, Sebastián, Romero & Arauzo 2017; Stevens, McDermott, Boland, Pawlikowska & Humphreys 2017). These studies demonstrate that the use of audience response technology can facilitate active learning, collaboration and prompt feedback.

Perhaps the most significant characteristic of this technology is its ability to provide the lecturer with instantaneous, potentially detailed analysis of the level of comprehension of students, so that the lecturer can tailor the lecture to his/her audience, in real time, and so enhance active learning in the classroom (Caldwell 2007; Duncan 2006; Smith, Annis, Kaplan & Drummond 2012; Twetten, Smith, Julius & Murphy-Boyer 2007). One of the major advantages of using audience response technology, identified by various researchers, is the identification of misconceptions held by members of an audience, i.e. the learners or students (Anderson, Healy, Kole & Bourne 2013; Barnett 2006; Lundeberg et al. 2011). Audience response technology is especially effective in identifying individual learning needs in larger groups of learners (Barnett 2006; Cutts et al. 2004; Draper & Brown 2004). During question and answer sessions, the effective use of audience response technology improves an educator’s ability to determine whether or not the majority of learners understand the material being presented, thus allowing the educator to avoid spending unnecessary time on content that is already understood. Researchers have also highlighted the benefit of using the audience response technology as part of formative assessment, finding it to be an effective teaching technique for the mastering of new material (Anderson et al. 2013; Han & Finkelstein 2013; Simelane & Skhosana 2012). Graham, Tripp, Seawright and Joeckel (2007:251) found that students preferred the use of audience response technology as part of formative assessment to summative assessment.

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In a recent review by Wood and Shirazi (2020), they found that a number of studies on the use of audience response systems in classrooms reported on increased engagement and interaction between lecturers and students. In addition, several studies observed increased student participation and interaction, especially in large classes (Wood & Shirazi 2020). Another recent review by Hussain and Wilby (2019) on the effectiveness of audience response systems in pharmacy education noted a number of studies that observed that students participated more actively in classrooms where audience response technology was employed.

Laurillard (2012:59) describes the learning process as an active process that is triggered by a personal goal. The means of acquiring this goal is within the learner's capability. The learner's conceptual understanding is formed by getting feedback from previous actions or getting feedback from someone else, which is then used to modify future actions. The three components of active learning are action, for example answering a question, getting feedback, which can take the form of discussions, and modifying actions.

Audience response technology can facilitate this process. A number of design models have been developed describing the process. This research study used technology-enhanced formative assessment (TEFA) as a lens to evaluate audience response activities (Faasen 2016). TEFA is a design model developed by Beatty and Gerace (2009), which is considered the most comprehensive model for the use of audience response technology thus far. They define the four principles of TEFA as follows:

- 1) Motivate and focus student learning with question-driven instruction;
- 2) Develop students' understanding of scientific fluency with dialogical discourse;
- 3) Inform and adjust teaching and learning decisions with formative assessment; and
- 4) Help students develop metacognitive skills and cooperate in the learning process with meta-level communication.

(Beatty & Gerace 2009:153)

The process starts with the setting of questions or problems that focus on learning. It is therefore more than just assessing previously acquired knowledge. This is called question-driven instruction. Questions are asked about content that is currently being learned. By answering the question, the learners identify any gaps in their knowledge, which motivates them to focus on the learning process in order to close this gap. Beatty and Gerace (2009:153) posit that the educator should "raise dilemmas for them to wrestle with, and challenge the limits of their context dependent knowledge". Learners then learn that knowledge enables them to solve problems, and that learning is not merely about memorising content to recall at a later stage, for example during a test or examination (Beatty & Gerace 2009:153).

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A question-driven approach encourages a learner's intrinsic motivation. By realising that they do not understand or grasp a concept, learners are motivated to participate in the learning activity in order to succeed. This is in line with the constructivist approach which states that learning starts with addressing beliefs and knowledge already in learners' minds.

The second principle requires that this knowledge be explored and articulated by means of discourse. Beatty and Gerace (2009:154) point out that dialogical discourse is therefore used to:

... clarify thought through the process of articulation and externalization; to expose students to different points of view and lines of thinking; to promote analysis and resolution of disagreements; to supply stimuli, context, and tools for individual sense-making; and to provide practice speaking the social language of science.

The third TEFA principle is formative assessment. The results of the system feedback are used to adapt teaching methods and address gaps in knowledge.

The fourth TEFA principle helps students to develop metacognitive skills with meta-level communication. Learners are informed about the pedagogical design of the instruction and about how the learning takes place. Learners are given agency in their learning process so that they can make more insightful decisions about their own learning.

In theory, giving students the freedom to participate actively and to have agency with regard to their own learning through audience response systems seems like a winning recipe. There are, however, several factors that influence the practical implementation of this technology in the educational context, as will be illustrated in a number of case studies below. This study investigated the integration of audience response systems as part of active learning at Stellenbosch University.

In spite of the obvious advantages to using this type of technology, it does pose challenges to both educators and students. Research suggests that educators may be reluctant to embrace the use of audience response technology because effective integration of this technology necessitates that they learn new skills and assume different roles in the teaching-learning situation (Beatty 2004; Burnstein & Lederman 2001).

Students too could find it difficult to adjust to changes resulting from the introduction of audience response technology. Students who are generally passive during lessons, do not like the idea of being forced to engage in class activities (Beatty 2004:7). Such students could find it difficult to adapt, especially if they cannot see the reason

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for the change. Kane (2004) points out that the success of a learning activity depends not only on the activity itself, but also on learners' perception of the activity. Hence it is important for the lecturer to explain the new method from the start.

THE EDUCATOR'S ROLE IN THE TWO-WAY PEDAGOGICAL RELATIONSHIP

In a literature review by Han (2014) on the use of audience response technology, he found that educators followed one of two approaches when introducing audience response activities. He differentiated between teacher-centred and student-centred approaches. Student-centred approaches would entail the incorporation of active learning approaches with the educator giving the learner more agency in the learning process. Teacher-centred approaches would incorporate monitoring of student attendance, for example, meaning that the educator still dominates the learning process. By monitoring student attendance, the educator forces students to attend class based on the assumption that attending class will improve a learner's ability to learn. The aim of both approaches is to improve learning, but the first approach gives learners more agency in their own learning process, while the second approach removes this agency.

Many educators see the value of moving to a student-centred or active learning approach. However, educators' willingness and ability to move from a teacher-centred approach to a student-centred approach are influenced by a number of factors. An educator's capabilities can strongly influence the successful implementation of active learning approaches. For example, if an educator introduces audience response activities as part of an active learning process, the educator needs to assume altered or new roles in the teaching-learning situation and learn new skills (Beatty 2004; Burnstein & Lederman 2001). These include technical skills, but also content and pedagogical skills. The educator needs to learn how the technology works but should also adopt current pedagogical approaches. A new pedagogical approach requires that content is presented differently from what educators are used to. Abrahamson (2006:10) found that limited subject knowledge deterred educators from attempting to incorporate audience response technology into their lessons, because this could require that they answer questions that they had not expected, and that they may not feel confident answering.

THE LEARNER'S ROLE IN THE TWO-WAY PEDAGOGICAL RELATIONSHIP

The importance of engaging learners actively in the learning process and the positive effects on the quality of learning have been well established by several research studies.

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Dori and Belcher (2005:274) established that technology-enabled active learning considerably improved student pass rates. Crimmins and Midkiff (2017:436) found that a well-structured lesson using active learning improved academic outcomes. Ada (2009:145) discovered a positive correlation between active participation in online discussion groups and the quality of cognitive skills fostered. A study by McClanahan and McClanahan (2002:95) revealed that active learning did not only contribute to students asking more questions, but also that the quality of the questions after an active learning activity improved. Activities included group discussions, reflection activities, brainstorming and debriefing sessions. Scholten and Dubois (2017:1696) found that students who actively took responsibility for their learning process and engaged in collaborative learning managed to develop higher-order learning in content as well as skills needed for the workplace.

Interpreting the positive effects of active learning through the lens of the capabilities approach highlights that active learning enables valued 'beings' and 'doings' by giving learners the freedom to participate actively in their own learning process, thereby affording them the opportunity to improve the quality of their learning. Both Sen and Nussbaum emphasise that individual choice is crucial (Nussbaum 2005). This means that when a lecturer introduces a learning activity in the educational context, the question should be: would students find this activity valuable enough to enhance their learning process, and would they therefore be motivated to participate in this activity? The same goes for the use of technology in the educational context: would students find engagement with this technology valuable enough so that they consider the engagement important enough to enhance their learning? For an audience response activity to be successful, both the educator and the learner should believe that engagement in this active learning process will improve teaching and learning.

THE STUDY

As part of Stellenbosch University's aim to enhance student learning through the use of technology (SU, n.d.), the Information Technology Division of the university investigated various audience response systems for use in the teaching and learning context. These systems included dedicated audience response devices, but due to various practical considerations it was eventually decided to opt for the use of mobile devices, coupled with audience response software. Since students were already using a wide variety of mobile devices, a BYOD (bring your own device) approach was followed. Audience response software was developed which integrated with the university's learning management system.

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Audience response activities were subsequently introduced in a number of courses on an experimental basis. Five of these courses formed part of this study in which I attempted to answer the following research questions:

- How successful was the implementation of the audience response activities?
- Did the introduction of audience response activities improve the learning process?
- Did the students experience that these activities gave them greater agency in their own learning?

Data gathering methods included observation of lessons facilitated by the participating lecturers. This included the identification and analysis of system software instabilities that occurred during lessons, which may have negatively influenced the functionings of the audience response activities. In addition, I conducted interviews with the participating lecturers to determine which aspects of the activity influenced their capabilities and functionings. Student perceptions of the audience response activities were gathered by means of a survey. Ethical clearance and institutional permission for the study were granted by the Research Ethics Committee and the Institutional Research and Planning Division respectively.

The data gathered for each case study was individually analysed starting with the results from the observation schedule. Then the data gathered during the lecturer interviews was used to gain an understanding of the design of the lesson. Subsequently the numerical results of the student survey were analysed and compared and contrasted to the narrative answers to the open-ended questions in the questionnaire. This was done to identify possible explanations for the numerical results.

FINDINGS

Due to significant contextual differences, the findings from the analysis of the survey data, the interview data and the observations are presented according to the five courses involved in the project, constituting five case studies.

Case study 1: Mathematics Education

The subject taught in this case was Mathematics Education to fourth-year students. There were approximately 60 students in the class. The lecturer introduced audience response activities primarily to improve the response rate from students. Even though she did get responses from students, she felt that not enough students responded to questions asked in class. In an effort to solve this problem, she asked students to respond to questions on paper, which they would hand in after the lesson. She would mark the responses and give feedback during a subsequent lesson. The introduction

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of an audience response activity would solve both problems: it would improve participation and the responses were automatically marked and aggregated by the system.

The lecturer followed an active learning approach throughout the lesson. The questions were all related to the teaching of mathematics. These questions raised a number of related issues which were then followed up by group discussions enabling the students to clarify and defend their points of view. However, the lecturer did not use the audience response system for any of these questions. She only used it for the last question, and the students were then notified that this question would be discussed during a follow-up period.

The lecturer was a proficient educator who had already followed an active learning approach before introducing audience response activities. The students had already been given agency in their learning process by means of the question-based approach and active group discussions, which required them to participate actively in the lesson. The introduction of the audience response activities therefore did not improve this process. The lecturer admitted that the biggest obstacle in the introduction of the audience response activities was her ineptness with technology. Since she was new to this kind of technology, she admitted that it sometimes resulted in chaos and the unsuccessful implementation of audience response activities. She was therefore reluctant to use it throughout the lesson, because she was concerned that it would result in a failed learning experience.

Only 10 of the students completed the questionnaire. Of those who responded, 80% believed that the audience response activities contributed to a better learning experience. They also valued the anonymity of the system.

The only improvement here was the automatic marking of the questions that had previously been done on paper and had been marked by an assistant.

In this case, the two-way relationship was already positive in that the lecturer used active learning approaches to give students agency in their learning process, and most students actively embraced these approaches by participating in discussions and responding to the lecturer. The students were therefore given agency and they embraced this agency by actively participating. The introduction of technology improved the administration process, but not the learning process.

Case study 2: Logistics

In the second case study, the subject taught was Logistics to third-year students. There were approximately 150 students in class during the class observation.

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The original exercise entailed that the students completed questions on paper which were submitted at the end of the period. The students' answers were then marked and handed back in a follow-up lesson. The questions involved calculations that had to be performed.

When the lecturer introduced the audience response activity, he expected the students to complete the questions on paper, but also to type the final answer on their mobile device as part of the audience response activity. Since these answers were text based, they were not aggregated by the system. The lecturer had an assistant who helped to download the answers to a spreadsheet and aggregated the answers to enable them to see how the majority had voted.

The students worked at their own pace. As soon as the students started completing the first questions, the lecturer started to respond to the feedback he had received from the submitted answers. The students therefore had to continue completing the questions, both on paper and on their mobile device, and at the same time pay attention to what the lecturer was saying about their already submitted answers.

The lecturer introduced audience response activities so that he could determine which questions the students struggled with; that is, where most of the students had submitted the wrong answer. This means that he could focus on explaining the questions that the students struggled with. He thought it would save time, and thus improve his teaching. He did not track student participation in the audience response activities.

The questionnaire was completed by 36% of the students. The majority of the students (51%) did not believe that the introduction of audience response activities had improved their learning process. The comments indicated that it wasted time, that it caused the lecturer to lose control, and that the ultimate result was chaos:

In big classes in which the lecturer has less control over the class, the clicker test has the ability to become very time consuming and therefore very frustrating.

It is a good idea which is not applied properly. It has the effect that the class is not effectively controlled.

The experience that I have had thus far is that the use of the clickers leads to chaos and nobody benefits from the experience.

Students also found that the device itself impaired their functionings. The size of the screen and the uploading process were also identified as barriers:

It is difficult to discern the 0's on the clicker system, e.g. 513'000'000'000. With large numbers it is easier to get confused with the number of 0s for the answer without the '-' sign. Currently it is represented as 513000000000.

Financial implications were also identified as a barrier. They did not feel that the use of the audience response activities had improved their learning in such a way that is was worth using their own devices and mobile data for this purpose.

As in the first case study, the students were already actively involved in this lesson by completing the questions on paper. The introduction of technology complicated this process and made it more difficult for the students to be actively involved. The technology introduced here did not improve the two-way relationship between the lecturer and the students. It actually harmed this relationship. The students felt that the introduction of audience response technology had impaired their learning process. However, the lecturer felt that it improved his teaching, because he did not have to explain every question in detail, but only the ones with which the students had problems.

Case study 3: Chemistry

In the third case study, the subject Chemistry was taught to approximately 240 first-year students. The first half of the lesson was spent explaining concepts. The audience response activity was introduced during the second half of the lesson to test what had been learnt during the first half.

The activity involved the answering of a multiple-choice question on the newly explained concepts. After entering their answers, students then discussed their answers with their peers and could submit an answer a second time. After everyone had submitted their answers, the lecturer gave feedback based on the aggregated feedback generated by the audience response system.

The lecturer tracked student participation as the students were required to complete at least 80% of audience response activities.

The lecturer introduced audience response activities because she wanted to give the students more agency in their learning by actively involving them in the learning process. She wanted them to be able to apply the knowledge learnt and not just passively sit and listen to her lecturing.

The questionnaire was completed by 38% of the students. The students were very positive about the use of the system and 78% believe that it had contributed to a better learning experience.

The following comment highlights the value of the cognitive process involved in actively answering the question:

The clicker tests are very effective. It helps you to capture a concept of the work in your brain. Sometimes you think you understand the work,

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but you don't and the clicker tests wakes you up in time so that you realise which aspects of the work you need to pay more attention to. If your participation counts for marks, then it will be good motivation to attend the class and to pay attention but sometimes all the students do not manage to access the clicker site or the batteries of their phones are dead and then it will be unfair if participation counts for marks. I have also struggled in the past to get access, but it still helped me, because I completed the calculations for the answer, even though I did not manage to submit the answer. The clicker activity is very helpful.

Another comment valued active participation:

The clicker tests are basically homework, but just takes longer. However, it helps to draw students' attention and to get them to participate actively and to pay attention in class.

This student also valued the fact that the activities improved concentration and understanding:

Knowing that I have to answer a question on the work explained, helps me to concentrate in class and I know immediately if I understand the work or not.

However, the following response from a student demonstrates that some students felt that this new process took away their agency. She still wanted to use familiar study methods and did not understand that this new method could give her more control over her learning process:

I prefer writing class activities and assessments because I find it easier to learn from physical material at a later stage than from reading things on screen. I also prefer and find it quicker to write any side/personal notes on the paper or assessments that I can read and learn from at a later stage, also I find that some lecturers go through concepts quite quickly and I am faster at writing than I am at typing.

The student was not familiar with this learning process and she felt that she was used to her old learning methods. She was comfortable with a rote learning process, because she knew that it would improve her capability to prepare for tests and examinations.

A sound pedagogical approach, combined with the effective use of technology, improved the two-way relationship for most of the students in this class. Most students valued and embraced the agency they had been given in their learning process. This led to the successful implementation of technology in this active learning process.

Case study 4: Biochemistry

The subject Biochemistry was taught to 72 second-year students. The audience response activity was used three times during the lesson. The questions were on the concepts that were going to be covered. The students therefore first answered the question and then, based on the feedback, the lecturer explained the concepts.

Only a small number of students participated in the activities. Many students did not attempt to answer the questions. Even though the response rate was low, the lecturer still used the aggregated feedback from the system to direct the lesson. Overall, the class was very apathetic and responded very little to anything the lecturer did.

The lecturer introduced the audience response activities because of the students' apathy. Answers were given anonymously, so the lecturer did not track student participation. He hoped that the anonymity would improve the students' response rate; in other words, he opted to give the students agency in their decision to participate.

The lecturer did not introduce peer discussions, so the students also did not have to explain or justify their answers.

In contrast to what the lecturer considered to be their general apathetic attitude, 67% of the students completed the questionnaire. Of these respondents, 80% believed that the audience response activities had contributed to better learning, whereas 64% of the respondents also valued the anonymity of the answering process.

The following quotes illustrate why the students had found the audience response activities beneficial. The comments pointed to better understanding; improved learning opportunity by being able to see how the whole class responded; the value of the anonymity of the platform, which encouraged participation; the immediacy of the feedback; and the fact that it enabled the lecturer to direct focus:

I have definitely learnt more and understood the work better when the lecturer uses clicker questions. It is very easy to use on my cell phone.

Clicker is cool if you actually take it as a learning opportunity and for you to assess yourself. It also gives you the opportunity to see how the entire class is doing (if they actually attempt the questions and not just give random answers).

It forces interaction with the material and provides an anonymous platform for me to test my understanding of the concept immediately without having to single myself out in front of a large class who can be overpowering.

You are able to see then and there if you are understanding the work or not instead of waiting until exam prep and not having a clue.

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We recently used the clicker and it helped the lecturer to see where he has to give more attention/explain more and spend less time on concepts that we understand very well.

The lecturer also felt that the audience response software improved his teaching, but he wished more students would participate.

The following quote voices similar sentiments to those of the Chemistry student highlighted above:

Even though using the clicker tests is very helpful I feel that it is more important for my future study efforts to write down these questions as they are presented. This (is) due to the fact that certain departments do not release practice questions papers. By using this time to write the question down it is sometimes difficult to think about the question and respond to the clicker as well.

The low response rate could be attributed to a number of factors. The following quote from a student referred to the fact that they did not always have data on their phones to enable them to participate:

Sometimes it's rather difficult as most of us work with data to access the internet, therefore we can't always participate.

So, even though the students did not actively submit their answers, they did answer the questions and therefore still benefitted from the activity.

When students were asked if they wanted their participation to count for marks, 58% of the students responded positively.

The lesson was well structured and the lecturer was efficient in using the technology. He, therefore, tried to improve the two-way relationship by actively involving the students. For unknown reasons, many students did not participate in these activities although the majority of those who answered the questionnaire felt that the integration of audience response activities could improve their learning process.

Case study 5: English Education

Case study 5 was on the teaching of the subject English Education to 140 second-year students.

The lecturer spent the first 20 minutes of the class lecturing. An audience response question was then introduced. The questions were on personality traits required to be a good teacher, and they entailed that the students would identify their own personality traits to determine what kind of teacher they would eventually be.

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No group discussions were introduced and the aggregated feedback from the system was also not used.

The lecturer had also introduced audience response activities to improve class participation. During the interview with the lecturer, she said that she sometimes used the aggregated feedback from the system and introduced peer discussions based on it. Student participation was anonymous and therefore not tracked.

Of the 50% of the students who completed the questionnaire, 78% felt that the audience response activities contributed to better learning.

The following response from a student illustrates that audience response technology makes it possible for more reserved students to participate as well:

I think clickers are a great idea, it gives a voice to those people in my class that don't usually have a say.

The fact that audience response technology makes active participation possible in class was valued by 64% of the students, as illustrated by the following response from a student:

Yes, because you get to see other people's opinion on certain matters and then they have the opportunity to state why they chose that answer and explain their reasoning to the class. This enables you to see their point of view and broadens your perspective on certain matters.

During this lesson, however, the objective of using the audience response activity was not clear. It did not contribute to a better learning experience and therefore did not enhance the two-way relationship. The students might as well have completed the questions on paper. One can therefore understand the following comment from a student:

I do feel the clickers CAN contribute to better learning in a way, but thus far, from the clickers I have participated in, I don't feel it has contributed to any learning.

DISCUSSION

As stated earlier, the successful integration of audience response activities requires in-depth subject knowledge, knowledge of technology and a new pedagogical approach. When one of these aspects is missing it may lead to failure. This was evident in some of the case studies.

In case study 1, the integration of audience response activities was unsuccessful because the lecturer was not comfortable with the technology. Even though her

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pedagogical approach was already successful and promoted active learning, the incorporation of technology did not further enhance this.

In case study 2, an ineffective pedagogical approach and using the wrong technology caused the integration of audience response activities to fail. The size of the mobile screen was not conducive to typing large numbers. This activity might have worked on a computer. Also, the lecturer could have structured the process better, for example, all students should have completed one question at a time, after which feedback was given, and then the lecturer could have continued to a second question, and so on.

In case study 3, the lecturer followed a question-based approach, followed by group discussions. The pedagogical approach was carefully thought through and the lecturer was proficient with the technology. This integration was successful.

In case study 4, the lecturer also followed a question-based approach, but this was not followed by group discussions. Students therefore did not have to defend their answers. This might have resulted in the low motivation of students to participate in the activities.

In case study 5, the feedback from the system was not used, nor was it followed up with peer discussions. Therefore, during this particular observation, the technology that was used did not contribute to a better learning experience. However, the student feedback illustrated that audience response activities had been effectively used by this lecturer before.

The capabilities approach entails that the individual has the freedom to choose; in this case, the freedom to choose to participate in a learning activity or not. However, if for some reason the majority of learners use this freedom to choose not to participate in a learning activity, active learning cannot occur and the learner actually withdraws from the relationship.

At the other end of this two-way relationship, the educator's capability also has a strong influence. In today's technological age, educators are expected to be knowledgeable about content, pedagogical practices and technology. Basic technological knowledge and skills are not always enough. It is expected of educators to be advanced users of technology.

Traditional pedagogical approaches took away the learners' freedom to choose. Learners were forced to complete exercises, write examinations, and follow strict pedagogical processes. Then with the advent of constructivism, learners were given more agency in their learning process. Pedagogical approaches became more flexible and were often directed by the learner. An active learning approach combines traditional teaching methods and aspects of constructivism. The learning process is

directed by the educator, but the learner is actively involved by answering questions and participating in group discussions. Active learning means that both educators and learners are active co-creators of knowledge within a pedagogical relationship.

CONCLUSION

I conclude that individuals do not only have the right to education, but the right to education that will make it possible to succeed so that they can access new capabilities and develop new functionings. This two-way relationship is not a simple process and, as these case studies have demonstrated, can be influenced by a number of variables. If technology is incorporated into this process, then it becomes even more complicated.

This two-way relationship will probably never be perfect, considering the number of variables involved in the teaching and learning process. However, what is important is that both parties take responsibility for this two-way relationship. The educator and the learner should work together to make this process successful.

REFERENCES

- Abrahamson LA. 2006. A brief history of networked classrooms: Effects, cases, pedagogy, and implications. In: DA Banks (ed). *Audience response systems in higher education: Applications and cases*. Hersey, PA: Information Science Publishing. <https://doi.org/10.4018/978-1-59140-947-2.ch001>
- Ada WW. 2009. Computer supported collaborative learning and higher order thinking skills: A case study of textile studies. *Interdisciplinary Journal of E-Learning and Learning Objects*, 5:145-167. <https://doi.org/10.28945/69>
- Anderson LS, Healy AF, Kole JA & Bourne LE. 2013. The Clicker technique: Cultivating efficient teaching and successful learning. *Applied Cognitive Psychology*, 27:222-234. <https://doi.org/10.1002/acp.2899>
- Barnett J. 2006. Implementation of personal response units in very large lecture classes: Student perceptions. *Australasian Journal of Educational Technology*, 22(4):1-17. <https://doi.org/10.14742/ajet.1281>
- Beatty ID. 2004. Transforming student learning with classroom communication systems. *Research Bulletin*, 2004(3):1-13. <https://bit.ly/3yZBr13>
- Beatty ID & Gerace WJ. 2009. Technology-enhanced formative assessment: A research-based pedagogy for teaching science with classroom response technology. *Journal of Science Education and Technology*, 18(2):146-162. <https://doi.org/10.1007/s10956-008-9140-4>
- Braxton JM, Eimers MT & Bayer AE. 1996. The implications of teaching norms for the improvement of undergraduate education. *The Journal of Higher Education*, 67(6): 603-625. <https://doi.org/10.2307/2943814>
- Burnstein RA & Lederman LM. 2001. Using wireless keypads in lecture classes. *The Physics Teacher*, 39:8-11. <https://doi.org/10.1119/1.1343420>

PART TWO • IN-CLASS EXPERIENCES

- Caldwell JE. 2007. Clickers in the large classroom: Current research and best-practice tips. *CBE-Life Sciences Education*, 6(1):9-20. <https://doi.org/10.1187/cbe.06-12-0205>
- Campbell C & Monk S. 2015. Introducing a learner response system to pre-service education students: Increasing student engagement. *Active Learning in Higher Education*, 16(1): 25-36. <https://doi.org/10.1177/1469787414558981>
- Chickering A & Gamson Z. 1987. Seven principles for good practice in undergraduate education. *The Wingspread Journal*, 9(2):1-5.
- Crimmins MT & Midkiff B. 2017. High structure active learning pedagogy for the teaching of organic chemistry: Assessing the impact on academic outcomes. *Journal of Chemical Education*, 94(4):429-438. <https://doi.org/10.1021/acs.jchemed.6b00663>
- Crouch CH & Mazur E. 2001. Peer instruction: Ten years of experience and results. *American Journal of Physics*, 69(9):970-977. <https://doi.org/10.1119/1.1374249>
- Cutts Q, Kennedy G, Mitchell C & Draper S. 2004. *Maximizing dialogue in lectures using group response systems*. Presented at 7th IASTED International Conference on Computer and Advanced Technology in Education, 16-18 August, Hawaii. <https://bit.ly/3z1iqVq> [Accessed 16 January 2015].
- DeBourgh GA. 2008. Use of classroom 'clickers' to promote acquisition of advanced reasoning skills. *Nurse Education in Practice*, 8:76-87. <https://doi.org/10.1016/j.nepr.2007.02.002>
- Dignath C & Büttner G. 2008. Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning*, 3(3):231-264. <https://doi.org/10.1007/s11409-008-9029-x>
- Dori YJ & Belcher J. 2005. How does technology-enabled active learning affect undergraduate students' understanding of electromagnetism concepts? *Journal of the Learning Sciences*, 14(2):243-279. https://doi.org/10.1207/s15327809jls1402_3
- Draper SW & Brown MI. 2004. Increasing interactivity in lectures using an electronic voting system. *Journal of Computer Assisted Learning*, 20:81-94. <https://doi.org/10.1111/j.1365-2729.2004.00074.x>
- Duncan D. 2006. ARSs: A new teaching aid with exceptional promise. *Astronomy Education Review*, 5(1):70-88. <https://doi.org/10.3847/AER2006005>
- Faasen M. 2016. A learning design framework for active learning using audience response systems. PhD dissertation, Stellenbosch, Stellenbosch University.
- Fernandez V, Simo P & Sallan JM. 2009. Podcasting: A new technological tool to facilitate good practice in higher education. *Computers & Education*, 53(2):385-392. <https://doi.org/10.1016/j.compedu.2009.02.014>
- Graham CR, Tripp TR, Seawright L & Joeckel GL. 2007. Empowering or compelling reluctant participators using audience response systems. *Active Learning in Higher Education*, 8(3): 233-258. <https://doi.org/10.1177/1469787407081885>
- Han JH. 2014. Closing the missing links and opening the relationships among the factors: A literature review on the use of clicker technology using the 3P model. *Educational Technology and Society*, 17(4):150-168. <https://doi.org/10.1080/1097198X.2014.951294>

CHAPTER 5 • USING AUDIENCE RESPONSE TECHNOLOGY ...

- Han JH & Finkelstein A. 2013. Understanding the effects of professors' pedagogical development with clicker assessment and feedback technologies and the impact on students' engagement and learning in higher education. *Computers & Education*, 65:64-76. <https://doi.org/10.1016/j.compedu.2013.02.002>
- Harper B. 2009. I've never seen or heard it this way! Increasing student engagement through the use of technology-enhanced feedback. *Teaching Educational Psychology*, 3(3):1-8.
- Hoffman C & Goodwin S. 2006. A clicker for your thoughts: Technology for active learning. *New Library World*, 107(9/10):422-433. <https://doi.org/10.1108/03074800610702606>
- Hussain FN & Wilby KJ. 2019. A systematic review of audience response systems in pharmacy education. *Currents in Pharmacy Teaching and Learning*, 11:1196-1204. <https://doi.org/10.1016/j.cptl.2019.07.004>
- Kane L. 2004. Educators, learners and active learning methodologies. *International Journal of Lifelong Education*, 23(3):275-286. <https://doi.org/10.1080/026037042000229237>
- Kay RH & LeSage A. 2009. A strategic assessment of audience response systems used in higher education. *Australasian Journal of Educational Technology*, 25(2):235-249. <https://doi.org/10.14742/ajet.1152>
- Kuh GD. 2001. Assessing what really matters to student learning. *Change*, 33(3):10-17. <https://doi.org/10.1080/00091380109601795>
- Kuh GD. 2003. What we're learning about student engagement from NSSE. *Change*, 35(2): 24-32. <https://doi.org/10.1080/00091380109601795>
- Laurillard D. 2012. *Teaching as a design science: Building pedagogical patterns for learning and technology*. New York, NY: Routledge.
- Lundeberg MA, Kang H, Wolter B, DelMas R, Armstrong N, Borsari B, Boury N, Brickman P, Hannam K, Heinz C, Horvath T, Knabb M, Platt T, Rice N, Rogers B, Sharp J, Ribbens E, Maier KS, Deschryver M, Hagley R, Goulet T & Herreid CF. 2011. Context matters: increasing understanding with interactive clicker case studies. *Educational Technology Research and Development*, 59:645-671. <https://doi.org/10.1007/s11423-010-9182-1>
- Mader S & Bry F. 2019. Fun and engagement in lecture halls through social gamification. *International Journal of Engineering Pedagogy*, 9(2):117-136. <https://doi.org/10.3991/ijep.v9i2.10163>
- Martyn M. 2007. ARSs in the classroom: An active learning approach. *Educause Quarterly*, 30(2):71-74.
- McClanahan E & McClanahan L. 2002. Active learning in a non-majors biology class: Lessons learned. *College Teaching*, 50(3):92-96. <https://doi.org/10.1080/87567550209595884>
- Moore AH, Fowler SB & Watson CE. 2007. Active learning and technology: Designing change for faculty, students and institutions. *Educause Review*, 42(5):42-60.
- Nussbaum MC. 2005. *Women and human development*. 8th Printing. New York, NY: Cambridge University Press.
- Nussbaum MC. 2011. *Creating capabilities: The human development approach*. Cambridge: Belknap Press of Harvard University Press. <https://doi.org/10.4159/harvard.9780674061200>

PART TWO • IN-CLASS EXPERIENCES

- Oakes CE & DeMaio DN. 2013. "I was able to have a voice without being self-conscious": Students' perceptions of audience response systems in the health sciences curriculum. *Journal of Allied Health*, 42(3):75-80.
- Pascarella ET. 2001. Identifying excellence in undergraduate education: Are we even close? *Change*, 33(3):18-23. <https://doi.org/10.1080/00091380109601796>
- Remón J, Sebastián V, Romero E & Arauzo J. 2017. Effect of using smartphones as clickers and tablets as digital whiteboards on students' engagement and learning. *Active Learning in Higher Education*, 18(2):173-187. <https://doi.org/10.1177/1469787417707618>
- Scholten K & Dubois A. 2017. Advancing the skill set of SCM graduates – an active learning approach. *International Journal of Operations & Production Management*, 37(11):1683-1699. <https://doi.org/10.1108/IJOPM-11-2015-0724>
- Sen A. 1999. The possibility of social choice. *The American Economic Review*, 89(3):349-378. <https://doi.org/10.1257/aer.89.3.349>
- Sen A. 2001. *Development as freedom*. Oxford: Oxford University Press.
- Sen A. 2004. Capabilities, lists, and public reason: Continuing the conversation. *Feminist Economics*, 10(3):77-80. <https://doi.org/10.1080/1354570042000315163>
- Simelane S & Skhosana P. 2012. Impact of clicker technology in a mathematics course. *Knowledge Management & E-Learning: An International Journal*, 4(3):279-292. <https://doi.org/10.34105/j.kmel.2012.04.023>
- Sitzmann KE & Ely K. 2011. A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin*, 137(3):421-442. <https://doi.org/10.1037/a0022777>
- Smith MK, Annis SL, Kaplan JJ & Drummond F. 2012. Using peer discussion facilitated clicker questions in an informal education setting: Enhancing farmer learning in science. *PLoS ONE*, 7(10):1-9. <https://doi.org/10.1371/journal.pone.0047564>
- Stevens NT, McDermott H, Boland F, Pawlikowska T & Humphreys H. 2017. A comparative study: Do 'clickers' increase student engagement in multidisciplinary clinical microbiology teaching? *BMC Medical Education*, 17(1):1-9. <https://doi.org/10.1186/s12909-017-0906-3>
- SU (Stellenbosch University). n.d. Vision 2040 and strategic framework, 2019-2024. <https://bit.ly/3hkvPCg> [Accessed 1 September 2019].
- Twetten J, Smith MK, Julius J & Murphy-Boyer L. 2007. Successful clicker standardization. *Educare Quarterly*, 4:63-67.
- Vygotsky L. 1978. *Mind in society: the development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.
- Wood R & Shirazi S. 2020. A systematic review of audience response systems for teaching and learning in higher education: The student experience. *Computers & Education*, 153:1-16. <https://doi.org/10.1016/j.compedu.2020.103896>
- Zhao C & Kuh GD. 2004. Adding value: Learning communities and student engagement. *Research in Higher Education*, 45(2):115-138. <https://doi.org/10.1023/B:RIHE.0000015692.88534.de>

CHAPTER 5 • USING AUDIENCE RESPONSE TECHNOLOGY ...

- Zhao C, Kuh GD & Carini RM. 2005. A comparison of international student and American student engagement in effective education practices. *The Journal of Higher Education*, 76(2):209-231. <https://doi.org/10.1353/jhe.2005.0018>
- Zimmerman BJ. 2008. Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1):166-183. <https://doi.org/10.3102/0002831207312909>
- Zimmerman BJ & Bandura A. 1994. Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal*, 31(4):845-862. <https://doi.org/10.3102/00028312031004845>