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# The Impact of Quantum Learning in Secondary School Students: A Case Study in Geometry

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***Abstract***

This research was aimed to produce learning device at Quantum Teaching which focused on geometry and to know effectiveness of Quantum teaching on Geometry in grade X. The development of learning device was used 4-D model (Thiagarajan, et al.) with several modifications. The learning device which had been gained were Lesson Plan, Students Worksheet, and Test Instruments. The data source of this study was the students at Madrasah Aliyah Negeri (MAN) 5 Barabai grade X in academic year 2014/2015: X-A would be the trial class and X-B would be the implementative class. Based on the trial result, which had been obtained was a good instruments of quantum teachings after it was being validated by experts and it had fulfilled these requirements: (1) teacher's ability to manage this learning was good, (2) students activities were in ideal time, (3) students responses was positive, and (4) Test instruments was valid, reliable and sensitive. Thus, based on descriptive analysis, this quantum learning was also effective to learn geometry because it had fulfilled the effectiveness requirements, which are: (1) teacher's ability to manage this learning was good, (2) students' activities were in ideal time, (3) students' responses were positive, and (4) classically, students reached their mastery standard: there were 83,33% from all of the students who got ≥70 for their score.

Keywords: The Development of Learning Device, Effectiveness of Quantum Teaching, Geometry.

**Abstrak**

Penelitian ini bertujuan untuk menghasilkan perangkat pembelajaran kuantum yang baik untuk materi geometri di kelas X dan untuk mengetahui keefektifan pembelajaran kuantum untuk materi geometri di kelas X. Pengembangan perangkat pembelajaran yang dilakukan menggunakan model 4-D (model Thiagarajan dkk) yang telah dimodifikasi. Perangkat pembelajaran yang dihasilkan berupa: (1) Rencana Pelaksanaan Pembelajaran (RPP), (2) Lembar kerja Siswa (LKS), dan (3) Tes Hasil Belajar (THB). Sumber data pada penelitian ini adalah siswa kelas X MAN 5 Barabai tahun pelajaran 2014/2015 dengan kelas XA sebagai kelas ujicoba dan kelas XB sebagai kelas implementasi. Berdasarkan hasil ujicoba perangkat, diperoleh perangkat pembelajaran kuantum yang baik karena dinyatakan valid oleh pakar/ahli dan memenuhi syarat: (1) kemampuan guru mengelola pembelajaran memenuhi kriteria baik, (2) aktivitas siswa dalam pembelajaran berada pada rentang waktu ideal, (3) respons siswa terhadap pembelajaran positif, (4) tes hasil belajar memenuhi kriteria valid, reliabel, dan sensitif. Berdasarkan hasil analisis deskriptif diperoleh bahwa pembelajaran kuantum efektif untuk mengajarkan materi geometri karena memenuhi syarat keefektifan: (1) kemampuan guru mengelola pembelajaran memenuhi kriteria baik, (2) aktivitas siswa dalam pembelajaran berada pada rentang waktu ideal, (3) respons siswa terhadap pembelajaran positif, (4) ketuntasan belajar secara klasikal tercapai, yaitu sebanyak 83,33% dari seluruh siswa memperoleh nilai ≥ 70.

**Kata kunci:** Pengembangan Perangkat, Keefektifan Pembelajaran Kuantum, Geometri.

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## Introduction

Mathematics learning that has been carried out so far tends to be teacher-centered, besides teaching teachers only focus on completing the material without regard to good learning conditions for students. The teacher enters the class and presents the material then gives examples of questions and then students are asked to do the practice questions. Learning like this is often carried out without much variation in learning. This causes students to be less given the opportunity to experience and develop their own learning activities so that students are less actively involved in learning. In fact, Asmani (2011) argues that learning is essentially an active process of the learner in building his knowledge. If learning does not provide an opportunity for students to take an active role, then learning is contrary to the nature of learning.

One alternative that can make students more active in learning activities and pay attention to a comfortable and pleasant atmosphere is quantum learning. Quantum learning actively involves students at each stage and prioritizes the creation of a comfortable atmosphere to support student learning activities. Quantum learning places great emphasis on the meaningfulness and integrity of the learning process. According to De Porter (2010), quantum learning is "interactions that convert energy into light". It means that the interactions in question turn students' natural abilities and talents into a light that will benefit themselves and others.

Quantum learning relies on the concept "Bring Their World to Our World, and Bring Our World to Their World" and this is the main principle which is the basic reason behind all strategies, models, and beliefs in quantum learning (De Porter, 2010). This principle reminds the importance of a teacher entering the world of students in the first step, because this action will give permission for a teacher to lead, guide, and facilitate their journey towards broader awareness and knowledge. This can be done by linking what will be taught with an event, thought, or feeling gained from their home, social, athletic, musical, artistic, recreational, or academic life. After the link is formed, then students can be brought into the world of teachers to further be given an understanding of the material to be taught. This is where new vocabulary, mental models, formulas, and others are revealed. As we explore connections and interactions, both students and teachers get new understanding and "Our World" is expanded to include students and teachers. Finally, with a broader understanding and deeper mastery, students can bring what they learn into their world and apply it to new situations.

Quantum learning uses a learning design framework known as TANDUR (Grow, Natural, Name, Demonstrate, Repeat, Celebrate) (Sujatmika, 2018; Ulandari, 2017). The first step "Grow" is to provide sufficient apperception so that from the beginning of the activity students are motivated to learn. Then students can understand What Benefits for me (AMBAK). "Natural" means to give real experience to students to try. "Name" that is by providing keywords, concepts, models, formulas, strategies and other methods. "Demonstrate" that is by providing opportunities for students to demonstrate their abilities. "Repeat" is to give an opportunity to repeat what students have learned and emphasize that students can and can indeed. "Celebrate" means recognition for the completion, participation, and acquisition of skills and knowledge. The celebration will add to the satisfaction, pride, and self-confidence of students. The material chosen in this study is geometry. This material is suitable to be developed with a quantum learning model that has a TANDUR learning design framework.

Based on the description above, the researcher is interested in developing a quantum learning tool for class X geometry material. Furthermore, the device will be applied in learning to determine the effectiveness of quantum learning on geometry in class X.

## Method

This research can be classified as a research development followed by descriptive research because this research was conducted to develop quantum learning tools so that a good quality learning tool is produced to teach geometry material in class X. Furthermore, research is conducted to describe the effectiveness of quantum learning for geometry material in class X The device development procedure used in this study refers to the modified -4D model (Thiagarajan, 1974).

The population in this study were students of class X MAN 5 Barabai 2014/2015 school year. One class is taken randomly as a device trial class and then another class is chosen as a device implementation class to find out the effectiveness of quantum learning. The participants are students in class XA MAN 5 Barabai 2014/2015 school year. The research instrument developed was the validation sheet of the learning device, the observation sheet of the teacher's ability to manage learning, the observation sheet of student activity, the student response questionnaire, and the learning achievement test. The observation sheet and response questionnaire were adapted from previous studies. While the learning outcomes test is made by the researcher. The learning tool developed is said to be of good quality if it is declared valid by the validator and after being tested meets the following criteria: (1) The ability of the teacher to manage learning meets the minimum criteria of "good"; (2) Student activities are in the ideal time percentage; (3) Student responses to positive learning; and (4) The learning achievement test fulfills valid, reliable, and sensitive criteria.

The participants for the device implementation class are students in class XB MAN 5 Barabai 2014/2015 school year. The instruments and data collection techniques in this stage are the same as those used in the learning device testing phase. The data analysis technique used is descriptive statistical data analysis which is used to analyze the effectiveness of quantum learning on geometry material in class X. The analyzed data are the teacher's ability to manage learning, student activity data, student response data, and student learning outcomes data.

Descriptive data analysis of student learning outcomes aims to describe the completeness of student learning outcomes based on the tests carried out. a student is said to have finished his study individually if the score obtained by the student is at least 70 out of a maximum score of 100. While classical learning completeness is achieved if the class is more than or equal to 75% of students completing their study. Furthermore, quantum learning is said to be effective if the following aspects are met, namely student learning outcomes are classically complete, the teacher's ability to manage learning is minimal, effective student activity, and student responses to positive learning.

## Result and Discussion

### Description of Development Results of Learning Devices

Based on the first research objective, a quantum learning device for the geometry material was arranged. The equipment produced consisted of: Learning Implementation Plan (RPP), Student Worksheet (LKS), and Learning Outcomes Test (THB). To find out the quality of the learning device, a learning device test is conducted. The achievement of good learning device criteria is determined based on the results of data analysis of student activities, the ability of teachers to manage learning, student responses, and the results of the pretest and posttest. The results of the device trial can be seen in the following table:

Table 1. Achievement of Good Quality Learning Tool Criteria

| No | Aspect | Note |
|---|---|---|
| **1** | Student Activity | Effective |
| **2** | Teacher's Ability to Manage Learning | Good |
| **3** | Student Response | Positive |
| **4** | Learning Outcomes Test | Valid, Reliable and Sensitive |

Based on the development of learning tools with a modified 4-D model, a good quality quantum learning tool is produced for geometry material in class X MAN 5 Barabai, so it can be used for device implementation.

### Description of Device Implementation Results

Based on the second research objective, a device is implemented to determine the effectiveness of quantum learning on geometry material in class X. Data collected at this stage are the teacher's ability to manage learning, student activity data, student response data, and learning outcome data. The data is analyzed descriptively to determine the effectiveness of quantum learning.

The implementation of the device was carried out in the selected class three times and ended with a test. During learning observations are made of student activities and the teacher's ability to manage learning. Questionnaire responses from students were distributed after the test was completed.

As for the analysis of the data obtained in the implementation of the device include: the results of the implementation of the test showed that students' mastery learning is classically achieved, where from 24 students, as many as 20 students who completed their studies (got a score ≥ KKM, with KKM = 70). So the percentage of students' mastery learning is 83.33%. The results of observations of the ability of teachers to manage learning shows that every aspect of each meeting observed scores well and very well. The average score of each aspect observed is more than 4 so that according to established criteria it can be said that the ability of teachers to manage learning meets the criteria well.

In addition, observations of student activities during three meetings indicate that every aspect of student activity for each meeting is at the ideal time tolerance interval, so it can be said that student activities fall into the effective category. The results of the student response questionnaire showed that the number of students who chose the positive category exceeded 80%. So based on this and referring to predetermined criteria it can be concluded that student responses are positive.

Based on the description above, the achievement of the effectiveness of quantum learning for geometry material is determined based on classical learning completeness, the ability of teachers to manage learning, student activities, and student responses to learning can be seen in the following table:

Table 2. Achievement of the Effectiveness of Quantum Learning

| No | Aspect | Note | Conclusion |
|---|---|---|---|
| **1** | Student Activity | Effective | Effective |
| **2** | Teacher's Ability to Manage Learning | Good | |
| **3** | Student response | Positive | |
| **4** | Learning outcomes | Completely classical | |

From the table above it can be seen that effective quantum learning can be given to class X students on geometry material.

**Discussion**

Quantum learning involves students actively in its implementation. The teacher no longer dominates the lesson so that students have plenty of time to discuss with other students in the group. Student activities are apparent when students carry out activities at a natural and named stage, they are so enthusiastic about doing activities related to the material being studied to then write down concepts they understand from the activity. Students also work well together when solving LKS questions and they actively ask the teacher if they encounter difficulties. At the demonstration stage, students present the results of their group work, other groups enthusiastically respond by asking questions and completing imperfect answers. This is supported by Zeybek (2017) that design of quantum learning encourages students success and enable learners to make their learning life, practice and content more meaningful.

Thus, quantum learning provides an opportunity for students to be more active in learning and provides opportunities for students to gain experience through activities aimed at finding concepts learned. This is in accordance with the opinion of Bruner (Slavin, 2000) who suggested that students learn concepts and principles through active participation in gaining experience and conducting experiments that allow them to find their own principles. In addition, quantum learning makes students more enthusiastic and enthusiastic in learning, students also have the opportunity to demonstrate the results of their work so they can develop confidence. This is supported by Super camp's research (De Porter, 2010) that the application of quantum learning can increase motivation and self-confidence. Moreover, quantum learning result an increased of mathematical strategic thinking skills of students (Herman, 2019).

In addition, the teacher can actively direct, motivate, and guide students to be able to understand and solve problems according to their own abilities. The teacher visits groups that are experiencing difficulties, then guides students so they are able to understand and solve problems in the worksheet. In other words, the teacher's role is as a facilitator in learning. When students solve problems in worksheets, sometimes there are several groups that ask questions or need guidance at the same time so that requires the teacher to divide time well so that all groups get good guidance. Guidance conducted by the teacher is in accordance with Vigotsky's theory (Nur, 2004), which provides a number of assistance to students in the form of instructions, encouragement, or warnings to students at an early stage, then reduce it and provide opportunities for students to take over greater responsibilities after he is able to do it himself. In addition, the guidelines carried out are also able to make student communication more effective. This is in line with Afacan and Gurel (2019) who concluded that quantum learning makes a positive contribution to students' communication skills.

## Conclusion

Based on the above results, for the development of learning devices using the 4-D model, quantum learning tools are produced for good quality geometry material. The learning kit consists of RPP, LKS, and THB. This is because the requirements for good learning tools have been met, namely the ability of teachers to manage learning to meet good criteria, effective student activity, which is shown by each category of student activity is at the ideal time tolerance limit, student responses to positive learning, indicated by the percentage of students who chose a positive category for each aspect of the response of more than 80%, and the test results were valid, reliable and sensitive.

As for quantum learning, it is effective in teaching geometry of points, lines, and fields. This is indicated by the fulfillment of the requirements for learning effectiveness, namely the completeness of student learning classically fulfilled, which is as much as 83.33% of students complete learning, effective student activity, which is shown by each student activity is in the ideal time tolerance criteria, the ability of teachers to manage learning meets good criteria, and student responses to positive learning as indicated by the percentage of students who chose positive categories for each aspect that responded to more than 80%.

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