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[Research Article]

Metaanalyzing The Effect of Quantum Teaching Model on The Competence of Understanding Science Learning Concepts

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ABSTRACT

Understanding concepts in science learning is something that absolutely must be mastered by students. Various studies have been conducted by researchers to obtain the best model or approach to improve students' understanding of concepts. One of them is the Quantum teaching model. This research is a meta-analysis of 24 articles from national and international journals that have been accredited and have an ISSN. The results of the meta-analysis show that there is an influence of the Quantum Teaching model on the competence of Concept Understanding in science learning. Judging from the level of education, the Quantum Teaching model has the highest influence at the elementary level. Meanwhile, in terms of the materials and teaching media used, the highest influence was obtained on the phet media and followed by the use of LKS or LKPD.

Keywords: Quantum Teaching, Understanding Concepts, Science

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1. INTRODUCTION

The rapid advancement of technology in the 21st century demands efforts to improve the quality of education and teacher professionalism more quickly. Along with the shift in mindset in learning that gave birth to a new paradigm in learning. The new paradigm arises because of anomalies in the world of education, especially in the teaching and learning process. The more sophisticated the technology, the more professional teachers must lead students so that the basic purpose of learning is not missed, namely understanding the concept of learning itself.

Changes in the educational paradigm occur in various disciplinary fields, as well as occurring in Science Learning (IPA). According to Syafrial (2018) science learning in everyday life has a very important role in understanding natural phenomena, so that it can be more wise in managing its environment. Along with the development of science, qualified Human Resources (HR) are also needed. To improve the quality of human resources in the field of science, it is necessary to apply higher quality science learning. The ability to choose a model and apply it in the learning process is very important, because this ability will make learning effective.

One of the learning models that can be used is the *Quantum Teaching* model, which is a teaching package that includes all the energy (abilities) to maximize the learning process (Nurlaela, 2021). This learning model is based on cognitive psychology and can focus attention on quality and meaningful interactions (Hamdayama, 2014). The use of this learning model can change the various interactions that exist in and around the learning moment by removing obstacles that hinder the natural learning process, compiling appropriate teaching materials, effective ways of learning, and active involvement of students and teachers (Nurlaela, 2021). Thus, this learning model will liven up the classroom with a pleasant learning atmosphere and increase students' learning participation. Interaction between teachers and students can foster new knowledge and increase students' understanding in learning science.

The syntax of Quantum Teaching learning is known as TANDUR. According to Cahyaningrum (2019), "TANDUR is divided into six stages, namely as follows; (1) *Tumbuhkan*, at this stage the process carried out is to foster interest in learning and motivation of students by creating a classroom atmosphere or by recalling previous material related to the material to be studied. (2) *Alami*, at this stage, educators provide opportunities for students to gain general experiences that can be understood by students, so that students can construct their own knowledge based on their experiences. (3) *Namai*, at this stage, educators provide key words, concepts, theories, principles and others which are the main material that becomes the learning message. and satisfy learners' brains with questions about their experiences. (4) *Demonstrasikan*, educators provide opportunities for learners to be able to demonstrate or apply their abilities, provide opportunities for learners to perform demonstrations, present work results, and discuss them.

Meanwhile, the educator's task is as a facilitator and mediator of the discussion. (5) *Ulangi*, strengthening neural connections by educators showing learners ways to repeat material and emphasizing that learners really know and understand what they have learned. (6) *Rayakan*, the last stage is that educators provide recognition such as congratulating or rewarding the efforts that students have made in displaying their completion, participation, acquisition of skills, and knowledge." According to Aulia, et al (2020) the TANDUR type Quantum teaching learning model has several advantages including, (1) Students understand the material better because a material is discussed 3 times, namely when "*Namai*", "*Demonstrasi*", "*Ulangi*" and have previously had experience from the "*Alami*" syntax (2) Teach students to be more confident and more active; motivate students to develop their potential. (3) Every student is valued (experience gained in everyday life can also be

used in learning. Research on the effect of the Quantum Teaching Model on the competence of understanding the concept has been widely done and the results apparently reveal that Quantum Teaching is able to improve learning outcomes, especially the concept understanding ability of students.

Problems and solutions that have been carried out by previous researchers who have been contained in several articles make researchers feel interested in conducting metaanalysis research in the form of metaanalysis of the influence of Quantum Teaching Models on Competence in Understanding Science Learning Concepts. The formulation of this research problem is how the effect of the Quantum Teaching Model on Concept Understanding Competence in terms of education level, and type of media / teaching materials. The purpose of this research is twofold. First, to see how much influence is given by the Quantum Teaching Model in terms of education level on Concept Understanding Competence, and secondly in terms of the type of teaching material/media.

2. METHOD

This research uses the metaanalysis method. Metaanalysis is research conducted by summarizing, reviewing and analyzing data from several studies that have been conducted. The first category of research analyzed was about the Quantum Teaching Model, the second had an influence on the competence of understanding concepts that could be calculated effect size and the third was used in science learning from elementary to high school level .

The results of the analyzed research were collected through google scholar from 2016 to 2022. From the search results obtained articles in national and international journals that have been accredited and have ISSN as many as 24 articles that meet the criteria and can be calculated the effect size value.

The steps of data analysis are (1) identifying the type of research and research variables that have been found, entered in the appropriate variable column, (2) identifying the mean and standard deviation of the experimental group data / before treatment and the control class / after treatment for each subject / sub research that has been tested, (3) calculating the *effect size* using the following statistical parameters (Ramadhani, D P, dkk. 2021):

1. Average in one group

$$ES = \frac{\bar{X}_{post} - \bar{X}_{pre}}{SD_{pre}}$$

Description:
ES = Effect Size
$\bar{X}_{post}$ = Posttest average
$\bar{X}_{pre}$ = Pretest average
SD_{pre} = Pretest standard deviation

2. Average of each group (two groups posttest only)

$$ES = \frac{\bar{X}_{experiment} - \bar{X}_{control}}{SD_{control}}$$

Description:
ES = Effect Size
$\bar{X}_E$ = Experimental average
$\bar{X}_C$ = Control average
SD_C = Standard deviation of control class

3. Average of each group (two groups pre post tests)

$$ES = \frac{(\bar{X}_{post} - \bar{X}_{pre})_{experiment} - (\bar{X}_{post} - \bar{X}_{pre})_{control}}{\frac{SD_{pre\ control} + SD_{pre\ experiment} + SD_{post\ control}}{3}}$$

Description:
ES = Effect Size
$\bar{X}_E$ = Experimental average
$\bar{X}_C$ = Control average
SD_C = Standard deviation of control class

4. Chi–Square

ES = $\frac{2r}{\sqrt{1-r^2}}$; r = $\sqrt{\frac{X^2}{n}}$

5. t count

ES = t $\sqrt{\frac{1}{n_{experiment}} + \frac{1}{n_{control}}}$

Description:
ES = Effect Size
n_E = Number of experimental groups
n_K = Number of control group

6. P-value
CMA (Comerhensive Meta Analisis Sofware)

After the effect size is calculated based on the appropriate formula, then the effect size is categorized with the effect size criteria according to Diancer in Table 1.

Table 1. Effect Size Criteria (ES)

ES	Category
ES ≤ 0,15	Very Low
0,15 < ES ≤ 0,40	Low
0,40 < ES ≤ 0,75	Medium
0,75 < ES ≤ 1,10	High
ES > 1,10	Very High

(C*ohens in Ramadhani, DP, et al. 2021*)

3. RESULT AND DISCUSSION

The results of this study were conducted to see the effect of the quantum teaching model on the competence of understanding science learning concepts. Data were obtained from journals that are relevant to this research, and support the calculation of the *effect size of* each journal. A total of 24 journals have been selected based on predetermined criteria.

The results obtained from the calculation of the *effect size of* the 24 journals that have been analyzed are classified into three parts. First, a general division based on the source of the journal and the effect size category. Second, based on the level of education and third based on teaching materials/media. Data from the analysis of articles in general about the effect of quantum teaching models on students' concept understanding are presented in Table 2.

Table 2. General Article Grouping

Journal Code	Journal Source	ES	Category
P1	(Indrasati, H., Indrawati, & Bambang S., 2016)	0,01	Very Low
P2	(Afriana, Anna, & Any, 2016)	0,65	Low
P3	(Baroroh, Trapsilo, & Subiki 2017)	0,22	Medium
P4	(Gumay, Nindya, & Ahmad, 2018)	0,24	Low
P5	(Cahyaningrum, Yahya & Ardian, 2019)	1,16	Very High
P6	(Faj, Jamal, & Ajo, 2018)	0,30	Low
P7	(Lubis, Mutiara, & Dedes, 2019)	0,63	Medium
P8	(Damanik, 2017)	0,67	Medium
P9	(Aulia et al, 2020)	2,88	Very High
P10	(Nasution, & Simamora, 2021)	2,15	Very High
P11	(Ayu, Tri, & Wahyu, 2019)	1,64	Very High
P12	(Lokaria, & Nopa, 2018)	0,54	Medium
P13	(Haryono & Suci, 2019)	0,09	Very Low
P14	(Anggriani, & Ida, 2019)	3,46	Very High
P15	(Dananjaya, Suastra, & Sudiatmika, 2016)	0,63	Medium
P16	(Kamila, Trapsilo, & Rayendra, 2017)	3,02	Very High
P17	(Ermawati, et al, 2020)	0,77	High
P18	(Khotimah, Tri & Ovilia, 2018)	1,94	Very High
P19	(Fayanto, et al, 2019)	0,48	Medium
P20	(Donuata, 2019)	0,06	Very Low

Journal Code	Journal Source	ES	Category
P21	(Wote, et al, 2020)	6,44	Very High
P22	(Wibawa, & I.G.A. Agung Sri Asri, 2020)	1,35	Very High
P23	(Putri, N.Dantes, & K Suranata, 2020)	0,84	High
P24	(Astari & Tias, 2018)	0,66	Medium

The calculation of the effect size value of the 24 articles that have been selected as seen in table 2 obtained an average of 1.29 which means it is in a very high category. This means that the *Quantum Teaching* Model has an influence on concept understanding in science learning. This is in line with the research of Aulia, F, et al (2020) which shows a significant difference in the experimental class using the Quantum Teaching model resulting in higher concept understanding competence than the results shown in the control class with the conventional model.

This is supported by Samidi's statement quoted by Aulia, F, et al (2020) "that in the Quantum teaching type TANDUR learning model students will better understand the material because it will be discussed 3 times and teach students to be more confident". Learning is said to develop well if students go through it feeling happy, actively involved and enjoying all the learning process. Students should always get new inspiration at the end of every lesson.

Table 3: Grouping of Articles by Level of Education

Education Level	Number of articles	Mean ES	Category
SD	4	2,32	Very high
Junior high school/middle school	7	0,79	High
SMA/SMK	13	1,23	Very High

Pengaruh Model Quantum Teaching ditinjau dari pelaksanaannya pada jenjang pendidikan, maka terlihat bahwa hasil effect size pada jenjang SD menunjukkan hasil yang paling tinggi dengan rata-rata 2,32 dalam kategori sangat tinggi. Hasil penelitian Keliat dkk yang dikutip Khasanah dkk (2019) menyatakan bahwa "anak usia sekolah (6-12) tahun yang memiliki perkembangan psikososial yang normal, yaitu anak mampu bertanggung jawab dan menyelesaikan tugas yang diberikan (disekolah maupun dirumah), memiliki rasa bersaing (Kompetitif), memiliki hoby; menggambar, membaca buku bercerita,bersepeda Serta suka berkelompok dan memiliki sahabat." Hal ini menjadi salah satu alasan bahwa di jenjang SD model Quantum Teaching paling tinggi pengaruhnya. Karena model Quantum Teaching memang menciptakan situasi yang menyenangkan bagi siswa untuk belajar, ditaburi penghargaan dan pujian.

Table 4. Grouping articles based on teaching materials/media

Typeof teaching material/media	Number of articles	Means ES	Category
LKS/LKPD	3	1,66	Very high
Flash Media	1	0,22	Low
Real Laboratory	3	0,85	High
Phet Media	1	3,46	Very high
Video	1	0,63	Medium
Games	1	0,84	High

Of the 24 articles on the effect of the Quantum Teaching Model on concept understanding in science learning obtained, only 10 articles include teaching materials or media used in the study. There are 2 teaching materials or media that are

in a very high category, namely the use of LKS / LKPD and Phet Media.

According to Kamila, et al (2017 "Quantum taching is a teaching method that has the main principle of bringing them into our world and delivering our world to their world. The meaning of this principle shows that the first step a teacher must take in starting the learning process is to enter the world of students, the way by linking the subject matter to be given with an event that occurs in their real life. After the link is formed, the teacher then provides an understanding to students about the material being taught". Therefore, the presence of LKS is very helpful in exploring student knowledge to develop more rapidly. So that the enthusiasm for learning that is explored by the Quantum Teaching model and supported by LKS as a visual motor, the understanding of student concepts is getting better.

Likewise, the use of PhET media as a virtual practicum media is very helpful for students to understand science learning concepts. PhET Colorado interactive simulation is a fun and discovery-based interactive simulation media in the form of software and can be used to clarify physical concepts or phenomena that have been practiced (Anggriani, S: 2019). By using this PhET media, students are expected to be able to apply the concepts that have been obtained during learning in theory and practicum to the simulations that have been contained in the PhET media (Mubarok, et al. 2014). As we all know, the experience gained from trying directly will make it easier for students to understand the concept of the material they are learning. This is in line with the statement of Yuli, F & Mufit, F (2021) that pintegrating virtual laboratories is used when the time needed to conduct experimental experiments at school is not possible, besides the use of virtual laboratories can be used anywhere and anytime. In other words, phet media as one of the virtual laboratories can be tried by students again anywhere after class learning is over. Repetition of learning will create an experience that sticks to students so as to increase their understanding of the concept.

4. CONCLUSION

Changes in the educational paradigm should not eliminate the basic principles in science learning, especially in the competence of students' concept understanding. Based on metaanalysis research conducted on 24 articles regarding the Quantum teaching model on understanding concepts in science learning, a very high effect size value was obtained. This means that there is an influence of the Quantum Teaching Model on understanding concepts in science learning.

This researchaims pfirst, to see how much influence is given by the Quantum Teaching Model in terms of of the level of education on Concept Understanding Competence, and secondly in terms of the type of teaching material / media. From the analysis of 24 related articles, it was found that the level of education showed the highest effect at the elementary level. While in terms of the use of teaching materials or media shows a very high effect size on the use of LKS / LKPD and phet media.

Analysis of these 24 journals illustrates to researchers that there are still many opportunities to improve understanding of concepts in science learning with the Quantum Teaching model by combining with more varied teaching materials or teaching media. Because in fact the more varied the learning carried out by educators with their students, the more students' understanding of concepts will increase.

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