Self-Efficacy and Self-Regulation in Mathematics Learning: Validity and Reliability of Instruments in Private Junior High School Students

Ovan, Universitas Negeri Surabaya, Indonesia
Yusuf Fuad, Universitas Negeri Surabaya, Indonesia
Mega Teguh Budiarto, Universitas Negeri Surabaya, Indonesia

The Asian Conference on Education 2024
Official Conference Proceedings

Abstract
Measuring junior high school students' self-efficacy and self-regulation in mathematics requires valid and reliable measuring instruments. This study aimed to test the validity and reliability of the instrument of the Self-Efficacy Questionnaire (SEQ) and Self-Regulation Questionnaire (SRQ) of junior high school students in mathematics. This research method uses a quantitative approach. Before being given to students, the SEQ and SRQ were empirically validated by three senior lecturers in mathematics education with average scores of 4.60 > 3.50 and 4.50 > 5.50 respectively. SEQ and SRQ was given to 9th-grade students of SMP Muhammadiyah 4 Malang City for 30 minutes, and the researcher directly supervised the implementation. The results of SEQ declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.976 > 0.70, meanwhile the results of SRQ declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.971 > 0.70. The 20 valid SEQ and SRQ statements can be used to evaluate junior high school students' self-efficacy and self-regulation in mathematics. It is suggested that future researchers test the instrument on a larger population because the students involved in this study were too few, namely nine students, and the number of statements in the questionnaire should also be considered to be compiled in large numbers.

Keywords: Self-Efficacy, Self-Regulation, Mathematics, Validity, Reliability

Introduction

Research investigations, scientific discoveries, and contemporary discoveries all rely on mathematics, which is a subject that is pertinent to modern schooling (Batiibwe et al., 2020; Mozahem et al., 2021). Mathematics is regarded as the most crucial topic in the secondary school curriculum, connecting algebra, geometry, and trigonometry. It can also be utilised to solve difficulties in daily life (Laranang & Bondoc, 2020). Due to its ability to impact mathematical comprehension and learning, self-efficacy has been extensively described in earlier study (Bandura et al., 1997; Yuksel & Alci, 2012). In the process of learning mathematics, this suggests that students' self-efficacy is crucial (Mumcu & Aktas, 2015; Rittmayer & Beier, 2008). The belief in one's capacity to acquire and excel in mathematics classes is known as self-efficacy in mathematics (Kumar, 2022; Kundu & Ghose, 2016). A conviction that success in maths class will follow from doing particular behaviours. These beliefs, however, have been demonstrated to predict mathematical performance more accurately than other belief structures linked to mathematics (Mumcu & Aktas, 2015; Yuksel & Alci, 2012).

Students with High self-efficacy indicate strong motivation to improve their learning achievement, while students with low self-efficacy tend to find it difficult to improve their learning achievement (Ilgün et al., 2012; Özgen & Bindak, 2011). Student self-efficacy can be measured through three components, namely magnitude, strength, and general (Bandura et al., 1997; Laranang & Bondoc, 2020). Magnitude relates to a person's level of confidence that it can be completed. Strength relates to the level of strength or weakness of a person's beliefs regarding their perceived abilities or individual expectations of their abilities. Generally related to self-efficacy that occurs in certain domains or applies to various activities and situations.

Self-efficacy and mathematics are a complete study to reveal student behavior in solving mathematical problems. The research results show that student self-efficacy influences students' mathematics performance and thanks to good self (Bandura, 1982; Kumar, 2022; Mukhtar et al., 2021). Other research also shows that students' poor self (Görgün & Tican, 2020; Recber et al., 2017; Schukajlow et al., 2022). Thus, self-efficacy in Mathematics is a determining factor in student success.

Similar to self-efficacy, the concept of self-regulation is also rooted in the social cognitive theory proposed by Bandura (Bandura et al., 1997). Self-regulation can be done if students can control themselves in solving problems then evaluating and planning during the learning process (Li et al., 2020). Self-regulation is a process in which students deliberately pursue predetermined goals by controlling, monitoring, and regulating cognitive/metacognitive processes and student learning behavior (Zimmerman, 2000).

According to Zimmerman (2000), pupils must be able to control themselves during the learning process in order to attain the desired outcomes, which include achievement in mathematics. In the classroom, students have the power to guide themselves to affect their own behavioural reactions in addition to being influenced by outside forces. When given learning tasks, students can use cognitive, metacognitive, and behavioural learning strategies to exert control over their activities.

Math learning outcomes can be enhanced by students who exhibit strong self-regulation and vice versa. Students who possess strong self-regulation are able to solve geometry problems

and enhance their learning outcomes. For instance, they are able to concentrate, differentiate between important and irrelevant information, and employ efficient techniques to retain information in long-term memory and retrieve it when required (Arora et al., 2020). On the other hand, pupils who struggle with self-control perform poorly when it comes to solving mathematical problems (Marchis, 2012). This suggests that studies on self-regulation in math problem solving are necessary.

In relation to evaluating student self-efficacy and self-regulation in mathematics, it needs to be supported by capable tools, one of which is a valid instrument. This research aims to measure instruments that are suitable for measuring student self-efficacy and self-regulation in mathematics classes. A valid instrument is very useful for measuring student self-efficacy and self-regulation. Research on the validity and reliability of self-efficacy and self-regulation instruments has been conducted by previous researchers (Anderson & Betz, 2001; Britner & Pajares, 2006; Hampton & Mason, 2003; Lent et al., 1991; Lopez & Lent, 1992; Usher & Pajares, 2007), but it is still rarely done in Indonesia, especially self-efficacy in junior high school students' mathematics classes.

Method

This research uses a quantitative research design. Data collection was carried out in 2022 at Muhammadiyah 4 Middle School, Malang City. The sample size for class 9 at this school consists of one group, 6 boys students and 3 girls students. The researcher chose this research location because he had made observations regarding the problems faced by students, namely low mathematics scores student, self-efficacy, and self-regulation. The Self-Efficacy Questionnaire (SEQ) and Self-Regulation Questionnaire (SRQ) instrument consists of 20 statements in the form of a 1-5 Likert scale. Based on the indicators compiled, the classification of SEQ statements can be divided into three dimensions, namely the first is magnitude which includes statements number 1-5. Second, strength includes statements number 6-13. Third, generally includes statements number 14-20. Meanwhile, the SRQ statement classification consists of indicators, namely planning which includes statements number 1-6, implementation which includes statements number 7-14, and reflection which includes statements number 15-20.

SEQ was adapted from Laranang & Bondoc (2020) about students' self-efficacy in mathematics, meanwhile SRQ was adapted from Brown and colleagues., (1999) about students' self-regulation in mathematics. Before being given to students, the SEQ and SRQ were empirically validated by three senior lecturers in mathematics education with average scores of $4.60 > 3.50$ and $4.50 > 5.50$ respectively. SEQ and SRQ was given to 9 grade 9 students of SMP Muhammadiyah 4 Malang City for 30 minutes, and the researcher carried out direct supervision and was assisted by a mathematics teacher in its implementation. SEQ and SRQ aims to obtain appropriate responses from students for the purposes of this research.

After getting students' answers, SEQ and SRQ validity and reliability were tested. Apart from differences in statement items in the questionnaire, researchers also took into account the situation, conditions, learning location, facilities, and abilities of the students. Test the validity and reliability of SEQ and SRQ using product moment person correlation and Cronbach's alpha.

Results

The results of the validity and reliability tests started from the SEQ, then followed by the SRQ. Both instruments were subjected to descriptive statistical tests with the help of SPSS software version 29.0. The results of the SEQ validity and reliability test show that students' self-efficacy varies. The original SEQ and the translated results into Indonesian can be seen in appendix 1.

The self-efficacy questionnaire (appendix 1), adapted and developed according to the needs of junior high school students in Indonesia. The development of the self-efficacy questionnaire can be seen in Table 1 below.

Table 1: Validity Value of the Self-Efficacy Questionnaire (SEQ)

No	SEQ Statement	WM	VD	Indication	Sig. 2-Tailed
1	I feel confident enough to ask questions in my math class	3.11	Neutral	Moderately high	0.019
2	I am confident that I can do well on the math test.	3.33	Neutral	Moderately high	0.001
3	I believe that I complete math assignments of varying difficulty	3.56	Agree	High	0.005
4	I am confident that I am able to understand and complete mathematics assignments	3.44	Agree	High	0.007
5	I am confident that I am able to choose strategies well in completing mathematics assignments	3.00	Neutral	Moderately high	0.011
6	I believe that I am the type of person who is good at mathematics.	3.22	Neutral	Moderately high	0.004
7	I am confident that I can understand the content in mathematics assignments	3.44	Agree	High	0.001
8	I am confident that I can get an “A” when I study mathematics.	3.44	Agree	High	0.005
9	I am confident that I am able to persist in my efforts to face tasks and challenges	3.22	Neutral	Moderately high	0.017
10	I am confident that I can learn well when given mathematics assignments.	3.22	Neutral	Moderately high	0.001
11	I feel confident when taking math tests.	3.22	Neutral	Moderately high	0.009
12	I still try to complete math assignments even though the assignments are difficult to do	3.44	Agree	High	0.001
13	I believe that I am the type of person who can do math	3.22	Neutral	Moderately high	0.001
14	I feel that I will be able to do well in future math assignments	3.44	Agree	High	0.001

No	SEQ Statement	WM	VD	Indication	Sig. 2-Tailed
15	I am confident that I can do mathematics when I am given a mathematics assignment	3.44	Agree	High	0.013
16	I believe that I can think like a mathematician.	3.22	Neutral	Moderately high	0.009
17	I feel confident when using mathematics outside of school.	3.11	Neutral	Moderately high	0.001
18	I am confident that I can complete math assignments using various methods	3.33	Neutral	Moderately high	0.013
19	I am confident that I can solve math tasks that I have never encountered before	3.00	Neutral	Moderately high	0.009
20	I am sure that mathematics will be useful for my future	3.78	Agree	High	0.011
Overal Weighted Mean		**3.31**	**Neutral**	**Moderately high**	**0.007**

Legend: Range	Verbal Description	Indication
5.00 - 4.21	Strongly Agree (SA)	Very high
4.20 - 3.41	Agree (A)	High
3.40 - 2.61	Neutral (N)	Moderately high
2.60 - 1.81	Disagree (D)	Low
1.80 - 1.00	Strongly Disagree (SD)	Very low

Based on Table 1, the mean is 3.31, the verbal description is declared neutral and it is identified that SEQ is in the moderately high category. Then 20 statements were declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.976 > 0.70, meaning that the data is concluded to be reliable. Based on the three indicators of self-efficacy measured in the SEQ instrument, satisfactory results were obtained, where 20 SEQ statements were declared valid and reliable. This means that this instrument can be used to measure students' self-efficacy at the junior high school level.

Meanwhile, the results of the validity and reliability tests for the SRQ obtained different results for each item of the SRQ statement. The original SRQ and the translated results in Indonesian can be seen in appendix 2. The self-regulation questionnaire (appendix 2), adapted and developed according to the needs of junior high school students in Indonesia. The development of the self-regulation questionnaire can be seen in Table 2 below.

Table 2: Validity Value of the Self-Regulation Questionnaire (SEQ)

No	SRQ Statement	WM	VD	Indication	Sig. 2-Tailed
1	I am able to make plans for myself.	3.56	Agree	High	0.001
2	I am able to carry out plans that I have made myself.	3.56	Agree	High	0.002
3	I have so many plans that it's hard for me to focus on any one of them.	4.11	Agree	High	0.038
4	I can stick to plans that are working well.	3.11	Neutral	Moderately high	0.001
5	I have no trouble making plans to help me achieve my goals.	3.89	Agree	High	0.001
6	Minor problems or distractions won't throw me off my plan.	3.56	Agree	High	0.001
7	I can usually solve problems that I have planned in advance.	2.89	Neutral	Moderately high	0.020
8	Once I see things that are not right then I immediately do something about it to fix it.	3.33	Neutral	Moderately high	0.019
9	I call others for help when I need it.	3.56	Agree	High	0.006
10	I am able to manage the environment in which I play/study.	3.44	Agree	High	0.005
11	As soon as I see a problem or challenge, I start trying to find a solution and solve it quickly.	3.78	Agree	High	0.033
12	I am good at finding information to solve the problems I face.	3.11	Neutral	Moderately high	0.006
13	When I experience obstacles/challenges, I usually look for the information I need.	3.11	Neutral	Moderately high	0.012
14	When I want to make a decision, I connect it with knowledge and experience that is in line with my understanding.	3.56	Agree	High	0.020
15	I usually double check my math work before submitting it to the teacher.	3.44	Agree	High	0.008
16	When I get a bad grade in math, I keep studying to improve in the future.	3.56	Agree	High	0.005
17	If I want to change, I keep improving myself.	3.67	Agree	High	0.017
18	I learned from my previous mistakes.	3.22	Neutral	Moderately high	0.033
19	I usually evaluate what I have done	3.89	Agree	High	0.023
20	I am the type of person who doesn't give up easily.	3.67	Agree	High	0.001
Overal Weighted Mean		**3.50**	**Agree**	**High**	**0.013**

Legend: Range	Verbal Description	Indication
5.00 - 4.21	Strongly Agree (SA)	Very high
4.20 - 3.41	Agree (A)	High
3.40 - 2.61	Neutral (N)	Moderately high
2.60 - 1.81	Disagree (D)	Low
1.80 - 1.00	Strongly Disagree (SD)	Very low

Based on Table 2, The mean is 3.31, the verbal description is declared agree and it is identified that SRQ is in the high category. Then 20 statements were declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.971 > 0.70, meaning that the data is concluded to be reliable.

Based on the three indicators of self-regulation measured in the SRQ instrument, satisfactory results were obtained, the same as the SEQ, where 20 SRQ statements were declared valid and reliable. This means that this instrument can be used to measure students' self-regulation at the junior high school level. The SEQ and SRQ instruments that are valid and reliable, each of which is indicated as Moderately high and high, of course have a long process. Starting from obtaining the creation of both instruments, obtaining data from students, analyzing data, and thinking about the usefulness of these two instruments. In Indonesia, research that is relevant to the results of this study is still lacking, so researchers need to adapt to the results of previous studies such as research conducted by Laranang & Bondonc (2020) which validated the self-efficacy instrument and the work of Brown and colleagues., (1999) who compiled a self-regulation questionnaire.

Discussion

A five-point Likert scale is used in the SEQ and SRQ. Most self-efficacy questionnaires use an adapted version of the Sources of Mathematics Self-Efficacy Scale (SMES) developed by Lent and colleagues., (1991). A number of its components have been modified for usage in academic and social contexts after being initially created to evaluate students' sources of mathematical self-efficacy (Anderson & Betz, 2001; Britner & Pajares, 2006; Lopez & Lent, 1992; Usher & Pajares, 2007). A scale to gauge students' sources of mathematical self-efficacy was also created by Matsui and colleagues., (1990) and modified for use with younger pupils (Klassen, 2004). The Sources of Academic Self-Efficacy Scale was created by Hampton and Mason (2003), verified, and then utilised with students who struggled academically in high school and college. Other researchers have employed alternative measures as stand-ins for one or more sources (Chin & Kameoka, 2002; Johnson, 2005) or have depended on unpublished source items (Bates & Khasawneh, 2007; Stevens & Jr, 2006).

Regarding the sources of self-efficacy, there are two key reasons why accurate and trustworthy measuring tools are required. First, self-efficacy plays an important role in students' academic and career choices (Hackett, 2017). Bandura's social cognitive theory, which holds that self-efficacy cannot be adequately assessed without evaluation, is another significant factor supporting the need for psychometrically valid measures of the origins of self-efficacy (Locke, 1987). Researchers must use valid and reliable metrics that accurately reflect their hypothesised sources and their place in the larger social structure if they hope to comprehend the composition of students' self-efficacy. In the field of academic motivation, where the sources of self-efficacy have frequently been operationalised and assessed in ways

that are very different from how Bandura (1997) hypothesised them, this cognitive theory is especially significant.

Several previous studies have shown that self-efficacy instruments can be used and declared valid and reliable, whether collecting self-efficacy instruments for students in tertiary institutions or high schools (Anderson & Betz, 2001; Britner & Pajares, 2006; Hampton & Mason, 2003; Lent et al., 1991; Lopez & Lent, 1992; Usher & Pajares, 2007). The self-efficacy instrument for junior high school students in Indonesia is still under-researched, so the SEQ in this study can be recommended for measuring student self-efficacy, especially at the junior high school level. The SEQ was adapted from Laranang & Bondoc (2020) which consisted of 14 items, then we added 6 statement items, so that the SEQ in this study became 20 statement items, all of which were declared valid and reliable.

Then the self-regulation questionnaire has been developed by several researchers in various countries such as research conducted by Pichardo and colleagues., (2014) who validated the self-regulation questionnaire for students in Spain. Where 50% (n = 417) of students have been confirmed and suggested that the measurement is more efficient to do. SRQ is also adapted from Brown and colleagues., (1999). We adjust to the conditions of students in mathematics classes in Indonesia, so we adjust several sentences related to students in mathematics classes. As the statistical test that has been explained that 20 SRQ items are declared valid and reliable. This study is related to Bagçeci & Kanadli (2014) report on a similar study reporting the validation of a student self-regulation questionnaire at the junior high school level in Turkey. A total of 762 middle school students in Gaziantep were involved in this study, specifically students in grades 5, 6, 7, and 8 in the 2012-2013 academic year. The values obtained were 0.477 and 0.818 respectively and the total correlation was between 0.24 and 0.47. The results of the Pearson correlation of the questionnaire test-retest were obtained at 0.85 and the Cronbach Alpha reliability was 0.78, so the ASRQ adapted into Turkish is valid and reliable. Likewise, the adapted SRQ was obtained valid and reliable into Indonesian.

Conclusion

This research is useful for future students in mathematics classes because the 20 self-efficacy and self-regulation questionnaire statements were declared valid and reliable. The impact of this research is that the SEQ and SRQ which is declared valid can be used to measure students' self-efficacy and self-regulation in mathematics classes, especially at the junior high school level. It is advised that students put in more study time in order to raise their maths proficiency. By actively participating in study sessions with peers, having conversations in math classes, and feeling confident when handed arithmetic homework, they should cultivate a positive attitude towards the topic. By boosting their self-confidence, students can work harder to change their attitudes towards mathematics and become more driven to learn the subject. This research can be supported by similar studies conducted in other cities.

Recommendations

The factors that influence self-efficacy and self-regulation in mathematics can be identified through additional research investigations on larger populations. In order to provide a secure learning environment for kids, educators can uphold a favourable school atmosphere. Teachers can use innovative teaching and learning tactics to increase students' interest in studying mathematical concepts and theories while also helping them build high self-efficacy

and self-regulation to succeed in mathematics. In addition to helping their children who struggle with maths, parents can also assist them understand why their children have a bad attitude towards maths. In order to promote greater academic performance by raising and bolstering higher levels of student success and motivation, schools might suggest ways to enhance their mathematics programs that are specific to the needs, interests, and issues of their students.

Acknowledgements

The first author would like to express their gratitude to the Higher Education Funding Center (BPPT) of the Ministry of Education, Culture, Research and Technology, the Indonesia Endowment Fund for Education (LPDP) of the Ministry of Finance, Republic of Indonesia, STKIP YPUP Makassar, Universitas Negeri Surabaya, and SMP Muhammadiyah 4 Malang City for supporting this doctoral research process.

References

Anderson, S. L., & Betz, N. E. (2001). Sources of Social Self-Efficacy Expectations: Their Measurement and Relation to Career Development. *Journal of Vocational Behavior*, *58*(1), 98–117. https://doi.org/10.1006/jvbe.2000.1753

Arora, R., Arora, P., & Malhotra, N. (2020). *Scholastic Achivement in Mathamatics of Senior Secondary School Students in Relation To Their Self Regulated Learning*. *10*(1), 1553–1569.

Bagçeci, B., & Kanadli, S. (2014). The Study of Adapting Self-Regulation Questionnaire into Turkish. *Journal of Education and Human Development*, *3*(3). https://doi.org/10.15640/jehd.v3n3a22

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122–147. https://doi.org/10.1037/0003-066X.37.2.122

Bandura, A., Freeman, W. H., & Lightsey, R. (1997). Self-Efficacy: The Exercise of Control. In *Journal of Cognitive Psychotherapy* (Vol. 13, Issue 2, pp. 158–166). https://doi.org/10.1891/0889-8391.13.2.158

Bates, R., & Khasawneh, S. (2007). Self-efficacy and college students' perceptions and use of online learning systems. *Computers in Human Behavior*, *23*(1), 175–191. https://doi.org/10.1016/j.chb.2004.04.004

Batiibwe, M. S. K., Taliba, C., Nalule, R. M., & Puglia, C. (2020). Investigating Math Self-Efficacy and Math Anxiety Regarding Gender, A-Level Math Entry Grade and Mathematics Achievement. *Journal of Education and Practice*, *11*(26), 41–53. https://doi.org/10.7176/jep/11-26-05

Britner, S. L., & Pajares, F. (2006). *Sources of Science Self-Efficacy Beliefs of Middle School Students*. *43*(5), 485–499. https://doi.org/10.1002/tea.20131

Brown, J. M., Miller, W. R., & Lawendowski, L. A. (1999). Self-Regulation Questionnaire. In L. VandeCreek & T. L. Jackson (Ed.), *Innovations in clinical practice: A source book* (Vol. 17, pp. 281-292-281–292). Professional Resource Press/Professional Resource Exchange.

Capaldi, D. M., & Rothbart, M. K. (1992). Development and Validation of an Early Adolescent Temperament Measure. *The Journal of Early Adolescence*, *12*(2), 153–173. https://doi.org/10.1177/0272431692012002002

Chin, D., & Kameoka, V. A. (2002). Psychosocial and contextual predictors of educational and occupational self-efficacy among Hispanic inner-city adolescents. *Hispanic Journal of Behavioral Sciences*, *24*(4), 448–464. https://doi.org/10.1177/0739986302238214

Görgün, S., & Tican, C. (2020). Investigation of Middle School Students' Math Self-Efficacy Perceptions and Math Problem Posing Attitudes. *International Education Studies*, *13*(11), 86. https://doi.org/10.5539/ies.v13n11p86

Hackett, G. (2017). *8. Self-efficacy in career choice and development* (and S. B. on Bob Lent, Nancy Betz, Ed.; pp. 232–258).

Hampton, N. Z., & Mason, E. (2003). Learning disabilities, gender, sources of efficacy, self-efficacy beliefs, and academic achievement in high school students. *Journal of School Psychology*, *41*(2), 101–112. https://doi.org/10.1016/S0022-4405(03)00028-1

Humphrey, L. L. (1982). Children's and teachers' perspectives on children's self-control: The development of two rating scales. *Journal of Consulting and Clinical Psychology*, *50*(5), 624–633. https://doi.org/10.1037/0022-006X.50.5.624

Ilgün, M., Azak, A. Z., & Takunyaci, M. (2012). Development of Self Efficacy and Attitude Toward Analytic Geometry Scale (SAAG-S). *Procedia - Social and Behavioral Sciences*, *55*(October), 20–27. https://doi.org/10.1016/j.sbspro.2012.09.472

Johnson, R. D. (2005). *An empirical investigation of sources of application-specific computer-self-efficacy and mediators of the efficacy—Performance relationship*. *62*, 737–758. https://doi.org/10.1016/j.ijhcs.2005.02.008

Klassen, R. M. (2004). A cross-cultural investigation of the efficacy beliefs of South Asian immigrant and Anglo Canadian nonimmigrant early adolescents. *Journal of Educational Psychology*, *96*(4), 731–742. https://doi.org/10.1037/0022-0663.96.4.731

Kumar, A. (2022). Self-Efficacy in Mathematics and Students of Geometric Levels of District Una of Himachal Pradesh. *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)*, *2*(7), 2581–9429. https://doi.org/10.48175/568

Kundu, A., & Ghose, A. (2016). *The Relationship Between Attitude And Self Efficacy In Mathematics Among Higher Secondary Students*. *21*(4), 25–31. https://doi.org/10.9790/0837-2104052531

Laranang, J. A. I., & Bondoc, J. M. F. (2020). Attitudes and Self- Efficacy of Students toward Mathematics. *International Journal of English Literature and Social Sciences*, *5*(5), 1392–1423. https://doi.org/10.22161/ijels.55.11

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Mathematics Self-Efficacy: Sources and Relation to Science-Based Career Choice. *Journal of Counseling Psychology*, *38*(4), 424–430. https://doi.org/10.1037/0022-0167.38.4.424

Li, S., Chen, G., Xing, W., Zheng, J., & Xie, C. (2020). Longitudinal clustering of students' self-regulated learning behaviors in engineering design. *Computers and Education*, *153*(April), 103899–103899. https://doi.org/10.1016/j.compedu.2020.103899

Locke, E. A. (1987). Social Foundations of Thought and Action: A Social-Cognitive View, by Albert Bandura. Englewood Cliffs, NJ: Prentice-. *The Academy of Management Review*, *12*(1), 169–171.

Lopez, F. G., & Lent, R. W. (1992). Sources of Mathematics Self-Efficacy in High School Students. *The Career Development Quarterly*, *41*(1), 3–12. https://doi.org/10.1002/j.2161-0045.1992.tb00350.x

Marchis, I. (2012). Self-Regulated Learning and Mathematical Problem Solving. *The New Educational Review*, *27*(1), 195–208.

Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. *Journal of Vocational Behavior*, *37*(2), 225–238. https://doi.org/10.1016/0001-8791(90)90042-Z

Moilanen, K. L. (2007). The Adolescent Self-Regulatory Inventory: The Development and Validation of a Questionnaire of Short-Term and Long-Term Self-Regulation. *Journal of Youth and Adolescence*, *36*(6), 835–848. https://doi.org/10.1007/s10964-006-9107-9

Mozahem, N. A., Boulad, F. M., & Ghanem, C. M. (2021). Secondary school students and self-efficacy in mathematics: Gender and age differences. *International Journal of School and Educational Psychology*, *9*(sup1), S142–S152. https://doi.org/10.1080/21683603.2020.1763877

Mukhtar, M., El Islami, R. A. Z., Damanhuri, D., & Hamundu, F. M. (2021). Information and Communication Technologies to Improve Problem Solving and Self-Efficacy: Exploring Geometry Learning Using Dynamic Mathematics Software Geogebra. *International Journal of STEM Education for Sustainability*, *1*(1), 45–52. https://doi.org/10.53889/ijses.v1i1.4

Mumcu, Y. H., & Aktas, M. C. (2015). Multi-program high school students' attitudes and self-efficacy perceptions toward mathematics. *Eurasian Journal of Educational Research*, *59*, 207–226. https://doi.org/10.14689/ejer.2015.59.12

Özgen, K., & Bindak, R. (2011). Determination of self-efficacy beliefs of high school students towards Math Literacy. *Kuram ve Uygulamada Egitim Bilimleri*, *11*(2), 1085–1089.

Pichardo, C., Justicia, F., Fuente, J. D. L., Martínez-Vicente, J. M., & Berbén, A. B. G. (2014). Factor Structure of the Self-Regulation Questionnaire (SRQ) at Spanish Universities. *The Spanish Journal of Psychology*, *17*, E62. https://doi.org/10.1017/sjp.2014.63

Recber, S., Isiksal, M., & Koc, Y. (2017). Investigating Self-Efficacy, Anxiety, Attitudes and Mathematics Achievement Regarding Gender and School Type. *Anales de Psicología*, *34*(1), 41. https://doi.org/10.6018/analesps.34.1.229571

Rittmayer, A., & Beier, M. (2008). Overview: Self-efficacy in STEM. *SWE-AWE CASEE Overviews*, 1–12.

Schukajlow, S., Blomberg, J., Rellensmann, J., & Leopold, C. (2022). The role of strategy-based motivation in mathematical problem solving: The case of learner-generated drawings. *Learning and Instruction, 80,* 1–9. https://doi.org/10.1016/j.learninstruc.2021.101561

Stevens, T., Olivárez, A., Jr., & Hamman, D. (2006). The Role of Cognition, Motivation, and Emotion in Explaining the Mathematics Achievement Gap Between Hispanic and White Students. *Hispanic Journal of Behavioral Sciences, 28*(2), 161–186. https://doi.org/10.1177/0739986305286103

Usher, E. L., & Pajares, F. (2007). Self-Efficacy for Self-Regulated Learning: A Validation Study. *Educational and Psychological Measurement*, *20*(10), 1–21.

Yuksel, H. G., & Alci, B. (2012). Self-Efficacy and Critical Thinking Dispositions as Predictors of Success in School Practicum Self-Efficacy and Critical Thinking Dispositions as Predictors of Success in School Practicum. *International Online Journal of Educational Sciences*, *4*(1), 81–90.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press. https://doi.org/10.1016/B978-012109890-2/50031-7

Contact emails: ovan.21029@mhs.unesa.ac.id
yusuffuad@unesa.ac.id
megatbudiarto@unesa.ac.id

ORCID: https://orcid.org/0000-0002-7325-7830
https://orcid.org/0000-0002-9589-7839
https://orcid.org/0000-0002-9052-3141

Appendices

Appendix 1. Adapted Self-Efficacy Questionnaire

No	SEQ From Laranang & Bondoc (2020)	Translate in Indonesia
1	I feel confident enough to ask questions in my mathematics class	Saya percaya diri untuk mengajukan pertanyaan pada pelajaran matematika
2	I believe I can do well on a mathematics test.	Saya yakin selalu dapat mengerjakan tes matematika dengan baik.
3	I believe I can complete all the assignments in a mathematicscourse.	Saya yakin mampu memahami dan menyelesaikan tugas pada pembelajaran matematika
4	I believe I am the kind of person who is good at mathematics	Saya adalah tipe siswa yang pandai matematika.
5	I believe I will be able to use mathematics in my future careerwhen needed.	Saya yakin bahwa matematika akan berguna untuk masa depan saya ketika dibutuhkan
6	I believe I can understand the content in a mathematics course.	Saya yakin dapat memahami materi pada pelajaran matematika
7	I believe I can get an "A" when I am in a mathematics course.	Saya yakin bisa mendapatkan nilai "A" untuk mata pelajaran matematika.
8	I believe I can learn well in a mathematics course.	Saya yakin mampu bertahan dalam menghadapi tugas dan tantangan dalam kehidupan sehari-hari
9	I feel confident when taking a mathematics test.	Saya percaya diri saat mengikuti tes matematika.
10	I believe I am the type of person who can do mathematics.	Saya yakin bahwa saya tipe siswa yang bisa mengerjakan matematika
11	I feel that I will be able to do well in future mathematics courses.	Saya dapat mengerjakan tugas matematika dengan baik di masa depan
12	I believe I can do the mathematics in a mathematics course	Saya yakin dapat mengerjakan matematika ketika saya diberi tugas matematika
13	I believe I can think like a mathematician.	Saya yakin bahwa saya bisa berpikir seperti ahli matematika.
14	I feel confident when using mathematics outside of school.	Saya percaya diri ketika menggunakan matematika pada kegiatan luar sekolah.

Appendix 2. Adapted Self-Regulation Questionnaire

No	**SRQ From Brown et al., (1999)**	**Translate in Indonesia**
1	I usually keep track of my progress toward my goals.	Saya biasanya melacak kemajuan saya untuk mencapai tujuan saya.
2	My behavior is not that different from other people's.	Perilaku saya tidak jauh berbeda dengan orang lain.
3	Others tell me that I keep on with things too long.	Orang lain mengatakan saya terlalu lama melakukan sesuatu.
4	I doubt I could change even if I wanted to.	Saya ragu bahwa saya bisa berubah, sekalipun saya mau.
5	I have trouble making up my mind about things	Saya kesulitan mengambil keputusan tentang berbagai hal
6	I get easily distracted from my plans.	Saya mudah teralihkan dari rencana saya.
7	I reward myself for progress toward my goals.	Saya memberi penghargaan pada diri sendiri atas kemajuan menuju tujuan saya.
8	I don't notice the effects of my actions until it's too late.	Saya tidak menyadari dampak tindakan saya sampai semuanya terlambat.
9	My behavior is similar to that of my friends.	Perilaku saya mirip dengan teman-teman saya.
10	It's hard for me to see anything helpful about changing my ways.	Sulit bagi saya untuk melihat adanya manfaat dari perubahan kebiasaan saya.
11	I am able to accomplish goals I set for myself.	Saya mampu mencapai tujuan yang saya tetapkan untuk diri saya sendiri.
12	I put off making decisions.	Saya menunda pengambilan keputusan.
13	I have so many plans that it's hard for me to focus on any one of them.	Saya mempunyai begitu banyak rencana sehingga sulit bagi saya untuk fokus pada satu saja.
14	I change the way I do things when I see a problem with how things are going.	Saya mengubah cara saya untuk melakukan sesuatu ketika saya melihat masalah bagaimana sesuatu berjalan.
15	It's hard for me to notice when I've “had enough” (alcohol, food, sweets).	Sulit bagi saya untuk menyadari kapan saya sudah “cukup” (alkohol, makanan, permen).
16	I think a lot about what other people think of me.	Saya banyak berpikir tentang apa yang orang lain pikirkan tentang saya.
17	I am willing to consider other ways of doing things.	Saya bersedia mempertimbangkan cara lain dalam melakukan sesuatu.
18	If I wanted to change, I am confident that I could do it.	Jika saya mau berubah, saya yakin saya bisa melakukannya.
19	When it comes to deciding about a change, I feel overwhelmed by the choices	Ketika harus memutuskan untuk melakukan perubahan, saya merasa kewalahan dengan banyaknya pilihan.
20	I have trouble following through with things once I've made up my mind to do something.	Saya kesulitan menindaklanjuti sesuatu yang sudah saya putuskan untuk dilakukan.
21	I don't seem to learn from my mistakes.	Saya tampaknya tidak belajar dari kesalahan saya.
22	I'm usually careful not to overdo it when working, eating, drinking.	Saya biasanya hati-hati untuk tidak terlalu berlebihan ketika bekerja, makan, minum.

No	**SRQ From Brown et al., (1999)**	**Translate in Indonesia**
23	I tend to compare myself with other people.	Saya cenderung membandingkan diri saya sendiri dengan orang lain.
24	I enjoy a routine, and like things to stay the same.	Saya menikmati rutinitas, dan ingin segala sesuatunya tetap sama.
25	I have sought out advice or information about changing.	Saya telah mencari saran atau informasi tentang perubahan.
26	I can come up with lots of ways to change, but it's hard for me to decide which one to use.	Saya dapat menemukan banyak cara untuk berubah, tetapi sulit bagi saya untuk memutuskan cara mana yang harus digunakan.
27	I can stick to a plan that's working well.	Saya dapat berpegang pada rencana saya yang berjalan dengan baik.
28	I usually only have to make a mistake one time in order to learn from it.	Saya biasanya hanya perlu membuat kesalahan satu kali untuk dapat belajar darinya.
29	I don't learn well from punishment.	Saya tidak belajar dengan baik dari hukuman.
30	I have personal standards, and try to live up to them.	Saya mempunyai standar pribadi dan berusaha untuk memenuhinya.
31	I am set in my ways.	Saya sudah mantap dengan cara-caraku.
32	As soon as I see a problem or challenge, I start looking for possible solutions.	Begitu saya melihat masalah atau tantangan, saya mulai mencari kemungkinan solusinya.
33	I have a hard time setting goals for myself.	Saya kesulitan menetapkan tujuan untuk diri saya sendiri.
34	I have a lot of willpower.	Saya memiliki banyak tekad.
35	When I'm trying to change something, I pay a lot of attention to how I'm doing.	Ketika saya mencoba mengubah sesuatu, saya banyak memerhatikan bagaimana saya melakukannya.
36	I usually judge what I'm doing by the consequences of my actions.	Saya biasanya menilai apa yang saya lakukan berdasarkan konsekuensi tindakan saya.
37	I don't care if I'm different from most people.	Saya tidak peduli jika saya berbeda dari kebanyakan orang.
38	As soon as I see things aren't going right I want to do something about it.	Begitu saya melihat sesuatu tidak berjalan dengan baik, saya ingin melakukan sesuatu.
39	There is usually more than one way to accomplish something.	Biasanya ada lebih dari satu cara untuk mencapai sesuatu.
40	I have trouble making plans to help me reach my goals.	Saya kesulitan membuat rencana untuk membantu saya mencapai tujuan saya.
41	I am able to resist temptation.	Saya mampu menahan godaan.
42	I set goals for myself and keep track of my progress.	Saya menetapkan tujuan untuk diri saya sendiri dan melacak kemajuan saya.
43	Most of the time I don't pay attention to what I'm doing.	Seringkali saya tidak memperhatikan apa yang saya lakukan.
44	I try to be like people around me.	Saya mencoba untuk menjadi seperti orang-orang di sekitar saya.

No	**SRQ From Brown et al., (1999)**	**Translate in Indonesia**
45	I tend to keep doing the same thing, even when it doesn't work.	Saya cenderung terus melakukan hal yang sama, bahkan ketika itu tidak berhasil.
46	I can usually find several different possibilities when I want to change something.	Saya biasanya dapat menemukan beberapa kemungkinan berbeda ketika saya ingin mengubah sesuatu.
47	Once I have a goal, I can usually plan how to reach it.	Begitu saya punya tujuan, biasanya saya bisa merencanakan cara mencapainya.
48	I have rules that I stick by no matter what.	Saya memiliki aturan yang saya patuhi, apa pun yang terjadi.
49	If I make a resolution to change something, I pay a lot of attention to how I'm doing.	Jika saya bertekad untuk mengubah sesuatu, saya akan memberi banyak perhatian bagaimana saya melakukannya.
50	Often I don't notice what I'm doing until someone calls it to my attention.	Sering kali saya tidak menyadari apa yang saya lakukan sampai seseorang memberitahu saya.
51	I think a lot about how I'm doing.	Saya banyak berpikir tentang apa yang sedang saya lakukan.
52	Usually I see the need to change before others do.	Biasanya saya melihat perlunya perubahan sebelum orang lain melakukannya.
53	I'm good at finding different ways to get what I want.	Saya pandai menemukan berbagai cara untuk mendapatkan apa yang saya inginkan.
54	I usually think before I act.	Saya biasanya berpikir sebelum bertindak.
55	Little problems or distractions throw me off course.	Masalah-masalah kecil membuat saya keluar jalur rencana saya.
56	I feel bad when I don't meet my goals.	Saya merasa buruk jika saya tidak mencapai tujuan saya.
57	I learn from my mistakes.	Saya belajar dari kesalahan saya.
58	I know how I want to be.	Saya tahu bagaimana saya ingin menjadi.
59	It bothers me when things aren't the way I want them.	Saya merasa terganggu ketika segala sesuatunya tidak berjalan sesuai keinginan saya.
60	I call in others for help when I need it.	Saya meminta bantuan orang lain ketika saya membutuhkannya.
61	Before making a decision, I consider what is likely to happen if I do one thing or another.	Sebelum mengambil keputusan, saya mempertimbangkan apa yang mungkin terjadi jika saya melakukan sesuatu.
62	I give up quickly.	Saya cepat menyerah.
63	I usually decide to change and hope for the best.	Saya biasanya memutuskan untuk berubah dan berharap yang terbaik.