Pharmacy students' experience towards active learning using 'Clickers'[1][2][3]

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ABSTRACT

The knowledge and application of pharmacology is central to ensuring that pharmacists are able to fulfil their professional roles. Academics teaching pharmacology in the pharmacy programme at the University of KwaZulu-Natal must ensure 'learning that lasts' despite being faced with ever increasing student numbers. In an attempt to achieve this, active learning, using clickers (an example of an audience response system), was incorporated into an undergraduate pharmacology module in the pharmacy programme with the aim of improving large group student learning. While clickers have been increasingly used as a tool to promote active learning in the higher education domain, little is known about students' experience towards its use in undergraduate pharmacy programmes. This study sought to describe students' experience and opinions on active learning strategies using clickers. This was a quantitative, descriptive study that utilised a self-administered questionnaire conducted amongst level three pharmacy students enrolled in a pharmacology module. Overall, student feedback was positive, as they indicated that they enjoyed using clickers - and had an improved understanding of the course content. Students additionally benefited from the increased facilitator and peer interaction. This study provides a motivation for including this teaching pedagogy in other modules in the pharmacy programme.

Keywords: pharmacology teaching, audience response systems, clickers, active learning, pharmacy education

INTRODUCTION

Pharmacology, which is both a basic and an applied science (Merriam-Webster, 2011), is a core subject competency taught across all four years of the Bachelor of Pharmacy (B.Pharm) degree at the University of Kwa-Zulu Natal (UKZN). It is defined as the science of drugs, including their origin, composition,

pharmacodynamics, pharmacokinetics, therapeutic use, adverse-effects and toxicology (Merriam-Webster, 2011). A thorough knowledge of the concepts and its application is essential for successfully fulfilling the pharmacist's role as the custodian of medicines and for offering patients the best treatment outcomes possible. Furthermore, literature reveals that both prescribing and dispensing errors in practice have been linked to deficiencies in knowledge and inadequate training in pharmacology (Desai, 2016). Thus, strengthening efforts to improve the delivery of pharmacology education through new pedagogies has become increasingly important. The universal acknowledgment that pharmacology courses form the backbone of therapeutic medicine use, and knowing that it is essential for the effective treatment and management of conditions and diseases in modern medicine (Shankar, et al., 2003), emphasises the need for constantly reviewing and updating teaching pedagogies.

Traditionally, at UKZN, pharmacology modules have been delivered via a didactic approach across all four years of the B.Pharm programme. This approach is primarily beneficial to the lecturer, as it offers a convenient, cost effective, efficient and standardised way of delivering information to a large group of students (Luscombe & Montgomery, 2016). Unfortunately, didactic teaching creates a teacher-centred and passive learning environment with minimal student participation (Luscombe & Montgomery, 2016; Osinubi & Ailoje-Ibru, 2014), which is counteractive to the self-directed learner ethos that the discipline of Pharmaceutical Sciences is striving to attain. Encouraging students to take responsibility for their own learning is a growing theme in health professional education, as it presents a promising methodology for lifelong learning (Murad & Varkey, 2008), and is an important skill set required for future professional success, given the continuous advances in the biomedical sciences (Murad & Varkey, 2008). Furthermore, the current predominantly didactic approach contravenes the technologically progressive students that are now entering university and enrolling into the B.Pharm programme. Students enrolling for an undergraduate degree are used to having vast amounts of knowledge available to them via the internet, and a didactic teaching approach does not hold any attraction for these students. Recognising this, a natural question therefore arose as to 'how do we as academics revolutionise traditional teaching and learning activities that are capable of imparting the correct content whilst being technologically progressive, innovative and captivating for students?' Incorporating active learning strategies in the undergraduate pharmacology curriculum seems to be the rational next step, particularly as several studies revealed that in comparison to didactic teaching, active learning in higher education courses has resulted in better academic outcomes for students (Hake, 1998; Michael, 2006).

The term 'active learning' refers to a variety of processes aimed at engaging students in the learning process. These can include case studies, computerised tutorials, audience response systems (clickers), and team-based learning (Stewart et al., 2011). Active learning occurs when students actively participate and engage in their learning, and it moves away from the historic didactic approach where students are merely passive listeners. The main advantage of active learning is that it enhances students' retention of knowledge and promotes learning and critical thinking (Gavaza, Campbell & Mullins, 2012). The above-mentioned advantages thus made it an attractive new teaching strategy, which spoke to the type of learners and future young professionals the discipline aims to develop. Active learning is not only beneficial to students – it also helps academics to gauge student comprehension, engage students, and enhance interactivity amongst students. According to Monaghan et al. (2011), educational technology has not directly caused improvements in education, but rather indirectly influenced positive changes in teaching practice.

After reviewing possible options of including active learning in classroom teaching, clickers were introduced in a level 3 pharmacology module in the programme, based on their feasibility and availability. This, however, was the first exposure of students to using clickers. Clickers, or audience response systems (ARS), are remote control devices used by students to respond anonymously to multiple-choice questions posed by the instructor through a PowerPoint® interface. The main aim of introducing clickers in lectures

was to capture and maintain student attention throughout the lecture, and monitor progress and student comprehension so that deficiencies may be addressed immediately, and improve grades and student satisfaction (Meguid & Collins, 2017).

While the use of clickers is increasing in popularity in various health science disciplines (Liu, Gettig & Fjortoft, 2010), little information exists pertaining to its use in pharmacy (Gavaza et al., 2012; Stewart et al., 2011). Furthermore, despite the consistent feedback from student Quality Promotion and Assurance (QPA) reports, stating that lectures incorporating active learning strategies and principles are preferable to didactic teaching, it is often the case, that several students do not engage with active learning tasks. Thus, this study attempted to investigate the opinions of level three B.Pharm students, towards active learning with clickers, in order to support the implementation of this pedagogy in the discipline.

METHODS

Study design

This was a quantitative, descriptive study that utilised a self-administered questionnaire that was designed by Gavaza et al. (2012) upon receiving permission from the author.

Context

The study involved level three pharmacy students enrolled for the course entitled, Pharmacology II (PHRM 301) at the University of KwaZulu-Natal. The average number of students enrolled for the module is 90, however, annual enrolment increased to 120 students in 2019. Students registered for the course come from diverse backgrounds in terms of religion, language, ethnicity and self-directed learning skills. The aim of the module was to provide learners with a basic understanding of the pharmacology of drugs affecting mediators of inflammation and pain (College of Health Sciences UKZN, 2017). The course was taught during allocated lecture periods of 45 minutes each. The PHRM 301 course has traditionally been taught via didactic-based lectures of concepts, principles and application.

Intervention

The active learning pedagogy was applied to one section of the PHRM 301 module, taught over six weeks, early in the first semester. As was the case in previous years, students were provided with the lecture notes that would be covered during the lecture period prior to the lecture. The content was first taught didactically as in the previous years.

The intervention was applied in a follow-up session, run in a tutorial format by the lecturer. At the start of the session, students were required individually to answer a series of Multiple-Choice Questions (MCQs) using clickers, based on the topic covered in the previous lecture. The correct answer was not revealed at this stage. The questions posed, included a balance of knowledge and application questions (presented as clinical case studies). Students were then randomly assigned into groups of six students, to discuss these questions. After peer discussions, students were once again individually required to answer the same set of questions. This time the correct option, as well as the students' responses, were revealed. A graph was then displayed on the PowerPoint® slide, indicating only the number of students who had chosen each option, without any identifiers. The lecturer could view the responses for both the first and second attempts. The correct answer was then revealed, allowing for discussions to rationalise why each of the incorrect answers was unsuitable, and created an opportunity for the instructor to identify student misconceptions on the content tested. In this way, each individual student could assess his / her own understanding. The process further provided immediate feedback to students during the class session without singling out individual students.

Data collection

The questionnaire consisted of three sections. Section 1 elicited basic demographic information. Section 2 consisted of seven Likert-type questions which were used to measure students' opinions of active learning in which they had participated during the module. Each item in the questionnaire was rated using a bipolar semantic differential scale anchored by strongly disagree (1) and strongly agree (5). The final section consisted of one open-ended question, where students were asked to describe what they liked most about using clickers.

The questionnaire was administered in the form of a self-administered anonymous paper-based survey distributed in class, for which students were given time to complete. Unfamiliar terminology (i.e. self-directed learning and didactic teaching) used in the questionnaire was explained to students.

Data analysis

Data were collected, captured electronically and processed using Microsoft® Excel® 2013. For the closed-ended questions, descriptive statistics were generated and responses were tabled. For the open-ended question, responses were recorded, analysed thematically and grouped in order of prevalence. The frequency count for common comments was determined and all the repeated responses were reported only once.

Ethical Consideration

Gatekeeper permission and ethical approval for this study were obtained from the UKZN Humanities and Social Sciences Research Ethics Committee (HSS/0026/013). Student consent was obtained prior to administration of the questionnaire. All ethical considerations were adhered to, such as respect for persons, confidentiality and privacy. Participation in the study was voluntary and participants were given the option to withdraw from the study at any time.

RESULTS

Out of a total of 85 students enrolled for the module, 82 students completed the questionnaire, of which 17% were male and 83% were female.

Table 1 presents the students' opinions on using clickers as an active learning strategy in the PHRM 301 module. The first five questions addressed students' opinions on the usefulness of clickers in improving their learning and attitude toward the course content. The next three questions explored students' opinions on the delivery of the intervention.

Feedback was generally positive. A narrow majority (58.54%) felt that the intervention improved their ability to take responsibility for their own learning. The majority (71.95%) of students acknowledged the benefit of using clickers in achieving exam readiness, improving understanding of the course material (79.25%), and in recognising the correlation between the material covered in class and the active learning session (79.27.%). Fifty-four students (65.85%) felt that clickers improved their attitude toward the subject, and only 39 students (47.56 %) found AL more effective than didactic learning.

In terms of the delivery of the intervention, opinions were sought on responses, suggested areas for improvement, pertaining particularly to the time allocated to the intervention and articulation of the purpose of the exercise. Despite the majority (71.95%) of students agreeing that sufficient time was dedicated to active learning, a minority (48.78%) reported that the purpose of the session was well articulated by the lecturer.

Table 1:

Opinions on AL in the pharmacology module (n=82)

Item	Disagree / strongly disagree, n (%)	Neutral, n (%)	Agree / strongly agree, n (%)
AL is more effective than lecture-intensive didactic learning.	9 (10.98)	34 (41.46)	39 (47.56)
AL helped me to become a self-directed learner.	7 (8.54)	27 (32.93)	48 (58.54)
AL helped me to prepare for exams in the course.	6 (7.32)	17 (20.73)	59 (71.95)
AL improved my understanding of the material covered in the course.	5 (6.1)	12 (14.63)	65 (79.27)
AL improved my attitude toward the subject.	8 (9.76)	20 (24.39)	54 (65.85)
There was a direct / discernible correlation between the material covered in class and the AL	2 (2.44)	15 (18.29)	65 (79.27)
Sufficient class time was devoted to AL	4 (4.88)	19 (23.17)	59 (71.95)
Lecturer clearly articulated the purpose of AL	7 (8.54)	35 (42.68)	40 (48.78)

A total of 52 students responded to the open-ended question. These are listed in order of prevalence in Table 2. From the comments in Table 2 it is clear that students felt that they had a better understanding of the lectures, both from actively participating as well as from having immediate feedback on their own understanding – they thus immediately knew when concepts were not clear and could ask for this to be explained again. In addition, several students commented on the fact that they enjoyed group work, and the fun-element associated with the use of clickers.

Table 2:

Open-ended question responses (n=52)

Describe what you liked most about using clickers	Number of responses (n)
Enjoyed working with class members and the peer discussion	16
Clickers were fun and exciting	8
Tested my knowledge of my work and helped with revision	8
Helped me to rate myself	7
Interaction between class and lecturer	7
Allows you to understand the lecture and module content more clearly	7
Helped to prepare for tests and exams	5
Feedback to all questions	3

Describe what you liked most about using clickers	Number of responses (n)
Enjoyed working through clinical case studies	2
I found the questions informative	2
Makes you enthusiastic about learning	1
You learn from your mistakes	1
It is a balance between conventional learning and a new style	1
Having to research some questions	1

Overall, the feedback from the closed- and open-ended questions regarding the use of clickers as an active learning intervention appeared to be mostly positive.

DISCUSSION

In this technologically progressive era, faculty members at higher education institutions are increasingly pressured to be innovative in the classroom and to adapt appropriately the educational methods they employ. While lecturers might understand the benefit of trying a new teaching approach, it is not always clear if students feel the same way. This study documented the opinions of students towards using an innovative teaching strategy, an audience response system, as an active learning strategy in a large classroom. The use of technologies, such as clickers, allows active learning, i.e. student engagement and interaction in the classroom, ultimately improving the quality of students' learning, (Cain, Black & Rohr, 2009; Caldwell, 2007).

This was a novel teaching approach for pharmacy students at UKZN, who have not been exposed to anything similar during their university education. As can be expected, pharmacy students have an established learning culture as to the format of teaching sessions expected as they have been consistently taught in the didactic fashion since level one. Hence, when asked if they found active learning more effective than lecture-intensive didactic learning, just less than half of the respondents agreed, with the majority being neutral or in disagreement. This response was probably to be expected from a group of students who had been predominantly didactically trained; students are understandably apprehensive and uncomfortable with transforming their roles from passive to active learners. Despite the overall positive feedback from the interactive teaching sessions, students appear conflicted with the innovation in teaching that they perceivably value, yet may find challenging to initiate. This lack of confidence in the effectiveness of AL in comparison to didactic teaching amongst students was consistent with a qualitative study that explored the experience of medical students learning in the large group teaching environment and is thus not unique to our student population (Luscombe & Montgomery, 2016). Similar to this study, research by Luscombe and Montgomery (2016) suggests that there is already an established learning culture within a faculty, that students are accustomed to, and expect. Students require time to adjust to a new method of teaching, with perceptions being likely to change for the positive, with perseverance in using the new method of teaching.

Overcoming the initial fear of trying something new in the classroom and being expected to participate on an individual level, students agreed that the use of technology was a highlight during these lecture sessions – students indicated that the clickers were fun and exciting to use.

This is reflective of the general trend in the literature pertaining to students' attitudes toward using clickers (McDermott & Redish, 1999; Draper, 2002; Caldwell, 2007). An additional theme emanating from the

open-ended questions, were that students enjoyed the increased level of interaction between the lecturer and students. Similarly, studies by Knight and Wood (2005) revealed that in classes that introduced clickers, lecturers were viewed by students as being more aware of students' needs, cultivating a more caring and friendly environment.

Despite not being directly attributed to the use of clickers, but rather the layout of the session, it seems, that the most benefit was achieved from working with peers in smaller groups. It would have been ideal to explore qualitatively the dimension and benefits of peer learning emanating from this study, however, this fell beyond the initial scope of the research. Similar clicker studies revealed that the strength of active learning, also highlighted from student feedback in this study, is the interaction it fostered between students, who often found it easier to understand concepts explained to them by their peers rather than the lecturer (Caldwell, 2007). Students feel that discussing questions with other students is helpful, as it aids understanding. Results from both the closed- and opened-ended questions confirmed this.

Students valued that the intervention helped in their exam and test preparation, which for the researchers seemed predictable, given their experience with the exam driven nature of the students enrolled in the programme. This outcome, however, was not tested by conducting a pre- and post-intervention test, but the literature reveals that overall the use of clickers either has a positive impact or does not harm exam scores (Knight & Wood, 2005). Students valued the fact that clickers helped them to rate and reinforce their learning. This is probably rooted in the anonymity of the process, as it allows students to compare their answers with the rest of the class, with the reassurance they are not alone in answering a question incorrectly, under the safety of being kept unnamed (Bunce, VandenPlas & Havanki, 2006).

The results from this study show that overall students found active learning had a positive impact on learning, academic achievement, and satisfaction with the class experience. It is clear that using educational technology, like clickers, and incorporating active learning strategies, creates a stimulating learning environment that fosters self-directed learning. This study is in agreement with findings from Monaghan et al. (2011) that found students take more responsibility for their own work and teachers work more as mentors and less as presenters of information.

The findings from this study, furthermore indicated the change in pedagogy from didactic to a more student-centred approach to have been successful from the students' point of view. When introducing new teaching strategies, it is imperative to ensure that these are not merely for the benefit of the lecturer, but also for the end-users, i.e. the students. Given the positive feedback from students, it is thus anticipated that this teaching approach can be used in other modules in the B.Pharm programme. This would, however, require discipline consensus on where best to introduce the intervention, to prevent student fatigue from using this technology.

By implementing active learning strategies in teaching, it is however not necessary to abandon didactic lectures altogether - active learning can easily be inserted into a traditional lecture as it is not necessarily the teaching technology in itself that directly causes improvement, but rather the positive change in teaching practice brought about by using technology in teaching (Monaghan et al., 2011).

Recommendations

The study should be followed with a qualitative study to further interrogate and identify the reasons for student responses. A possible positive outcome that was not measured in this study was whether this active learning strategy affected student grades and lecture attendance. Despite the positive student response with using the clickers, results revealed that there were still areas of improvement required in delivering the clicker session by the facilitator. Therefore, an important recommendation, moving forward would be

to develop a more detailed training and orientation programme for both faculty and students, in order to sensitise and familiarise them to active learning strategies in the discipline. This is important, as the discipline team plans to implement more active learning sessions both in pharmacology and other subjects taught in the discipline.

Limitations

The questionnaire developed in the Gavaza et al. (2012) study did not report on the validity and reliability of the instrument, however the questionnaire was appraised by an academic teaching in the pharmacology programme for face-validity.

CONCLUSION

Active learning with the use of clickers was incorporated into an undergraduate B.Pharm module to improve student learning in a larger group. According to student feedback, this strategy was effective in promoting student interaction; students learned from their peers and had a better understanding of concepts covered – it is thus clear that active learning achieved its goal.

Graduates of the B.Pharm programme at UKZN are required to possess a variety of complex skills and attitudes in order to fulfil their future challenging roles in the South African healthcare system. They need to be able to use and translate a body of scientific, medical, and clinical knowledge to decipher complex scientific and clinical problems (White et al., 2016). Pure didactic delivery of module content alone, is unable to achieve this. The increasing awareness amongst academics of the shortfalls associated with didactic teaching, which amongst others, includes its inability to promote self-directed learning, warrants the use of innovative strategies such as active learning.

Overall, this has been a valuable innovation for the module, and will be expanded in the future. The aim is thus to continue using, evaluating and improving upon this strategy of active learning using clickers in the B.Pharm programme at UKZN.

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