



Review

Using mentimeter to enhance learning and teaching in a large class

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Mentimeter is a web-based Clicker, Audience Response System (ARS) or Student Response System (SRS) which allows students to answer digital questions using a mobile device. It has the potential to transform the classroom environment into a more interactive, engaging and inclusive one. In this paper, a brief literature review has been provided which addresses the benefits of using ARS including Mentimeter in a large class. Additionally, the mechanics behind how the workings of the Mentimeter, its features and applications have been evaluated in order to offer the instructors with the insights about using Mentimeter for their own practice. Finally, a case study has been explained where Mentimeter was used for the formative assessment. In the present study, a Mentimeter formative assessment model has been developed which can be implemented as a good practice in Higher Education (HE). A survey on perception of students about using Mentimeter has been assessed and from the results, it is evident that using Mentimeter has a positive impact on students' attitude and performance, learning environment and technical aspects. These results will be further discussed by linking pedagogical theories and its benefits.

Keywords: Mentimeter, Audience Response System, classroom interaction, formative assessment, student perception

INTRODUCTION

Teaching a large class in Higher Education (HE) is, both, a great challenge and an incredible opportunity. Student engagement in a large class is crucial for achieving the learning outcomes. Mentimeter is a web-based interaction tool, much like the other Audience Response System (ARS) or Clicker that can be used in a large class to engage students in active learning. In general, students answer the question such as multiple-choice question (MCQ) displayed on Mentimeter using their smartphone with the help of the Internet. They can also use other devices such as laptops and tablets with which they can access the Mentimeter website. By the means of Mentimeter, the teachers can assess the understanding of the students instantly and provide their feedback accordingly.

While writing about the good practice in HE, Chickering and Gamson (1987) came up with seven principles

including "encourages active learning" and "gives prompt feedback". These two principles can be implemented via Mentimeter by involving the students in structured exercises and co-operation, and letting them know what they have learnt and where they need to improve. Many lecturers such as Micheletto (2011) have attributed the lack of student engagement to the obstacle to achieving learning outcomes. However, this lack of student engagement can be eliminated by the proper use of Mentimeter (Hill and Fielden, 2017). It is possible to create interactions between learner-content, learner-instructor and learner-learner (Moore, 1993) through the use of Mentimeter. The histogram feedback for MCQs (Nicol and Macfarlane-Dick, 2006) created by Mentimeter can trigger a classroom discussion which is a challenge in a large class.

With the traditional method of teaching, to assess a

student's understanding, the instructor takes the answer to the question by "show-of-hand" (Cline, 2006). However, this technique is of great limitations, particularly in a large class: only a few students tend to participate; mostly the confident ones; lack of anonymity; some students incline to copy; loss of data once the hands are down (Abrahamson, 2006) and is of relatively slow process. To avoid these issues, Clickers are introduced in the modern classes. Clickers provide a more effective teaching strategy than the traditional assessment (Duzhin and Gustafsson, 2018). Using the Clicker technology, students can answer the questions displayed on the classroom screen anonymously by using the hand-held device. At present, smartphone-based ARS like Mentimeter is replacing the Clickers, following the fact that it does not allow to write texts easily in the conventional device. In addition, the use of smartphone-based ARS relieves the extra burden on the lecturer to maintain the university-owned devices (Hwang et al., 2015).

It is well documented that ARS has a positive impact both for teachers and learners (Caldwell, 2007; Kay and LeSage, 2009). The key purpose of using this technology is to break the inefficient one-way communication embedded in the traditional lectures where teachers are the only speakers and students are the listeners. Additionally, it compensates for the difficulty that students face in maintaining concentration at those lectures by promoting participation of the students in the learning process. The other advantages of using ARS are: Improvement in student attendance (Greer and Heaney, 2004); students are more focused during the lecture (Bergtrom, 2006); keeping anonymity; student engagement (Simpson and Oliver, 2007) and inclusion (Hill and Fielden, 2017); students actively discuss their misconceptions with their peers and compare the results (Draper and Brown, 2004); enhancement in learning performance of the students; teachers can modify the instructions based on student's feedback and improve the quality of teaching through a better explanation (Elliott, 2003); formative assessment (Beatty, 2005); and regular feedback on learning (Cline, 2006).

Recently, Mentimeter has started paving the way to enhance the learning and the teaching in HE (Lock, 2015; Little, 2016; Rudolph, 2017; Nosek, 2017; Hill and Fielder, 2017). It has already been used to increase the student engagement and inclusion (Hill and Fielden, 2017). The features of Mentimeter are quite promising to use in HE (Little, 2016; Rudolph, 2017).

Lock (2015) emphasised on how the Imperial College London gains value from using Mentimeter system. In her article, she highlighted three types of learning activities which can be run using this system. These are: Formative assessment, pop quiz and exit pass. These three activities helped the lecturers access the understanding of the students about the concept, performance and understanding of the contents, respectively.

Little (2016) provided a technological review of Mentimeter as Student Response System (SRS). This study recommended that Mentimeter can be useful for the quiz,

survey and student-led teaching where the session is driven by the answers of the students to the in-class questions. By investigating his students' viewpoints, it was proposed that the Mentimeter activities can increase their engagement, focus and enjoyment.

Rudolph (2017) reported a short review of Mentimeter. According to this study, Mentimeter improves the student participation during MCQ compared to sessions without it. He identified the Mentimeter as an interactive tool to use for lecture and workshop. While giving a good review of the features of Mentimeter, he also pointed out the negative effect of world cloud feature: The fonts and words become very small if the number of answers is very large.

Nosek (2017) presented a comparative analysis between the Mentimeter and another web-based ARS called Poll Everywhere. This analysis reported that the Mentimeter is more user-friendly, intuitive and compatible with mobile device than PollEverywhere. For example, the audience needs to input a URL into a web browser to connect to PollEverywhere whereas only a simple code can be used for Mentimeter.

Hill and Fielder (2017) studied the positive effects of Mentimeter on the student engagement and inclusion. One of the aims of their work was to investigate the perceptions of the University students on the interactive online quizzes using Mentimeter and whether it improves the student engagement. In one case, Mentimeter was used for a level 4 biology module. When asked for a feedback to observe the students' perceptions of Mentimeter quizzes, 13 out of the 17 participated and the responses of the students are shown below in Figure 1.

Figure 1 illustrates that more than 80% of the participants think that the interactive Mentimeter quizzes were fun. Some also support that the use of Mentimeter breaks up the lectures and reinforces the information which is necessary for quality learning. Beside these responses, all students mentioned that they would recommend using Mentimeter to the other lecturers.

From the studies mentioned above, it is evident that ARS has a great potential of improving teaching quality in a large class. As a result, many lecturers adopt Mentimeter as an ARS in their practice. However, very little research is available on how Mentimeter can promote the learning experience in a large class where student engagement is challenging to achieve.

This paper aims to help bridge this gap in the research work. The article will mainly deal with the beneficial effect of using Mentimeter for a large class in HE by evaluating Mentimeter's features, its systematic use in the formative assessment for a large course and analysing the corresponding students' responses.

Mechanism of Mentimeter and its Features

Mentimeter is a user-friendly web-based ARS system which is currently used by more than 8 million people (Mentimeter, 2017a). Lecturers, mainly, use it to ask questions to the students and take feedback from them anonymously through the Internet. The questions, answers,

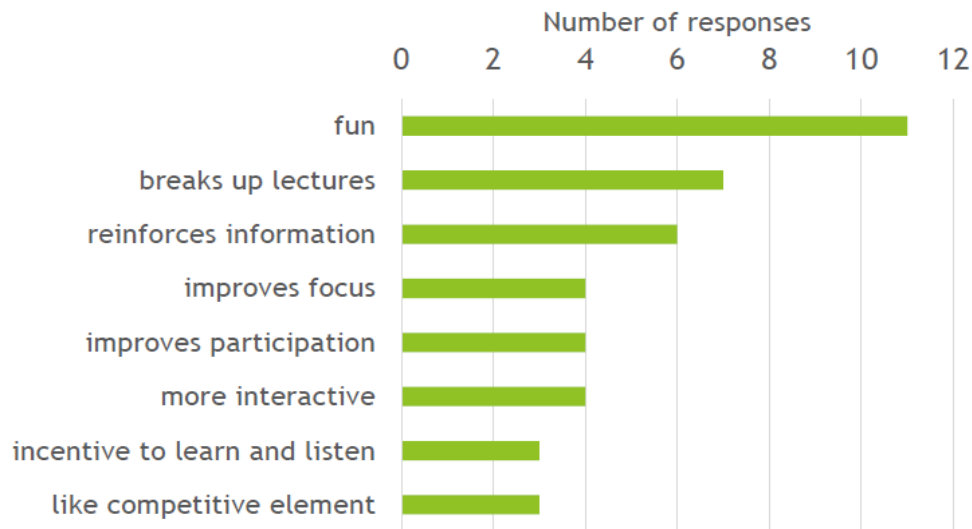


Figure 1. Students' responses to interactive Mentimeter quizzes (Hill and Fielden, 2017).

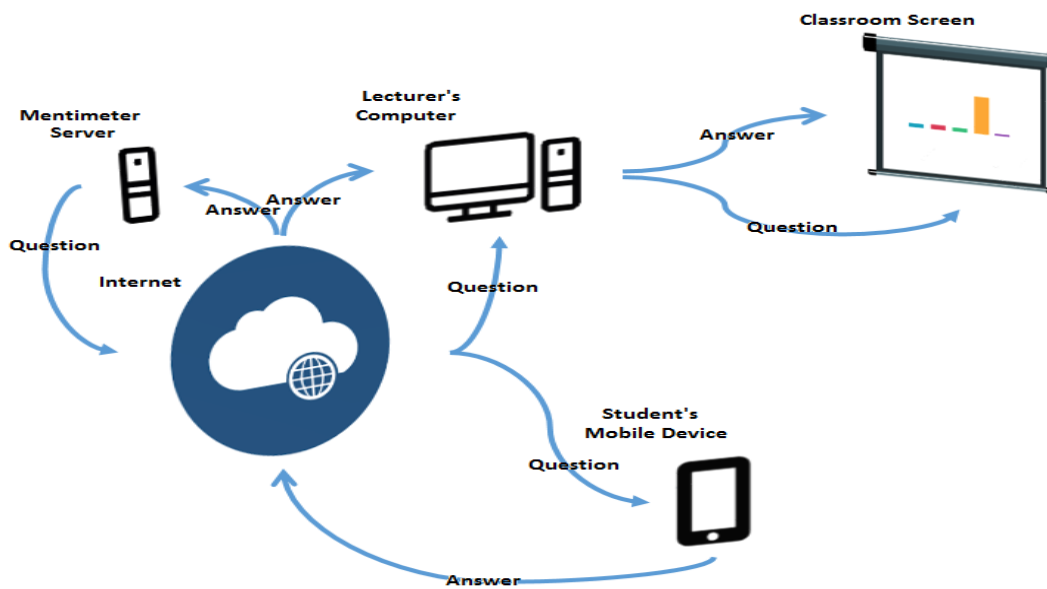


Figure 2: The schematic of the mechanism of Mentimeter in the lecture.

and feedback from a session can be stored as data, e.g. excel file for further analysis. The schematic of this mechanism of Mentimeter in the lecture is further shown below in Figure 2.

The key features of Mentimeter (Mentimeter, 2017b) and their applications in a large class are explained below in Table 1.

An example of the Mentimeter MCQ used in the Materials and Electrical Science Module (level 4) at the University of Hertfordshire (UH) by the Authors has been presented in Figure 3. The histogram shows the response of the

students to a question in percentage.

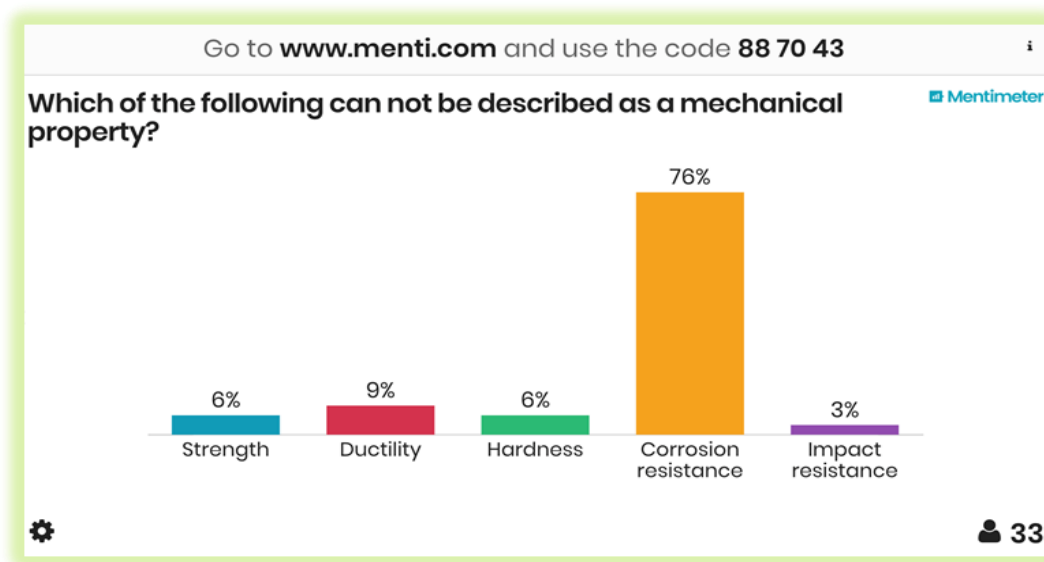
A case study of using Mentimeter for formative assessment in the large class

Background

Mentimeter was used for the formative assessment during the lecture under the level 4 Materials and Electrical Science Module at the University of Hertfordshire (UH). There were 262 engineering students in the class. Once the

Table 1. The features of Mentimeter and their applications

Features	Applications
Multiple Choice	Multiple choice questions with or without image; formative assessment; enhancement of student engagement, active learning, and enjoyment.
Image choice	Aid Visual learners according to the VARK model (Fleming, 2001).
World cloud	Emphasise the most common words submitted by the students in real-time.
Quiz	Engage students in fun and learning-intense competition.
Scales	Evaluating the teaching activity with the learning environment.
Questions from the audience	Evaluate the lecture.
Who will win?	Test and develop knowledge of the students from an instructor, reinforce students' learning. It promotes gamification (Pettit et al., 2015) in lecture, energises the students and motivates them. Additionally, it supports Behaviourist (Skinner, 1968) approach to learning (Naismith et al., 2004).
Quick slides	Lecture presentation.

**Figure 3:** Mentimeter MCQ used by the Authors for Material and Electrical Science Module (level 4).

module was over, a survey was carried out among 25 students (approximately 10 %) from that class including 20 males and 5 females who volunteered in this study. The survey was used to analyse perception of the students towards using Mentimeter in a large class.

Formative assessment

In education, what influences students the most is not the teaching but the assessment (Gibbs and Simpson, 2004). Both the summative and formative assessment are popular to monitor learning of students in HE. Formative assessment can be taken as a good practice in pedagogy because it generates a feedback information that can be used not only by students to enhance their learning and achievement, but also by teachers to re-align their teaching in response to need of the learners (Nicol and Macfarlane-Dick, 2006). As a result, formative assessment improves the quality of the teaching activities, and the related learning outcomes for students. To implement a formative

assessment effectively, teachers need not only substantial knowledge but also the useful classroom materials that can help them make the inferences about what students know with respect to key domain competencies, and about what next to target for instruction (Bennett, 2011). Mentimeter can be adapted as one of these useful classroom materials for a formative assessment process as it is easy and quick to prepare, present and answer questions through Mentimeter.

In the present study, in order to implement formative assessment, Mentimeter was used to generate different types of questions including multiple choice and open-ended questions based on the lecture content. For example:

- ❖ Multiple choices (control questions), e.g., “Which of the following cannot be described as a mechanical property?”

- ❖ Word cloud (open-ended questions), e.g., “What are the applications of semiconductor?”

For a 60 mins of lecture, only five questions were prepared and the questions were presented at the last

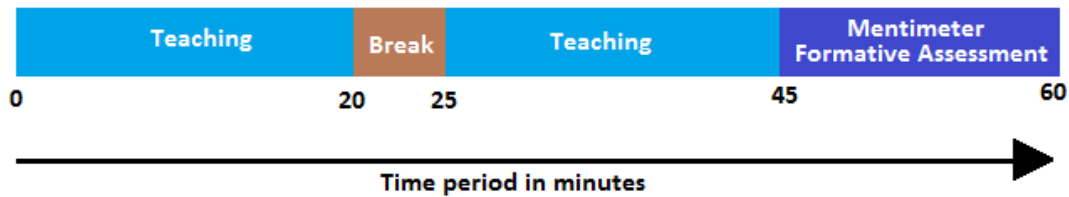


Figure 4: Teaching plan used in Materials and Electrical Science Module (level4) Lecture.

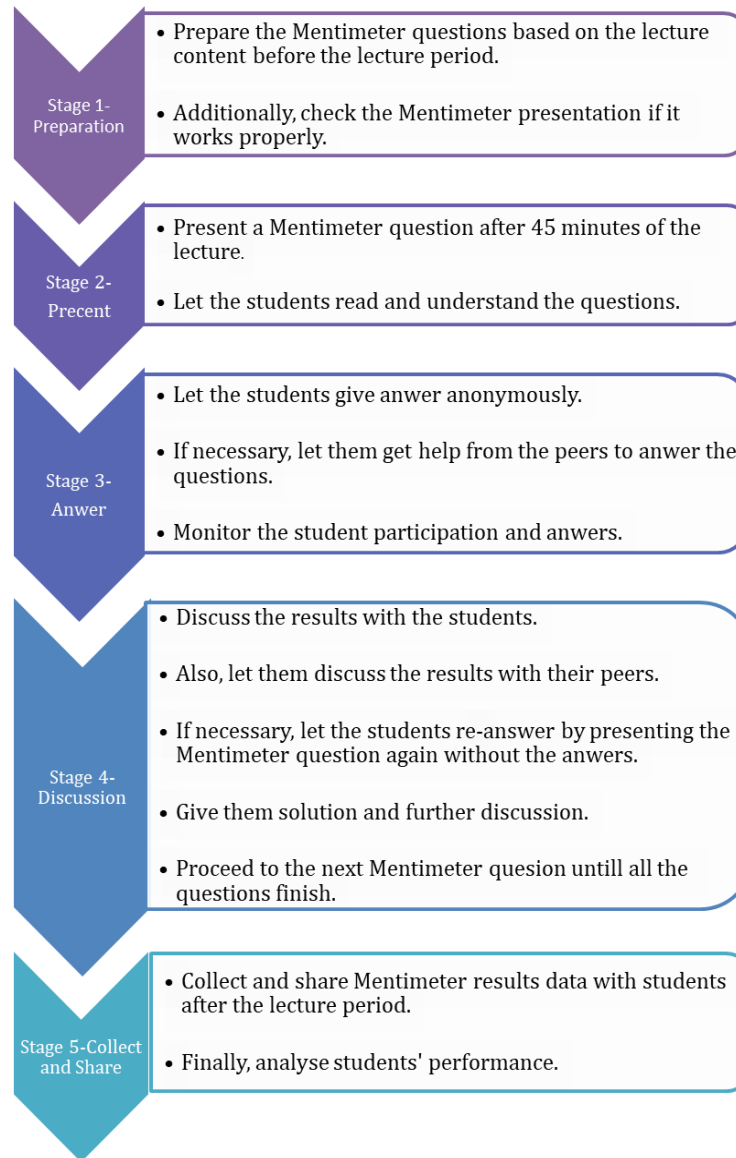


Figure 5: Mentimeter formal assessment model.

fifteen minutes of the lecture as shown in Figure 4. It is a common practice to use around five questions for fifty minutes of class instructions (Elliot, 2003). Furthermore, five minutes of break was taken after the first twenty minutes of lecture so that the students can recover from the mental fatigue caused by the continuous lecture. Even the

study by Burns (1985) has proven that the average human attention span lasts up to twenty minutes, within that period, the recall in memory considerably suffers after fifteen to twenty minutes. The model of the overall process to implement Mentimeter is illustrated in Figure 5.

To implement Mentimeter, all the questions should be

Table 2. Survey results of students' perceptions about Mentimeter.

Main Themes	Survey Questions	Mean Value(n=25)	Standard Deviation
Attitude	1. I prefer Mentimeter over Clicker and raising hand	4.20	1.02
	2. I enjoyed using Mentimeter for formative assessment	4.04	1.00
	3. Using Mentimeter encouraged me to attend the lecture	3.20	0.98
	4. Mentimeter helped me pay attention in the class	4.00	1.06
	5. Using Mentimeter increased my interest about the subject	3.48	0.98
	6. I recommend Mentimeter to other large class	4.24	1.18
Technical	1. I liked Mentimeter features	3.92	0.98
	2. I found no technical difficulty using Mentimeter	4.52	0.70
	3. Mentimeter instructions are clear to understand	4.48	0.81
	4. Mentimeter was easy to access, powerful and flexible	4.48	0.64
	5. Mentimeter was fast and interactive	4.24	0.99
	6. Mentimeter was user-friendly and convenient	4.64	0.56
Performance	1. Using Mentimeter helped me understand the course content better	3.52	0.82
	2. Using Mentimeter for formative assessment was challenging	2.56	1.06
	3. Using Mentimeter helped me apply my knowledge	3.6	1.02
	4. Mentimeter helped me compare my responses with others	4.12	0.86
	5. Mentimeter helped me to get a prompt feedback on my learning	3.88	0.95
	6. Using Mentimeter helped me to perform well in the final test	3.48	1.10
Learning environment	1. Using Mentimeter encouraged class discussion	3.36	1.20
	2. Using Mentimeter improved student engagement	3.92	1.13
	3. Using Mentimeter improved inclusion	3.72	1.11
	4. Using Mentimeter improved participation of the students	4.12	0.86
	5. Using Mentimeter improved the classroom interaction	3.88	0.99
	6. Using Mentimeter encouraged active learning	3.96	1.04

Strongly Disagree=1, Disagree=2, Neither agree nor disagree=3, Agree=4 and Strongly Agree=5.

prepared before the lecture. It is better to start preparing all the questions well before the module starts so that the instructor can have enough time to train themselves on Mentimeter. It will further help them to produce the quality questions for formative assessment which is considered as a challenge (Caldwell, 2007). Mentimeter can be used in different stages of lecture (Hill and Fielden, 2017) depending on the Instructor's teaching style, e.g., the Authors preferred using Mentimeter towards the end of the lecture.

The students should not need extra training to use the Mentimeter as it provides continuous instruction on their mobile device throughout the process. The change in the results can be shown in the form of live histogram feedback which makes the formative assessment process dynamic. The live histogram also allows to monitor the progress of the process and make it time effective. On the other hand, this histogram feedback helps in triggering the classroom discussion (Nicol and Macfarlane-Dick, 2006). It is important to spend enough time in the discussion before presenting the next Mentimeter question. This helps students and their peers to share the dialogue as well as improves their understanding about the learning topic. Finally, the results should be shared with the students to support in their further studies after the lecture. At the same time, This data is subject to analyse and check the students' performance, and to design, and develop teaching style, and course materials.

Students' perceptions about using Mentimeter

A survey was carried out based on 24 questions among 25 students, which contained a scale/ranking from 1 (strongly disagree) to 5 (strongly agree) as shown in Table 2. The mean scores were consistently higher which favoured the use of Mentimeter. To model the survey questions, other survey studies on Mentimeter (e.g., Little, 2016; Hill and Fielder, 2017) were followed. The bar charts of the mean scores are also provided in Figure 5 for further discussions.

Discussion of students' perceptions linking pedagogic theories and benefits

From the results above in Table 2 and Figure 5, it is evident that the views of the students towards using Mentimeter was affirmative.

The students found Mentimeter formative assessment enjoyable (Figure 6 (1)). They also recognised that Mentimeter helped them to pay attention in the class. The Mentimeter quiz also engaged in another study (Hill and Fielder, 2017). Little (2016) also suggests that the Mentimeter activities can increase the focus and enjoyment of the students. Like other Clickers, it can increase student attendance (Greer and Heaney, 2004). Students also preferred Mentimeter over conventional technology in the present study, such as the Clickers. Bringing the Clickers and distributing them to all of the students in a large class

Table 3. General comments of students' perceptions about Mentimeter

Complimentary Comments
"I really enjoyed using the Mentimeter because it is much more reliable than the Clickers. Also, since it is available on your phone, almost everyone can access it easily as 99% of people own a smartphone. Inclusive. Consolidate learning. Makes lectures more interesting."
"I think it would be perfect. You can know if the app is working or not but in Clickers you don't."
"Mentimeter shows faster response by the system and easier to compare other people's opinion or choices. It's a much better technique than Clickers."
"It's good, it gets students to engage, recap, apply and conclude material in the lecture and it gets people to speak to their colleagues."
"Mentimeter is a good way to engage all the students in large classes. Clicker is a bit technical as we have to change the channel in different rooms and we cannot know if we are connected or not but in Mentimeter we know we are connected."
"A normal lecture room usually has more than 200 students which makes it hard for the teacher to engage with the students. Mentimeter makes it easy. It also helps students to participate in the lecture more confidently."
"I would definitely recommend using Mentimeter in a large class. It makes it really easier for the students to interact and able to understand the course content better. I really like the way this tool is presented to students to enhance their studies and also to clear any doubts if someone may have. Also, getting the prompt feedback makes it a great tool compared to other normal learning tools."
"I believe that Mentimeter offered an interactive fun and educational aspect to lectures that assisted in my learning in key subject areas. It added an element of fun to the lecture, learning other lectures. Promoted learning."
"Mentimeter was very helpful for me in understanding this module. I think Mentimeter is a good way to engage with students in large classrooms."
Critical Comments
"I found Mentimeter took up a vastly disproportionate amount of the lecture time and felt it was a poor substitute for actual teaching."
"Not recommended too disruptive and an excuse to mess around for some class members."
"Using mobile and connecting it to the internet during the class could sometimes serve as a distraction."
Technical Improvements
"A reliable WiFi connection is essential. More reliable WiFi connection is essential. More statistics/feedback could be provided to students about their answers."
"There can be a slot for student ID or name in the beginning so this can be used for phase testes as well."
"Have an extra phone ready in class in case some students forget their phone or run out of battery."
"Use a more stable and stronger WiFi connection in the room as sometimes, the connection is weak and doesn't record the response causing delays and distribution."
General Improvements
"Not everyone will participate, I am not sure how to fix this perhaps an incentive could be offered, e.g., price for the highest scoring students across the semester."
"Use timer for every question."
"I think it can be improved if Mentimeter had device like Clicker to access and answer the quiz. Some student may not have access through phones. Therefore, I think there should be a specific device for Mentimeter."
"Maybe adding some hint feature with the choices of question, to think more deeply about the right choice. This can make learning efficient by gaining more knowledge on that topic. It is still anyways a great tool to use."
"There should be less anonymity, students should use their name, instead of derogatory terms for example. There should be a leader board, get points depending on how quick you answer, it boosts morale and act as an incentive."

has been a burden for some lecturers (Hwang et al., 2015). At the same time, raising hands is not out of concern as the data regarding the students' answers get lost once their hands are down (Abrahamson, 2006). Some of the comments of the students are presented in Table 3.

According to the students, Mentimeter was technologically sound (Figure 6(2)). It was also user-friendly, as evidenced by the number of positive comments presented in Table 3, which agreed well with Nosek (2017). Mentimeter is considered an interactive tool (Rudolf, 2017), and students in this present study also identified it as interactive and fast. However, the main drawback of using web-based Clickers like Mentimeter is that they cannot be used without the internet. In the study of Hwang

(2015), some students commented that the WiFi signal was not strong enough for all of the students in the classroom to use at the same time. In addition, technical comments in Table 3 also highlighted the necessity of better WiFi connections to improve the user experience. Therefore, universities should invest more in better WiFi connections to enhance their learning experience.

Mentimeter helped students perform well in their final test (Figure 6(3)). They understood the course content and applied their knowledge. Bloom's taxonomy (Krathwohl, 2002) indicates that 'understand' and 'apply' are the cognitive processes by which thinkers encounter and work with knowledge (Figure 7). Mentimeter also helped prompt feedback, which is considered good practice

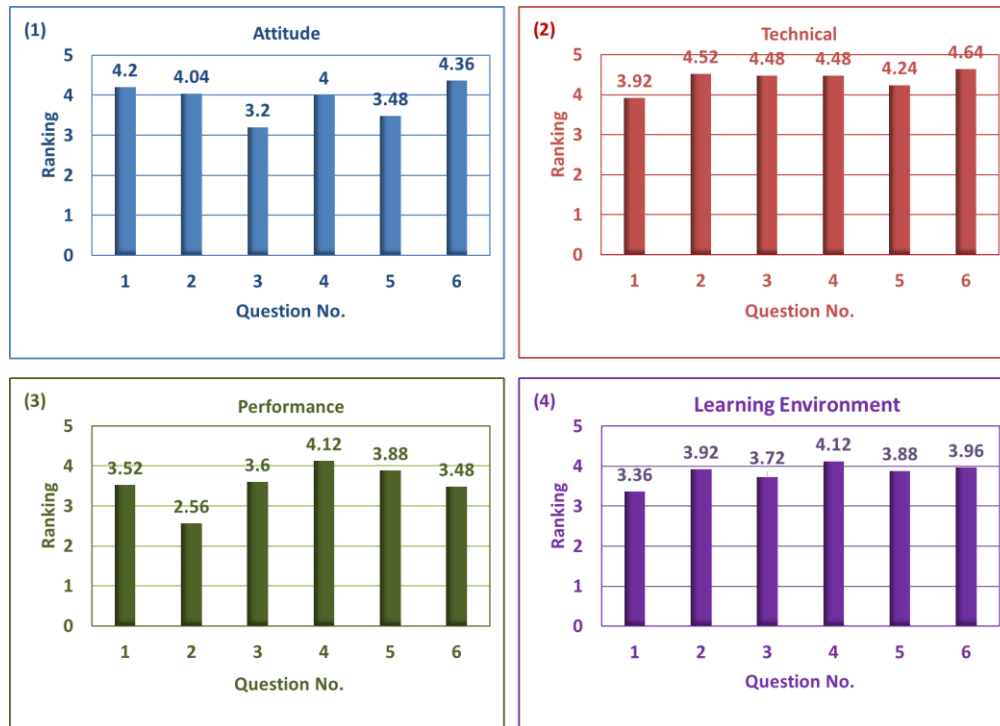


Figure 6: Bar charts showing students’ perceptions: (1) Attitude, (2) Technical, (3) Performance and (4) Learning Environment.

Bloom’s Taxonomy

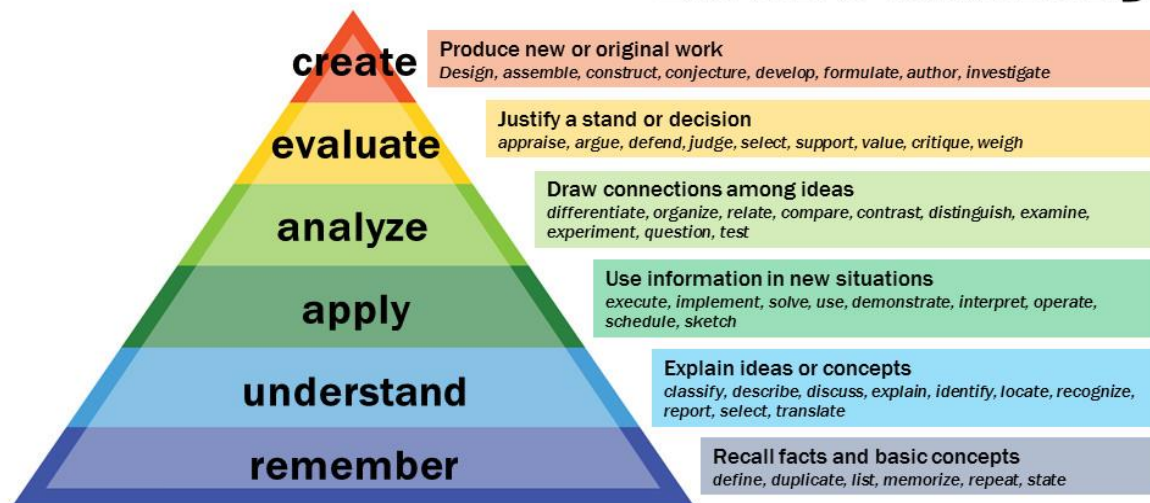


Figure 7: Creative Commons attribution on an image of the Bloom’s Taxonomy (Vanderbilt University, 2018).

(Chickering and Gamson, 1987). However, in this study, students did not find Mentimeter formative assessment challenging (Figure 6(3)). Therefore, ‘Quiz’ and “Who will win?” (Table 1) type questions can be added along with the MCQ to make it more challenging. Moreover, Imperial College London is currently benefiting from Mentimeter (Aronsson, 2017) by using it for formative assessment, including pop quizzes and exit passes.

Mentimeter has been proved to promote student engagement (Little, 2016), participation, classroom interaction and inclusion (Hill and Fielder, 2017) which are the key factors for an effective learning environment. In this present study, students’ perceptions have also supported these findings (Figure 6(4)) and complementary comments in Table 2. Using mobile phone-based ARS made classes more interactive and less boring (Tremblay, 2010). This

classroom interaction can be of three types: learner-content, learner-instructor and learner-learner (Moore, 1993). Moreover, students felt that Mentimeter encouraged active learning which is considered as one of the seven principles of good practice in undergraduate education (Chickering and Gamson, 1987). Nicol and Macfarlane-Dick (2006) argued that one of the seven principles of good feedback practice is “encourage teacher and peer dialogue around learning” and the histogram feedback of ARS can be used as a trigger for peer discussion and teacher-managed discussion in large class. Again, deep learners tend to share a constructive attitude toward using clickers, especially when perceived advantages of using the Clickers in their learning (Kelvin, 2017). A very few students disliked the use of Mentimeter in a large class. They found it to be a poor substitution for traditional lecture material as explained in the critical comments of Table 3. However, this could be improved by experience through a timely structured lecture session which offers a balance between lecture material and Mentimeter use. Overall, the response has been hugely positive and students’ perceptions clearly suggest that it encouraged class discussion. Therefore, this present study established that the students are welcoming the use of Mentimeter in the large class as it promotes elements, such as interaction, inclusivity, engagement, and participation which are essential for the high standard learning experience.

Conclusion

Overall, Mentimeter is easy to access, a powerful and flexible tool which has the solution to improve learning and teaching in the large class. It can play a key role in changing the dynamics of the large classroom by promoting active learning, student participation, and enjoyment. Formative assessment can be more interactive and fun using Mentimeter. The formative assessment data can also be stored and analysed further to design and manage the course. Students also appreciate that the technology integrated learning through Mentimeter has the pedagogical benefits. Teachers, on the other hand, can benefit from using Mentimeter to assess students’ understanding and improve their own teaching style.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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