

Using Technology for Formative Assessment to Improve Students' Learning

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ABSTRACT

One way that technology can be a considerable support in teaching and learning is by improving the ability to offer formative assessment of the learners' skills and knowledge during the teaching and instructional process. Providing immediate feedback during the formative assessment process, with the aim of improving students' performance, is very crucial in learning and teaching. This study investigates the effectiveness of using the classroom response system *Plickers*, which is a technology based formative assessment tool, in improving students' learning. A descriptive mixed method design was implemented in this study. A questionnaire was used to collect data from 166 students in Bahrain Teachers College, University of Bahrain. The findings revealed that students believe in the importance of formative assessment and receiving immediate feedback which is supported by the use of *Plickers*. Moreover, the findings showed that using *Plickers* for formative assessment aid the learning process as it improves students' participation; saves the learning time, guarantees equal participation opportunities, and creates fun and exciting learning environment. The findings also encourage instructors to integrate technology tools such as *Plickers* in their classrooms to help them assess the effectiveness of their teaching and their students' learning.

Keywords: Formative assessment, teacher education, improves teaching, improve learning, educational technology, Plickers, online tools.

INTRODUCTION

The integration of technology in classrooms becomes a necessity for effective teaching that improves learning, specially in the 21st century; where the road to motivate and encourage students to learn is paved with their passion to technology and digital tools. With the advent of technology and its role in education, a wide body of research has developed in investigating the role of technological instructions in the educational process and their effect in improving the interactive education environment (Danielson, 2011; Ali and Elmahdi, 2001; Fawzi, 2010; Irving, 2015; Damick, 2015; Caldwell, (2007; Baylor, and Ritchie, 2002) A number of these studies have provided evidence of the significant contribution which technology makes to improve the methods of teaching, learning and assessment which positively impact the students' knowledge and skills.

One of the important and interesting uses of modern online classroom response systems to enhance students' learning is using them for formative assessment. Irving (2015) asserted that these tools "assist in the formative assessment process by supporting classroom environments that allow students and teachers to assess learning and providing mechanisms to present information about student learning during instructional sequences" (p. 380).

Popham (2011, p. 270) defined formative assessment as "a planned process in which assessment-elicited evidence of student's' status is used by teacher to adjust their ongoing instructional procedure or by students to adjust their current learning tactics". Formative assessment provides students with just in time specific and non-evaluative feedback that improve their performance. Effective teachers in every corner of the world strive to engage their students in formative assessment process to gauge understanding and correct misconceptions by utilizing multiple techniques such as diagnostic tests, startup activities, exit cards, pop quizzes, group discussion, think-pair-share, etc. Teachers also equally benefit from applying formative assessment techniques as they

provide them with the opportunity to assess their teaching effectiveness and, accordingly, adjust and modify their teaching activities. In other words, formative assessment informs instruction.

There are a number of affordable newly introduced technologies and software that aid teachers to use formative assessment during the instructional process which enhance learning and assessment. One of these technologies are classroom response systems; mainly referred to as CRSs. These technologies include, but not limited to, Clickers, *Socrative*, *Kahoot*, *Plickers* and *RecaP*. The common denominator among these technologies is their ability to collect real-time formative assessment data that helps teacher to provide just-in-time feedback. Beatty and Gerace (2009) reported that “Teachers have limited time to assess students’ performances and provide feedback, but new advances in technology can help solve this problem” (p. 142).

The technology based formative assessment tool *Plickers*, which many called “*Clickers without clicking*”, is an online classroom student response system that uses paper coded cards. Most importantly, the students do not need any electronic devices to participate in the assessment process. The teacher only needs to create an account on Plickers.com. To create an account on Plickers, a teacher will be asked to provide his/her first and last name, a valid email address and create a password. Later, with the available online guidelines or a limited training, he/she can easily build questions bank and start to use it for nearly zero cost.

This research investigated the effectiveness of using *Plickers* for formative assessment to enhance students’ learning. The authors of this study are full time professors at Bahrain Teachers College (BTC). They are utilizing and using *Plickers* in their regular classroom activities for more than three years. For the purpose of this study, and in order to achieve more precise results, each researcher used *Plickers* three times during the first semester of the academic year 2016/2017 to give students immediate feedback for activities he/she has done. The courses in which *Plickers* was used are under the English Language Education and Science and Education Studies departments in BTC. The study was conducted for a period of 12 weeks; in an attempt to use the tool in assessing the students when they were learning different concepts. At the end of the semester, the questionnaire was distributed to the students with the objectives of investigating their opinions about the effectiveness of using *Plickers* as a formative assessment tool to enhance their learning.

LITERATURE REVIEW

Formative assessment is the major area of interest within classrooms that “provides teachers and students with continuous, real time information that informs and supports instruction” (Ramsey & Duffy, 2016). The crucial need to adjust teaching and learning to gather evidence for the purpose of improving student learning demanded for formative assessment to be considered as a central part of classroom learning. This is due to the help formative assessment extends in leading students during the class time in understanding skills and concepts; in addition to making decisions about moving forward to achieve the course learning objectives.

On the other hand, formative assessment yielded substantial learning gains with the affordable wireless 21st century technology that are designed to enhance students’ learning. While Preszler et al (2007) highlighted collecting quick and immediate data about students’ understanding as one of the advantages of using technology in formative assessment. Ramsey and Duffy (2016) identified two major advantages: a) supporting individualized learning, and b) opening up time in lecture courses for interactive sessions.

Moreover, interest emerged in the integration of online classroom response systems (CRSs) which are considered “promising” (Beatty and Gerace, 2009) and affordable tech-tools used by teachers when they use formative assessment in the classroom, e.g., Clickers, Plickers, Kahoot digital quizzes, Socrative and ReCaP. Research findings reported that CRSs enhanced questioning and feedback when technology is integrated with pedagogy (Roschelle, Penuel & Abrahamson, 2004); and maximized learner engagement (Schell, Lukoff, & Mazur, 2013) and had a positive effect on students’ attitudes and academic performance (Preszler et al, 2007).

The ‘tech-help’ extended by these systems is seen in activating students’ thinking, enhancing immediate feedback, motivating participation, and fostering knowledge-centered discussion. Likewise, the essential features of the CRSs help teachers in effectively transforming the classroom from teacher-centered to students-centered. This takes place because CRSs help in assessing students’ learning by polling subject related questions, collecting students’ responses instantly and quickly, and finally, projecting the responses to the whole class. Accordingly, CRSs help teachers in effectively and efficiently assess students’ knowledge, concepts and skills. What added to teachers’ preference in accepting to use CRSs as part of technology-based formative assessment is the user-friendly features they hold. All that are needed to bring CRSs into action is using two input devices- the teacher’s classroom computer and his/her cell phone/tablet. The teacher starts by posing a question, students raise the answers on their cards and the CRSs “software collects the responses, aggregates them, and displays to

the class in a bar chart showing the number of students selecting each response” (Roschelle, Penuel and Abrahamson, 2004; Beatty, 2004; Fies and Marshall 2006. In: Beatty and Gerace, 2009).

This study examines the use of *Plickers*, also known as paper clickers, as one of the CRSs used for classroom formative assessment. Teachers use *Plickers* in different specialization around the world; for example, in courses like algebra (Damick, 2015); science (Beatty and Gerace, 2009), biology (Preszler et al, 2007). According to Damick (2015), *Plickers* could be used for many different purposes to formally assess students; such as for warm up or exit tickets. Each student has no other option but to participate in selecting an answer. After seeing the percentage of the class and how each individual student performed on the question, the teacher, uses the live view tab that projects the answers from the teacher’s digital device to the screen board (Damick, 2015).

There is a large volume of published studies describing the effect of technology based formative assessment on the teaching and learning process (Sheill, Lukoff, & Mazur, 2013; Beatty & Gerace, 2009; Damick, 2015; Preszler et al, 2007; Caldwell, 2007; Roschelle, Penuel, & Abrahamson, 2004). However, none of the available studies covered the use of using technology for formative assessment to improve students’ learning at the university classrooms in Bahrain. The study will try to answer the following three questions from the students’ perception:

- 1) What is the effectiveness of using formative assessment to improve learning?
- 2) What is the impact of using *Plickers* as classroom response system technology in providing immediate feedback to enhance students’ learning?
- 3) What is the usefulness of implementing *Plickers* as a technology tool in aiding formative assessment in the classroom?

METHODOLOGY

The study employed mixed research methods: quantitative by using the means and standard deviations and qualitative by analyzing students’ responses to three open-ended questions. Three open-ended questions were used to boost the authenticity of the results. No pre-determined answers were required and the participants were free to express their opinions. On the same lines, Woike (2007) describes open-ended responses as “A unique and perhaps most important aspect is that they offer individuals freedom of expression” (p. 293). Participants were asked to respond to a questionnaire that was validated by two experts in the use of technology and education. Both of them are assistant professors who have been teaching for more than 15 years. One is specialized in technology and the other in education.

Sample

The study sample consisted of 166 BTC students representing various academic levels (year one to year four) and divisions (Cycle one, Islamic and Arabic, Math and Science, and English). A cluster sampling technique was used because the authors wanted students from each academic years and different divisions. Therefore, the sections were selected randomly and then all the students in those selected sections participated in the study. The questionnaire was presented to them in their classroom and data was collected by using *Plickers*.

Instruments

The questionnaire used in this study consisted of 17 items that are related to the importance and effectiveness of using formative assessment (5 items), technology (1 item), *Plickers* (7 items) and whether or not they would plan to use it in their future classrooms (4 items) in the classroom. Statements are rated on a five-point Likert scale ranging from one (Strongly Disagree) to five (Strongly Agree). For open-ended questions, only three questions were used to ask students about their perception on how effective is using *Plickers* in the classroom in teaching and/or learning; if they plan to use it in their classrooms when they become teachers and why; and if there are any problems that may occur when using it in the classroom. The open-ended questions gave the participants the opportunity to elaborate and explain in-depth their perception regarding the use of *Plickers* as a tool for formative assessment to improve learning. The use of the mixed methods is to triangulate the data collection so deeper understanding can be attained.

RESULTS AND DISCUSSION

This section presents the results and discussion of the students’ responses using the mean and standard deviation statistics and their responses to the open-ended questions. When answering the open-ended questions, interestingly, not only their responses supported the answers they offered in the questionnaire, but they also highlighted other important aspects related to this study, “So the qualitative material generated from open-ended questions may reveal innermost thoughts, frames of reference, emotional reactions and cultural assumptions that may or may not be accessible by other methods” (Woike, 2007, p. 293). Although, the participants’ qualitative responses covered a wide range of aspects, the researchers highlight the most important themes emerged from

these responses. These themes are: engagement, checking for understanding, equal opportunity to participate, excitement and fun, saving the learning time, breaking the routine, ease of use, network problem and lack of infrastructure in schools.

Table 1: *Descriptive Statistics for the Formative Assessment Statements*

Items	Mean	SD
Formative assessment should be an integral part of classroom learning.	4.57	0.77
Formative assessment helps teachers identify difficult concepts that students are struggling to understand.	4.46	0.89
Formative assessment helps teachers identify skills students are having difficulty acquiring.	4.29	0.96
Formative assessment provides information needed to adjust teaching and learning while it is happening.	4.38	0.80
Formative assessment is guiding teachers and students in making decisions about how to move forward to reach their goals.	4.28	1.00
Overall	4.40	0.54

It is apparent from this table that in investigating students perception about the importance of implementing formative assessment in their classroom, their responses showed how highly they view the importance of formative assessment (Mean = 4.40, SD = 0.54) in identifying different concepts that students are struggling to understand (Mean = 4.46, SD = 0.89), in identifying skills students are having difficulty acquiring (Mean = 4.29, SD = 0.96), in providing information needed to adjust teaching and learning while it is happening (Mean = 4.38, SD = 0.80), and in guiding teachers and students in making decisions about how to move forward to reach their goals (Mean = 4.28, SD = 1.00). The results also showed that participants agree that formative assessment should be an integral part of classroom learning (Mean = 4.57, SD = 0.77).

In response to the first open-ended question “As a student, how effective is using *Plickers* in the classroom for the teaching and learning process?” participants overwhelmingly agree that *Plickers* is an effective tool in aiding the learning process. As students, they argue that *Plickers* help them to be engaged in the lesson. One student wrote, “I think that it’s very useful method to engage all students to participate even they are shy or quiet.” On the same line, another respondent stated, “I think this method attract the students and makes them interest[ed].” A third participants wrote “the students will be engaged and enjoy their learning.” One participant argued, “It motivates all learners and engages them.” Another aspect that the participants offered in response to the above question is about checking understanding, which can be quickly and easily obtained by using *Plickers*. For example, one respondent stated, “It measures the students understanding in a fun and different way”. Another respondent wrote, “I will use it to assess the students’ understanding”. A third student wrote, “Yes, because it’s a very interesting way to assess the students and check their understanding.”

Table 2: *Descriptive Statistics for Using Technology*

Items	Mean	SD
Using technology-based formative assessment in the classroom impacts students learning outcome	4.19	0.98

It is obvious that new generation (millennials) do like to use technology in their daily life and using it in the classroom has positive effect on students learning as stated by many researchers (Sheill, Lukoff, & Mazur, 2013; Preszler et al, 2007). Therefore, we asked the students if using technology-based formative assessment in the classroom impacts their learning outcomes, the results showed that they do agree (Mean = 4.19, SD = 0.98). For the open-ended question “Do you plan to use *Plickers* in your classrooms when you become a teacher? If the answer is yes, would you please explain the reasons?” indicated that they will use *Plickers* in the future when they become teachers. They offered a number of reasons; one of which is the excitement and fun that technology brings to the classroom; as one participant put it this way “it is fun of all ages for primary school or college students will have fun.” Another participant wrote “it makes the lesson very easier and in a fun way”. A second aspect that the researchers identified in the participants’ responses to the above question is saving the learning

time. “Yes, I plan to use Plickers [because] it saves the learning time,” mentioned one respondent. Another respondent stated, “Another thing, it saves time because it can be done in a very quick [way].” Many of the respondents maintain that Plickers is good to break the traditional classrooms’ routines, as mentioned by one of the respondents in writing “Plickers is a great way to change the routine and change the ordinary atmosphere of the class”. Moreover, the participants indicated that using Plickers gives equal opportunities to all students to participate. “Students will have an equal chance to participate in the class,” stated one respondent. Another participant wrote, “Yes [I will use it] because by it all the students will be participating.” A third respondent stated, “It gives all students the chance to respond”.

Table 3: *Descriptive Statistics for the Plickers*

Items	Mean	SD
Plickers helps students get immediate feedback.	4.17	1.11
Plickers is simple for teachers to use in the class.	4.22	1.02
Plickers allows teachers to collect real-time formative assessment data without the need to use students’ devices.	4.22	1.07
Plickers helps in saving students’ responses for later use.	4.04	1.14
Plickers helps in showing students responses graphically.	4.27	1.02
I like it when teachers use Plickers in the classroom.	4.54	0.86
I feel comfortable in giving honest responses when teachers use Plickers.	4.12	1.27
Plickers allows students to deduce what incorrect answers are and why they are incorrect.	3.98	1.31
Students feel excited when Plickers is used for the first time.	4.49	1.01
Plickers helps in checking students’ progress and understanding of the content.	4.19	1.09
I plan to use Plickers with my students when I become a teacher.	4.26	1.04
Overall	4.23	0.56

The authors of this study have been using *Plickers* in their classroom and were interested in finding out its effectiveness for formative assessment to enhance students’ learning. Therefore, to further explore the usefulness of implementing *Plickers* as a technology tool in aiding formative assessment in the classroom, overall, students indicated that they agree on the usefulness of implementing *Plickers* as a technology tool in aiding formative assessment in the classroom (Mean = 4.23, SD = 0.56). As students, participants showed that they like and feel excited when instructors use Plickers in the classroom (Mean = 4.54, SD = 0.86), (Mean = 4.49, SD = 1.01), respectively. Furthermore, they stated that they plan to use Plickers with their students when they become teachers (Mean = 4.26, SD = 1.04). The students participated in this study know the features that *Plickers* provides its users, e.g. it helps students get immediate feedback about their responses; simple to use in the classroom, allows teachers to collect real-time formative assessment data without the need to use students’ devices, helps in saving students responses for later use, effective in showing students responses graphically with a mean range of 4.04 – 4.27 and standard deviation 1.02 – 1.14.

In analyzing and discussing the open-ended responses, the researchers centered their attention on the relevance of the responses to the research’s main questions. In other words, to what extent the participants’ open-ended responses contribute to the research questionnaire. Evidently, these responses supported the participants’ statements in the questionnaire, which strongly supported the researchers’ hypothesis that Plickers positively enhances formative assessment and consequently improves students’ learning. For example, improving students’ engagement by using Plickers as a tool for formative assessment is a huge factor in creating an effective learning environment that promotes learning.

In the open-ended questions, the participants' responses to the above statements are, overwhelmingly, about the difficulties and problems related to technical aspects. For example, one participant wrote, "the network might not work or it might be slow". Another respondent stated, "Sometimes there is no internet service in the classroom so it will be hard to for the teacher to move from one question to another," a third participant wrote, "The teacher may face technological problems. For example, access to the Internet." An additional aspect that emerged from the respondents' answers to the above question is that *Plickers* is only limited to objective questions. For example, one of the respondents wrote, "The teacher is limited to use the multiple-choice questions." On the other hand, some respondents questioned the security of the information, "You don't guarantee that there won't be no bugs in the application that may delete all the histories and answers you saved in the application."

The positive impact of using technology to improve learning as presented in the results of this study is in line with what a number of researchers have argued (Irving 2015, Ramsey & Duffy, 2016, Baylor and Ritchie, 2002). The participants also pointed out that the use of *Plickers* in the classroom creates fun and excitement which, eventually, aid the learning process. Another important factor identified by the respondents which expected to improve students' learning is that using *Plickers* saves the learning time. Giving all students in classroom equal opportunity to participate in one class session is a farfetched goal for many teachers. However, the respondents argued that *Plickers* eliminates this obstacle and gives all students, even the shy ones, equal opportunities to participate.

In regard to the problems, challenges and difficulties that teachers may face in using *Plickers* in classrooms, most of the participants pointed out that technology resources and support are the main issues. Some studies (Ali and Elmahdi, 2001; Fawzi, 2010) indicate that teachers' reluctance in adopting technology in their teaching activities is a global phenomenon. At the top of the factors that influence teachers to use technology is the technical support offered. Teachers do not integrate technology in their teaching activities unless they have been provided with just-in-time technical support. Ali and Elmahdi (2001) highlighted the proper integration of technology into instructional activities; stating that when technology tools "are not incorporated for the intended use, because of the inability to use, it defeats the very purpose for which they have been made available (p. 72).

CONCLUSION

An enormous amount of literature stressed the effectiveness of using formative assessment in the teaching and learning process. The main goal of the current study was to determine the effectiveness of using the technology based formative assessment tool classroom *Plickers*, in improving students' learning. The most obvious finding to emerge from this study is that using technology based tools, such as *Plickers*, enhances formative assessment and, consequently, improves students' learning. In addition, it is found that students' engagement is improved, when the teacher uses *Plickers* for formative assessment which leads to creating an effective learning environment that promotes learning. Furthermore, these tools help in providing individualized learning and engaging students with the feedback which, in turn, leads to creating effective teaching and learning environment. The participants in this study indicated the importance of using technology based formative assessment. Moreover, using technology based tools such as *Plickers* helps in providing feedback and makes the class interesting, fun and informative. Nevertheless, the Ministry of Education in Bahrain encourages the use of technology in all education institutions. Further empirical research is needed to investigate the effectiveness of using technology based tools for formative assessment and feedback on students' achievements and performance.

LIMITATIONS

Due to practical constraints, this paper cannot provide a comprehensive review of the perceptions of all the students in the University of Bahrain as the data was collected from one educational college. Collecting data from other colleges at the University of Bahrain, or other universities in the Kingdom of Bahrain, would make the results generalizable in a larger context.

RECOMMENDATIONS

On the basis of the results and findings this study recommends instructors to:

- Engage their students in formative assessment process to gauge understanding and correct misconceptions. Teachers can also check their teaching effectiveness and, accordingly, adjust and modify their teaching activities and strategies.
- Integrate technology in the classrooms because it enhances students' learning when it is used for formative assessment.
- Utilize new digital apps and software (like *Clickers*, *Socrative*, *Kahoot*, *Plickers* and *RecaP*) that aid them to apply formative assessment in their classrooms. These technologies collect real-time formative assessment data that help teachers provide instant feedback.

- Realize that formative assessment is a major teaching strategy within classrooms that provides both teachers and students with continuous, real time information that informs and supports teaching and learning.

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