



Systematic Literature Review: Science Self-Efficacy in Science Learning

Tinjauan Pustaka Sistematis: Efikasi Diri dalam Pembelajaran Sains

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Article History:

Received: 20-08-2021; Received in Revised: 16-09-2021; Accepted: 21-09-2021

Abstract

Learning success is often represented by numbers that indicate the extent to which students can achieve educational goals. However, basically, the success is determined by how much effort and their self-efficacy in learning. Therefore, the purpose of this study is to describe students' self-efficacy in learning and teachers' self-efficacy in teaching science. To obtain more comprehensive data and explanations, the Systematic Literature Review method was used in this study. This method is used to analyze 168 articles indexed by Google Scholar. In general, the stages of this research include planning, conducting, and reporting. The research was conducted by referring to three research questions, namely (1) How is the student's self-efficacy in learning science?, (2) How is the teacher's self-efficacy in teaching science, and (3) how is the relationship between self-efficacy and other variables. The results obtained indicate that Science Self-efficacy in students can be raised by familiarizing students to obtain success in learning science while in teachers it is raised through teaching practicum training. This research is expected to provide an overview for researchers and teachers to develop self-efficacy in science learning.

Keywords: Science learning; Systematic Literature Review; Self-efficacy.

Abstrak

Kesuksesan belajar sering direpresentasikan dengan angka yang menunjukkan sejauh mana siswa dapat mencapai tujuan pendidikan. Namun, pada dasarnya kesuksesan tersebut ditentukan oleh seberapa besar usaha dan self-efficacy mereka dalam belajar. Oleh karena itu, tujuan penelitian ini adalah memaparkan Self-efficacy siswa dalam belajar dan Self-efficacy guru dalam mengajar IPA. Untuk memperoleh data dan penjelasan yang lebih mendalam, metode Systematic Literature Review digunakan dalam penelitian ini. Secara umum tahapan penelitian ini mencakup planning, conducting dan reporting. Penelitian dilakukan dengan mengacu pada tiga pertanyaan penelitian, yaitu (1) Bagaimana Self-efficacy siswa dalam belajar IPA? (2) Bagaimana Self-efficacy guru dalam mengajar IPA dan (3) Bagaimana keterkaitan antara Self-efficacy dan variabel lainnya. Hasil yang diperoleh menunjukkan bahwa Science Self-efficacy pada siswa dapat dimunculkan dengan membiasakan siswa untuk memperoleh kesuksesan dalam pembelajaran IPA sedangkan pada guru dimunculkan melalui pelatihan praktikum mengajar.

Kata Kunci: Efikasi Diri; Pembelajaran IPA; Systematic Literature Review; Self-efficacy

Introduction

Learning is an integral part of every level of education. From these learning outcomes, students are expected to be at least able to master the content of learning such as mathematics, science and social studies. Therefore, researchers in education carry out various innovations in terms of internal factors (motivation, attitudes, self-efficacy, etc.) and external factors (learning media, environment, learning facilities, etc.)¹. The designed learning is carried out oriented to student activities with an emphasis on science skills². Students are expected to elaborate the information obtained in class with events related to science encountered in everyday life. In addition, argumentation skills are also essential because they have great potential for students' communication skills. For example, through discussion, the reconstruction of students' knowledge will occur from scientific conceptions³

Student can practice solving problem in the real world Through science learning and provide an overview of future job prospects⁴. When students enter the world of work, science learning indirectly gives them moral values such as responsibility, being democratic and caring for others. However, what needs to be concentrated on is the student's attitude towards science learning itself; if students have a positive attitude towards science learning, it will lead to motivation and good results in learning⁵.

Students' motivation and abilities significantly contribute to their learning success⁶. Science lessons focus not only on understanding the material but also on the formation of student attitudes⁷. When student learning has shown good social interaction, they will work together and have

¹ Yudhie Suchyadi and Nita Karmila, "The Application of Assignment Learning Group Methods through Mincro Scale Practicum to Improve Elementary School Teacher Study Program College Students Skills and Interests in Following Science Study Courses," *Journal of Humanies and Social Studies* 03, no. 02 (2019): 95–98; Debora N Sudjito, Natalia R Keliat, and Susanti P Hastuti, "Integrated Science Learning Using Scientific Approach in Junior High School in Semarang Regency," *Indonesian Journal of Science and Education* 2, no. 1 (2018): 69–74; Mawardi and Sri Handayani, "Faktor-Faktor Peninjang Kemampuan Belajar Di Sekolah Dasar Negeri Lae Langge Kecamatan Sultan Daulat," *Jurnal Pendidikan Islam* 10, no. 2 (2019): 98–113.

² Sulthon, "Pembelajaran IPA Yang Efektif Dan Menyenangkan Bagi Siswa Madrasah Ibtidaiyah (MI)," *Elementary* 4, no. 1 (2016): 39–54.

³ Pawel Ciesla and Anna Michnieweska, *Teaching and Learning Science at All Levels of Education* (Krakow: Peadagogical University of Krakow, 2014).

⁴ (Isdaryanti et al., 2018; Shidiq, 2016)

⁵ (Hidayat et al., 2020; Mujtaba et al., 2018; Shidiq & Yamtinah, 2019; Yamtinah et al., 2017)

⁶ Ahmad Soleh, Pramono, and Suratno, "Faktor - Faktor Yang Mempengaruhi Keberhasilan Siswa Kelas 2 TMO SMK Texmaco Semarang Pada Mata Diklat Service Engine Dan Komponen - Komponennya," *Jurnal OTM* 9, no. 2 (2009): 57–64;

⁷ Astalini, Dwi Agus Kurniawan, and Nugroho Kurniawan, "Analisis Sikap Siswa Terhadap IPA Di SMP Kabupaten Muaro Jambi," *Jurnal Pendidikan Sains* 8, no. 1 (2020): 18–26.

independence in learning⁸. the high interest of students in science learning which was shown through several attitudes, namely curiosity, being open to new knowledge and having a career picture by pursuing science⁹. However, not all students have positive perceptions and attitudes about science. Therefore, teachers can overcome this assumption by providing different packaging when teaching science¹⁰. If students have a positive attitude towards science, it will affect their confidence in learning, which is called self-efficacy in this study.

Self-efficacy refers to self-confidence in doing something. If someone has faith before doing something, they will get good results. Students can develop their self-efficacy by comparing one's work with the results of the work they do¹¹. Self-Efficacy is not related to the skills possessed but is related to the individual's belief in the skills possessed. So, efficacy is not a measure of student success in learning, although the two things are interrelated.¹². Because research also shows that self-efficacy has a relationship with student achievement¹³.

Self-efficacy is not only owned by students but also by teachers. And also, not different by gender¹⁴. This is valuable to study because Self-efficacy is one of the determinants of success in learning. Student self-efficacy can be trained through learning models, while teacher self-efficacy is trained through training¹⁵. In order to obtain complete and comprehensive information and data, the researcher intends to study more deeply about Self-efficacy by using the Systematic Literature Review method.

⁸ Paino and Wisnu Desmawan, "Analisis Sikap Siswa Pada Pembelajaran IPA Di SDN 124/VIII Sidorejo Kabupaten Tebo," *Integrated Science Education Journal* 1, no. 2 (2020): 49–53.

⁹ Martianingsih, Utari, & Saepuzaman, (2016)

¹⁰ Abu Ridlo, "Deskripsi Sikap Siswa Dalam Mata Pelajaran IPA Di SMP IT Ashidiqi," *Journal Evaluation in Education* 1, no. 2 (2020): 32–36.

¹¹ Shari L Britner and Frank Pajares, "Sources of Science Self-Efficacy Beliefs of Middle School Students," *Journal of Research in Science Teaching* 43, no. 5 (2006): 485–499.

¹² Tiara Oktaviana, Rianto, and Wasidi, "Pengaruh Model Pembelajaran Dan Efikasi Diri Terhadap Prestasi Belajar IPA," *DIADIK: Jurnal Ilmiah Teknologi Pendidikan* 8, no. 1 (2019): 69–77.

¹³ Aswin, Djadir, & Rusli, (2019)

¹⁴ Dekant Kiran and Semra Sungur, "Middle School Students' Science Self-Efficacy and Its Sources: Examination of Gender Difference," *Journal Science Education Technology* 21 (2012): 619–630.

¹⁵ I Ketut Dena Yasa et al., "Peningkatan Efikasi Diri Siswa Pada Mata Pelajaran IPA Kelas IV SD Melalui Model Pembelajaran Numbered Head Together," *MIMBAR PGSD Unidksha* 8, no. 3 (2020): 330–341; Sadia Shaukat, Venkat Rao Vishnumolakala, and Amani K Hamdan Alghamdi, "Science Teachers' Perceptions of Personal Science Efficacy Beliefs and Science Teaching in Saudi Arabia, Pakistan, and the United Arab Emirates," *EURASIA Journal of Mathematics, Science and Technology Education*, 2020, 16, no. 8 (2020): 1–11.

Systematic Literature Review (SLR) is a literature review method used to systematically identify journals and articles ¹⁶. This method uses three general stages, namely planning, conducting, and reporting. ¹⁷ discusses Self Efficacy using the SLR method, which reveals the relationship between Self-efficacy (SE) and Adversity Quotient (AQ) in learning mathematics. ¹⁸ also discusses self-efficacy using the SLR method; the results discuss the factors influencing students' self-efficacy in learning mathematics. The two previous studies that discussed self-efficacy were only student oriented. Therefore, the novelty from this SLR study discusses self-efficacy in science learning, which includes teachers and students. This research is expected to provide information and reference to improve teachers and students' self-efficacy.

Method

Systematic Literature Review (SLR) is used in this study to examine, evaluate and interpret research related to Self Efficacy in Science Learning. With this method, the researcher conducts a systematic review of journal articles by following the steps set out by ¹⁹, which is planning, conducting, and reporting in Figure 1.

1. Research Procedure



Figure 1. Stages of Research Procedure

The planning or planning stage is the initial stage in conducting SLR research, namely determining the research object and more specific research questions ²⁰. Furthermore, after determining the object of research in the form of Self-Efficacy in science learning, a conducting process or implementation of the SLR is carried out, namely searching for articles using predetermined keywords. Furthermore, at the reporting stage, the researcher writes down each article's results that are adequate to be used as a report.

¹⁶ (Shidiq et al., 2020a; 2021b; Triandini et al., 2019)

¹⁷ Putra & Roza (2020)

¹⁸ Roslan & Maat, (2019)

¹⁹ Kitchenham et al., (2009)

²⁰ (Shidiq et al., 2021)

1). Research Question

The purpose of this article is to provide a complete picture related to Self-Efficacy in science learning. Therefore, to make this review more effective, research questions are made that can help this paper:

RQ 1. How is the students' self-efficacy in learning science?

RQ 2. How is the Self-Efficacy of teachers/prospective teachers in teaching science?

RQ 3. How is Self-Efficacy related to other variables?

2). Search Process

This process is the stage where articles related to the research question are searched. The keywords used are "Student's Self Efficacy towards Science", "Relationship between science self-efficacy", and "Teacher's Self Efficacy in Teaching Science". The databases used in this study are Google Scholar, Elsevier, Education Resource Information Centre (ERIC), and Tandfonline. This database was chosen because of its good reputation

3). Inclusion and Exclusion Criteria

This stage is the determination of the criteria for the article to be used. The criteria are: (C1). The articles obtained have a publication year ranging from 2014 - 2021, (C2). Sourced from a predetermined database, (C3). The data used are only journal papers related to Self-Efficacy in science learning.

Based on the described procedure, 168 articles were found. Of the articles, only 7 met the first research question (RQ1), 10 met RQ2 and 8 met RQ3. The remaining articles were not continued for analysis because they did not meet or could not answer the research questions. Illustration of article selection can be seen in Figure 2

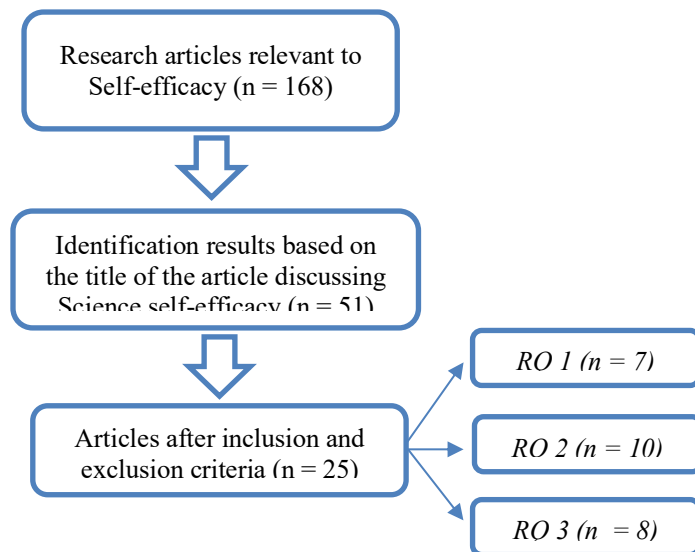


Figure 2. Article selection scheme

2. Research Object

Self Efficacy in science learning is the main topic in this research. The topic was chosen because Self-efficacy is an attitude possessed by students and teachers and can affect many other variables related to learning. Therefore, Self Efficacy can be broadly identified, starting from the amount of self-efficacy in a person, its source, its effect on other variables and how to improve it.

Result and Discussion

Table 1. The results of the analysis of articles that answer RQ 1

No	Title	Results
1	<i>Understanding the development of interest and self-efficacy in active-learning undergraduate physics courses</i> (Remy Dou, Eric Brewe, Geoff Potvin, Justyna P. Zwolak & Zahra Hazari - 2018)	<ol style="list-style-type: none"> 1. This study examines classroom interaction in the context of a broader career theory of Self-efficacy in learning Physics and the development of interest in Physics 2. Students with a high interest in physics will develop high self-efficacy in physics 3. The success or failure of the completed task, as well as the encouragement or emotion experienced during the task, will form students' self-efficacy
2	<i>An Investigation of Junior High School Students' Science Self-Efficacy and its Correlation with Their Science Achievement in Different School Systems</i> (Rena Siti Hasanah, Hayat Sholihin, Ikmanda Nugraha - 2021)	<ol style="list-style-type: none"> 1. This study compares the Science Self-efficacy of students attending public schools and private schools 2. There is no difference in the category between the Science Self-efficacy of public school students and private schools; both are in the medium category 3. The level of student self-efficacy in both schools is influenced by the implementation and learning approach used by the teacher 4. Science Self-efficacy of students in both types of schools does not affect student learning achievement 5. Science Self-efficacy of students is not the only factor that influences or is used as a prediction in obtaining science scores
3	<i>Self-Efficacy and Motivation: Improving Biology Learning Outcomes Of Senior High School Students</i>	<ol style="list-style-type: none"> 1. This study analyzes the relationship between three variables, namely Self-efficacy, learning motivation and Biology learning outcomes 2. There is a relationship between self-efficacy on student learning motivation

No	Title	Results
	(Fahmie Firmansyah , Ratna Komala, Rusdi - 2018)	<ol style="list-style-type: none"> 3. There is a direct relationship between students' learning motivation and Biology learning outcomes 4. There is a direct relationship between Self-Efficacy and Biology learning outcomes
4	<p><i>"I'm just not that great at science": Science self-efficacy in arts and communication students</i></p> <p>(Eileen McBride, W. Wyatt Oswald, Lindsey A. Beck, Amy Vashlishan Murray-2019)</p>	<ol style="list-style-type: none"> 1. This study analyzes three variables, namely Science Self-efficacy, connection to science and student anxiety about learning science 2. There is an increase in students' Science Self-efficacy and connection to science, although there is no change in their anxiety about learning science 3. The research was conducted at international schools, which consisted of various nationalities; there was an increase in Science Self-efficacy in minority students to compete with their other classmates. 4. Students' self-efficacy cannot be used to predict their learning outcomes. However, there is an increase in their confidence in using science in everyday life.
5	<p><i>Reducing the gender gap in students' physics self-efficacy in a team- and project-based introductory physics class</i></p> <p>(Tobias Espinosa, Kelly Miller, Ives Araujo, Eric Mazur- 2019)</p>	<ol style="list-style-type: none"> 1. This study aims to analyze the effect of active physics learning on students' self-efficacy 2. After being taught using project-based learning, female students' self-efficacy increased so that they were equal to the self-efficacy level of male students. 3. This finding is essential considering the assumption that in physics lessons, the Science Self-efficacy of male students is always higher than female students.
6	<p><i>Analysis Of Physics Problem Solving In The Perspective Of Self Efficacy and Adversity Quotient</i></p> <p>(Napis-2018)</p>	<ol style="list-style-type: none"> 1. This study aims to analyze the impact of Science Self-efficacy and Adversity Quotient on solving Physics problems 2. There is a direct positive influence of Science Self-efficacy on Physics problem solving, 3. There is an influence of adversity quotient on solving Physics problems, 4. There is an influence of Self-efficacy (self-efficacy) on the adversity quotient,

No	Title	Results
		5. There is an indirect effect of Science Self-efficacy on solving Physics problems through the adversity quotient.
7	<i>Students' self-efficacy for science in different school systems</i> (Bat - Shahar Dorfman, David Fortus - 2018)	<ol style="list-style-type: none"> 1. The study was conducted on three different school systems, traditional, democratic and Waldorf. 2. In each type of school, students have low Science Self-efficacy because they think science is a complex subject. 3. There is a decrease in Science Self-efficacy when entering grade 7, which is caused by the environment, teacher and student comparison group.

Table 2. The results of the analysis of articles that answer RQ 2

No	Title	Results
1	<i>Teacher Training and Preservice Primary teachers self-efficacy for Science Teaching.</i> (Chantal Velthuis-Petra Fisser-Jules Pieters-2014)	<ol style="list-style-type: none"> 1. Teacher training for elementary pre-service science teacher can increase self-efficacy at the end of the first year. However, no significant difference in self-efficacy was found between the years in the following program. 2. High mastery of the material and frequent teaching frequencies can increase the self-efficacy of prospective elementary science teachers 3. There is no significant difference between the self-efficacy scores of pre-service science teacher from the two universities. University A specializes in pedagogic practice, while University B specializes in strengthening science content. However, these two things do not affect increasing the self-efficacy of prospective science teachers. The assessment technique used at University A is the assignment of practical and theoretical pedagogical knowledge, while at University B, both use theoretical assessment. The assessment technique used does not affect the self-efficacy of prospective science teachers.
2	<i>Changes in Science Teaching Self-Efficacy Among Primary Teachers Education student</i>	<ol style="list-style-type: none"> 1. This study provides evidence that science content lectures can increase the self-efficacy of elementary science teacher candidates.

No	Title	Results
	(David Palmer-Jeanette Dixon-Jennifer Archer-2015)	2. Self-efficacy of elementary pre-service science teacher lasts a long time after ten months 3. Factors that become effective sources for increasing Self-efficacy are: a. Perceptions of learning how to teach science at the primary level b. Understanding of the science context
3	<i>Pre-service Science teacher's Beliefs, attitudes, and self-efficacy: a multicase study</i>	1. There is an increase in confidence, science attitudes and self-efficacy in science teacher candidates 2. Self-efficacy, scientific beliefs and attitudes have a reciprocal relationship with each other 3. The factors that influence the increase are: a. Mastery b. Experienced c. Verbal persuasion d. Psychological and cognitive aspects
4	<i>Pre-service elementary Teacher's Science Self-Efficacy Beliefs and Science Content Knowledge</i> (Deepika Menon-Troy D.Sadler-2016)	1. There is an increase in the self-efficacy of pre-service science teacher after attending Physics lectures. 2. Before and after going through lectures, statistically, there is no relationship between self-efficacy and understanding of the physics context of science teacher candidates 3. Changes in the self-efficacy of pre-service science teacher and changes in contextual understanding have a moderate correlation. So it can be concluded that other factors influence the increase in student self-efficacy during the Physics lecture
5	<i>Science as Learner and as a Teacher: Measuring Science Self-Efficacy of Elementary Preservice Teachers</i>	1. Research shows a significant increase in self-efficacy and science attitudes of pre-service science teacher after attending science content lectures for one semester. Qualitative data accompany data to support quantitative data. 2. Influential factors in increasing self-efficacy are: Experimental design projects and centralized science learning
6	<i>Investigation of the Self-Efficacy Beliefs of Pre-Service Science Teachers in Terms of Following and Using the Field of Education</i>	1. The level of prospective science teachers participating in educational innovation is high but using innovation in education is still low. They do not use primary sources such as theses and conferences; instead, they use

No	Title	Results
	(Hulya Dede-Zeynel Abidin Yilmaz-Nail Ilhan-2017)	<p>search engines such as yahoo, google and webpages.</p> <p>2. Self-efficacy has an average score above three, so it can be said that all prospective teachers have good self-efficacy</p> <p>3. Self-efficacy changes with the use of educational innovations. The use of Social Media and Thesis as learning resources can increase the self-efficacy of prospective science teachers.</p>
7	<i>Science Teachers' Perceptions of Personal Science Efficacy Beliefs and Science Teaching in Saudi Arabia, Pakistan, and the United Arab Emirates</i> (Sadia Shaukat, Venkat Rao Vishnumolakala, Amani K. Hamdan Alghamdi - 2020)	<p>1. This research is translational research involving several countries</p> <p>2. The results confirm the need to change the system in the science teacher education program</p> <p>3. The level of self-efficacy of teachers in teaching science can improve student achievement on international standardized tests such as science</p>
8	<i>Secondary Science Teachers' Self-Efficacy Beliefs and Implementation of Inquiry</i> (Fatma Kaya, Lisa A. Borgerding, and Tanzimul Ferdous-2020)	<p>1. There is a relationship between teacher self-efficacy and the implementation of the five phases in inquiry learning</p> <p>2. Teachers are also more confident in teaching science through teacher-centred inquiry rather than student-centred inquiry.</p> <p>3. The teacher's background in terms of content knowledge, pedagogical knowledge, and experience are variables that affect teacher self-efficacy</p>
9	<i>The Measurement of Science Teaching Efficacy Belief Instrument (STEBI): Sustaining Teacher's Quality</i> (Jaka Warsihna1, Zulmi Ramdani, Lidwina Felisima Tae-2021)	<p>1. This study aims to develop and validate an instrument to measure teacher self-efficacy in teaching science or the Science Teaching Efficacy Belief Instrument (STEBI).</p> <p>2. This study shows that STEBI has good psychometric properties.</p> <p>3. The STEBI concept in this study has produced four factors: positive pedagogy in motivating students, facing changes and challenges, teachers' perceptions of ideal pedagogy, and teacher enthusiasm in teaching.</p>

No	Title	Results
		4. Psychometrically, this research has produced a STEBI instrument for use in Indonesian
10	<i>Self-Efficacy Beliefs of Interdisciplinary Science Teaching (Self-ST) Instrument: Drafting a Theory-Based Measurement</i>	<ol style="list-style-type: none"> 1. This study aims to develop an instrument used to measure teacher self-efficacy when teaching science that is combined with other disciplines 2. The resulting instrument is following the specific context of Self-efficacy
	(Kevin Handtke * and Susanne Bögeholz-2019)	

Table 3. The results of the analysis of articles that answer RQ 3

No	Title	Results
1	<i>Conception of memorizing and understanding in learning, and Self-Efficacy Held by University Biology Majors</i>	<ol style="list-style-type: none"> 1. This study shows a relationship between the conception of memorization and understanding of Biology learning. 2. Students in clusters 1 and 2 see Biology learning as understanding or a mixture of understanding and memorization. In the third cluster, students saw biology learning only as memorization, while in the fourth cluster, they did not agree with the conception of memorization or understanding of biology learning. 3. Students in clusters 1 and 2 have high self-efficacy compared to students in clusters 3 and 4 4. Each cluster of students who have majors related to Biology indeed considers Biology as continuous memorization accompanied by understanding
	(Tzu-Chiang Lin, Jyh-Chong Liang-Chin Chung Tsai -2015)	
2	<i>The Impact of a Professional development model on middle school science teachers' efficacy and implementation of Inquiry.</i>	<ol style="list-style-type: none"> 1. Professional development programs provide opportunities for teachers to learn science content and inquiry-based learning skills: self-efficacy gains and the expected learning outcomes decrease when the teacher completes the program. 2. Teacher professional development programs can improve the quality of inquiry learning if teachers are given time to practice inquiry skills.
	(Christine Lotter-Whitney Smiley - Stephen Thompson-	

No	Title	Results
	Tammie Dickenson-2016)	3. A safe learning environment in schools can increase teacher self-efficacy.
3	<i>How an-inquiry based classroom lesson intervenes in science efficacy, career-orientation and self-determination</i> (S.Schmid-F.X Bogner-2017)	<ol style="list-style-type: none"> 1. The SMQ II subscale is a suitable instrument for measuring self-efficacy, self-determination and career motivation because it has good validity and reliability. 2. Only self-determination can be affected by the application of guided inquiry learning. 3. Only self-efficacy and career motivation have a reciprocal relationship 4. Only self-efficacy and career motivation have a relationship with student achievement. So students who have low achievement will have low self-efficacy and career motivation 5. Similar to student achievement, self-efficacy and career motivation have a relationship with students' science learning outcomes, but not with non-science learning outcomes
4	<i>Investigating the interrelationships among conception of, approaches to, and self-efficacy in learning science</i> (Lanqin Zheng, Yan Dong, Rong Huai, Chun Yen Chang and Kausahal-2018)	<ol style="list-style-type: none"> 1. Students' low conceptions of learning correlate to students' shallow approaches, and high learning conceptions relate to students' inner approaches. Self-efficacy is divided into two levels, namely high and low, and the internal approach used by students can influence both. 2. A deep understanding of elementary students' perceptions of science learning can provide additional insight to improve teachers' pedagogic practices
5	<i>The Effects of Student's Attitudes and Self-Efficacy on Science Achievement</i> (Adiyo Roebiyanto-2020)	<ol style="list-style-type: none"> 1. This study analyses student achievement in learning science, which is predicted by using self-efficacy, student attitudes towards science, school and teaching 2. The results found that students' attitudes and self-efficacy have a significant direct role in determining student achievement in learning science. To be more specific, attitudes towards science have the most significant impact, above self-efficacy
6	<i>Self-Efficacy Relationship on Science Achievement amongst National Secondary School Students</i>	<ol style="list-style-type: none"> 1. This study examines the level of Science Self-efficacy and academic achievement and the difference in the level of Science Self-efficacy between male and female students. It identifies the relationship between

No	Title	Results
(Nor Liyana Jamil, Siti Nur Diyana Mahmud-2019)		<p>students' science self-efficacy and their academic ability.</p> <ol style="list-style-type: none"> 2. The level of students' Science Self-efficacy is in the medium category 3. There is a significant difference between the Science Self-efficacy of male and female students even though their learning outcomes are relatively the same
7	<i>Examining the mediating effect of science self-efficacy on the relationship between metavariabes and science achievement</i>	<ol style="list-style-type: none"> 1. The purpose of this study was to examine the relationship between metavariabes (meta conceptual awareness, meta conceptual regulation, affective awareness, and affective regulation) and scientific achievement through the mediating role of self-efficacy. 2. Science Self-efficacy mediates the relationship between meta conceptual regulation and affective regulation and scientific achievement. Students who monitor and evaluate existing conceptions and control their emotions tend to have high science self-efficacy and higher scientific achievement. 3. Meta conceptual awareness, meta conceptual regulation, and affective regulation positively predict Science self-efficacy, which in itself is a positive predictor of science achievement 4. Metavariabes is an essential component of knowledge achievement through self-efficacy.
8	<i>An Induced Successful Performance Enhances Student Self-Efficacy and Boosts Academic Achievement</i>	<ol style="list-style-type: none"> 1. This study is an experimental study of Bandura's self-regulation theory in junior high school students. 2. One successful experience will promote students' self-efficacy. Teachers present more straightforward anagram assignments for students using the presentation method, resulting in a successful experience. These success-induced students demonstrated increased self-efficacy and maintained this increased self-efficacy for an entire year. 3. Male students who were induced success showed improvement in their academic achievement.

1. RQ 1 How is the students' self-efficacy in learning science?

Self-efficacy is the belief in a person to do something. The term Science Self-efficacy (SSE) appears when associated with learning science, describing students' beliefs in completing science-related tasks. Science Self-efficacy that students have depends on how complicated the job is. The success or failure of the task and the encouragement or emotion experienced while doing the task will shape the students' Science Self-efficacy²¹. This needs to be a consideration because the level of students' Science Self-efficacy is influenced by the implementation and learning approach used by the teacher²².

Project-based learning methods are an alternative in increasing students' Science Self-efficacy²³. This method makes students actively involved and has control over the project being developed. Students experience a different experience when compared to the usual learning method. So that student learning outcomes will also increase and the increase in Science Self-efficacy²⁴. If it is associated with problem-solving, students' Science Self-efficacy has a direct relationship, although it cannot always be used as a predictor of student success²⁵. Science Self-efficacy is a self-assessment from students; when students think that learning science is complex, then their Science Self-Efficacy is also affected²⁶

2. RQ 2. How is the Self-Efficacy of teachers/prospective teachers in teaching science?

Self-efficacy is a person's ability to know what he has understood or what he can complete. The articles that have been analyzed show that there are two points of view on a person's self-efficacy, namely self-efficacy as a teacher (teachers and prospective teachers) and self-efficacy as learners (students).

²¹ Remy Dou et al., "Understanding the Development of Interest and Self-Efficacy in Active-Learning Undergraduate Physics Courses," *International Journal of Science Education* 0, no. 0 (2018): 1–19.

²² Rena Siti Hasanah, Hayat Sholihin, and Ikmanda Nugraha, "An Investigation of Junior High School Students' Science Self-Efficacy and Its Correlation with Their Science Achievement in Different School Systems," *Journal of Science Learning* 4, no. 2 (2021): 192–202.

²³ Tobias Espinosa et al., "Reducing the Gender Gap in Students' Physics Self-Efficacy in a Team- and Project-Based Introductory Physics Class," *Physical Review Physics Education Research* 15, no. 1 (2019): 10132.

²⁴ Fahmie Firmansyah and Ratna Komala, "Self-Efficacy and Motivation: Improving Biology Learning Outcomes of Senior High School Students," *Journal Pendidikan Biologi Indonesia* 4, no. 3 (2018): 203–208.

²⁵ Napis, "Analysis Of Physics Problem Solving In The Perspective Of Self Efficacy and Adversity Quotient," *Formatif: Jurnal Ilmiah Pendidikan MIPA* 8, no. 1 (2018): 31–42; Eileen McBride et al., "'I'm Just Not That Great at Science': Science Self-Efficacy in Arts and Communication Students," *Journal Research Science Teaching* (2019): 1–26.

²⁶ Bat-shahar Dorfman and David Fortus, "Students' Self-Efficacy for Science in Different School Systems," *Journal Research Science Teaching* (2019): 1–23.

All articles have the same goal, namely, to obtain information about self-efficacy to improve policies related to the curriculum, especially the curriculum of the teacher-printing study program. The ten articles place self-efficacy as the dependent variable. This shows that many things can influence self-efficacy. These articles emphasize that the factors that influence self-efficacy are science content lectures and teacher and prospective teacher professionalism programs.

Practical teaching training for pre-service science teacher can increase their self-efficacy in the first year, but no significant difference was found²⁷. Teacher self-efficacy in teaching can be maintained by having a good perception of science learning and teachers' understanding of science content²⁸. Factors that influence the increase in self-efficacy are Experimental design projects and centralized science learning²⁹. Meanwhile, if carrying out inquiry learning, the teacher has self-efficacy when the inquiry learning is teacher-centered, not student-centered³⁰. As with students, the magnitude of a teacher's self-efficacy cannot be used as a benchmark in assessing how much understanding they have³¹. In addition, the experience and frequency of teaching teachers are also factors in the formation of self-efficacy³².

Learning innovations that occur due to technological advances make teachers apply various teaching methods and materials. Not all teachers can make changes. Most teachers only follow innovation but do not participate in innovation. This is because teachers do not read primary references such as theses and conferences. In this regard, teacher self-efficacy changes along with the use of educational innovations. The use of social media and Thesis as learning resources can increase the self-efficacy of prospective science teachers³³.

²⁷ Chantal Velthuis and Petra Fisser, "Teacher Training and Pre-Service Primary Teachers," *Journal Science Teaching Education* (2013).

²⁸ David Palmer et al., "Changes in Science Teaching Self-Efficacy among Primary Teacher Education Students," *Australian Journal of Teacher Education* 40, no. 12 (2015): 27–40.

²⁹ Christine Lotter et al., "The Impact of a Professional Development Model on Middle School Science Teachers' Efficacy and Implementation of Inquiry," *International Journal of Science Education* 0, no. 0 (2017): 1–30.

³⁰ Fatma Kaya et al., "Secondary Science Teachers' Self-Efficacy Beliefs and Implementation of Inquiry Secondary Science Teachers' Self-Efficacy Beliefs and Implementation of Inquiry ABSTRACT," *Journal of Science Teacher Education* 00, no. 00 (2020): 1–15.

³¹ Deepika Menon, "Preservice Elementary Teachers' Science Self-Efficacy," *Journal of Science Teacher Education* (2016).

³² Mahsa Kazempour and Troy D Sadler, "Pre-Service Teachers' Science Beliefs, Attitudes, and Self-Efficacy: A Multi-Case Study," *Teaching Education* (2015): 37–41.

³³ Hulya Dede, Zeynel Abidin Yilmaz, and Nail İlhan, "Investigation of the Self-Efficacy Beliefs of Pre-Service Science Teachers in Terms of Following and Using the Innovations in the Field of Education," *Journal Education and Training Studies* 5, no. 2 (2017): 1–10.

The research results on student self-efficacy in teaching science are widely used as a reference for improving teacher-producing university programs or courses³⁴. The instrument most often used to measure self-efficacy as a teacher is STEBI-B (*Science Teaching Efficacy Beliefs Instrument – form B*)³⁵. while measuring Self-efficacy as a teacher in teaching science combined with other disciplines is Self-Efficacy Beliefs of Interdisciplinary Science Teaching (SELF-ST)³⁶

3. RQ 3. How is self-efficacy related to other variables?

The articles that have been analyzed show the diversity of research subjects, ranging from elementary students, pre-service teacher to teachers. This indicates that anyone owns efficacy. But what makes the difference is the main factor that influences it. In elementary school students, self-efficacy is controlled by the learning approach studied by students. Self-efficacy for teachers can be increased if they participate in professional development accompanied by training to apply a learning method. In contrast, for prospective teachers, efficacy can be increased through science content lectures.

Professional development programs provide opportunities for teachers to learn science content and inquiry-based learning skills³⁷. While Self-efficacy gains and expected outcomes from learning decrease when teachers complete the program³⁸. In addition to various subjects, Science Self-efficacy can also be associated with various other variables. To be more specific, attitudes towards science have the most significant impact on self-efficacy³⁹

³⁴ Shaukat, Vishnumolakala, and Alghamdi, "Science Teachers' Perceptions of Personal Science Efficacy Beliefs and Science Teaching in Saudi Arabia, Pakistan, and the United Arab Emirates."

³⁵ Jaka Warsihna, Zulmi Ramdani, and Lidwina Felisima Tae, "The Measurement of Science Teaching Efficacy Belief Instrument (STEBI): Sustaining Teacher ' s Quality," *Psychology and Education* 58, no. 3 (2021): 2972–2979.

³⁶ Kevin Handtke and Susanne Bögeholz, "Education Sciences Self-Efficacy Beliefs of Interdisciplinary Science Teaching (SELF-ST) Instrument: Drafting a Theory-Based Measurement," *Educational Sciences* 9, no. 249 (2019): 1–25.

³⁷ Muhammad Fuad et al., "Exploring Teachers' TPACK: Are Indonesian Language Teachers Ready for Online Learning during the COVID-19 Outbreak?," *Universal Journal of Educational Research* 8, no. 11B (2020): 6091–6102; Anda Juanda, Ari Syahidul. Shidiq, and Dindin Nasrudin, "Teacher Learning Management: Investigating Biology Teachers' TPACK To Conduct Learning During the Covid-19 Outbreak," *Jurnal Pendidikan IPA Indonesia* 10, no. 1 (2021): 48–59, <https://journal.unnes.ac.id/nju/index.php/jpii/article/download/26499/11445>.

³⁸ Lotter et al., "The Impact of a Professional Development Model on Middle School Science Teachers' Efficacy and Implementation of Inquiry."

³⁹ Adiyo Roebianto, "The Effects of Student ' s Attitudes and Self-Efficacy on Science Achievement," *Jurnal Pengukuran Psikologi dan Pendidikan Indonesia* 9, no. 1 (2020): 1–10; Yamtinah, Masykuri, and Shidiq, "Gender Differences in Students' Attitudes toward Science : An Analysis of Students' Science Process Skill Using Testlet Instrument."

In facing daily exams, students usually memorize the material to feel safe taking the exam. In addition to memorizing, some students prefer to understand the material. Students who understand the content and context of science in everyday life have high self-efficacy⁴⁰. This understanding is obtained from a learning approach. Suppose students have a deep learning approach. In that case, it also affects students' Science self-efficacy because students who have a shallow learning approach are not confident enough in their abilities⁴¹.

Students' learning ability is also associated with their future career motivation. Students who have career motivation have self-efficacy, affecting their learning outcomes⁴². Students who monitor and evaluate existing conceptions and control their emotions tend to have high science self-efficacy and then high scientific achievement⁴³. The variable most often associated with students' Science self-efficacy is student achievement. The results found that students' attitudes and self-efficacy have a significant direct role in determining student achievement in learning science. The teacher can raise the teacher's self-efficacy by giving easy tasks. This process is called success induction. If it is associated with gender, male students who are induced success show a significant increase in academic achievement⁴⁴. These results are confirmed by research which reveals a significant difference between the Science Self-Efficacy of male and female students even though their learning outcomes are relatively the same⁴⁵.

Conclusion

In general, Science Self-efficacy is a person's belief in solving problems that require scientific resolution or those related to science. Students and teachers share this belief. Science Self-efficacy in students can be raised by getting students to succeed in learning science, while in teachers, it is raised

⁴⁰ Tzu-chiang Lin et al., "Conceptions of Memorizing and Understanding in Learning, and Self- Efficacy Held by University Biology Majors," *International Journal of Science Education* 37, no. 3 (2014): 446-468.

⁴¹ Lanqin Zheng et al., "Investigating the Interrelationship among Conceptions of, Approaches to and Self Efficacy in Learning Science," *International Journal of Science Education* 40, no. 2 (2018): 139-158.

⁴² S Schmid and F X Bogner, "How an Inquiry-Based Classroom Lesson Intervenes in Science Efficacy , Career-Oriented and Self- Determination," *International Journal of Science Education* 0, no. 0 (2017): 1-19.

⁴³ Zubeyde Demet Kirbulut and Esen Uzuntiryaki-kondakci, "Examining the Mediating Effect of Science Self-Efficacy on the Relationship between Metavariabes and Science Achievement," *International Journal of Science Education* 0, no. 0 (2019): 1-20.

⁴⁴ Akitoshi Uchida, Robert B Michael, and Kazuo Mori, "An Induced Successful Performance Enhances Student Self-Efficacy and Boosts Academic Achievement," *AERA Open* 4, no. 4 (2018): 1-9.

⁴⁵ Jamil & Mahmud, (2019)

through teaching practicum training. Information about Science Self-efficacy owned by both teachers and students is essential to know so that teachers can design their learning and university officials who produce teachers can innovate in study programs for prospective teachers.

Of all the articles that have been analyzed, there is nothing that clearly distinguishes the learning of teachers/prospective teachers who have high self-efficacy or those who have low efficacy, both in terms of student perceptions or student achievement. Based on this, it is advisable to conduct a follow-up study with a comparative study design regarding learning outcomes and student perceptions of teacher with high and low efficacy. After that, it can be seen how vital teacher efficacy is in improving student performance. In general, student performance, in this case, is how well students prepare before and during learning and how well students master the material presented by the teacher.

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