Investigating Indonesian Students' Meta-Affective of Positive and Negative Affect in Science Learning

Pipih Nurhayati[1], Ari Widodo[1], Achmad Samsudin[1]

[1]Program of Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
pipih.nurhayati@upi.edu

Abstract.This study aims to assess students' meta-affective ability of positive and negative affect during learning science. This study adopted a quantitative approach through a survey of 90 junior high school students aged 12-14 years in Indonesia. The instrument used was a meta-affective scale consisting of 26 statements with indicators of affective awareness and affective regulation. The sub indicators are awareness, expression and regulation of positive and negarive affect. SPSS 25 was used to test variance of each indicators of the questionnaires, Item Response Theory (IRT) Rasch was used doing analysis of the tendencies. The results showed that students began to show the development of meta-affective ability in science learning. The analysis showed that students were more aware of and regulated positive affect like happiness or pride than a negative affect like disapointment or sadness during science learning. The recommendation from these findings is that nowadays awareness and regulation of negative affect needs to be addressed in science learning.

Keywords: Meta-Affective, Positive and Negative affect, Science Learning

1 Introduction

Indonesian students follow a science learning curriculum that is structured into various stages from early childhood through high school. At the junior high school level, they are situated within Phase D, characterized by a focus on two fundamental aspects of science learning: comprehension of scientific principles and the development of practical skills [1]. During this phase, students are anticipated to articulate the occurrence of natural laws across a spectrum ranging from a micro to macro scale and establish relationships within interconnected systems. They apply their comprehension of learned concepts to make informed decisions and address challenges encountered in their daily routines. Despite the curriculum's emphasis on these skills, the advancement of learning outcomes in science education within Indonesia remains unprogressive from 2008 to 2019. This stagnation is evidenced by the consistent PISA scores for science literacy in Indonesia, which have remained stagnant in the 380s range. [2]. One factor influencing educational achievements is students' capacity to regulate emotions during the learning process recognized as meta-affective competence

M. A. Wulandari et al. (eds.), *Proceedings of the International Conference on Teaching, Learning and Technology (ICTLT 2023)*, Advances in Social Science, Education and Humanities Research 825,
https://doi.org/10.2991/978-2-38476-206-4_34

Meta-affective denotes emotions intertwined within cognitive processes, encompassing emotion monitoring and using emotions to oversee different facets. Meta-affective" refers to an individual's capacity to comprehend and manage their emotions at a higher or more abstract level. It involves understanding and regulating emotions through a reflective or meta-cognitive process [3]–[5]. Meta-affective has multiple dimensions, the initial understanding is that meta-affective has two components: awareness and regulation of affect [4]. Furthermore, three components were found, namely affect monitoring, affect regulation and affect about affect. These abilities support coordination between knowledge and experience [6].

From various science education studies, it has not been found how students are distributed in their meta-affective abilities, whether students are more able to realize and manage positive affect or vice versa. This study will provide inspiration for other researchers to focus on what our students have not mastered. Thus, the study revolves around primary research inquiries: How tendencies of meta-affective in aware and regulate positive and negative affect in science learning?

2 Methods

This quantitative study was conducted in October 2023 in schools located in the West Java province of Indonesia. The researcher employed purposive sampling, contacting science teachers from four schools with diverse basic curricula. Data were gathered from 90 junior high school students in the West Java Province of Indonesia. The sample comprised students from two different types of schools: a public school and a faith-based school. Among the respondents, there were 60 (66.7%) twelve-year-olds, 28 (31.31%) thirteen-year-olds, and the remaining students were fourteen years old. The gender distribution consisted of 41 (45.6%) male students and 49 (54.4%) female students. Fifty-nine percent of the respondents identified as Muslim, while forty-one percent identified as Christian.

This study used a questionnaire instrument called the Meta-Affective Traits Scale for Young Science Learners (MAT-SYL). This questionnaire consists of 26 items that cover two Meta-Affective indicators, Affective Awareness and Regulation (Kondacki, 2016). Development and innovation were carried out on the instrument in the context of statements in items based on the science learning process at school. Affective awareness has sub-indicators of positive affective awareness and negative affective awareness. Positive affective awareness is the ability to realize feelings of pride, pleasure, enjoyment, relief and feelings of interest. This sub-indicator is measured through five items such as "I can feel interest in certain science materials only". Negative affective awareness is the ability to feel negative feelings such as anxiety, disappointment, boredom, anger and sadness.

This assessment tool comprises 26 statement items rated on a scale of 1 to 5, indicating from no self-reflection (1) to strong self-reflection (5). To validate the instrument, SPSS 25 was employed, utilizing Pearson correlation due to the scale or interval nature of the data. The validity of each statement was assessed, considering a Pearson Correlation value greater than or equal to 0.207 (N = 90, Significance 5%) as indicative

of validity. The findings from the validity test of all 26 statement items concluded that each statement demonstrated validity. For reliability evaluation, SPSS's analyze and scale reliability feature was utilized, employing the Cronbach's Alpha test. The resulting Cronbach Alpha value of 0.892 indicates high reliability for the questionnaire package, suggesting its dependable use in assessments or research.

3 Result

In accordance with the research objectives, the distribution of students' ability to realize affect and manage it was analyzed. The questionnaire data was processed using excel. The first data obtained is the average per indicator, score category and testing the difference in average scores using ANOVA (Analysis of variance) with the help of SPSS 25 which is shown in Table 1.

Table 1. Analysis of meta-affective ability of junior high school students per sub-indicator

Indicators	Sub-Indicators	Averages	Categories	Analysis of Variance test
Positive Affect	Awareness	3.8	Good	Homogenity:0.257
	Expressing	3.7	Good	ANOVA: 0.002
	Regulating	3.1	Good	(Sig.)
Negative	Awareness	3.2	Good	
Affect	Expressing	3.2	Good	
	Regulating	2.7	Fair	

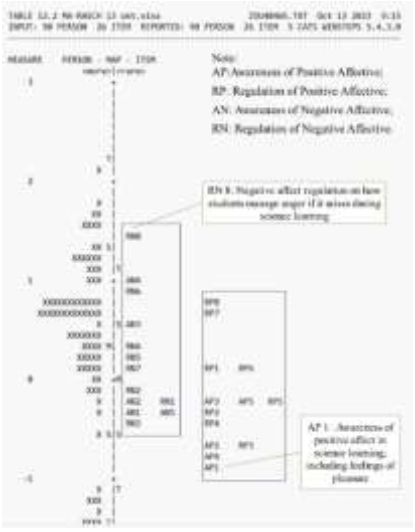

Fig. 1. Per-item analysis of positive and negative affective sub-indicators

Based on the results of the analysis, it is known that significantly different between positive and negative affect of meta-affective students. Known in each indicator

students have a tendency to realize, express and manage positive affective rather than negative. Based on the results of the questionnaire, it is found that students have been able to feel positive affectives such as pride, pleasure, joy, and negative affectives such as anxiety, disappointment, boredom, anger and sadness. Based on Figure 1, in-depth analysis, RASCH analysis was conducted per item for positive and negative affective statements. It is known that the distribution of awareness and positive regulation is lower, which indicates that students have more mastery than negative one. Negative Regulation is a challenge for students, looking back into the instrument that question RN8 is how students regulate anger during science learning. AN4 also showed students' difficulty in realizing boredom in class. RN6 explained that students find it difficult to manage disappointment if the experiment is not to their liking.

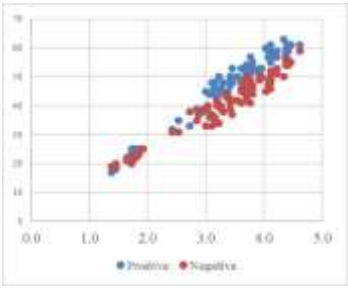

Fig. 2. Meta-Affective distribution of average positive and negative affect in science learning

The mastery of meta-affective skills by students becomes evident in the statements with the lowest frequency, notably AP1, AP2, AP3, and AP4. These statements reflect the ability to acknowledge positive emotions experienced during learning, such as feeling proud upon achieving a good science grade, experiencing pleasure upon receiving praise from the science teacher, feeling excitement when presenting science work successfully to the class, and recognizing a sense of relief after performing well in a science practical exam. Figure 2 illustrates that, overall, students tend to exhibit a greater propensity to recognize and regulate positive affect rather than negative affect.

4 Discussion

Positive and negative affect can be realized and managed by children who have meta-affective abilities. Students are able to feel positive feelings such as pleasure, pride, or satisfaction. Students who can manage positive feelings will affect their learning outcomes on a concept [7]. Likewise with negative affect, students are able to recognize anxiety, nervousness or anger when learning. Students who are able to express, and turn these emotions into positive actions will affect their learning outcomes [8]. A student equipped with a positive attitude, a strong self-concept, and substantial prior knowledge is anticipated to undergo a smoother and quicker learning process, leading to greater academic achievements [9]. Feelings of frustration or uncertainty often leads students to feel disengaged. In this context, understanding when and how learners can be motivated rather than demoralized by "negative" feelings arising during science learning is

crucial. Hence, it's found that the development of productive meta-affect fundamentally involves reframing rather than avoiding challenging moments [5]. Recent research increasingly highlights the interconnectedness between science students' comprehension of content, cognitive management, emotional characteristics, and drive [8]. By having self-awareness of the emotions felt and the ability to regulate emotions, individuals can be more effective in engaging in learning activities and achieving their academic goals.

5 Conclusion

Meta-affective encompasses both awareness and regulation, encompassing dimensions of positive and negative affect. Statistical tests revealed significant differences in students' abilities to recognize and handle positive and negative affect. Across all indicators, students showed a tendency to acknowledge, express, and manage positive emotions more readily than negative ones. They encountered difficulty in recognizing feelings of boredom and transforming them into positive emotions. Additionally, feelings of anger sometimes arose when fatigued from science lessons, and managing these emotions remained a challenge.

References

1. Kemdikbudristek.: Capaian pembelajaran tingkat paud, dasar dan menengah kurikulum merdeka. Kemdikbudristek. Jakarta (2022).
2. Schleicher, A.: PISA 2018: Insights and interpretations. OECD Publishing, Paris (2019).
3. Goldin, G. A., Epstein, Y. M., Schorr, R. Y., Warner, L. B.: Beliefs and engagement structures: behind the affective dimension of mathematical learning, ZDM. Int. J. Math. Educ., 43 (4), 547–560 (2011).
4. Uzuntiryaki-Kondakci, E., Kirbulut, Z. D.:The development of the meta-affective trait scale, Psychol. Sch., 53 (4), 359 (2016).
5. Rebolledo-Mendez, G., Huerta-Pacheco, N. S., Baker, R. S., du Boulay, B.: Meta-affective behaviour within an intelligent tutoring system for mathematics, Int. J. Artif. Intell. Educ., 32 (1), 174–195 (2022).
6. Schultz, S. E., Wixon, N., Allessio, D., Muldner, K., Burleson, W., Woolf, B., & Arroyo, I.: Blinded by science? exploring affective meaning in students' own words. In: 13th International Conference, ITS 2016, Zagreb, Croatia, June 7-10, 2. Proceedings 13, 314-319. Springer International Publishing, Heidelberg (2016).
7. Kirbulut, Z. D.: Exploring the relationship between metavariables and self-efficacy in chemistry, Eurasian J. Educ. Res., 19 (81), 37–56 (2019).
8. Kander, T. N., Lawrence, D., Fox, A., Houghton, S., Becerra, R.: Mindfulness-based interventions for preadolescent children: a comprehensive meta-analysis, J. Sch. Psychol.,102, 101261 (2024).
9. Haynes, M., Brown, A., Nichols, K., Parveen Musofer, R.: Measurement of student attitudes to science and association with inquiry-based learning in regional schools, Int. J. Sci. Educ., 45 (8), 593–612 (2023).