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A systematic review of the current trend of STEM education and its implications for discipline of social science

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ABSTRACT

STEM education is being emphasized globally as a way to cultivate talents required in the 21st century as a key to solving current and future problems. This paper investigates the trends of existing education policies, identifies new issues, and discusses how to improve issues when applying STEM convergence education policies using a systematic literature review. Based on this review, the purpose of this study is to identify and analyze current trends in STEM (science, technology, engineering, and mathematics) education and issues arising from international research in the field. The data analyzed consists of a systematic literature review reflecting various issues in STEM education through selection criteria and expert group reviews. Five key issues were identified through a systematic analysis of 19 studies. First, STEM education is widely recognized as an educational trend in many countries, including the United States, Canada, Australia, and Turkey. Second, STEM education positively contributes to the improvement of students' cognitive, affective, psychomotor, and career development. Third, the successful implementation of STEM education requires diverse teaching tools and technologies. In addition, enhancing teachers' expertise in STEM education is a critical factor in its success. Finally, the effective practice of STEM education necessitates diversity, equity, and valid and reliable research designs. The findings of this study provide implications for the strategic direction and implementation of STEM education, along with suggestions for future research.

I. Introduction

Thomas Kuhn is known for introducing concepts of paradigms and revolutions to explain significant changes in the evolution of science (Pires, 2012). He argued that new groundbreaking provides fresh ways of thinking about existing phenomena, so it is inappropriate or even impossible to consider the world in terms we used before by changing our basic understanding or paradigm. However, when our scientific understanding is overturned by these ideas, we abandon ideas, explanations, and practices based on old concepts and say that a revolution has occurred.

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Revolutions occur not only in science but in all spheres of human experience. In science education and related fields, we now seem to have entered a potentially revolutionary era with respect to various proposals for STEM education.

STEM education refers to education based on the convergence of several subjects (science, technology, engineering, and mathematics). This convergence of subjects helps students to conduct in-depth research based on cooperation as well as knowledge of each subject and develop the ability to solve real-life problems through critical and creative thinking (Breiner et al., 2012). Therefore, STEM education is being emphasized globally as a way to cultivate talents required in the 21st century as a key to solving current and future problems (Brophy et al., 2008). This new educational paradigm focuses on convergence education based on inquiry activities as an effort to prepare the next generation to contribute to the community and lead the future economic society through learning.

It includes various types of career education and the participation of community experts (Parkin, 2018). To many people, STEM appears to be emerging as an important new educational paradigm. The rapid development in various fields, including science and technology, and the globalization of economic and industrial communities imply that future societies will be quite different from the present ones and school education needs to make active efforts to cultivate the talents the future society will require. Countries like the United States and Canada have integrated STEM education into school curricula and are implementing policies to support its growth at the national level.

The adoption of STEM education in these nations reflects efforts to secure future national competitiveness by actively cultivating human resources needed in future societies. Therefore, it will be necessary to seek innovative changes in education policies and practical application methods in line with current trends focused on revitalizing STEM education. Advanced countries are innovating education policies and practices in line with these trends, with collaboration among policymakers, educators, researchers, and community leaders playing a pivotal role (Parkin, 2018). In addition, many researchers have conducted studies on the effects, limitations, and challenges of STEM education policies to guide improvements in their application (Kanadi, 2019).

This paper investigates the trends of existing education policies, identifies new issues, and discusses how to improve issues when applying STEM convergence education policies using a systematic literature review. Based on this review, the purpose of the study is to identify and analyze current trends in STEM and issues in STEM education research. The study aims to identify and analyze global trends in STEM education and provide recommendations for developing and evaluating STEM education policies.

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2. Research procedure

To investigate the current trend of STEM education and its implications, this paper employs the systematic review process which involves six main steps: 1) research topic selection, 2) literature collection, 4) literature review, 4) analysis target selection, 5) qualitative comparison and analysis of analysis target, and 6) comprehensive result derivation (Timulak, 2014). In the process of selecting the analysis target, the target can be grouped around common topics and subdivided by item. The researcher's professional and comprehensive insight on the subject plays an important role in the process of performing each step (Izzah & Wiyanto, 2018). Data for this study was collected through Google Scholar and the Educational Resources Information Center (ERIC), Springer, and the Web of Science. The year of publication or writing of the search target literature was set from 2010 to 2020 to limit the investigation to relatively recent issues. For data analysis, the validity and reliability of the study were verified for the literature collected for data analysis, and the issues discussed and dealt with the most frequently in terms of the effectiveness of STEM education were analyzed. As a result, the issues of STEM education were selected as 'International Trends in STEM Education', 'Effects of STEM Education: Cognitive, Affective, Psychodynamic, and Career Area Improvement', and 'Effects of STEM Education according to Faculty Variables: Teaching Method, Teacher Professionalism'. In addition to analyzing the overall trend of STEM education, literature classified by item was used to analyze the content qualitatively through in-depth comparative analysis. In the case of quantitative meta-analysis, the effect size of detailed factors was checked and the degree of effect was reflected in the analysis.

3. Findings

3.1. Trends in International STEM Education

The reviewed literature highlights trends and key issues in STEM education research. These studies provide valuable insights into the application, effectiveness, and improvement of STEM policies worldwide. STEM education policies in many developed countries are based on a wide range of theoretical and practical forms of research, and many researchers are working hard to improve STEM education systems by analyzing their effects and overcoming problems. First, studies have been conducted on the effectiveness of STEM education in the cognitive, affective, and psychomotor domains. Some examples are studies on the effects of STEM education on students' achievement (e.g. Batdi, et al., 2019), academic attitudes or interests (e.g. Siregar et al., 2020), students' problem-solving abilities, creativity, and cooperation through communication (e.g. Sarica, 2020). Second, studies on the effectiveness of classes using specific technologies, such as digital technology and augmented reality in STEM education, have been conducted (e.g. Zainuddin & Iksan, 2019). Third, studies have explored the effect of STEM education on students' careers (e.g. Kanadli, 2019). Fourth, among these studies, there were studies on women or the underprivileged (e.g. Murphy et al., 2019) that argued for the differential application of STEM education opportunities, especially for women or the underprivileged. These studies not only provide important clues to verifying the effectiveness of STEM education, but they can also be used to construct effective strategies in applying STEM education in the future. Finally, limitations such as STEM educators' qualifications and expertise problems, lack of support systems, lack of research cooperation, lack of instructional materials, and diversity of evaluation methods are major challenges for STEM education to address in the future (Ejiwale, 2013). The findings reflect global trends in STEM education and underscore the importance of addressing these challenges for its continued success.

3.2. The effectiveness of STEM education

Research on STEM education has been conducted from various angles to synthesize its effects on students. Studies that synthesized the research on STEM education concluded that it improves students' cognitive domain (e.g. Batdi, Talan, & Semerici, 2019), affective domain (e.g. Batdi, Talan, & Semerici, 2019), and psychodynamic domain (e.g. Kanadli, 2019), and influences students' career interest and maturity (e.g. Murphy et al., 2019).

3.2.1. Improves the cognitive domain of students

Various studies on learners' cognitive changes through STEM education have been compiled, and meta-analyses have been conducted to synthesize them. Becker and Park (2011) meta-analyzed the effect of an integrated approach between STEM subjects on learners' academic achievement. They focused on teaching and learning methods with an integrated approach, which is an important characteristic of STEM education. The study calculated the effect of STEM education on learners' academic achievement with 33 effect sizes in 28 studies and concluded that classes with an integrated approach between STEM subjects positively affect students' academic achievement in those subjects. In addition, the following studies explain the impact of STEM education on learners' academic achievement using effect size" for conciseness. This effect size can be interpreted according to the interpretation of the effect size presented by Cohen (1988). First, Sarac (2018) synthesized the results of 23 international academic journals and calculated the effect size as 0.442. This is a moderate effect size. Based on this, it can be concluded that STEM education positively influenced students' academic achievement. Second, Batdi, Talan, and Semerici (2019) calculated the effect size as 0.655 after synthesizing the research results of international journals for 26 research results. Their study is also of a moderate effect size, and it can be concluded that STEM education leads to a positive improvement in students' academic achievement. In addition, looking at the effect size in various studies on the effectiveness of STEM education on students' academic achievement, Belland et al. (2015) reported an effect size of 0.53, while D'Angelo, Rutstein, and Harris reported 0.62" for clarity and parallel structure. All

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of these studies showed a moderate effect size based on Cohen's (1988) criteria.

On the other hand, some research results show that STEM education helps students improve their cognitive performance. Sarica (2020) emphasizes that STEM education has a positive effect on students' academic achievement as a result of analyzing graduate papers related to STEM education in Turkey. Specifically, STEM education has a positive effect on students' scientific knowledge improvement (Kandli, 2019). In particular, the primary driver of cognitive improvement through STEM education is student participation in STEM classes. After qualitatively synthesizing related papers, Batdi, Talan, and Semerici (2019) emphasized that STEM classes induce the active participation of students and provide meaningful learning to students compared to other teaching methods, thereby contributing to students' cognitive improvement. As a result of analyzing the impact of STEM education by school level, it was found that cognitive improvement in elementary schools was higher than that in other school levels (e.g. Becker & Park, 2011). For example, in a study by Batdi, Talan, and Semerici (2019), the effect size in elementary school was 1.222, which indicates a remarkably high effect, and it was significantly higher than that of middle school (0.406) and high school (0.307).

3.2.2 Improves the affective domain of students

Various studies have been conducted on the improvement of learners' affective domains through STEM education, and meta-analyses have been conducted to synthesize these findings. According to a study by Sarac (2018), STEM education has a positive effect on students' attitudes toward STEM. An effect size of 0.62 was derived from 23 papers, indicating that the effect on academic achievement was greater than 0.442. In the same context as these results, STEM education improves interest and motivation for STEM subjects, and the results have been found to have statistically significant effects (Yildrim, 2019). In addition, various qualitative meta-analysis studies and systematic literature studies synthesize and describe the effects on learners' affective domains. In particular, STEM education positively influenced middle school students' attitudes toward STEM (Izzah & Wiyanto, 2018) and improved students' attitudes in science classes (Sarica, 2020). STEM education also positively influences student interest and attitude toward engineering, enabling successful instruction due to improvement in learners' learning motivation (Batdi, et al.,2019). STEM classes provide more engaging activities and improve their motivation to continue participating in classes.

Research on the improvement of the affective domain through STEM education has been verified and mentioned through various countries internationally. Kanadli (2019) emphasizes that STEM classes are a good way to improve students' learning aspirations and motivation, especially their attention and interest, as a result of synthesizing changes in the affective domain of students based on 22 studies in Turkey. In addition, according to Kang's (2019) study, the impact of

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integrated STEM education in Korea is effective in learning both the cognitive and affective domains of students, but it is particularly effective in the affective domain. Finally, Murphy et al. (2019) analyzed Australian STEM-related documents and emphasized that STEM education should be structured in the direction of improving students' curiosity and confidence. Factors such as school level, race, and gender are being discussed as important issues in relation to the practice of STEM education (Lawner et al., 2019). According to a study by Young, Ortiz, and Young (2017), it is necessary to further study the improvement of STEM interest in younger students and determine how long this interest lasts with growth. This can be a strong basis for the long-term establishment of STEM education by conducting STEM classes at an earlier school level. In addition, middle school is a time when there are changes related to the preparation of STEM learning in the future, and it is also a time when achievement, confidence, and interest in STEM fields can disappear, especially for girls (Young, et al., 2017). Therefore, it is necessary to consider the decisive timing of STEM education well by considering school level and gender (Zeng et al., 2018).

3.2.3 Improves the psychodynamic domain of students

The improvement of students' abilities through STEM education has been studied in various ways, and meta-analyses were conducted to synthesize the findings. STEM education has a positive effect on students' problem-solving ability and creativity (Sarica, 2020), students' improvement of scientific process ability (Sarac, 2018), engineering and design ability and idea generation ability (Kanadli, 2019), and collaboration or digital technology ability (Murphy et al., 2019). Specifically, Sarac (2018) calculated a large effect size of 0.82 as a result of synthesizing the research results on the improvement of students' science process function through STEM classes. This represents a larger effect size compared to improvements in the cognitive and affective domains. Active participation in STEM education is expected to enhance students' psychodynamic functions" for conciseness (Batdi, et al.,2019). It can enhance students' planning and practical STEM abilities through project-based and problem-solving classes, as well as their engineering skillse. In addition, through these activities, research, communication, collaboration, and problem-solving skills can also be improved (Murphy et al., 2019).

4. Effectiveness of STEM education according to teaching variables

Research in the field of STEM education contributes to the growth and development of diverse student perspectives. In addition, a topic that has been studied extensively for the practice of STEM education is the enhancement of teaching methods and teacher professionalism. Various attempts and efforts have been made from the perspective of teaching methods in STEM education (e.g. Zainuddin & Iksan, 2019) and research on improving teacher professionalism" for conciseness (e.g., Lynch et al., 2019; Murphy et al., 2019).

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4.1 Effectiveness of STEM Education by Teaching Method

STEM education focuses on learner-centered instruction through the use of various teaching tools and techniques" for clarity and conciseness. Teaching tools and techniques in STEM instruction have been shown to have a statistically significant positive effect on students' learning outcomes (e.g. Iván˜ez & Delgado-Kloos, 2018; Pellas et al., 2016). Specifically, Belland et al. (2015) synthesized the cognitive effects through computer-based instruction in STEM education and found that the effect size was 0.53. This shows a moderate effect and indicates that computer-based STEM instruction has an effect on improving students' cognitive domains. In STEM instruction, computer-based scaffolding activities, characterized by problem-based instruction, facilitate learning, as they provide cognitive help to students. In addition, studies dealing with computer-based simulation in STEM education have an effect size of 0.62, which is above medium (D'Angelo, et al., 2016). In other words, simulations in STEM instruction improve student learning outcomes. Meanwhile, as a result of synthesizing research using augmented reality in STEM education, Ibán˜ez and Delgado-Kloos (2018) have studied the improvement of students' affective domains in STEM classes using augmented reality and suggest that research is needed in relation to teaching and learning strategies such as inquiry-oriented classes and flipped learning. Maximizing student learning was the most important issue in STEM classes using various teaching tools and technologies, highlighting how computer-based activities facilitate learning and underscore the importance of instructional design (Belland et al., 2015).

4.2 Effectiveness of STEM education according to the professionalism of teachers

Issues related to teachers' professionalism in the practice of STEM education have been emphasized in studies and systematic reviews. For STEM classes to be conducted smoothly, teachers first need appropriate knowledge, class confidence, and teaching ability (Murphy et al., 2019). For this, teacher training or opportunities to enhance professionalism should be provided (e.g. Murphy et al., 2019). Ejiwale (2013) pointed out the insufficient professionalism and preparation of teachers as obstacles to the successful realization of STEM education. In consideration of the lack of qualified teachers and teachers' readiness for STEM education, strategic and planned investment and support are needed to enhance teachers' professionalism. Even if teachers are aware of the value and importance of STEM education, they desperately need sufficient support and collaboration for STEM classes (Batdi, et al., 2019). Although more specific support and research is needed, the enhancement of teachers' professionalism is an important factor in the successful realization of STEM education. Specifically, as the demand for teacher professionalism has grown, many studies have focused on professional development, such as STEM training and seminars. Lynch et al. (2019) emphasized the direction of the improvement of STEM programs for teachers as a result of reviewing STEM teaching

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improvement programs. The researchers found that STEM programs for teachers are more effective when they deal with specific situations in which curriculum data can be used directly and focus on content knowledge for teachers, teaching content knowledge, and student understanding knowledge (Lynch et al., 2019). In addition, teachers need expertise in STEM classes supported by resources to address challenges in the context of teaching STEM classes (Lynch et al., 2019).

5. Conclusions and suggestions

To revisit the discussion of revolution, we should consider STEM education's position from Thomas Kuhn's perspective. It is difficult to explain the element of a single paradigm that guides the work of all science educators, but many studies have presented several issues in the related topics. This paper tells us that there are areas that require further consideration and improvement. STEM education is an educational strategy to produce competitive convergent talents in the future society, and it is a global trend for innovation in education policy. To this end, research literature related to STEM education was collected and selected, and 19 research papers were analyzed qualitatively. The issues that are discussed and dealt with the most often in terms of the effectiveness of STEM education are: 1) international trends in STEM education, 2) student's perspective: cognitive, affective, psychodynamic, and career area improvement, and 3) teacher's perspective. The studies classified by item were used to synthesize the core contents of each issue through qualitative meta-analysis. The findings can be summarized into four results.

First, the research and practice of STEM education is an international phenomenon and has common issues. Several countries use STEM education as a strategy for improving future competitiveness and innovation, and the composition of these strategies has been based on extensive research on future society, economy, and industry. STEM education in many countries is focused on breaking down barriers between disciplines and nurturing the talents required by the future society through a convergent approach. In addition, for the effective practice and application of STEM education, studies have been conducted to verify its effectiveness and find limitations. The consistency of the research results increases the reliability of the effects of existing STEM education on specific areas and provides important information regarding the strategic application of STEM education. In addition, limitations, including teacher expertise, data shortages, and insufficient support, offer insights for improving policies" for brevity and clarity for STEM education.

Second, STEM education has positively improved students' cognitive, affective, psychodynamic, and career-related areas. In terms of cognitive domain, STEM education was found to be effective in improving students' academic achievement and scientific knowledge. Active participation and the provision of meaningful learning were the main reasons for this

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improvement. In the affective domain, STEM education was found to be effective in improving students' interest, attitude, learning motivation, and attention to STEM subjects, and it was found that it can be used to improve students' curiosity and confidence. In addition, STEM education showed positive effects in the psychodynamic areas of problem-solving ability, creativity, scientific and engineering process ability, digital technology, and collaboration ability, and it was found to increase student interest in careers in the STEM field.

Third, various teaching tools and technologies are used for STEM education. Thus, teacher expertise in using these tools is important for successful STEM classes. For STEM education, research confirms that computers, simulations, augmented reality technologies, and mobile technologies are widely used in schools , or teaching strategies such as design-based, problem-based, project-oriented, and inquiry-oriented are commonly employed. To use a specific skill or tool in the course of instruction, teachers must possess sufficient experience and knowledge of the skill and tool, and to provide meaningful learning opportunities to students, teachers must apply these tools effectively, drawing on professional knowledge and instructional strategies" for simplicity and clarity. As a result of analyzing and synthesizing internationally conducted STEM education meta-research, three major discussion points could be drawn. First, for the effective verification of STEM education, research is needed that considers the validity and reliability of research design. Meta-analyses aggregate multiple studies on a specific topic, and the quality of research design influences the magnitude of the educational effect (Young, et al., 2017). Therefore, when well-designed research is used for analysis, the effectiveness of STEM education can be evaluated more accurately. Second, a STEM education strategy considering equity is required. Regarding the effect of STEM education on the affective domain and career path, several research results emphasize STEM education for women and the underprivileged (Murphy et al., 2019; van den Hurk, Melissen, & van Langen, 2019). In particular, Young, Ortiz, and Young (2017) mention that the achievement, confidence, and interest in STEM fields vary during adolescence and emphasize the need for further research on improving interest in lower-grade students, as well as on the relationship between interest and development and continuity.

Fourth, enhancing teacher professionalism is essential for STEM education. Compared to traditional teaching methods, STEM education requires high professionalism on the part of teachers in the use of various teaching tools and skills. In fact, a lack of qualified teachers, inadequate preparation, and insufficient investment were identified as major obstacles to the realization of STEM education (Batdi, et al., 2019). Therefore, continuous and effective efforts for the professional development of teachers for STEM education are required. Suggestions based on this study are as follows. The internationally conducted meta-research on STEM education provides important implications for its application. However, education policy strategies and school-level contexts may vary across countries. Therefore, a meta-study on

STEM education suitable for each country's educational situation is needed. In addition, a macroscopic analysis and synthesis of these studies is necessary. In general, the results of derivation through systematic review often analyze cognitive, affective, or psychodynamic areas individually or target only specific elements of that area. It is necessary to use the existing STEM education across the countries as an opportunity to reflect on and identify the characteristics of teaching and learning design and the relationship with variables that affect the effect size.

Reference

Batdi, V., Talan, T., & Semerici, C. (2019). Meta-thematic analysis of STEM education. International Journal of Education in Mathematics, Science and Technology, 7 (4), 382-399.

Becker, K., & Park, K. (2011). Effects of integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. Journal of STEM Education, 12 (5), 23-38.

Belland, B. R., Walker, A. E., Olsen, M. W., & Leary, H. (2015). A pilot meta-analysis of computer-based scaffolding in STEM education. Journal of Educational Technology & Society, 18 (1), 183-197.

Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. School Science and Mathematics, 112 (1), 3-11.

Brophy, S., Klein, S., Portsmore, M., & Rogers, C. (2008). Advancing engineering education in P-12 classrooms. Journal of Engineering Education, 97 (3), 369-387.

Cohen, J. (1988). Statistical power analysis for the bahavioral science (2nd ed.). Hillsdale,NJ: Lawrence Earlbaum Associations.

D'Angelo, C. M., Rutstein, D., & Harris, C. J. (2016). Learning with STEM simulation in the classrooms: Finding and trends from a Meta-analysis. Educational Technology, 56 (3), 58-61.

Ejiwale, J. (2013). Barriers to successful implementation of STEM education. Journal of Education and Learning, 7 (2), 63-74.

Ibáñez, M. & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. Computers & Education, 123 , 109-123.

Izzah, S., & Wiyanto, W. (2018). The effect of STEM education on the attitudes of secondary school students: A metaanalysis. Advanced in Social Science, Education and Humanities Research, 247, 454-458.

ISSN: 2455-8834

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Kanadi, S. (2019). A meta-summary of qualitative findings about STEM education. International Journal of Instruction, 12 (1), 959-976.

Kang, N. (2019). A review of the effect of integrated STEM or STEAM (science, technology, engineering, arts, and mathematics) education in South Korea. Asia-Pacific Science Education, 5 , 1-22.

Lawner, E. K., Quinn, D. M., Camacho, G., Johnson, B. T., & Pan-Weisz, B. (2019). Ingroup role models and underrepresented students' performance and interest in STEM: A meta-analysis of lab and field studies. Social Psychology of Education, 22, 1169-1195.

Lynch, K., Hill, H. C., Gonzalez, K. E., & Pollard, C. (2019). Strengthening the research base that informs STEM instruction improvement efforts: A meta-analysis. Educational Evaluation and Policy Analysis, 41 (3), 260-293.

Murphy, S., MacDonald, A., Danala, L., & Wang, C. (2019). An analysis of Australian STEM education strategies. Policy Futures in Education, 17 (2), 122-139.

Parkin, A. (2018) Canada 2067. Supporting Education Transformation in Canada: The Intersection of Canada 2067 and Education 2030 Framework for Action . London, ON: Let's Talk Science.

Pellas, N., Kazanidis, I., Konstantinou, N., & Georgiou, G. (2017). Exploring the educational potential of three-dimensional multi-user virtual worlds for STEM education: A mixed-method systematic literature review. Educational Information Technology, 22 , 2235-2279.

Pires, Flávio. (2012). Thomas Kuhn's 'Structure of Scientific Revolutions' applied to exercise science paradigm shifts: Example including the Central Governor Model. British journal of sports medicine. 47. 10.1136/bjsports-2012-091333.

Sarac, H. (2018). The effect of Science, Technology, Engineering and Mathematics – STEM educational practices on students' learning outcomes: A meta-analysis study. The Turkish Online Journal of Educational Technology, 17 (2), 125-142.

Sarica, R. (2020). Analysis of postgraduate theses related to STEM education in Turkey: A meta-synthesis study. Acta Didactica Napocensia, 13 (2), 1-29.

Siregar, N., Rosli, R., Maat, S., & Capraro, M. (2020). The effect of Science, Technology, Engineering and Mathematics (STEM) program on students' achievement in Mathematics: A meta-analysis. International Electronics Journal of Mathematics Education, 15 (1), 1-12.

Timulak, L. (2014). Qualitative Meta-Analysis. In U., Flick. (Ed). The sage handbook of

ISSN: 2455-8834

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qualitative data analysis . Washington, DC: Sage.

Yildirim, B. (2016). An analyses and meta-synthesis of research on STEM education. Journal of Education and Practices, 7 (34), 23-33.

Young, J., Ortiz, N., & Young, J. (2017). STEMulating interest: A meta-analysis of the effects of out-of-school time on student STEM interest. International Journal of Education in Mathematics, Science and Technology, 5 (1), 62-74.

Zainuddin, S. H., & Iksan, Z. (2019). Sketching engineering design in STEM classroom: A systematic review. Creative Education, 10 (12), 2775-2783.

