Editorial Team

EDITOR IN-CHIEF

- Assoc. Prof. Dr. Drs. Abubakar Ajalil, M.Si, SCOPUS ID. 58634461600, Universitas Serambi Mekkah, Indonesia

MANAGING EDITOR

- Dr. Dian Aswita, S.Pd, M. Pd, Universitas Serambi Mekkah, Aceh, ID SCOPUS : 57202957850, Indonesia

SECTION EDITORS

- Prof. Dr. Magdalena Mo Ching Mok, M. Ed, Educational University of Hongkong, ID SCOPUS 7006024212, Hong Kong
- Dr. Asriani, S. Pd., M. Pd, Universitas Serambi Mekkah, Indonesia
- Dr. Hj. Rani Siti Fitriani, S.S,. M. Hum, Universitas Pasundan, Bandung, Indonesia
- Dr. Wahyu Khafidah, S.Pd.I, MA, Serambi Mekkah University, Indonesia
- Dr. Usman Effendi, S.Sos., MM, Universitas Persada Indonesia YAI Jakarta, Indonesia, Indonesia
- Dr. Hj. Darmawati, M. Pd, Universitas Serambi Mekkah, Banda Aceh, Indonesia
- Dr. Arfriani Maifizar S,E, M.Si., Universitas Teuku Umar Aceh Barat, Indonesia, ID SCOPUS 57210744149., Indonesia
- Zhao Jing, M. ED, Gizhou Education University, China, China
- Nurlaili Ramli, S. SiT., MPH, Health Polytechnic of the Ministry of Health in Aceh, Aceh Besar. ID SCOPUS 57195919249, Indonesia
- Zaiyana Zaiyana Putri, Universitas Serambi Mekkah, ID SCOPUS 57211267424, Indonesia
- Fitri Wulandari, S.Pd., M. Hum, Universitas Islam Riau, ID SINTA 6704089, Indonesia
- JUNAIDI S, PD., M.PD., Universitas Serambi Mekkah, Indonesia
- Said Ali Akbar, S. Pd., M. Si, Universitas Serambi Mekkah, Banda Aceh ID SCOPUS 57190374979, Indonesia
- Muhammad Fajrin Pane, SH.I., M. Hum, Politeknik Tanjung Balai, Sumatera Utara, Indonesia
- Anita Noviyanti, S. Pd., M. Pd, Universitas Serambi Mekkah, Banda Aceh, Indonesia, ID SCOPUS 57219092073, Indonesia
- Drs. Burhanuddin AG,. M. Pd, Universitas Serambi Mekkah, Aceh Indonesia, ID SCOPUS 57219343469, Indonesia
- Drs. Jailani, M. Pd, Universitas Serambi Mekkah ID SCOPUS 57219098536 Indonesia
- Drs. Ridhwan Ismail, M. Pd, Universitas Serambi Mekkah ID SCOPUS 57219091724, Indonesia
- Drs. Yulsafli - MA, Universitas Serambi Mekkah, ID SCOPUS , Indonesia
- Drs. Anwar S. Pd., M. Pd, Universitas Serambi Mekkah, Banda Aceh ID SCOPUS 58634699300, Indonesia

- Drs. Muhammad Isa, M. Pd, Universitas Serambi Mekkah, Aceh ID SCOPUS 57205735891, Indonesia
- Prof. Mahendran, P.hD, Universitas Pendidikan Sultan Idris, Malaysia
- Dr. J. Karthikeyan, Ph.D, National College, Tiruchirappali, India
- Sophia Manning, Ph.D, Kean University New Jersey, USA

WEB AND OJS MANAGER

- Munawir Munawir, ST,. MT, Universitas Serambi Mekkah, ID SCOPUS 57194214483 Indonesia

ADMINISTRATOR OFFICE AND LAYOUT TEAM

- Dra. Ismawirna M. Pd, Universitas Serambi Mekkah, Banda Aceh, Indonesia. ID SINTA 6167918, Indonesia
- Dra. Armi M, Si, Universitas Serambi Mekkah, Aceh. Indonesia ID SCOPUS 57219094630, Indonesia
- Said Ali Akbar, S. Pd., M. Si, Universitas Serambi Mekkah, Banda Aceh ID SCOPUS 57190374979, Indonesia

ENGLISH LANGUAGE ADVISORS

- Septhia Irnanda, S.Pd., M.Tsol., Ph.D, Unversitas Serambi Mekkah, Aceh ID SCOPUS 5720957372, Indonesia
- Sabrina, S. Pd., M. Appling., M. Tran, Universitas Serambi Mekkah, Banda Aceh, Indonesia
- Muhammad Aulia, S.Pd., MTSOL,.MA.(Res)., Ph.D, Syiah Kuala University, Aceh, ID Scopus 58785862800, Indonesia

LAYOUT EDITORS

- Samsuddin Samsuddin, Program Studi Teknik Komputer - Universitas Serambi Mekkah
- Dr. Nasir Ibrahim, SE., M. Si, Universitas Serambi Mekkah, BId, Ekonomi dan Design Grafis
- Elvitriana Elvitriana, Prodi Teknik Lingkungan- Fakultas Teknik Universitas Serambi Mekkah
- Firdaus Firdaus, Designer Grafis Zoom Printing, Aceh, Indonesia

PROOFREADERS

- Prof. Dr. Asnawi Abdullah, BSc.PH, MHSM, MSc.HPPF, DLSHTM, Ph.D, Universitas Muhammadiyah, Aceh, ID SCOPUS : 57202957850, Indonesia
- Ery Utomo, P.hD, Universitas Negeri Jakarta
- Muslem Daud, S. Ag., M. Ed., Ph.D, Universitas Serambi Mekkah, Aceh, Indonesia, Indonesia
- Dr. Faradiba Sari Harahap, S. Pd., M. Pd, Politeknik Tanjung Balai, Sumatera Utara, Indonesia
- Dr. Muhammad Subhan, Ph.D., M.Sc., B.Eng., MLogM, Aff.M.ASCE, King Abdul Aziz University, Saudi Arabia
- Muhammad Aulia, S.Pd., MTSOL,.MA.(Res)., Ph.D, Syiah Kuala University, Aceh, ID ORCHID, Indonesia
- Exkarach Denang, M. Ed., Ph,D, Udom Tani University, Thailand
- Sabrina, S. Pd., M. Appling., M. Tran, Universitas Serambi Mekkah, Banda Aceh, Indonesia
- Yunisrina Qismullah Yusuf, S. Pd., M. Ed., Ph.D, Universitas Syiah Kuala, Aceh, ID SCOPUS : 55351138500, Indonesia
- Dr. H. Muhammad Alfatih Suryadilaga, S.Ag., M. Ag, Universitas Islam Negeri Sunan Kalijaga, Depok, Indonesia

Jurnal Serambi Ilmu
Journal of Scientific Information and Educational Creativity
Vol. 25, No.1
Maret 2024
pISSN 1619–4849
eISSN 2549-2306

The Impact Of Integrated And Separate Meta-Affective And Meta-Cognitive-Based Training On Students' Reconciling Tensions And Dilemmas Competency In Science Learning

Lilit Rusyati[1], Nuryani Y. Rustaman[2], Ari Widodo[3], Minsu Ha[4]

[1]Lilit Rusyati is the Lecturer of Universitas Pendidikan Indonesia, Indonesia
[2]Nuryani Y. Rustaman is the Lecturer of Universitas Pendidikan Indonesia, Indonesia
[3]Ari Widodo is the Lecturer of Universitas Pendidikan Indonesia, Indonesia
[4] Minsu Ha is the Lecturer of Seoul National University, Republic of Korea

Corespondimng Authoor email : lilitrusyati@upi.edu

Abstract
In a world marked by inequity, young people will be required to become adept at balancing tensions, dilemmas, and trade-offs, such as balancing equity and freedom, autonomy and community, innovation and continuity, and efficiency and the democratic process, in local settings with sometimes global implications. This study uses The Static-Group Pretest-Posttest Design. There are 50 students in integrated training and 50 students in separate training who are in the 7th, 8th, and 9th grades. Teachers frequently guide students in the use of meta-affective and meta-cognitive strategies during the science learning process in integrated training, whereas researchers train students in the interpretation and independent use of meta-affective and meta-cognitive strategies during separate science learning. The instrument used was a questionnaire with five Likert scales (1 = not at all typical of me, 2 = not very typical of me, 3 = somewhat typical of me, 4 = fairly typical of me, and 5 = very typical of me). The competence of "reconciling tensions and dilemmas" is constructing with four indicators, namely integrated way, inter-relations, logics and positions, and perspectives. Based on general data for all grades, students who received meta-affective and meta-cognitive training separately from science learning experienced an increase. Meanwhile only one indicator namely logics and positions is positive changes in integrated meta-affective and meta-cognitive-based training. This shows that students can think and carry out activities in various ways to understand science independently, without having to be guided by the teacher.

Keywords: *Integrated training, Meta-affective, Meta-cognitive, Reconciling Tensions and Dilemmas, Separate training*

INTRODUCTION

Thinking-related knowledge is called metacognitive knowledge or related to metacognitive knowledge (Harrison & Vallin, 2018). Improving pupils' memory is the aim

of metacognition in the classroom (Finley et al., 2010; Murphy & Castel, 2020; Rivers, 2021). Focusing on the material that will stick in their memories the most may help students overcome the overwhelming feeling that they typically have when studying for an exam (Murphy & Castel, 2020). As they make decisions in scenarios that are comparable to those they will face on a real exam, students can effectively assess their learning during practice exams (Rivers, 2021). Students' application of these tactics in basic lab assignments implies that experience or training can aid in the development of these metacognitive skills. Information technology may have an effect on how metacognition affects memory and learning (Finley et al., 2010). Metacognition also affects students' experiences learning with technology. Comprehending metacognition enhances note-taking, self-awareness, and comprehension during studying (Brady & Forest, 2018). Additionally, a strong association was observed between critical thinking skills and metacognitive abilities (Amin et al., 2020; Carless, 2019; Mohseni, 2020).

The feelings that students experience prior to an exam and its meta-affective inclinations (Uzuntiryaki-Kondakci & Kirbulut, 2016). Emotions can be changed if they are under control. The effects on performance and deficiencies in crucial domains including schooling and emotional control are profound (Harley et al., 2019). An emotional path where immersion predicted presence and favorable emotions, and a cognitive path where immersion encouraged a positive cognitive value of the activity in line with the control value theory of achievement feelings (Makransky & Lilleholt, 2018). Emotions force one to process information that is unrelated or irrelevant to the activity at hand, adding needless cognitive strain and competing with other tasks for working memory space. One of the learning objectives is to manage one's emotions, and this can affect the intrinsic cognitive load (Plass & Kalyuga, 2019).

Meta-affective and meta-cognitive are associated, whereas meta-affective and transformational competencies are related. These competencies provide as areas where students can collaborate to create a "learning compass" that shows potential paths that young people can follow in their personal and professional lives. Students are able to take on responsibility, work through difficulties and disputes, and form new morals (OECD Directorate for Education and Skills, 2018). In children, adolescents, and adults, transformational social and emotional learning seeks to advance equity and excellence. Prioritize racial and ethnic issues above all else in order to solve the wider range of disadvantages that currently exist. To strengthen these skills and draw attention to the necessity of adult professional development in order to maximize the success of these programs for a range of kids and adults (Jagers et al., 2019). Exposes the many accomplishment inequalities that exist in our society and highlights the need for a new educational strategy that puts more of an emphasis on the 4Cs, critical thinking, creativity, communication, and collaboration (Soulé & Warrick, 2015).

METHODS

This study used the Static-Group Pretest-Posttest Design. The main difference between the static-group pretest-posttest design and the static-group comparison design is

that the pretest is administered to both groups. These are the static groups, also known as the non-equivalent control group design (Fraenkel et al., 2012). In the seventh, eighth, and ninth grades, there are fifty students enrolled in integrated training and fifty students enrolled in separate training. Teachers assist students in applying meta-affective and meta-cognitive methods on a regular basis in integrated training; in separate training, researchers teach students to understand and use these same strategies independently when learning science. A diagram of this design is shown in Figure 1.

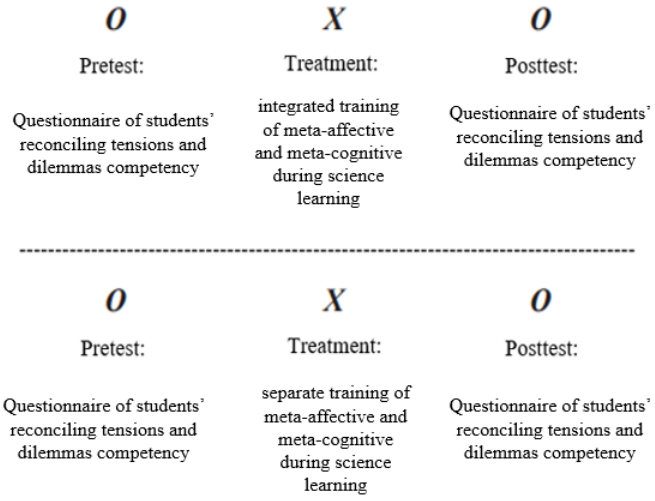

Figure 1. The static-group pretest-posttest design for comparing integrated and separate training of meta-affective and meta-cognitive during science learning

The questionnaire instrument consist of 12 statements with five Likert scales (1 = not at all typical of me, 2 = not very typical of me, 3 = somewhat typical of me, 4 = fairly typical of me, and 5 = very typical of me). The competency of "Reconciling Tensions and Dilemmas" consists of four indicators, namely integrated way, inter-relations, logics and positions, and perspectives. The Winsteps Rasch Model was utilized to analyze the 445 student responses obtained from the validation testing in order to determine the item reliability index and person reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). Table 1 depicts the reliability index's findings based on the Winsteps Rasch Model and IBM SPSS Statistics 25.

Table 1
Reliability Index of Transformative Competencies Questionnaire by using Winsteps Rasch Model and IBM SPSS Statistics 25

Transformative Competencies	N of students	N of items	Person Reliability	Item Reliability	Cronbach's Alpha	Category
Reconciling tensions and dilemmas	445	12	0.85	0.95	0.89	Acceptable

According to Table 1, the person and item reliability indices of the survey created for this study are suitable and adaptable to other kinds of research (Bond & Fox, 2015; Fischer & Molenaar, 2012). In addition to calculating the reliability index using the Winsteps Rasch Model, the data from the test results were also computed with IBM SPSS Statistics 25 to see Cronbach's Alpha, which indicates the reliability index (Meyers et al., 2019; Yockey, 2016). The questionnaire designed for this study has a high Cronbach's Alpha score, therefore it can be utilized for a variety of research purposes. Upon conducting the index validity test, every statement on this survey was found to be valid, yielding positive outcomes (Rusyati et al., 2021). The findings from the creation of the reconciling tensions and dilemmas competencies questionnaire are shown in Table 2.

Table 2.
The Final Version of Transformative Competencies Questionnaire Development

Competency	Indicator	Code	Item
Reconciling Tensions and Dilemmas	Integrated way (Ability to think with two or more things combined in order to avoids premature conclusions)	TC-13	When I studied science, I thought in various ways to understand science.
		TC-14	When studying science, I do activities in various ways to understand science.
		TC-15	If I get new information in class, I will not immediately conclude but will look for other sources to corroborate the conclusion.
	Inter-relations (Ability to take into account the interconnections and interrelations between contradictory or incompatible ideas)	TC-16	I thought of understanding science by considering the relationship between opposing ideas.
		TC-17	I undertake activities to understand science by considering the relationship between opposing ideas.
		TC-18	If there are ideas that don't match, I try to find connections with other ideas while studying science.
	Logics and Positions (Ability to learn to think and act from both logics and positions)	TC-19	When studying science, I used logic to understand science.
		TC-20	When studying science, I use the point of view of a certain position to understand science.
		TC-21	I understand science easier, if I use logic that I make myself.
	Perspectives (Ability to learn to think and act from both short- and long-term perspectives)	TC-22	When studying science, I tried to think from a short-term and long-term perspective/perception.
		TC-23	When studying science, I tried to act from both short and long term perspectives/perceptions.
		TC-24	While studying science, I was able to sort out short-term and long-term viewpoints/perceptions.

RESULTS & DISCUSSION

The competence of "reconciling tensions and dilemmas" is constructing with four indicators, namely integrated way, inter-relations, logics and positions, and perspectives. The average score (mean) for each indicators of competency “reconciling tensions and dilemmas” by comparing on integrated and separate training is illustrating in Table 3.

Table 3.
The Average of Students’ Transformative Competencies “Reconciling Tensions and Dilemmas” in Integrated and Separate Training

No	Indicators	Integrated Training			Separate Training		
		Initial Condition	Final Condition	Changes	Initial Condition	Final Condition	Changes
1	Integrated way	3.57	3.37	-0.2	3.41	3.46	**0.05**
2	Inter-relations	2.99	2.80	-0.19	3.00	3.24	**0.24**
3	Logics and positions	3.57	3.58	**0.01**	3.57	3.74	**0.17**
4	Perspectives	3.12	2.89	-0.23	2.90	3.07	**0.17**

In a world characterized by inequality, students will need to learn how to effectively manage conflicts, trade-offs, and tensions in local contexts that occasionally have global ramifications. Examples of these balances include equity and freedom, autonomy and community, innovation and continuity, and efficiency and the democratic process. It is unusual that achieving a compromise between conflicting demands leads to an either/or choice or even a single answer. Students will need to adopt a more relationship-focused mindset, eschewing preconceived notions. In a world of interdependence and conflict, students can only ensure their own well-being, and the well-being of their families and communities, if they possess the ability to comprehend the needs and desires of others. To be future-ready, students need to develop more holistic ways of thinking and doing, considering the ties and connections between seemingly contradictory or incompatible ideas, logics, and attitudes from both the short- and long-term perspectives. That is, students need to develop their ability to think in systems (OECD Directorate for Education and Skills, 2018).

The best way to conceptualize mind-wandering is as a multidimensional construct held together by patterns of overlapping and non-overlapping components. Treating mind-wandering as a heterogeneous construct and precisely quantifying or describing the many properties of the mind-wandering under investigation are necessary when using a family-resemblances approach to mind-wandering (Weinstein, 2018). Three strategies can be utilized to investigate the uncertainty inherent in scientific activity and encourage students to participate in more complicated and authentic inquiries: starting with challenging phenomena, iterating on investigations, and leveraging variability in students' study approaches (Manz & Suárez, 2018). Additionally, while learning science as a foundation for more cautious thinking and behavior, pupils are unaware of the impacts (consequences) in the future. Most argumentation interventions and their modest results are the result of misplacing argument as a separate skill that can be addressed with certain kinds of

education. Because it was only reasonable for students to disagree on how to effectively convey the ideas they were learning (Sandoval et al., 2019). The motivation of teachers and students was adversely affected by a number of problems, including anxiety, interpersonal challenges, and internet connectivity (Elhadary et al., 2020).

The capacity to discern the links and ties between ideas that at first glance appear to be unrelated or incompatible is known as interrelationships. Three actions are represented by this indicator. In order to understand science, students looked at the relationship between opposing viewpoints. Students learn the interaction of opposing concepts through exercises that help them understand science better. When studying science, students try to connect concepts that don't correspond with other ideas. This fact demonstrates how students can use their own metacognitive and meta-affective abilities to comprehend relationships; in other words, they grasp that when studying science, there can be disparities in concepts. Students learn to accept the presence of competing theories as a result of this need, which also gives them a way to learn about scientific phenomena. Furthermore, students also try to connect the ideas that do not match, thus finding an important line. Table 4 describes the data recap per scale of students' transformative competencies in competency "Reconciling Tensions and Dilemmas".

Table 4
The Percentage of Students' Transformative Competencies "Reconciling Tensions and Dilemmas" per Scale

Scale	Integrated Training		Separate Training	
	Initial Condition	Final Condition	Initial Condition	Final Condition
Not at all typical of me (1)	2%	3%*	5%	2%
Not very typical of me (2)	19%	19%	20%	20%
Somewhat typical of me (3)	37%	41%	38%	32%*
Fairly typical of me (4)	29%	29%	25%	35%
Very typical of me (5)	14%	9%*	12%	12%

** Contrary to the ideal expectation.*

Based on Table 4, the fairly typical scale (4) for students in the separate training group increased more than in the integrated training group. Meanwhile, the very typical scale (5) in the integrated training group experienced a decrease, but in the separate training group it remained at a constant level. The mental models of young children typically point in two distinct directions: one corresponds to immediate activities for solving short-term problems, while the other refers to sustainability and prevention. In addition, it seems that children's individual contributions to the two environmental issues under study are entwined with group contributions. More precisely, when voicing their ideas, children seemed to think similarly about the environmental issues raised (Iliopoulou, 2018). A model of long-term student involvement with feedback includes unresolved learning issues, double-loop feedback processes, and single-loop feedback processes. Feedback spirals are suggested as an alternative technique for examining intricate, repeated long-term learning processes, since feedback loops are mostly focused on the short term. The two most

significant practice consequences are the growth of student feedback literacy and self-regulation (Carless, 2019). Figure 2 describes the visualization of the comparison of students' transformative competencies in competency “Reconciling Tensions and Dilemmas” in integrated and separate training on category ideal (>0%), fixed (0%), and non-ideal (<0%).

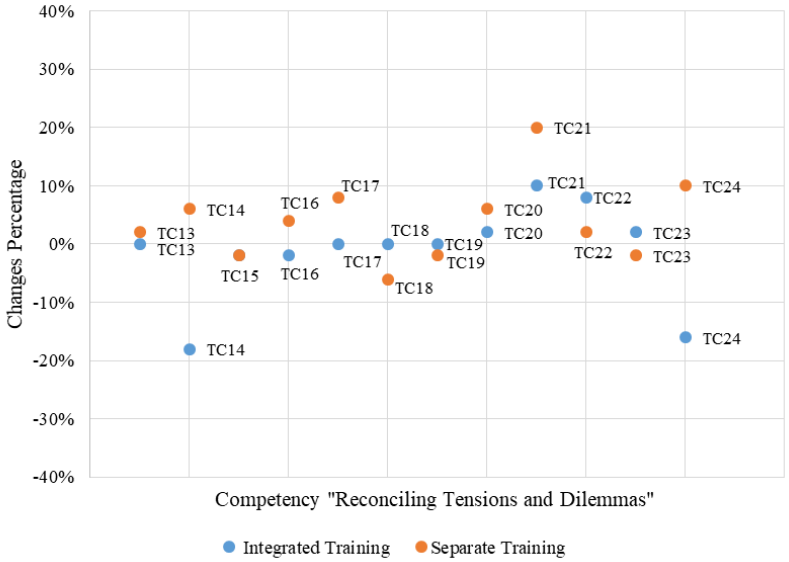

Figure 2. The Comparison of Students' Transformative Competencies in Competency “Reconciling Tensions and Dilemmas” in Integrated and Separate Training on Category Ideal (>0%), Fixed (0%), and Non-Ideal (<0%)

Figure 2 shows that separate training, namely the implementation of meta-affective and meta-cognitive strategies independently implemented by students, is more effective in helping students to develop transformative competencies in the competency "reconciling tensions and dilemmas". It is proven that integrated training has more non-ideal conditions than integrated training. However, there are three indicators that both cannot be developed with integrated or separate training. Integrated way indicator on TC-15: "If I get new information in class, I will not immediately conclude but will look for other sources to corroborate the conclusion", inter-relations indicator on TC-18 " If there are ideas that don't match, I try to find connections with other ideas while studying science”, and logics and positions indicator on TC-19 " When studying science, I used logic to understand science". The majority of students retain and comprehend the knowledge. The results show that while explaining dilemma scenarios, students are better able to use brief phrases and prior knowledge. Provides students with the opportunity to enhance their critical thinking, creativity, and reasoning skills while practicing problem-solving and project-making skills (Rahmawati et al., 2021).

TC-21 "I understand science easier if I use logic that I make myself" has a very big improvement by being developed using separate training. This shows that students use their

own logic to understand science more easily. If science is taught in the classroom using a naturalized logic rather than the classical logic, which rejects abduction, the creative part of thinking that leads to discovery, as erroneous and unworthy of inquiry. With such a logic, students are positioned as practical, not ideal, agents of reasoning, who are inferential specialists rather than inferential misfits when they formulate hypotheses (Ferguson, 2019). Students' critical thinking abilities and their ability to assess arguments, especially those made by practicing scientists, were enhanced by the addition of logic. Learning logic improves a student's capacity for problem-solving, writing, and understanding scientific literature as well as everyday events (Sobhanzadeh et al., 2021). Resource management strategies, motivation, and cognitive and metacognitive processes all have a big impact on how well science students perform. Students' motivation serves as one type of enabling factor for the intellectual effort, which is measured by the self-perceived use of science learning approaches. When it comes to motivational elements, which have a greater impact on students' achievement in science than cognitive and metacognitive skills, self-efficacy is the factor with the biggest influence (Ortega-Torres et al., 2020).

CONCLUSION

Students that got meta-affective and meta-cognitive training apart from science learning showed an increase, according to general data for all grades. Positive changes in integrated meta-affective and meta-cognitive-based training are the only indications that exist at this time, and they are logics and positions. This demonstrates that students do not need teacher guidance to grasp science; rather, they may think and act in a variety of ways.

REFERENCES

Amin, A. M., Corebima, A. D., Zubaidah, S., & Mahanal, S. (2020). The correlation between metacognitive skills and critical thinking skills at the implementation of four different learning strategies in animal physiology lectures. *European Journal of Educational Research*, *9*(1), 143–163. https://doi.org/https://doi.org/10.12973/eu-jer.9.1.143

Anwar, A., Agustina, Y., Yani, A., Abubakar, A., & Darmawati, D. (2022). The Relationship Between Transformational Leadership Headmaster With Teacher Performance. *Jurnal Serambi Ilmu*, *23*(1), 113-130.

Bond, T. & Fox, C. M. (2015). Applying the Rasch model, fundamental measurement in the human sciences (third edition). New York: Routledge.

Brady, M. & Forest, C. P. (2018). Metacognition, formative assessment, and student perspective: Learning about metacognition through in-class comparison of response systems. *The Journal of Physician Assistant Education*, *29*(2), 104–108. https://doi.org/https://doi.org/10.1097/jpa.0000000000000203

Carless, D. (2019). Feedback loops and the longer-term: towards feedback spirals. *Assessment & Evaluation in Higher Education*, *44*(5), 705–714. https://doi.org/https://doi.org/10.1080/02602938.2018.1531108

Çakici, D. (2018). Metacognitive awareness and critical thinking abilities of pre-service EFL teachers. *Journal of Education and Learning*, *7*(5), 116–129. https://doi.org/https://doi.org/10.5539/jel.v7n5p116

Elhadary, T., Elhaty, I. A., Mohamed, A. A., & Alawna, M. (2020). Evaluation of academic performance of science and social science students in Turkish universities during COVID-19 crisis. *Journal of Critical Reviews*, *7*(11), 1740–1751.

Ferguson, J. P. (2019). Students are not inferential-misfits: Naturalising logic in the science classroom. *Philosophy and Theory*, *51*(8), 852–865. https://doi.org/https://doi.org/10.1080/00131857.2018.1516141

Jailani, J., Almukarramah, A., Abubakar, A., Ibrahim, I., Ridhwan, M., Anwar, A., ... & Lukmanulhakim, L. (2022). Efforts to Increase Creativity and Achievement Learning Science through Empowerment Student Reasoning. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, *5*(4), 401-412.

Finley, J. R., Tullis, J. G., & Benjamin, A. S. (2010). Metacognitive control of learning and remembering. In *New science of learning* (pp. 109–131). Springer. https://doi.org/https://doi.org/10.1007/978-1-4419-5716-0_6

Fischer, G. H. & Molenaar, I. W. (2012). *Rasch models: Foundations, recent developments, and applications*. New York: Springer Science & Business Media.

Fraenkel, J.R.; Wallen, N.E.; and Hyun, H. H. *How to Design and Evaluate Research in Education*, Eighth Edi. New York: McGraw-Hill, 2012, pp. 269-270.

Harley, J. M., Pekrun, R., Taxer, J. L., & Gross, J. J. (2019). Emotion regulation in achievement situations: An integrated model. *Educational Psychologist*, *54*(2), 106–126. https://doi.org/https://doi.org/10.1080/00461520.2019.1587297

Harrison, G. M. & Vallin, L. M. (2018). Evaluating the metacognitive awareness inventory using empirical factor-structure evidence. *Metacognition and Learning*, *13*(1), 15–38. https://doi.org/https://doi.org/10.1007/s11409-017-9176-z

Iliopoulou, I. (2018). How young children think they can act for the environment: The case of forest and waste. *Education 3-13*, *46*(3), 249–263. https://doi.org/https://doi.org/10.1080/03004279.2016.1236829

Jagers, R. J., Rivas-Drake, D., & Williams, B. (2019). Transformative social and emotional learning (SEL): Toward SEL in service of educational equity and excellence. *Educational Psychologist*, *54*(3), 162–184. https://doi.org/https://doi.org/10.1080/00461520.2019.1623032

Makransky, G. & Lilleholt, L. (2018). A structural equation modeling investigation of the emotional value of immersive virtual reality in education. *Educational Technology Research and Development*, *66*(5), 1141–1164. https://doi.org/https://doi.org/10.1007/s11423-018-9581-2

Manz, E. & Suárez, E. (2018). Supporting teachers to negotiate uncertainty for science, students, and teaching. *Science Education*, *102*(4), 771–795. https://doi.org/https://doi.org/10.1002/sce.21343

Meyers, D. C., Domitrovich, C. E., Dissi, R., Trejo, J., & Greenberg, M. T. (2019). No TitleSupporting systemic social and emotional learning with a schoolwide

implementation model. *Evaluation and Program Planning*, *73*(1), 53–61. https://doi.org/https://doi.org/10.1016/j.evalprogplan.2018.11.005

Mohseni, F., Seifoori, Z., & Ahangari, S. (2020). The impact of metacognitive strategy training and critical thinking awareness-raising on reading comprehension. *Cogent Education*, *7*(1), 1–22. https://doi.org/https://doi.org/10.1080/2331186x.2020.1720946

Murphy, D. H. & Castel, A. D. (2020). Responsible remembering: How metacognition impacts adaptive selective memory. *Zeitschrift Für Psychologie*, *228*(4), 301–303. https://doi.org/https://psycnet.apa.org/doi/10.1027/2151-2604/a000428

OECD Directorate for Education and Skills. (2018). *The Future of Education and Skills 2030*. New York: OECD Secretary-General.

Ortega-Torres, E., Solaz-Portoles, J. J., & Sanjosé-López, V. (2020). Inter-relations among motivation, self-perceived use of strategies and academic achievement in science: a study with spanish secondary school students. *Sustainability*, *12*(17), 1–12. https://doi.org/https://doi.org/10.3390/su12176752

Plass, J. L. & Kalyuga, S. (2019). Four ways of considering emotion in cognitive load theory. *Educational Psychology Review*, *31*(2), 339–359. https://doi.org/https://doi.org/10.1007/s10648-019-09473-5

Rahmawati, Y., Afrizal, A., Dwi Astari, D., Mardiah, A., Budi Utami, D., & Muhab, S. (2021). The integration of dilemmas stories with STEM-project-based learning: Analyzing students' thinking skills using Hess' cognitive rigor matrix. *JOTSE: Journal of Technology and Science Education*, *11*(2), 419–439. https://doi.org/https://doi.org/10.3926/jotse.1292

Rivers, M. L. (2021). Metacognition about practice testing: A review of learners' beliefs, monitoring, and control of test-enhanced learning. *Educational Psychology Review*, *33*(3), 823–862. https://doi.org/https://doi.org/10.1007/s10648-020-09578-2

Rusyati, L., Rustaman, N. Y., Widodo, A., & Ha, M. (2021). Development of questionnaire instrument to assess students' transformative competencies in science learning. *Journal of Physics: Conference Series*, *2098*(1), 1–7. https://doi.org/https://doi.org/10.1088/1742-6596/2098/1/012035

Sandoval, W. A., Enyedy, N., Redman, E. H., & Xiao, S. (2019). Organising a culture of argumentation in elementary science. *International Journal of Science Education*, *41*(13), 1848–1869. https://doi.org/https://doi.org/10.1080/09500693.2019.1641856

Soulé, H. & Warrick, T. (2015). Defining 21st century readiness for all students: What we know and how to get there. *Psychology of Aesthetics, Creativity, and the Arts*, *9*(2), 178–186. https://doi.org/https://psycnet.apa.org/doi/10.1037/aca0000017

Uzuntiryaki-Kondakci, E. & Kirbulut, Z. D. (2016). The development of the meta-affective trait scale. *Psychology in the Schools*, *53*(4), 359–374. https://doi.org/https://doi.org/10.1002/pits.21910

Weinstein, Y. (2018). Mind-wandering, how do I measure thee with probes? Let me count the ways. *Behavior Research Methods*, *50*(2), 642–661. https://doi.org/https://doi.org/10.3758/s13428-017-0891-9

Yockey, R. D. (2016). SPSS DEMYSTIFIED: A step-by-step guide to successful data

analysis. New York: Routledge.

Jurnal Serambi Ilmu
Journal of Scientific Information and Educational Creativity
Vol. 25, No.1
Maret 2024
pISSN 1619–4849
eISSN 2549-2306