



Prospective Teachers' Metacognitive Awareness in Remote Learning: Analytical Study Viewed from Cognitive Style and Gender

Muhammad Asy'ari ^{1,*}, Cleci T. Werner de Rosa ²

¹ Department of Physics Education, Mandalika University of Education, Mataram, Indonesia

² Institute of Exact Sciences and Geosciences, University of Passo Fundo, RS, Brazil

*Correspondence: muhammadasyari@undikma.ac.id

Article Info	Abstract
Article History Received: March 2022; Revised: May 2022; Published: June 2022	<p>Cognitive regulation related to the learning independence is a problem that often appears in remote learning. It's related to metacognition awareness that claimed could facilitate learners in understanding how to learn and regulate the learning process to solve the new problem encountered. The current study aimed to investigate the prospective science teachers' (PST) metacognitive awareness in remote learning based on field-dependent and field-independent cognitive styles, and gender. Quantitative research with a survey method involving 100 PST was carried out in this study. The PST metacognitive awareness was collected using the Metacognition Awareness Inventory (MAI) instrument, while PST cognitive style was determined using the Group Embedded Figure Test (GEFT) instrument, which was empirically declared valid and reliable. The research data were analyzed using the independent sample t-test, and the Mann-Whitney test after the data distribution test was carried out using the Kolmogorov-Smirnov test. Based on gender differences, PST metacognitive awareness was not significantly different ($p>0.05$), while based on cognitive style, PST metacognitive awareness was significantly different ($p<0.05$) on indicators of procedural knowledge and conditional knowledge. In addition, PST metacognitive awareness was significantly different on indicators of procedural knowledge, conditional knowledge, planning, monitoring, debugging, and evaluation based on a review of cognitive styles and gender differences.</p>
Keywords Metacognitive awareness; Remote learning; Cognitive styles; Gender	
<div> https://doi.org/10.36312/ijece.v1i1.731</div> <div>Copyright© 2022, Asy'ari & da Rosa</div> <div>This is an open-access article under the CC-BY-SA License.</div> <div></div>	
How to Cite	Asy'ari, M., & da Rosa, C. T. W. (2022). Prospective Teachers' Metacognitive Awareness in Remote Learning: Analytical Study Viewed from Cognitive Style and Gender. <i>International Journal of Essential Competencies in Education</i> , 1(1), 18–28. https://doi.org/10.36312/ijece.v1i1.731

INTRODUCTION

The Covid-19 pandemic caused significant changes to education systems around the world. Social restrictions cause learning to be done online (remote learning) (Weeden & Cornwell, 2020). Cognitive regulation related to learning independence is a problem that often appears in remote learning (Rashid & Yadav, 2020). Cognitive regulation is related to metacognition awareness (Asy'ari et al., 2019; Perry et al., 2019) that claimed could facilitate learners in understanding how to learn (Sagitova, 2014) and regulate the learning process (Gonzalez-DeHass, 2016) to solve the new problem encountered (Perry et al., 2019). Students have good cognitive regulation stated carry out thinking processes such as planning,

monitoring, and evaluating (Asy'ari et al., 2019) simultaneously in learning (Donker et al., 2014).

Metacognition is suspected to be a key factor in academic development (Zohar & Barzilai, 2013), optimization of memory, learning outcomes (Sperling et al., 2012), students' self-regulation (Taasobshirazi & Farley, 2013) and has become a significant issue of educational research (Asy'ari et al., 2019; Muhali et al., 2019; Wirzal et al., 2022). The statements support by the focus of science learning has shown an orientation towards adaptability development and training, complex communication/social skills, non-routine problem-solving skills, self-regulation/self-development, and systems thinking (Quinn et al., 2012). Unfortunately, many teachers in Indonesia still do not understand metacognition (Syarifah et al., 2016), and metacognitive teaching to students tends to be neglected (Koswara & Mundilarto, 2018).

Previous research showed that students' metacognitive awareness was categorized as very weak (Fauzi & Sa'diyah, 2019). Tosun and Senocak (2013) reported that efforts to increase students' metacognition awareness could be made by implementing a problem-based learning model. However, the debugging sub-dimension was found not significantly increase in the inventory of students' metacognition awareness after learning. Furthermore, Asy'ari et al (2019) reported that the inquiry learning model did not have a consistent impact on the sub-dimensions of the information management system, monitoring, evaluation, and debugging. In general, it had a positive impact on increasing students' metacognitive knowledge and awareness.

The description signals that identifying students' metacognition and cognitive characteristics is important before metacognition learning is carried out in the classroom. There are many factors that can affect students' thinking skills, including gender (male and female) (Harish, 2015; Mahanal et al., 2017). However, the study results did not consider the potential differences in students' metacognition based on gender characteristics. The results showed a significant difference between female and male metacognitive awareness on planning, evaluation, and monitoring (Liliana & Lavinia, 2011). Females obtained significantly higher scores on metacognitive knowledge and metacognitive awareness than males (Abdelrahman, 2020). Unfortunately, the results of the previous study did not consider differences in metacognitive awareness based on a review of cognitive style characteristics. However, these characteristics were stated to affect students' thinking skills (Mutlu & Temiz, 2013; Özgelen, 2012).

Cognitive style is the tendency/differences of students consistently in organizing and processing information (Rasheed-Karim, 2021). Cognitive style can be a strong predictor to get a general idea of learning outcomes and one's abilities (Guisande et al., 2007), the way individuals perceive, organize, classify, and mark important environmental factors (Verawati et al., 2020). The results of empirical research have identified the dimensions of cognitive style that are generally known to be field independent (FI) and field dependent (FD) (Price, 2004; Sternberg et al., 2008). The difference in the characteristics of the FI and FD cognitive styles lies in the individual's method of processing the information obtained (Saracho, 2000). The results showed no differences in thinking styles in terms of gender, males tend to have FI cognitive style, and females tend to have FD cognitive style (Onyekuru, 2015). Further explained, the FD cognitive style has the characteristics of being quickly influenced by the environment in making decisions. At the same time, the FI tends to be more analytical and depends on the knowledge possessed in making decisions (Nozari & Siamian, 2015). On the other hand, Verawati et al. (2020) reported that students' critical thinking skills had the same

criteria based on the FI and FD cognitive styles review. Unfortunately, the study did not identify students' metacognition awareness.

The consequences of the research results that have been described previously indicate the influence of cognitive style and gender differences on metacognition awareness. Metacognition has become a significant issue in educational research in recent years, where gender and cognitive style are suspected to be factors that can affect thinking skills, including metacognition. Unfortunately, not many studies investigated students' metacognitive skills in terms of gender differences and cognitive styles, especially in remote learning context. This study aimed to investigate the prospective science teachers' (PST) metacognitive awareness in remote learning based on the components of declarative knowledge (DK), procedural knowledge (PK), conditional knowledge (CK), planning (P), information management (IMS), monitoring (M), debugging (D), and evaluation (E) (Schraw & Dennison, 1994) based on cognitive style FI and FD (Witkin & Goodenough, 1977) and gender.

METHOD

This research is quantitative research with a survey method. The research sample consisted of 100 prospective science teachers' (PST) from three universities in Mataram (Universitas Pendidikan Mandalika, Universitas Mataram, and Universitas Islam Negeri Mataram). The sample was divided into two groups of male and female PST to be given a cognitive style test to obtain male and female PST with FI and FD cognitive styles. The FI male group consisted of 23 PST, the FI female group consisted of 22 PST, the FD male group consisted of 29 PST, and the FD female group consisted of 26 PST. The group of the PST was then given a metacognitive awareness questionnaire to identify the PST metacognitive awareness of each group.

The cognitive style was identified using the Group Embedded Figure Test (GEFT) (Witkin & Goodenough, 1977), which had three parts with different completion times for each part, namely, the first part lasted three minutes, the second part lasted five minutes, and the third part lasted five minutes. The Metacognition Awareness Inventory (MAI) used in this study (Schraw & Dennison, 1994) which was adjusted to the context of natural science learning which was stated to be generally reliable (α Cronbach = 0,96) (Feiz, 2016; ýz, 2016). The GEFT score is interpreted into two categories, FD category if score obtained was 0-11, while FI category if score obtained was 12-18. The PST metacognitive awareness was descriptively calculated using the formula: Final score (K) = [(Score obtained / maximum item score) x maximum score]. The scores obtained were then converted into four categories, namely: K 1.33 (low); $1.33 < K 2.33$ (enough); $2.33 < K 3.33$ (good); and $3.33 < K 4.00$ (very good) (Asy'ari et al., 2019).

Inferential analysis using IBM SPSS 23 version was used to test the differences in PST metacognitive awareness based on cognitive style, and gender using independent sample t-test and Mann-Whitney U test were carried out after the normality test of PST metacognitive awareness data using the one-sample Kolmogorov-Smirnov test.

RESULTS AND DISCUSSION

Gender and Metacognitive Awareness

The PST metacognitive awareness based on gender differences was analyzed using the Mann-Whitney test. Based on the normality test result, the data stated not normally distributed ($p < 0.05$).

Table 1. The PST metacognitive awareness differences based on gender

Gender	N	Metacognition awareness			ΣN	p
		Mean Rank	SD	Normality (Sig.)		
Male	52	45.13	.39630	.013	100	.054
Female	48	56.31				

Table 1 shows the Mann-Whitney test result of the PST metacognitive awareness. The analysis result found that the gender differences has not significantly impact ($p > 0.05$) on PST metacognitive awareness.

Cognitive Style and Metacognitive Awareness

Table 2 shows that PST metacognitive awareness was significantly different ($p < 0.05$) based on differences in cognitive style between FI and FD. The category of PST metacognitive awareness was in the same category (good: $2.33 < K 3.33$). However, FI (mean: 2.6911) has a better mean score in comparison with FD score mean (mean: 2.4964).

Table 2. The PST metacognitive awareness based on the cognitive style differences.

Cognitive Style	N	Mean	SD	Normality (Sig.)	df	t	p
Field independent (FI)	45	2.691	.4481	.200	98	2.250	.027
Field dependent (FD)	55	2.496	.4157				

Independent sample t-test (Table 3) and Mann-Whitney test (Table 4) were then carried out to determine differences in indicators of PST metacognitive awareness based on differences in cognitive styles. The results showed that PST metacognitive awareness was significantly different only in the PK ($p < 0.05$) and CK ($p < 0.05$) indicators, while in other indicators, there was no significant difference.

Table 3. The result of independent sample t-test

Indicator	Cognitive style	Mean	SD	Normality (Sig.)	df	t	p
Declarative knowledge (DK)	FI	2.671	.4137	.079	98	1.195	.235
	FD	2.549	.5737				
Procedural knowledge (PK)	FI	2.755	.5829	.200	98	3.094	.003
	FD	2.410	.5297				
Conditional knowledge (CK)	FI	2.777	.5397	.200	98	2.644	.010
	FD	2.498	.5147				
Planning (P)	FI	2.720	.5194	.200	98	1.863	.065
	FD	2.525	.5193				
Debugging (D)	FI	2.711	.6023	.200	98	1.526	.130
	FD	2.538	.5303				
Evaluation (E)	FI	2.691	.5455	.200	98	1.392	.167
	FD	2.549	.4741				

Table 4. The result of Mann-Whitney test

Indicator	Cognitive style	Mean Rank	SD	Normality (Sig.)	ΣN	p
IMS	FI	54.67	.5332	.021	100	.192
	FD	47.09				
Monitoring (M)	FI	55.07	.4657	.020	100	.152
	FD	46.76				

Cognitive style refers to an individual's tendency to process information (Mawad et al., 2015) that is influenced by interactions with the environment (Özgelen, 2012) and made the differences between FI and FD learning outcomes (Nozari & Siamian, 2015) as found in this study. In line with this statement, the results of other studies also found differences in cognitive style correlated with the focus of one's attention (Bendall et al., 2016).

The results of this study indicate that cognitive style affects PST metacognitive awareness on PK and CK indicators related to the ability of knowledge organization to solve problems according to the conditions encountered (Ning, 2016) through monitoring, reflecting, and evaluating problem-solving steps (Lubur & Ate, 2018). This happens because of the characteristics of FD, which often fail to solve detailed problems, while FI is more analytical and detailed in problem-solving (Rastegar & Honarmand, 2016) so that the metacognition of FI students is better than FD (Tinajero et al., 2012).

Gender, Cognitive Style, and Metacognitive Awareness

The PST metacognitive awareness was significantly different based on a review of gender and cognitive styles. Table 5 shows that male FD and female FI metacognitive awareness was significantly different ($p < 0.05$). The assessment based on the mean score also indicates that the metacognitive awareness of female FI was better than male FD (mean: 2.7636 vs mean: 2.4328). In contrast to these results, the metacognitive awareness of male FI vs female FI, male FD vs female FD, and male FI vs female FD were not significantly different. The differences in metacognitive awareness of male FD and female FI were further identified based on indicators of metacognitive awareness. Table 6 shows that the difference in metacognitive awareness of male FD and female FI lies in the PK, CK, P, M, D, and E indicators. For information, all data variables in Table 6 meet the assumption of normality.

Table 5. The PST metacognitive awareness based on gender and cognitive style

Cognitive Style	Gender	N	Mean	SD	Normality (Sig.)	df	t	p
FI	Male	23	2.6217	.3679	.200	43	1.063	.294
FI	Female	22	2.7636	.5178				
FD	Male	29	2.5310	.4132	.002		Mann-Whitney test	.118
FD	Female	26	31.000					
FI	Male	23	2.6217	.3679	.200	47	.471	.640
FD	Female	26	2.5673	.4321				
FD	Male	29	2.4328	.3972	.076	49	-2.584	.013
FI	Female	22	2.7636	.5178				

Table 6. Differences in PST metacognitive awareness indicators based on gender (male FD vs. female FI)

Indicator	Cognitive style	Gender	N	Mean	SD	df	t	p
DK	FD	Male	29	2.5241	.5816	49	-1.160	.252
	FI	Female	22	2.7000	.4690			
PK	FD	Male	29	2.4069	.5028	49	-2.383	.021
	FI	Female	22	2.8000	.6761			
CK	FD	Male	29	2.4276	.5476	49	-2.243	.029
	FI	Female	22	2.7864	.5890			
P	FD	Male	29	2.4207	.5341	49	-2.671	.010
	FI	Female	22	2.8227	.5299			

Indicator	Cognitive style	Gender	N	Mean	SD	df	t	p
IMS	FD	Male	29	2.4379	.4262	49	-1.677	.100
	FI	Female	22	2.6727	.5741			
M	FD	Male	29	2.3138	.4198	49	-2.769	.008
	FI	Female	22	2.6727	.5053			
D	FD	Male	29	2.4759	.5275	49	-2.166	.035
	FI	Female	22	2.8182	.5981			
E	FD	Male	29	2.4414	.4516	49	-2.209	.032
	FI	Female	22	2.7773	.6346			

In line with this study, Rezai and Noori (Rezai & Noori, 2013) found that male tend to be more field-dependent than female. FD has the characteristics of having an interpretation based on factual form, short memory, likes a natural learning atmosphere so that it is difficult when learning situations are manipulated. At the same time, FI is more likely to have high motivation and concentration, likes a dynamic academic environment that allows for competition (Blakely & Tomlin, 2008). It was further explained that FI is superior in analyzing and in more detail in learning, while FD is superior in communication and social skills (Mefoh & Ezech, 2016). These characteristics cause differences in the awareness of metacognition of FI female students and FD male students in this study ($p < 0.05$).

CONCLUSION

This study investigated the engineering students' metacognitive awareness in remote learning based on cognitive style (FI and FD) and gender. The result shows that; (1) the metacognitive awareness of males and females is not significantly different; (2) metacognitive awareness is significantly different based on the FI, and FD cognitive style review, particularly on PK and CK; and (3) the PST metacognitive awareness was significantly different between FD male vs FI female on the indicators of PK, CK, P, M, D, and E.

RECOMMENDATION

This study contributes to the role of field-dependent/independent cognitive style and gender on the engineering students' metacognitive awareness, which has not been widely studied. However, the relationship between metacognitive knowledge and other affective components such as emotional ability and learning motivation needs to be investigated in the future.

Author Contributions

The authors have sufficiently contributed to the study, and have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Acknowledgement

This study is a cross-university research funded by the Mandalika University of Education. The author would like to thank those who have contributed during the implementation of the research.

Declaration of Interest

The authors declare no conflict of interest.

REFERENCES

- Abdelrahman, R. M. (2020). Metacognitive awareness and academic motivation and their impact on academic achievement of Ajman University students. *Heliyon*, 6(9), e04192. <https://doi.org/10.1016/j.heliyon.2020.e04192>
- Asy'ari, M., Ikhsan, M., & Muhali, M. (2019). The Effectiveness of Inquiry Learning Model in Improving Prospective Teachers' Metacognition Knowledge and Metacognition Awareness. *International Journal of Instruction*, 12(2), 455–470. <https://doi.org/10.29333/iji.2019.12229a>
- Bendall, R. C. A., Galpin, A., Marrow, L. P., & Cassidy, S. (2016). Cognitive Style: Time to Experiment. *Frontiers in Psychology*, 7. <https://doi.org/10.3389/fpsyg.2016.01786>
- Blakely, P. N., & Tomlin, A. H. (Eds.). (2008). *Adult education: Issues and developments*. Nova Science Publishers, Inc.
- Donker, A. S., de Boer, H., Kostons, D., Dignath van Ewijk, C. C., & van der Werf, M. P. C. (2014). Effectiveness of learning strategy instruction on academic performance: A meta-analysis. *Educational Research Review*, 11, 1–26. <https://doi.org/10.1016/j.edurev.2013.11.002>
- Fauzi, A., & Sa'diyah, W. (2019). Students' Metacognitive Skills from the Viewpoint of Answering Biological Questions: Is It Already Good? *Jurnal Pendidikan IPA Indonesia*, 8(3), 317–327. <https://doi.org/10.15294/jpii.v8i3.19457>
- Feiz, J. P. (2016). Metacognitive Awareness and Attitudes toward Foreign Language Learning in the EFL Context of Turkey. *Procedia - Social and Behavioral Sciences*, 232, 459–470. <https://doi.org/10.1016/j.sbspro.2016.10.063>
- Gonzalez-DeHass, A. (2016). Preparing 21st Century Learners: Parent Involvement Strategies for Encouraging Students' Self-Regulated Learning. *Childhood Education*, 92(6), 427–436. <https://doi.org/10.1080/00094056.2016.1251791>
- Guisande, M. A., Paramo, M. F., Soares, A. P., & Almeida, L. S. (2007). Field-Dependence-Independence and Career Counseling: Directions for Research. *Perceptual and Motor Skills*, 104(2), 654–662. <https://doi.org/10.2466/pms.104.2.654-662>
- Harish, G. C. (2015). Critical Thinking Skills among Ninth Standard Students in Relation to Gender, Intelligence and Study habits. *International Journal of Education and Psychological Research*, 2(3), 12–20.
- Koswara, A., & Mundilarto, M. (2018). Pengembangan handout fluida dinamik terintegrasi metakognisi untuk meningkatkan kemampuan aplikasi siswa SMA dan MA. *Jurnal Inovasi Pendidikan IPA*, 4(1), 11–25. <https://doi.org/10.21831/jipi.v4i1.6193>
- Liliana, C., & Lavinia, H. (2011). Gender Differences in Metacognitive Skills. A Study of the 8th Grade Pupils in Romania. *Procedia - Social and Behavioral Sciences*, 29, 396–401. <https://doi.org/10.1016/j.sbspro.2011.11.255>
- Lubur, D. N. L., & Ate, D. (2018). Tingkat Kemampuan Berpikir Siswa dengan Pendekatan Metakognitif Diskursif dan Pendekatan Konvensional. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, 2(1), 55–61. <https://doi.org/10.36312/e-saintika.v2i1.81>
- Mahanal, S., Tendrita, M., Ramadhan, F., Ismirawati, N., & Zubaidah, S. (2017). The Analysis of Students' Critical Thinking Skills on Biology Subject. *Anatolian Journal of Instruction*, 2(2), 21–39.
- Mawad, F., Trías, M., Giménez, A., Maiche, A., & Ares, G. (2015). Influence of cognitive style on information processing and selection of yogurt labels: Insights from an eye-tracking study. *Food Research International*, 74, 1–9. <https://doi.org/10.1016/j.foodres.2015.04.023>

- Mefoh, P. C., & Ezeh, V. C. (2016). Effect of field-dependent versus field-independent cognitive styles on prospective and retrospective memory slips. *South African Journal of Psychology*, 46(4), 542–552. <https://doi.org/10.1177/0081246316632969>
- Muhali, M., Yuanita, L., & Ibrahim, M. (2019). The Validity and Effectiveness of the Reflective-Metacognitive Learning Model to Improve Students' Metacognition Ability in Indonesia. *Malaysian Journal of Learning and Instruction*, 16(2), 33–74. <https://doi.org/10.32890/mjli2019.16.2.2>
- Mutlu, M., & Temiz, B. K. (2013). Science process skills of students having field dependent and field independent cognitive styles. *Educational Research and Reviews*, 8(11), 766–776. <https://doi.org/10.5897/ERR2012.1104>
- Ning, H. K. (2016). Examining heterogeneity in student metacognition: A factor mixture analysis. *Learning and Individual Differences*, 49, 373–377. <https://doi.org/10.1016/j.lindif.2016.06.004>
- Nozari, A., & Siamian, H. (2015). The Relationship between Field Dependent-Independent Cognitive Style and Understanding of English Text Reading and Academic Success. *Materia Socio Medica*, 27(1), 39. <https://doi.org/10.5455/msm.2014.27.39-41>
- Onyekuru, B. U. (2015). Field Dependence-Field Independence Cognitive Style, Gender, Career Choice and Academic Achievement of Secondary School Students in Emohua Local Government Area of Rivers State. *Journal of Education and Practice*, 6(10), 76–85.
- Özgelen, S. (2012). Students' Science Process Skills within a Cognitive Domain Framework. *EURASIA Journal of Mathematics, Science and Technology Education*, 8(4). <https://doi.org/10.12973/eurasia.2012.846a>
- Perry, J., Lundie, D., & Golder, G. (2019). Metacognition in schools: What does the literature suggest about the effectiveness of teaching metacognition in schools? *Educational Review*, 71(4), 483–500. <https://doi.org/10.1080/00131911.2018.1441127>
- Price, L. (2004). Individual Differences in Learning: Cognitive control, cognitive style, and learning style. *Educational Psychology*, 24(5), 681–698. <https://doi.org/10.1080/0144341042000262971>
- Quinn, H., Schweingruber, H., & Keller, T. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (p. 13165). National Academies Press. <https://doi.org/10.17226/13165>
- Rasheed-Karim, W. (2021). Intelligent Tutoring Systems, Learning and Cognitive Styles of Dyslexic Students. *International Journal of Emerging Technologies in Learning (IJET)*, 16(03), 20–35.
- Rashid, S., & Yadav, S. S. (2020). Impact of Covid-19 Pandemic on Higher Education and Research. *Indian Journal of Human Development*, 14(2), 340–343. <https://doi.org/10.1177/0973703020946700>
- Rastegar, M., & Honarmand, N. M. (2016). Field Dependence/Independence, Impulsivity/Reflectivity, Gender, and Cloze Test Performance of Iranian EFL Learners: A Study of Relations. *European Scientific Journal, ESJ*, 12(8), 408–422. <https://doi.org/10.19044/esj.2016.v12n8p408>
- Rezai, M. J., & Noori, M. (2013). On the effects of gender, age, status, years of EFL learning, and proficiency level on the field-independency/dependency of EFL learners and instructors. *Iranian EFL Journal*, 9(3), 409–428.
- Sagitova, R. (2014). Students' Self-education: Learning to Learn Across the Lifespan. *Procedia - Social and Behavioral Sciences*, 152, 272–277. <https://doi.org/10.1016/j.sbspro.2014.09.194>

- Saracho, O. N. (2000). A framework for effective classroom teaching: Matching teachers' and students' cognitive styles. In R. J. Riding & S. G. Rayner (Eds.), *International perspectives on individual differences* (Cognitive Styles, Vol. 1, pp. 297–314). Stamford, CT.
- Schraw, G., & Dennison, R. S. (1994). Assessing Metacognitive Awareness. *Contemporary Educational Psychology*, 19(4), 460–475. <https://doi.org/10.1006/ceps.1994.1033>
- Sperling, R. A., Richmond, A. S., Ramsay, C. M., & Klapp, M. (2012). The Measurement and Predictive Ability of Metacognition in Middle School Learners. *The Journal of Educational Research*, 105(1), 1–7. <https://doi.org/10.1080/00220671.2010.514690>
- Sternberg, R. J., Grigorenko, E. L., & Zhang, L. (2008). Styles of Learning and Thinking Matter in Instruction and Assessment. *Perspectives on Psychological Science*, 3(6), 486–506. <https://doi.org/10.1111/j.1745-6924.2008.00095.x>
- Syarifah, H., Indriwati, S. E., & Corebima, A. D. (2016). Metacognitive skills and motivation differences between male and female Xth grade student of public senior high school in Malang through reading questioning and answering (RQA) combined with think pair share (TPS) learning strategy. *Jurnal Pendidikan Biologi Indonesia*, 2(1). <https://doi.org/10.22219/jpbi.v2i1.3367>
- Taasobshirazi, G., & Farley, J. (2013). Construct Validation of the Physics Metacognition Inventory. *International Journal of Science Education*, 35(3), 447–459. <https://doi.org/10.1080/09500693.2012.750433>
- Tinajero, C., Lemos, S. M., Araújo, M., Ferraces, M. J., & Páramo, M. F. (2012). Cognitive style and learning strategies as factors which affect academic achievement of brazilian university students. *Psicologia: Reflexão e Crítica*, 25(1), 105–113. <https://doi.org/10.1590/S0102-79722012000100013>
- Tosun, C., & Senocak, E. (2013). The Effects of Problem-Based Learning on Metacognitive Awareness and Attitudes toward Chemistry of Prospective Teachers with Different Academic Backgrounds. *Australian Journal of Teacher Education*, 38(3), 61–73. <https://doi.org/10.14221/ajte.2013v38n3.2>
- Verawati, N. N. S. P., Hikmawati, H., & Prayogi, S. (2020). The Effectiveness of Inquiry Learning Models Intervened by Reflective Processes to Promote Critical Thinking Ability in Terms of Cognitive Style. *International Journal of Emerging Technologies in Learning (IJET)*, 15(16), 212–220.
- Weeden, K., & Cornwell, B. (2020). The Small-World Network of College Classes: Implications for Epidemic Spread on a University Campus. *Sociological Science*, 7, 222–241. <https://doi.org/10.15195/v7.a9>
- Wirzal, M. D. H., Halim, N. S. A., Md Nordin, N. A. H., & Bustam, M. A. (2022). Metacognition in Science Learning: Bibliometric Analysis of Last Two Decades. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, 6(1), 43–60. <https://doi.org/10.36312/esaintika.v6i1.665>
- Witkin, H. A., & Goodenough, D. R. (1977). Field dependence and interpersonal behavior. *Psychological Bulletin*, 84(4), 661–689. <https://doi.org/10.1037/0033-2909.84.4.661>
- ÿz, H. (2016). Metacognitive Awareness and Academic Motivation: A Cross-Sectional Study in Teacher Education Context of Turkey. *Procedia - Social and Behavioral Sciences*, 232, 109–121. <https://doi.org/10.1016/j.sbspro.2016.10.035>
- Zohar, A., & Barzilai, S. (2013). A review of research on metacognition in science education: Current and future directions. *Studies in Science Education*, 49(2), 121–169. <https://doi.org/10.1080/03057267.2013.847261>