A Meta-Analysis of Constructivist Approach on Students' Achievement

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Keywords: Meta-analysis, Constructivist, Students' Achievement.

Abstract: This study tries to get a proof about the question 'Does a Constructivist Learning Approach have any influence on students' achievement?' As results of a set examination of studies were presented in scientific articles conveyed out between 1997 and 2017 in science education, 73 studies were found in the initial search. After a second screening, 12 studies were selected to examine. The calculating effect size of Constructivist approach on students' achievement (ES: 0.87) was calculated by Comprehensive Meta-Analysis (CMA) version 2.0. In addition, calculated effect size considering grade level and models of learning. The results indicate that the effect sizes on the academic achievement of high school level are at a large level while on college is at a usual level (standard level). The conclusion shows that a constructivist approach has a positive effect especially on students' achievement. Concerning the results, authors made some recommendations for an educator, researcher, and further research.

1 INTRODUCTION

The theory of constructivism began with the developmental product of Jean Piaget (1896-1980). A constructivist approach implies that students construct information or knowledge through their real world experiences as personal mental model, more willingly than learn from abstract concepts (Bhattacharjee, 2015). On the constructivist approach, the perspectives will take from students' real life experience as the result. The theory suggests that students construct knowledge and meaning from their experiences (Kim, 2005; Driscoll, 2000). Belongs to (Brooks and Brooks, 1993), their opinion five basic principles on constructivism such as: "1) Posing relevant problems or issues, 2) Constructing materials around major concepts, 3) Trying to find and assessing students' perspective, 4) Balancing lessons based on students' points of view, finally 5) Appraising students learning outcome in the context of real-life learning." The constructivist approach encourages students to be actively included in the whole process of learning. It also suggested that learning material is organized based on the students' needs and interest to encourage and motivate the students. Through constructivist approach, it was believed that the goal of learning would be easily achieved. However, the utilization of it in the learning process is not much considered in the current curriculum system (Tobin, 2012). Steffe and Gale (1995) suggested that teacher should encourage students to learn from all aspect and therefore, the constructivist approach should be applied to promote collaboration between students and teacher in the learning process. It most essential in the current education system as students should be encouraged to construct their knowledge instead of being taught by the teacher. This approach also shifted the role of the teacher from the being the knowledge giver, into the facilitator to facilitate students in knowledge, reasoning and intuition sharing (Kleinhenz et al., 2007). It most essential in the current learning trend as every individual is unique and they construct their knowledge and understanding of the unique ways through their life experiences. Constructivist approach promoted two essential forms of learning where firstly students construct knowledge based on their personal experience and secondly that knowledge are then shaped so uniquely based on characteristics of every individual, and therefore it is long lasting or becoming permanent rather than those given knowledge obtained from teacher's explanation.

Mayasari, T., Handhika, J., Huriawati, F., Sasono, M., Kurniadi, E., Purwandari, P. and Yusro, A.
A Meta-Analysis of Constructivist Approach on Students' Achievement.
In *Proceedings of the Annual Conference on Social Sciences and Humanities (ANCOSH 2018) - Revitalization of Local Wisdom in Global and Competitive Era*, pages 488-491
ISBN: 978-989-758-343-8

2 METHODS

2.1 Data Collection

Various databases are used in this research with the help of Educational Resources Information Center (ERIC) via EBSCO Host, with supplementary information from Google Scholar, Wilson Web, and Digital Dissertation. As many as seventy-three researches examining the impact of the constructivist approaches in science learning were found in the first seeking. After performing the repetitive screening, there were only twelve studies were selected to be relevant as the source of data for this research based on abstract, content, and finding of the study.

2.2 Criteria for Inclusion

Some requirements were set to be identified as the primary and secondary data to this study namely: (1) Constructivist learning studies which published between 1997 and 2017. (2) can be found in google Scholar, Digital Dissertation, and ERIC through some keywords such as "constructivist" "constructivist approach", "constructivist learning", "inquiry", "problem based learning", "project based learning", "discovery learning", "experiential learning", "science education", "achievement", "learning", etc. (3) The article should verify the accomplishment of each student and quantitative findings.

2.3 Calculating Effect Sizes

The Twelve studies used in this meta-analysis present the dissimilar research models. Some statistical data from each research were recorded, belong mean scores, deviation standart, t-value, and p-value which then modified to an effect size metric by Glass (1976) conversion formulas, and Comprehensive Meta-Analysis (CMA) version 2.0 as indicated in Table 1. The personal effect size was informed to show the influence of integrative approaches among STEM subjects following the guidelines of Cohen (1988) to defining effect sizes where Effect Size = 0.2 (mean small effect), Effect Size = 0.5 (mean medium effect), and Effect Size = 0.8 (large effect).

3 RESULT AND DISCUSSION

The result shows that from twelve studies used in this analysis, found fourteen attainment effect sizes were gained. The study sample sizes used by the twelve published articles were ranged from twenty-five to one hundred and twelve students with the grades ranging from primary until university. Table 1 shows the effect sizes and a resume of every study's nature.

Table 1: Major features of twelve studies.

No	Study	N	Grade Levels	Models of Learning	Effect Size	Code
1	Abdelrahman and Abdelrahman (2014)	25	Middle School	Discovery learning	0.85	K1
2	Akınoğlu and Tandoğan (2007)	50	Middle School	Problem Based Learning	0.497	K2
3	Bilgin, Karakuyu, and Ay (2015)	33	College	Project Based Learning	0.131	K3
4	Clements (1997)	35	High School	Constructivist learning	1.26	K4
5	Gurses, Dogar, and Geyik (2015)	31	College	Problem Base learning	0.25	K5
6	Huffman, Goldberg, and Michlin (2003)	67	College	Constructivist learning	0.31	K6
7	Kazemi and Ghoraishi (2012)	41	College	Problem Base learning	0.14	K7
8	Klahr and Nigam (2004)	112	Elementary School	Discovery Learning	0.904	K8
9	Meijer and Riemersma (2002)	64	High School	Constructivist learning	0.62	K9
10	Reid, Zhang, and Chen (2003)	78	Middle School	Discovery Learning	ES : 2.32 No ES : 1.46 Total : 1.66	K10 K11 K12
11	Ryser, G., Beeler, J., and McKenzie (1995)	40	College	CSILE	1.91	K13
12	Selçuk and Çalişkan (2010)	25	College	Problem Base learning	0.38	K14

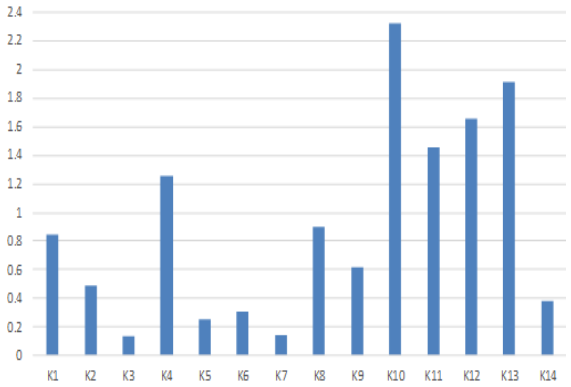

Figure 1: Fourteen achievement effect sizes of twelve studies.

Figure 1 denotes the allocation of the effect sizes which ranged from 0.25 up to 1.91. Four studies (K4, K11, K12, K13) shows the high effect sizes of more than 1.0, while another (K1, K2, K3, K5, K6, K7, K8, K9, K10, K14) shows the effect sizes of between 0 and 1.0. Effect size is obtained by calculating the discrepancy among the probationary and control group means divided by standard deviation of it.

The study concluded that constructive learning approach which used frequently in different lessons and subjects could significantly contribute to learners' academic achievement. Most Quantitative research done between 1997-2017 shows the effectiveness of constructive learning on academic achievement.

4 CONCLUSIONS

Based on the results above included in the meta-analysis, it was found that the outcomes of a constructivist approach in the educational process are most effectual for beginners' academic success. The synthesis of twelve research articles shows that learning with constructivist approach has a positive involve on students' learning outcomes. From education level views, the constructivist approach shows that the largest effect size at the higher education grade and the lowest effect size at the college level. Besides, the results of student's achievement on learning process with constructivist approach show the most significant effect size which showed by learning discovery models, and project-based learning shows the smallest effect size.

Through learning with the constructivist approach, the learners could construct their knowledge to improve the ability of literacy science and technology that appear from reading, writing, observing, and doing science activities so that it can be used in social life later and solve the problems which faced in daily of life. The results of the meta-analysis can be a guide or rules for Indonesian researchers to conduct empirical research related to learning with constructivism approach.

REFERENCES

Abdelrahman, P., Abdelrahman, K., 2014. The Effect of Using Discovery Learning Strategy in Teaching Grammatical Rules to first year General Secondary Student on Developing Their Achievement and Metacognitive Skills. *International Journal of Innovation and Scientific Research*. ***5***(2), 146–153.

Akınoğlu, O., Tandoğan, R. O., 2007. The Effects of Problem-Based Active Learning in Science Education on Students' Academic Achievement, Attitude and Concept Learning. *Eurasia Journal of Mathematics, Science and Technology Education*. ***3***(1), 71–81.

Bhattacharjee, J., 2015. Constructivist Approach to Learning-An Effective Approach of Teaching Learning. *Research Journal of Interdisciplinary and Multidisciplinary Studies (IRJIMS)*.

Bilgin, I., Karakuyu, Y., Ay, Y., 2015. The effects of project based learning on undergraduate students' achievement and self-efficacy beliefs towards science teaching. *Eurasia Journal of Mathematics, Science and Technology Education*. ***11***(3), 469–477.

Brooks, J. G., Brooks, M. G., 1993. In search of understanding. The case for constructivist classrooms, 101-118.

Clements, D., 1991. Enhancement of creativity in computer environments. *American Educational Research Journal*. ***78***(4), 309–318.

Cohen, J., 1988. *Statistical power analysis for the social sciences*, Lawrence Earlbaum. Hillsdale, NJ.

Driscoll, M. P., 2000. Constructivism. *Psychology of Learning for Instruction*.

Glass, G. V., 1976. Primary, secondary, and meta-analysis of research. *Educational Researcher*. ***5***, 3-8.

Gurses, A., Dogar, C., Geyik, E., 2015. Teaching of the Concept of Enthalpy Using Problem Based Learning Approach. *Procedia - Social and Behavioral Sciences*. *197*(February), 2390–2394.

Huffman, D., Goldberg, F., Michlin, M., 2003. Using computers to create constructivist learning environments: Impact on pedagogy and achievement. *Journal of Computer in Mathematics and Science Teaching*. *22*, 151–168.

Kazemi, F., Ghoraishi, M., 2012. Comparison of Problem-Based Learning Approach and Traditional Teaching on Attitude, Misconceptions and Mathematics Performance of University Students. *Procedia - Social and Behavioral Sciences*. *46*, 3852–3856.

Kim, J. S., 2005. The effects of a constructivist teaching approach on student academic achievement, self

concept, and learning strategies. *Asia Pacific Education Review. 6(1)*, 7-19.

Klahr, D., Nigam, M., 2004. The equivalence of learning paths in ealry science instruction. *Psychological Science*. *15*(10), 661–667.

Kleinhenz, Elizabeth, I., Lawrence, 2007. *Standards for Teaching: Theoretical Underpinnings and Applications, (Online) a*vailable at: http://research.acer.edu.au/teaching_standards/1

McNamara, J. F., Morales, P., Kim, Y., McNamara, M., 1998. Conducting your first meta-analysis: An illustrated guide. *International Journal of Educational Reform. 7*, 380-397.

Meijer, J., Riemersma, F., 2002. Teaching and testing mathematical problem solving by offering optional assistance. *Instructional Science*. *30*(3), 187–220.

Reid, D. J., Zhang, J., Chen, Q., 2003. Supporting scientific discovery learning in a simulation environment. *Journal of Computer Assisted Learning*. *19*(1), 9–20.

Ryser, G., Beeler, J., McKenzie, C., 1995. Effects of a computer-supported intentional learning environment (CSILE) on students' self-concept, self-regulatory behavior, and critical thinking ability. *Journal of Educational Computing Research*. *13*(4), 375–385.

Selçuk, G. S., Çalişkan, S., 2010. A small-scale study comparing the impacts of problem-based learning and traditional methods on student satisfaction in the introductory physics course. *Procedia - Social and Behavioral Sciences*. *2*(2), 809–813.

Steffe, L., Gale, J., 1995. *Constructivism in Education*, Routledge. New York.

Tobin, K. G., 2012. *The practice of constructivism in science education*, Routledge. New York.