

ENHANCE COGNITIVE LEARNING OF JUNIOR HIGH-SCHOOL STUDENTS THROUGH THE IMPLEMENTATION OF CONSTRUCTIVIST MODELS OF LEARNING BIOLOGY-BASED ICT (ICT-BASED MPBK)

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ABSTRACT

The purpose of the research is to see an increase in student learning outcomes through the implementation of learning with models of biological-based constructivist learning, information and communication technology (ICT-based MPBK). This research is descriptive research. Sampling was done in purpose random sampling. The subject of research is the grade VIIIA (31 persons) and VIIIB (29 people) SMP Negeri 6 Makassar. The number of overall students is as many as 60 people. The research design used was Pre-test and Post-test group design. The Data was collected by using the test results to learn instruments. Data were analyzed by descriptive in terms of averages and percentages. An increase in student learning outcomes used in the analysis of gain normalization. The results showed that the implementation of ICT-based MPBK models can improve the learning results of students with average index gain normalization of 0.7. Based on those results, the MPBK model-based ICT can improve the results of the study of biology students in JUNIOR high with a category.

Key words: CLMB ICT-based, Constructivist, E-Learning, Blended Learning, Learning outcome

1. INTRODUCTION

There is some research that reveals that the findings of the study of biology in junior high school tend to train only students simply to memorize facts. Therefore, students in general are powerless to confront the problems that demand thought and problem solving that are critical and creative. They are difficult to connect between the learning concepts and how their knowledge is used [1]. In addition, they are trying to understand concepts that are abstract, and they are failed to solve the problem if the content is changed [1]. The reality suggests that the ability of student's cognition has not been trained optimally. Lestasi found that most of the questions used by a biology teacher are limited at the level of cognition questions C1 and C2 [1]. Similar things are also reported by Fahirah, 1997, Rahayu, 2001 [2]. The results were in line with preliminary results of the study conducted at three junior high schools in Makassar, Indonesia. The research was assessed with a test that leads to process of high-order thinking skills. The research showed that the average value for each school is 25.13, 28.83 and 35.00 with the category are very low (Adnan, 2012 unpublished). In order to resolve the issue, the learning model based on a constructivist paradigm by utilizing information and communication technologies needs to be developed. The model is called Constructivist Learning Model for ICT-based Biology (CLMB ICT-based).

Constructivist learning theory believes that knowledge is actively constructed by the learner rather than received from teachers. They are more active in constructing knowledge than passive in receiving information [3, 4, 5] Cognitive constructivism holds that knowledge is constructed by learners individually based on previous experience and new information. Knowledge is the result of the internalization and externalization reality reconstruction lasting accurately [6]. Social constructivism holds that knowledge is the result of social construction within a socio-cultural context [3, 7] This learning environment supports collaborative learning through social interaction. It will improve lessons in analyzing the problem from different points of view and create many solutions [7]. This process allows students to construct new ideas rapidly with a high level of achievement. A collaborative learning process makes students working in harmony with each other. This process supports the ideas that positively affect the results of his studies. In addition, through this process, the learners participate in decision making, utilize the role of differences and work together with pleasure [7].

Constructivist Theories

Vygotsky argues that knowledge is constructed by children through social interactions in the proximal zone of development (zona perkembangan proksimal/ZPP) [8]. ZPP is the distance between the actual developmental levels characterized by the ability of a child to resolve the issue without the help of others. In addition, ZPP is the level of potential development characterized by the ability of a child to resolve the issue with the help of a teacher or work with more capable peers [8, 9, 10, 11]. In this context, learning requires teacher scaffolding. Scaffolding is a supporting mechanism that helps students to complete a task successfully within the zone of proximal development [9]. Bruner [12] suggested that paramount in learning is a way of storage and retrieval of information and relevant knowledge. Egbule [12] states that the greater the involvement of students in the study, the greater their retention rate. Bruner argues that students learn best when they found the facts, and they are related to each other. It is performed through exploration. Learn about inventions requires an active engagement in improving motivation [13]. Learn about invention can help learners to analyze, synthesize and think critically. According to Kolb, it represents the skill that is necessary for the acquisition of new knowledge, skills and concepts [13].

The Constructivist Theory in Learning Environment ICT-Based

The integration of ICT in learning will become a new power which gives ease in learning. Learning materials, such as media and other learning resources can be easily managed and utilized when they are required. Therefore, the learning process becomes more useful, practical and efficient. Maximum benefit of technology in learning is when it gives power and help in the construction of thought and knowledge. In General, there are five functions for technology in learning. The first is as a tool to assist in developing knowledge. The second is as a producer of information to deepen knowledge that supports the learning and development. The third is as a context to support learning by doing. The fourth is social media to promote learning by thinking. The fifth is like an intellectual partner to support learning and reflection [14]. In the online learning environment, there are three essential components that get the pedagogical justification which combines the Internet in teaching and learning process. The first is a tool for creating digital technologies and communication tools of expression. The second is tools to form relationships. The third is tools to manage the information and content [15].

The use of digital technologies to support teaching and learning process has an important role in presenting the learning [16]. There are some of the benefits of digital technology. The first is to provide a flexible time and location. The second is cost and time saving for educational institutions. The third is fostering its own learning with student-centered activities. The fourth is to create a collaborative learning environment by linking each of the students. The fifth is allowing unlimited access to electronic learning material. The sixth is enabling knowledge updated and maintained in an efficient manner [17]. It gives enormous opportunities for students to construct knowledge based on their experience.

Computer technology and the Internet have a massive influence on the effectiveness of education. These technologies allow the teacher to give a complex learning task in class, and apply a variety of learning methods. Some of the specific features and capabilities of the Internet allow the creation of an active learning environment for learners. Learners can quickly solve problems, take decisions, interact and make cooperation each other. The use of information and communication technology encourages learning and gives the opportunity to students in the form of problem-solving, process of creation idea, understanding of learners with the subject matter. In addition, it can increase the motivation of teachers and learners to learn and teach, as well as improving interaction between students and students and students and teachers [18].

The Constructivist Theory in Learning Environment for Blended Learning

Although based learning E-learning is growing by leaps and bounds, face-to-face learning never lost its popularity. In addition, the method of distance learning and E-learning never take the place of face-to-face learning. One reason is the student-teacher interactions that take place in a face-to-face learning cannot be achieved in distance learning or E-learning application forms [19]. Similar to traditional face-to-face learning environments, there are several limitations of the study in E-learning environment (Bonk and Graham, 2004 in [19]). This fact gave rise to the idea of a Blended learning approach, which takes the teachings of the two approaches together to correct the deficiency for each other [19].

The learning process that blends E-learning and traditional learning through face-to-face method is called blended learning [19, 20]. Blended learning combined with competency-based learning provides opportunities for students to get ahead not based on time spent on each subject but rather on their mastery of the curriculum and personalized learning, and students can direct its own analytical study [21]. Blended learning is a combination of excellence in learning, which is carried out face-to-face and virtually. Blended learning is a learning approach which utilizes two or more approaches of learning. The term of blended learning refers to learning activities of traditional face-to-face classes combined with E-learning in order to support the development of students' understanding [22]. Blended learning is often referred to as a combination of several media designed to complement each other and enhance meaningful learning [22]. Blended learning is recognized as integrating face-to-face learning and systematic learning in the situation of the same online courses.

Blended learning consists of three components namely face-to-face meeting in the classroom, independent learning, and discussion. The first component is the APPLE (autonomous personal use of paced learning). Independent learning according to the speed of learning of students can be facilitated through the material online. Online material can be in the form of a text file, hyperlinks, and interactive multimedia program. Learning material contains examples, exercises, and interaction. Therefore, students can be actively involved in

learning. The material developed without considering the learning design will just be a bunch of encyclopedia information without meaning [23].

The next component is the CARROT (collaborative learning in an online environment). The practice of collaborative learning in the form of discussions either among students or between students and teachers are an indispensable part of blended learning. In online discussions, especially those that are asynchronous, students can be encouraged to construct arguments that deepened their understanding of the problem. Task that needs to be accomplished by the teacher is moderating the discussion so that constructive discussions took place within the framework of learning [23].

The last component is LEMON (lectures in a classroom session). The face-to-face meeting guided by teachers is basic concoction of blended learning where the teachers can provide motivation to students to complete the lesson well. The first meeting is a crucial moment where teachers need to make engagement with students so that students have the commitment, the passion and a high ethos of learning. Through the use of face-to-face meetings, teachers can transfer experience and deeper idea. [23].

CLMB ICT-based

Constructivist Learning Model for Biology ICT-based (CLMB ICT-based) is a learning model that combines between face to face learning and online learning that is designed based on a blended learning approach and applied to the study of biology in junior high school. This Model is a form of constructivism theory in the implementation of learning by utilizing information communication and technology as multimedia, learning resources, learning activity and self-regulated learning. CLMB ICT-based is developed based on constructivist principles of learning, namely: Constructivist learning principles consist of several things. The first is learning a personalization. It includes the design of the curriculum and instruction according to the needs of individual students, autonomous in finding ways to learn on their own or manage their own measures of learning and the way they learn and implement flexible learning standards, criteria and scoring system. The Second is reflective thinking. It includes the excitation source for knowledge and evaluates thinking skills critically as well as instruction in the form of teacher questions. The third is problem-solving and investigation. It involves learning while doing, stimulating skill and the inquiry process in solving problems and doing research, as well as learning invention. The fourth is relevance to daily-life. It includes learning in authentic situations, such as in daily life and work experience and relevant to students. The fifth is collaborative learning. It includes the community of learning, group work, sharing knowledge, learning together and helping each other. The sixth is discussion. It includes discourse, debate, open conversation, expressed ideas, negotiations, and social interaction verbally. The seventh is teacher scaffolding. It includes guidance from teachers to achieve the task, the challenge of difficult tasks, and encouragement of learning and motivation [24]. The principles of constructivist learning are poured in the steps of learning face-to-face to form the syntax of learning that provide space for students to construct knowledge. In addition, the principles of constructivist learning are implemented in the form of online learning either that is synchronous (chat) or asynchronous (the forum, wiki, assignment, glossary, quiz, and message). Online learning provides a space for students to access unlimited learning, and builds relationships between students and students, students and teachers as well as teachers and the students. These relationships improve communication and interaction in learning. Therefore, students' learning outcomes increase effectively.

CLMB ICT-based learning model was developed based on constructivist theory with a blended approach to learning. This model is supported by the use of information and communication technology, either in face-to-face learning in the classroom or online learning. The following figure describes the application of CLMB ICT-based learning model

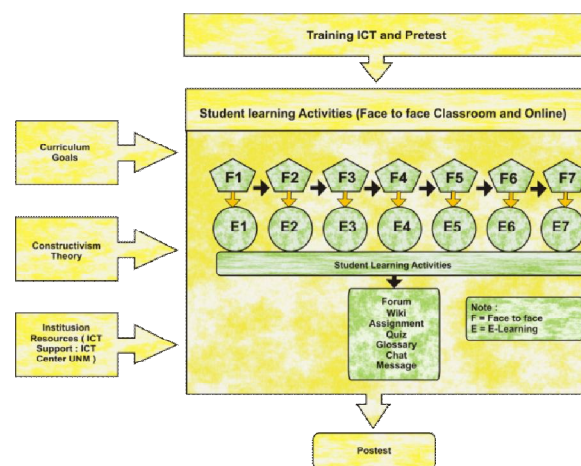


Fig. 1. Constructivism in CLMB ICT-based

Learning scenarios on face-to-face learning in the classroom consists of six phases. Phase I is motivation and presents objective of the learning. Phase II is learning information. Phase III is student organizing. Phase IV is construction of knowledge or skills. Phase V is evaluation and appreciation. Phase VI is establishment, training

and follow-up. In face-to-face learning, it is not only supported by ICT media, but also by students' handbook, and the students' worksheet developed based on the principles of constructivist learning. Therefore, the learning process takes place in a meaningful atmosphere.

In face-to-face activities, phase I (Motivation and presenting learning objectives) is characterized by several things. First, phase I motivate students through the appearance of the phenomenon, either artificial (for example animation, video, image), or natural (for example motion daughter shame, leaves, flowers, fruit and seeds). Second, the appearance of the phenomenon became the stimulus for students to give feedback or opinion. Third, the phenomenon and opinion of students became the basis for students to submit a problem or a question of learning. Fourth, the phenomenon and opinion became the basis for students to predict the learning topics. Fifth, it presents learning objectives. Phase II (learning information) is characterized by several things. The first is the submission of logistics learning either at a learning face-to-face or online learning. The second is the delivery of learning strategies. The third is the delivery of core learning material briefly. Phase III (student organizing) is characterized by several things. First, heterogeneous groups of students had formed before learning takes place. Second, the student membership in a group is maintained up to four times of the meeting. Third, a group of students on a face-to-face activity became part of a group of students at a time when working online. Fourth, organizing students in face-to-face activities is more on seating arrangements. Phase IV (construction of knowledge or skills) is characterized by some things. First, the students are studying in small groups. Second, each group member has duties and responsibilities that determine the success of the group. Third, Phase IV provides a portion of the time for students to work individually. Fourth, it gives a portion of a special time for students to exchange information and conduct peer tutor in their group. Fifth, it gives special portions for students to exchange information with other groups through class discussion. Sixth, this phase set the simple class discussion group because students do not have to leave their seat for a presentation. Seventh, when the presentation takes place, not all of the results of the group work are presented, but students only present one unit activities, while the units for other activities is the task of the other groups. Eighth, at the end of class discussion group, students are required to create a summary or a concept map or applications of the topic being studied. Ninth, when working individually and in groups, students are faced with the challenge of cognition that customizes the students to implement a number of process skills and higher-order thinking skills. Phase V (evaluation and appreciation) is characterized by some things. The first is giving evaluation to students. The second is giving awards for individuals and groups.

Phase VI is establishment, training and follow-up. In face-to-face activities, this phase serves as a preparation phase. The activities carried out are more likely to check the work of students directly. The activities provide feedback directly based on the work of students. The activities provide an affirmation to the students in relation to online tasks that will be accomplished by the students. For the next activity, the teachers close the learning process. Training, establishing, and following-up in fact, take place outside the face-to-face activities, and they are completed online. The tasks that are completed online consist of forums, and Wikipedia (performed in the group, and they are a supplement) quizzes, assignment (performed individually, and they are compulsory for every student), glossary, and chat (performed individually, and they are supplements).

On online activity, students are confronted with a number of assignments that need to be completed online. Each topic learning face-to-face is followed by online activity. The time used by each student to complete online tasks for each topic of study is ten days. The tasks given in the online activity provides convenience for students to interact and communicate with fellow students, and teachers. In addition, the tasks can establish a pattern of cooperation with groups of students, share ideas and understand, as well as solve problems together. The teacher performs consultation and guidance in the pattern of scaffolding. It is easy for students to construct knowledge, either individually or group. Therefore, learning outcomes can be improved. The following figure describes the process of the implementation of the learning on CLMB ICT-based.

The explanation above gives an overview that constructivist-based biology learning model of information and communication technologies have the potential to improve student learning outcomes. Based on these statements, then the formula concerns are: (1) how does the cognitive learning results description of grade VIII JUNIOR HIGH SCHOOL that taught with ICT-based MPBK? Moreover, (2) whether implementation of ICT-based MPBK models can enhance cognitive learning results student's JUNIOR HIGH class VIII?

As for the purpose of research is to (1) know the description of cognitive learning outcome's grade VIII JUNIOR HIGH SCHOOL that taught with ICT-based MPBK, and (2) the presence of increased cognitive learning results in student's JUNIOR HIGH class VIII through the implementation of ICT-based MPBK.

Cognitive Learning Results

Learning outcome is the ability of a student after he received a learning experience. In the learning process, there are three main domains that can be assessed, i.e. the domain of cognitive, affective and psychomotor. The third domain is the primary object of the assessment results of the study.

Cognitive learning results refer to the revised taxonomy of educational objectives [25] with the level of mastery of moves from low to high levels of cognition, namely cognitive 1 (C1) to cognitive 6 (C6). There are three kinds of learning scenarios, namely: (1) there are no desirable learning activities, (2) learning to memorize or rote learning, and (3) learning meaningful or meaning full learning [25]. Meaningful learning presents the knowledge and cognitive processes that students need to solve the problem. Problem solving occurred when students initiated the way to achieve a goal that has never been accomplished in understanding how to turn it around into a desired state [25]. In this context, students are required to think how to recognize problems, do abstraction solution on the problem solved. The students are required to perform the process of thinking.

2. RESEARCH METHODS

This research was carried out in SMP Negeri 6 Makassar in February-April 2013. Sample research VIII grade is A (31 students) and VIII B (29 students) SMP Negeri 6 Makassar. Champion and research sample assignment for purposive random sampling. The number of students was as a sample as many as 60 people. The study was designed in the form of pre-and Post test-test Group. Implementation of a learning activity is carried out either through personally or online activities (Figure 2).

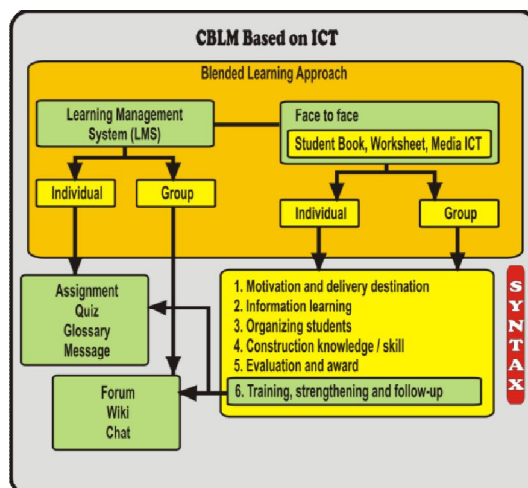


Fig. 2. The process of the implementation of the learning on CLMB ICT-based

The standards of competence which is taught in the second grade is to understand the systems within plant life, which is divided into seven-learning topics, namely: (1) structure and function of plant tissue, (2) the structure and function of root, stem and leaf, (3) the structure and function of interest, (4) the structure of fruit and seed, (5) Transport and photosynthesis, (6) Motion in plants, and (7) Pests, diseases and weeds in plants. Each topic is taught one time personally with online learning so that the number of meetings of each class as much as seven times, and at the end of learning done post-test.

Research instrument used is the test results of student learning that is designed to follow the revised Bloom's Taxonomy [25]. Before the use, the instrument is validated in advance by learning experts and practitioners to declare validly. Data collected by doing the test the results of learning. Test results of the study carried out two times, i.e. before the implementation of ICT-based MPBK (pre-test data) and after the implementation of the MPBK-based ICT (post data-test). The Data were analyzed using the research results of descriptive statistics in the form of average and percentage. Cognitive learning results are considered to be very good if the average value of ≥ 75 . Results of the study are considered effective when more than 80% of students achieving a value greater than or equal to 75. To see the magnitude of the increase in cognitive learning results students, data were analyzed by using the gain normalize [26]

3. RESULTS AND DISCUSSION

Results

The impact of ICT-based MPBK-cognitive ability of student's views was based on students' ability to answer the evaluation questions based on the level of cognitive process dimension. Cognitive ability is measured by the achievement of student learning results after following the MPBK-based learning with ICT. Student learning outcome after following the instruction indicated on table 1.

Table 1. Descriptive statistics pre test and post test learning outcomes grade VIII A and B with MPBK-based learning models ICT

No	Description	VIII A Class		VIII B Class	
		Pre-test	Post-test	Pre-test	Post-test
1	N	31	31	29	29
2	Avarege	32.5	78.97	36.81	83.67
3	Median	32.5	80.13	37.50	84.29
4	Modus	32.5	80.67	42.50	74.29
5	Standard Deviation	7.5	5.68	6.34	4.23
6	Variance	56.25	32.28	40.13	17.78
7	Range	27.5	26.63	25.00	18.08
8	The Minimum Value	20	63.25	20.00	74.29
9	The Maximum Value	47.5	89.88	45.00	92.38

Table 1 shows that the average value of a pre-test class VIII A of 32.5 ± 7.50 during the average value of the post-test of 78.97 ± 5.68 . The average value of a pre-test class VIII B was 6.34 ± 36.81 , during the average value of the post-test of 83.67 ± 4.23 . The average value of the combined pre-test class VIII A and B of $\pm 34,65$ 6.92. The average value of the combined class post-test VIII A and B was 81.24 ± 4.95 .

Of the 31 students who test in the class VIIIA, amount (%) of students achieves the value of ≥ 75 as much as 28 (90.32%) is. While in class VIII B, from 29 students following the test, the number of (percent) of students achieve the value of ≥ 75 as much as 28 (96.55 percent). When referring to the criterion of effectiveness, namely a minimum of 80% of students achieved a value of ≥ 75 , then the MPBK-Based is considered to be effective in the learning process.

Results of the analysis of the index gain cognitive learning results normalize class VIIIA found that on average the index gain of 0.69. When referred to in [26], then the increase is moderate ($g = 0.70 < \text{medium}$). Based on these results it can be concluded that the application of learning with MPBK-based ICT can improve student learning outcomes, even though its increase is still relatively moderate.

Results of the analysis of the index gain cognitive learning results normalize class VIIIB found that on average the index gain of 0.74. When referred to in [26], then the improvement is high ($g > 0.70 = \text{high}$). The average index gain, the combined cognitive learning results, normalize class VIIIA and B is by approximately 0.71. When referred to in [26], then the improvement is high ($g > 0.70 = \text{high}$).

Discussion

The improvement learning outcomes which occur after the application of CLMB ICT-Based cannot be separated from the application of constructivist learning paradigm and the introduction of ICT in the learning process. According to [27] all the learning outcomes of students, which is obtained through the application of personal and social constructivist gives better results, although, in its implementation, it requires the design of the theme so that the student effectiveness is equitable. According to the constructivist theory, learning is more effective if teachers use a constructivist method that is more focused on learning activities and experiences of students. In addition, it is based on the interaction of students and students with teachers, work with concrete materials in a realistic problem solving [28]. The description of learning as outlined above is a hallmark of social systems developed in learning with CLMB ICT-Based, particularly on the phase of construction of knowledge and skills. On online learning, students are confronted with tasks that are challenging and demanding independence as well as the discipline of learning as individuals including glossary tasks, quizzes, and assignment and social interaction in the tasks of wiki, forum and chat. Therefore, the tasks are to establish a learning community that built the harmony of personal and collaborative learning. It is one of the characters in CLMB ICT-Based Learning to build a combination of face-to-face and online or blended learning.

Blended is the right combination between e-learning and traditional classroom learning, which aims to improve the learning experience of students [28]. The way to find out the right combination between e-learning and traditional classroom learning is needed so that students' learning experience is useful and positive [28]. The combination pattern in CLMB ICT-Based is delivered alternately. Each learning face-to-face is accompanied with online learning. Learning resources and a number of supporting tools in the form of material, videos, animations and assignments-assignments in the form of a wiki, forum and glossary, can be accessed to students before learning face-to-face. Therefore, the learning resources provide an opportunity for students to prepare themselves in face-to-face learning. Although, quizzes and assignments have been put up online before learning face-to-face, a new opportunity to access them can be performed after the face-to-face activities are completed and accompanied by a strict time limit. Therefore, it becomes a challenge for students, especially in applying learning strategies.

Ability to present information visually is crucial for biology course. Real images, three-dimensional models, animations and interactive environment provide convenience in understanding learning objectives. The use of the internet and computers, gradually increase the understanding of students. By Blended learning model, students can perform a multimedia application through the internet that cannot be taught during face-to-face learning. In addition, the ability to view the course content before the face-to-face meeting allows students to learn the learning material. Students can discuss the important lesson on Internet environment (in the forum) and establish good communication with the teachers and other students [19]. Learning Management System (LMS) offers a variety of workspaces for facilitating information exchange and communication among the participants in the course. Educators distribute information to students, create learning materials, prepare assignments and tests, engage in discussions, manage the class far and allows collaborative learning with forums, chat, file storage area, and a news service [30].

Providing a challenge to the students will enhance their cognitive development. Challenging tasks provide many benefits, while the task that cannot be solved by the students even with the help of other people is not useful at all. Therefore, teachers should provide some task that can only be solved by the students through the help of others [9]. Task patterns became one of the characters developed in the students' Worksheets and assignments online. Therefore, implementation of the scaffolding is an inseparable part in the implementation of CLMB ICT-Based. According to [30] teaching and learning are more effective if learning involves the use of different methods, approaches, and strategies to maximize the acquisition of knowledge and skills development. Good teachers have always used more than one method or approach in their teaching. A good learner will always combine different strategies in learning. These opportunities are always presented in CLMB ICT-Based Learning, either in face-to-face or online learning.

4. CONCLUSION

Based on the results of research and studies that have been done, then it can be inferred several things, including

1. Cognitive learning Outcome's grade VIII JUNIOR HIGH which taught with the use of ICT-based MPBK is a very good and effective.
2. Use of ICT-based MPBK can improve the cognitive learning of JUNIOR high-school student results class VIII with high category.

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