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Learner Centered Classroom in Science Instruction: Providing Feedback with Technology Integration

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Abstract

"Learner centered" term points out environments that attention to the learners brings to the educational setting. This term includes teaching practices: effort to uncover what learners think in a specific problem on hand, talking about their misconceptions and, giving them situations to readjust their ideas. In Learner centered classrooms, teachers assess different student for feedback and revision. The two major, summative and formative, assessment reveal individual students' progress continually. Teachers, in many classrooms, provide feedbacks to students are relatively rare. Feedback is most effective in learning when students have the opportunity to use it to readjust their thinking. Technology integration, a part of learner centered classroom, is support to providing feedback in effective way. This paper explores the design of learner centered classroom in relation to the interactive technology integration which is based on using mobile technology to provide effective feedback in learning environment. Higher education students used mobile interactive technology with teacher, one term, in misconception in science course. Qualitative research design was used in this research. Focus group interview method was used to get data collecting. The study findings show that mobile technology supports feedback effectively and promote student engagement in the classroom.

Introduction

Learner centered classroom, within the past decade, has been an effective environment for enhancing the student's learning experience (Bishop, Caston, & King, 2014). Learner centered classroom has different, a specially aspect of student learning outcomes, from traditional classrooms. Traditional classrooms are based on "focus on teacher needs", "transmission of knowledge, skills, and experiences", "pull-out learning". On the other side, learner centered classrooms focus on learner outcomes. Such as, "Inquiry into teaching and learning", "job-embedded learning"(Loucks-Horsley, 1995). Learner centered classroom helps developing of students' real-life skills. For example, problem solving skills, and collaboration (An & Reigeluth, 2012).

Students already have knowledge, skills, attitudes, and beliefs about any of subject (Bransford, Brown, & Cocking, 2000). So, when they came to class, they may have prior knowledge of subject. Teachers should take consider of every students' knowledge for good instruction. If teachers want to establish learner centered classroom for effective teaching, they take care of response of students. And, teachers ask to students some questions to learn their knowledge about the subject (Borich, 2013).

Questioning is may be the simple way to learn students' knowledge. At that point, types of questions are very important to uncover how students understand the new concepts. Teachers use different techniques for questioning. But, to be effective all questions need to combined with feedback (OECD, 2005). For instance, if teacher ask to student verbal question, at same time he/she should give feedback to student. Feedback is most effective in learning when students have the opportunity to use it to readjust their thinking. If teacher want to ask any question to students, He/she select several students purposeful or randomly. There is no way to ask a question all students and give feedback to them at same time in classroom in traditional class.
In traditional classrooms environment, students' seating position are based on consecutive seating arrangement. The figure below illustrates the main characteristic of traditional classroom seating arrangement (Figure 1).

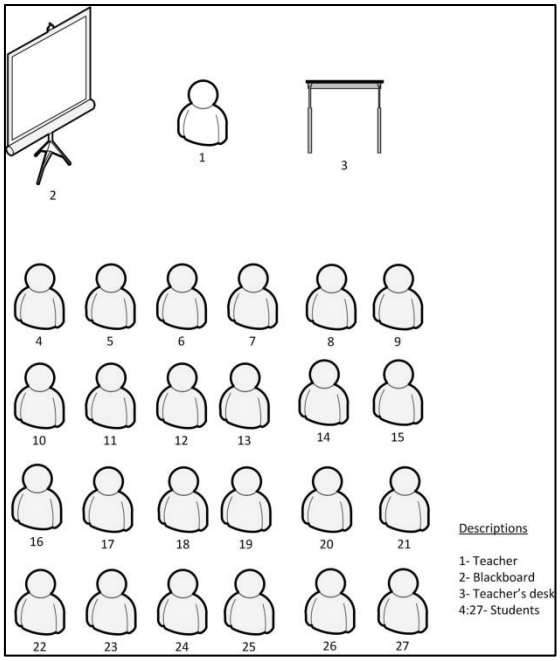

Figure 1**.** Seating position in traditional classroom

It is apparent from Figure 1 that teacher is in front of students and all students are consecutive seating position. This class is partly middle size of a classroom environment in school. Especially at the university level, classrooms are bigger and much more crowded. As it is shown in the Figure 1 student number 4 to 9 are in front of all other students and find the opportunity to more easily communicate with teacher. On the other side, Students sitting in the back, number 22 to 27, not have the same opportunities to communicate with teacher.

If learner centered classrooms focus on student's outcomes, that classrooms should give opportunities to students get feedback from teacher. Considering, students seating position and crowded classroom environment it is hard to reach all student at same time to give feedback in learning activity. Creating technology-enhanced classroom can be an effective way to solve that problem.

Technology-enhanced classrooms increase student achievements, and make classes more engaging, and provide professional tools for teachers. And, also connect schools with parents (Zucker, 2008). Technology not only using in classroom environment as an instructional tools but also use different type of area as a learning tools. Such as; distance learning, mobile learning, blended learning, distributed learning, e-learning…etc. But one of the technology maybe the most popular using in the classroom is "clickers". That technology is called different names by researchers. For instance; Beatty and Gerace (2009) are called: "Classroom Response System (CRS)", Blasco-Arcas, Buil, Hernandez-Ortega, and Sese (2013) are called: "Clickers", Nielsen, Hansen, and Stav (2013) are called: "Student Response System (SRS)", Wolter, Lundeberg, Kang, and Herreid (2011) are called: "Personal Response Systems (PRS)". As can be seen in literature the researcher use different names but all systems based on substantially similar technology.

Technological infrastructure of the system is based on clicker, access point, computer, and projector or screen. *Clicker:* A small hand device used by student for answer to questions. *Access point (AP):* A small portative device establishes a connection with clickers. *Computer:* With using that device teacher can ask questions to students and get back answer from the students with special software. *Projector (or screen):* Using for sharing or visualizing students' answers, collected by teachers' computer, to all students in the classroom.

Lots of studies were made by researcher to evaluate usage of "clicker" in instruction. Addison, Wright, and Milner (2009) investigated "using clickers to improve student engagement and performance in biochemistry course". They found that usage of clickers, particularly in increase students participation and engagement in lectures. Crossgrove and Curran (2008) used clicker as a course material in a long-term. Research show that "Students had positive opinions of the clickers", and "students' performance was significantly higher on exam". Oigara and Keengwe (2013) used "clickers as an instructional tool to promote active learning". They found that approximately all of students were positive opinion of using clickers in class lectures. And, clickers promoted participation of students' engagements.

That technology helps to establish multi-interactions (students to teacher and teacher to students, also student to student) in classroom environments. Teacher can ask any questions to students in the classroom any time. All students can answer those questions and also get feedback from the teacher in a short time. But, as with any technology, this technology can also get a cost for users. Students or schools should buy clickers. For instance, assuming that there is a medium size class and it has 24 students seated in (as can see on Figure 1). So, all students need a clicker device for attending.

Background of the Study

There are some significant changes in our lifestyle by technology, especially developing of cyberspace technology. People are started to interaction by online. The internet provides individuals with people's own spaces for their work such as writing, showcasing (Stein & Graham, 2014). At that point, we can say about students is that they meet internet technology before the teacher and school (Stein & Graham, 2014).

Pedagogical integration of technological tools into curriculum is becoming more of an issue (Kong, 2015). The schools and governments around the world are spending money for systems that is designed to personalize instruction and engage students (Henrie, Halverson, & Graham, 2015). It is hard to do learner centered learning environment, considering large classroom. On the other side, In classroom, positive teacher-student relationships are important factor for learner centered education (Cornelius-White, 2007). To establish a versatile interaction in classroom environment, pedagogical interaction of technological tools is play a fundamental role. Yılmaz and Sanalan (2015) reported that feedback is important for individualized learning and need to be design from regular classroom to interactive classroom. Their suggested interactive classroom environment can be shown as a pedagogical integration of technology tools.

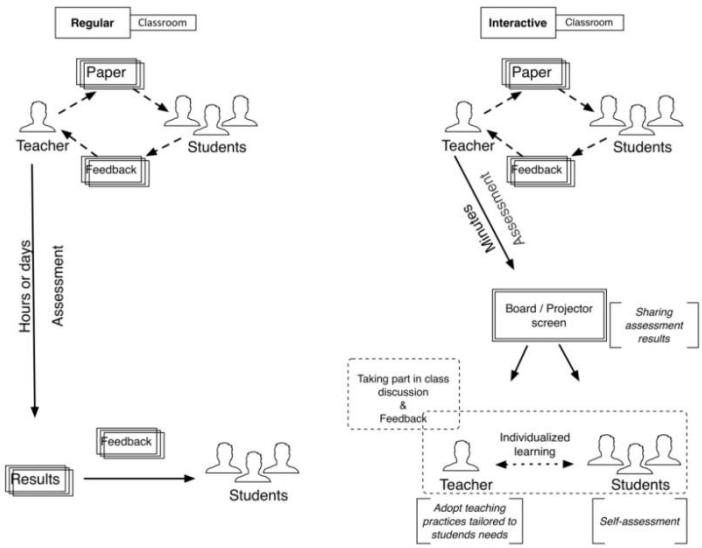

Figure 2. Regular classroom environments versus interactive classroom environment (Yılmaz & Sanalan, 2015)

Figure 2 presents the teacher and student interaction based on feedback is effect on individualized learning. If learner is center the instruction, classrooms should be designed for giving opportunities to learner get feedback from teacher. The aim of this study is to evaluate whether and how effective of self-phones as a clicker for establishing an interactive, learner centered classroom in science instruction.

Qualitative research approach was used in this study. This research approaches collect data through interviews, observations, and document analysis. The most common qualitative research approach is case study. 'Case study typically focus on small groups or individuals within a group and document that group's or individual's experience in a specific setting' (Lodico, Spaulding, & Voegtle, 2006). The qualitative research question was proposed below.

If self-phones use as "clickers", does it effective on supporting feedback in the classroom and designing learner centered classroom

Method

Participants

The study participants were eighteen undergraduate students enrolled in a Misconception in Science (It's an elective course) in the spring of 2015 semester faculty of education in the east of Turkey. The class sample consisted of 7 male and 11 female students. All participants were ranging from 21 to 27 years old (median age was 23 years). There were slightly more female than male students in the class (female 61.1% and male 38.8%).

Procedures

During the first week of class, the teacher and every student were given a special demo course for how would be used self-phone in classroom. During each session, students were used own self-phones by individually or with peers as a team. The self-phone based system helped to bring about student involvement through peer discussion. The teacher used clickers to examine students' conception or misconception. During lecture, feedback system based on self-phone, the following activities occurred: (a) the teacher asked questions to students to learn they already have knowledge about on the special science concept; (b) students wrote individual answers with using self-phones, (c) before to sharing students' answers to whole class, the teacher checked on all answers, get from students, in a short time, (d) all students' answers were displayed on projector screen, (e) teacher is given feedback to students about the answered questions and arranged discuss about scientific concepts of topic.

The feedback system based on self-phones used in class weekly for scientific concept quizzes (about 10 times during the semester). The quizzes consisted of changeable numerous questions, with a multiple choice, multiple answers, open-ended or true/false question that covered the lecture content. The teacher administered one question or concept quizzes before starting topic, during topic or end of the topic.

Instructional Tool: Feedback System based on Mobile Technology

Hardware system requirements: (a) Self-phone; mobile device can wireless connectivity feature over Wi-Fi networks or operator service using with 3G connectivity, (b) Computer; regular any type of personal computer has special port to connect projector, (c) Projector; A machine for projecting data from the computer onto a screen.
Software system requirements: (a) Internet browser; installed on computer and self-phones. User interacting that interface for sending or reading the questions-answers. (b) Socrative; a web interfaced program (also can be used special app downloaded from mobile app service). Feedback system based on mobile technology is illustrated on figure 3.

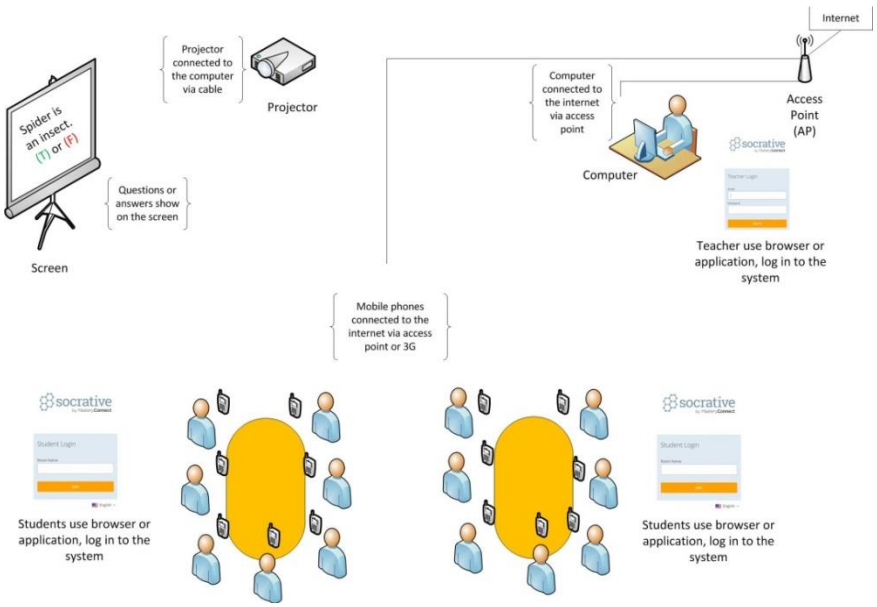

Figure 3. Educational setting of learner centered classroom

Data Collection and Analysis

This research focuses upon the meanings students assign to their experiences with using self-phone to learn new concepts in "Misconception in Science" course. The research is designed qualitative basement. Researcher is asked to students open-ended survey questions with a paper form. Survey questions were designed to gather information on student experiences use of self-phones as feedback system in the classroom. The questions were adapted from study of Manke-Brady (2012): (1) How did shared assessment results on screen cause you to evaluate your thoughts? (2) How have feedback system caused you to change the way you take notes? (3) How have feedback system caused you to compare your answers to other students? (4) How have feedback system helped you understand course concepts?

The data from the four open-ended survey questions responses were analyzed with Nvivo packed program. All students' response are explained a theme which is based on question. In all themes, illustrated specific figure and some students statements are given for explain to related concept nodes. These statements are called "Reference" and showed as "R" at the end of sentences. All Findings are figured in four themes.

Results and Discussion

Based on qualitative data, four question driven themes emerged from students' experiences. So, it can be seen below some nodes of themes duplicated. The data analysis results obtained from the first question are illustrated figure 4 which is named "students' thoughts" theme.

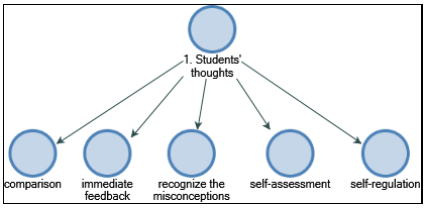

Figure 4. Students' thoughts

It is apparent from Figure 4 that students' thoughts grouped in five areas (5 nodes). Some of selected quotations from students are listed below. Also showed, how many times referenced a node.

- *Comparison (8 references):* "I had the opportunity to compare myself with others. I had the opportunity to see my right and wrong answer. (R8)"
- *Immediate feedback (3 references):* "It was effective, because I have received feedback instantly. (R2)"
- *Recognize the misconceptions (2 references):* "It helped me to think more deeply. I've seen my misconceptions more clearly by comparing the response of my friends (R1)"
- *Self-assessment (6 references):* "I had the chance to do self-assessment. I consider myself in front of mirror. (R2)"
- *Self-regulation (3 references):* "I was able to fix my mistakes. (R1)"

Making learning visible is useful for monitoring students' own understanding. The technology plays an important role when need to engagement and participation during the lecture (Ludvigsen, Krumsvik, & Furnes, 2015). Figure 4 illustrates that the interactive learning environments is provide an improvement the monitoring students' own learning in lectures. Students stated that they found an opportunity to saw all peers' answers ("comparison"). That's helps adjust students own understanding ("recognize the misconception", "self-assessment") and draw their own conclusions ("self-regulation"). Learner centered classroom environment conduct students' assessments not just for grades but to support learning (An & Reigeluth, 2012). Assessment takes on a particular role in curriculum such as defining goals, learning objectives (Corelli, 2015). At the end of assessment, formative feedback is improve students' learning (Shute, 2008). In figure 4 shows, the students found that instantly feedback ("immediate feedback") in lectures. The feedback is impact on adjust their own learning.

The data analysis results obtained from the second question are illustrated figure 5 which is named "change the way of taking notes" theme.

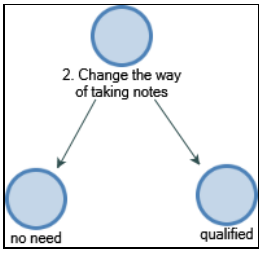

Figure 5. Change the way of taking notes

It is apparent from Figure 5 that students' thoughts grouped only in two nodes. Some of selected quotations from students are listed below. Also showed, how many times referenced a node.

- *No need* (3 references): "I have learned on a permanent basis without the need to take notes (R1)"
- *Qualified* (1 reference): "The system helped me more permanent learning. So, I did not have to take unnecessary notes (R1)"

In lectures, taking notes cause deeper process in the mind. That is a kind of cognitive ability and a time dependent process (Anderson & Armbruster, 1986). In science lectures, sometimes students don't choose best note format. They just use create outlines (Bellinger, 2016). Figure 5 illustrates that interactive learning environment changed students' taking notes habituation. All of them argue that environment effected on permanent learning. So they didn't need to take notes in lectures. Also, students have opportunity to take specific notes without unnecessary ones. Note taking is a cognitive difficult activity. Teachers need to prepare multiple simultaneous learning tasks for students (Boyle, Rosen, & Forchelli, 2016). Also, they need to guide learner toward managing their own current and future needs (Stacy & Cain, 2015). Findings based on figure 5 indicated an improvement in taking notes as well as support permanent learning when interactive learning environment used in instruction.

The data analysis results obtained from the third question are illustrated figure 6 which is named "comparing the answers" theme.

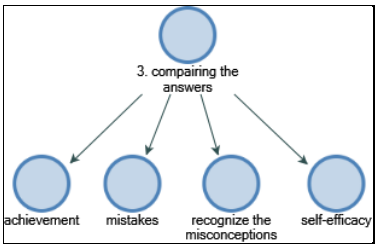

Figure 6. Comparing the answers

It is apparent from Figure 6 that students' thoughts grouped only in four nodes. Some of selected quotations from students are listed below. Also showed, how many times referenced a node.

- *Achievement* (7 references): "I saw my own success in the classroom. (R1)"
- *Mistakes* (4 references): "I noticed my mistakes and error. (R2)"
- *Recognize the misconceptions* (3 references): "I saw more clearly my own misconceptions by comparing the response of friends. (R2)"
- *Self-efficacy* (2 references): "I saw the point that I was inadequate. (R2)"

Self-efficacy is one's personal beliefs about their competence or effectiveness in a specific area. The student own experiences are the most effective source of efficacy information (Woolfolk, Hughes, & Walkup, 2008). Perceived efficacy in certain activities may seem particular from person to person (Bandura, 1997). Figure 6 illustrates that students have opportunities to show their mistakes and recognize the misconception, and evaluate their achievements. These findings are similar to figure 4 findings. All these are show that feedback effective on students learning as an adjuster factor. Because, students also said that they are inadequate in some point. Their perceived efficacy is changed with timely feedback in interactive learning environment. Chan and Lam (2010) reported that feedback, a specially formative and self-referenced, 'enabled students to perceive a sense of control over their progress were beneficial to their self-efficacy'.

The data analysis results obtained from the fourth question are illustrated figure 7 which is named "Understanding the course concepts" theme.

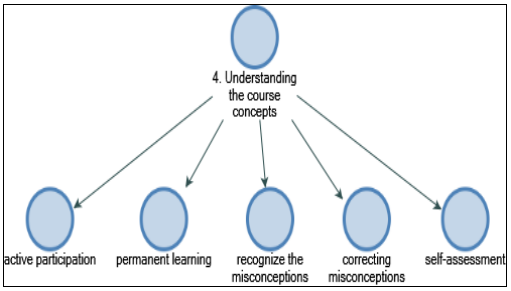

Figure 7. Understanding the course concepts

It is apparent from Figure 7 that students' thoughts grouped in five nodes. Some of selected quotations from students are listed below. Also showed, how many times referenced a node.

- Active participation (4 references): "We actively participate in the class because the system is fun." (R3)
- Permanent learning (3 references): "The system used is systematic and planned. So, it has provided permanent and effective learning." (R2)
- Recognize the misconceptions (2 references): "I saw more clearly how misconception is originated." (R1)
- Correcting misconception (3 references): "I had the misconception correction facility much more quickly"
- Self-assessment (2 references): "I realized that I should overthink before solve any problem or questions." (R2)

The fourth interview question was to how have feedback system helped you understand course concepts. Course content was (1) definition and general sources of misconception, (2) presenting samples of subject detected the existence of misconceptions from science education literature, (3) developing solution suggestions for no forming or removing of misconceptions and applying. Findings in the figure 7 indicated that feedback system was supported: (1) Learner centered: recognizing and correcting misconception, self-assessment (2) Classroom environment: Active participation and permanent learning.

Researchers who are studied about use of "clickers" in instructional environment have emphasized similar findings. Oigara and Keengwe (2013)'s study showed that students were satisfied with use of clickers as an instructional tools. Clicker 'promotes student engagement in the teaching and learning processes'. Blasco-Arcas et al. (2013) investigated the effect of clickers on student learning performance. They found that use of clickers have influence 'high level of interactivity with peers and with the teacher', 'active collaborative learning and engagement' and 'improves student learning performance'. Another research showed that students were generally 'positive toward the use of clickers'. It has potential to 'increase classroom interactions'(Wolter et al., 2011). According to Kay and LeSage (2009), key benefits for using ARSs increases in attendance, attention levels, participation and engagement and effective on interaction, discussion, contingent teaching, quality of learning, learning performance, and feedback.

In summary, teachers don't need any kind of technology in order to ask students thoughtful questions in classroom. They can just ask question and listen to answers in a simply way. The problem is with this strategy, do all students are engaged interactively. At that point, "Clicker" is new technology that is effective on interactivity. But, it needs to take in to account of cost and effective. Clickers can make learning and teaching in classroom more educationally productive, we can see all research about using clicker in educational setting. In class, all students need personal clicker to active participation. But it cost students or schools money. In this research, a feedback system designed with mobile phone instead of clicker. The results showed that the feedback system based on mobile phones, as an alternative to the clicker, provided a variety of benefits in science instruction: (A) recognizing and correcting the misconceptions students have in science literature, (B) timely systematic feedback about student understanding about the concepts, (D) promoting active engagement in classroom.

Limitations

In this study, we examined the effects of use of self-phone as a clicker for providing feedback in relatively small classes. It should be noted that more research is needed to the best practice of self-phone use to determine if it

can effective on support learner centered classroom. However, main and interaction effects were revealed for recognize and correcting misconception, permanent learning, self-assessment, self-regulation, self-efficacy, achievement, recognize mistakes, and active participation despite the small number of students reporting.

The most significant limitation of this study is that the results are based on responses to an interview questions that are relatively explanation of a personal concepts about feedback system based on mobile technology. Future research need to do in large samples and special survey should use for explain the effective factor of active learning environment in science instruction.

Conclusion

The present study was designed to determine the effect of usage of mobile technology as a feedback tools for establishing learner centered classroom in science instruction. As mentioned in the introduction, "clickers" using in the classroom to support instruction and learning, and students opinions are positive. From the data in Figure 3, it is apparent that students have no negative opinions. The system used in class not only effective on support immediate feedback but also effective on self-assessment and self-regulation. Also, that feedback is making easy to comparison of the students themselves with friends. And, it is effective on improvement in the quality as well as the quantity of peer discussions (Ludvigsen et al., 2015). Having peer assesses communicate with their peer need in order to produce high quality feedback (Hovardas, Tsivitanidou, & Zacharia, 2014). Feedback is influence on students' performance (Shute, 2008). But not all feedback is effective. Timely and specific feedback is suggested way to improve future performance of student (OECD, 2005). That student's response explains how the system used in class effective: "It helped me to think more deeply. I've seen my misconceptions more clearly by comparing the response of my friends." Also, as can be seen on Figure 6 and Figure 7, students' responses are positive on system used in class. It's especially effective on recognizing the misconceptions and correcting misconception. This of course is not alone and directly based on the used technology. In Figure 7 there is a clear explanation two response by students.

Active participation and permanent learning are very important factor for instruction. Edwards (2015), express active learning framework on three strategies. These are intellectually active learning, socially active learning, and physically active learning. Socially active instructional strategies based on small or whole group discussions, and small group projects. System used in class provides feedback to students, and also to teacher. So, all students in the class start to discussion about feedback that is include right or wrong answers. Interaction between teacher-student and student-student with discussions is impact on active learning.

The results of this study indicate that used system in the class, based on self-phone technology, suitable for designing learner centered classroom in science instruction. Self-phone effective on providing feedback. And, it probably would be future technology instead of clicker to provide active engagement in learner centered classrooms.

Promoting active engagement in classroom is important fact for learner centered classroom. Receiving immediate feedback from teacher is key element for engaging students learning activity. The system used in science instruction effective on: (1) Learning: recognize and correcting misconception, permanent learning, (2) Individual changes: self-assessment, self-regulation, self-efficacy, achievement, recognize mistakes, and active participation.

Note

This paper was presented at the International Conference on Education in Mathematics, Science & Technology (ICEMST), May 19 - 22, 2016, Bodrum-TURKEY.

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