JPPIPA 8(3) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effect of Collaborative Flipped Learning Strategy and Socio-cognitive Ability on Students' Metacognitive Skills

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DOI: 10.29303/jppipa.v8i3.1589

Article Info
Received: April 19, 2022
Revised: June 12, 2022
Accepted: July 20, 2022
Published: July 31, 2022

Abstract: The reality shows that instructors and students are having difficulty implementing online science education during the pandemic. The purpose of this study was to determine the effect of collaborative flipped learning (CFL) strategy and socio-cognitive ability on metacognitive skills and self-efficacy in primary school pre-service teachers who were currently enrolled in a Basic Science course. This objective was motivated by the current state of education and teaching, which necessitates the use of technology to facilitate learning activities. This study employed a quasi-experimental design with a non-equivalent control group and a 2 x 2 MANOVA inferential statistical test. Prior to undertaking the inferential statistical test, we ran assumption tests, specifically normality and homogeneity analyses. The analysis results showed that there was a discrepancy in metacognitive skills between students in the experimental class who were taught the CFL strategy and those who were instructed the conventional strategy, indicated by an $F_{calculated}$ value of 11.299 and a significance value of 0.001. The analysis results also showed that there was a significant difference in metacognitive skills between students with high socio-cognitive ability and those with poor socio-cognitive ability, indicated by an $F_{calculated}$ value of 39.9724 and a significance value of 0.000. It was also found that the interaction between the learning strategy and socio-cognitive ability influenced students' metacognitive skills. These findings suggest that educators should consider cognitive and social factors while implementing the collaborative flipped learning strategy to help students enhance their metacognitive skills.

Keywords: Collaborative flipped learning; Metacognitive skills; Self-efficacy; Socio-cognitive.

Citation: Abbas, S., Syawal, J., Akun, T., & Amin, A.M. (2022). The Effect of Collaborative Flipped Learning Strategy and Socio-cognitive Ability on Students' Metacognitive Skills. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1236–1242. https://doi.org/10.29303/jppipa.v8i3.1589

Introduction

At the moment, the science education system has experienced a sea change. Due to the COVID-19 pandemic, the previous learning plan, which included a variety of face-to-face interactions in the classroom and practical activities in the laboratory, proved difficult to implement. Learning activities have shifted from direct or face-to-face (offline) to indirect (online). Although online education is widely accepted as an efficient mode of instruction in the modern era, science education still needs to promote student inquiry and discovery. Online science instruction must emphasize approaches that engage students actively and collaboratively (Van Aalderen-Smeets & Van der Molen, 2015). Students' active participation in learning is critical for equipping them with the competitiveness and motivation necessary to succeed in the fast-paced digital era (Amin & Rosmiaty, 2017).

Field observations indicate that instructors and students struggle to apply online science learning, particularly during the COVID-19 pandemic. This challenge is caused by a lack of information about online learning design. Educators face constraints in terms of time and resources when it comes to designing online learning. Inadequate confidence in coping with systemic changes during a pandemic might stress educators and impair their performance when designing online science instruction (Bevins & Price, 2016). Furthermore,

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educators and students are already accustomed to traditional classroom-based learning, making it challenging for them to adapt to the educational changes.

To shift the conventional learning paradigm, new strategies that encourage students' active participation in the scientific process and are supported by appropriate technology are required. The implementation of proper learning strategies can have an effect on students' learning activities (Amin & Adiansyah, 2018). Collaborative Flipped Learning (CFL) is a new instructional strategy that aims to assist instructors and students in developing independent learning skills at home and in the classroom. CFL instruction is delivered via online videos and homework provided to students before meeting face-to-face in physical classrooms. This is believed to be a more successful and efficient method. Numerous studies have demonstrated that using video in CFL learning is more successful than using direct instruction (Clark & Mayer, 2012; Howland et al., 2014; Mayer, 2009). The current generation is a millennial generation that enjoys YouTube videos, and some have taken up the pastime of recording videos and posting them to the YouTube website as a YouTuber (Prensky, 2016).

Educators can simply access and produce instructional videos. Instructions in learning videos can also be used to assign homework to students. Students can also be assigned to make videos about their task outside of class. As a result, pupils have more time to work independently. Through CFL learning, educators and students can manage study time (Cole & Kritzer, 2009; Estes et al., 2014), engage actively and interactively both outside and inside the classroom (Schwarzenberg et al., 2018), and refine their responsibilities (O'Flaherty & Phillips, 2015).

Collaborative Flipped Laerning (CFL), which is based on social and constructivist behavioral theory, assists educators and students in enhancing learning activities, increasing motivation and self-regulation (Akçayir & Akçayir, 2018). This is critical since most of the theory provided via Flipped Classroom may be supplemented by direct activities conducted in class due to the increased time available. In science classes, the flipped classroom approach has been shown to aid in the development of stronger scientific conceptions (Ye et al., 2018). Furthermore, students that engage in collaborative work can hone their intelligence, abilities, and perseverance in the classroom (Sumadi et al., 2017). Combining these two strategies is expected to improve higher-order thinking skills such as metacognitive skills.

Socio-cognitive regulation and monitoring are critical for the success of CFL learning. Numerous studies have examined how collaborative learning affects socio-cognitive control. Collaborative learning behavior characterizes knowledge-building activities resulting in sharing cognition (Van den Bossche et al., 2006). A multiple regression analysis has revealed that the interpersonal context (interdependence, task cohesiveness, psychological security, and group potential) influences the social aspect of collaborative learning behavior, which in turn increases the attitude toward sharing cognition. Team intelligence in group learning is positively related to the primary component of social cognition, namely information processing. To be successful in learning, learners must develop a variety of competencies and skills earned through social interaction (Amin et al., 2017).

Additionally, current research on collaborative learning has emphasized group structure and composition, as well as group task regulation that affects achievement and learning outcomes (Dillenbourg, 1999; Sumadi et al., 2017). Some studies employ metacognitive dynamics, motivation, and emotion to facilitate the formation of shared knowledge (Khosa & Volet, 2014). The researchers also linked socio-cognitive and metacognitive elements to aspects of team regulation. There are, however, few studies that examine how several characteristics interact during the process of developing shared knowledge, organizing, and monitoring collaborative flipped classrooms to affect metacognitive skills.

Method

The pre-test/post-test control group design was utilized in this quasi-experimental investigation. The study involved 60 students from the primary school teacher education study program who were taking a basic science course. They were divided into two parallel classes. One parallel class served as an experimental group that engaged in collaborative learning in a flipped classroom setting. Meanwhile, the other class served as a control group taught using conventional methods of instruction. The intervention lasted six weeks, from August to October 2021. The dependent variable in this study was collaborative learning in a flipped classroom setting vs in a traditional classroom. The independent variable was metacognitive skills, while the moderator variable was socio-cognitive ability.

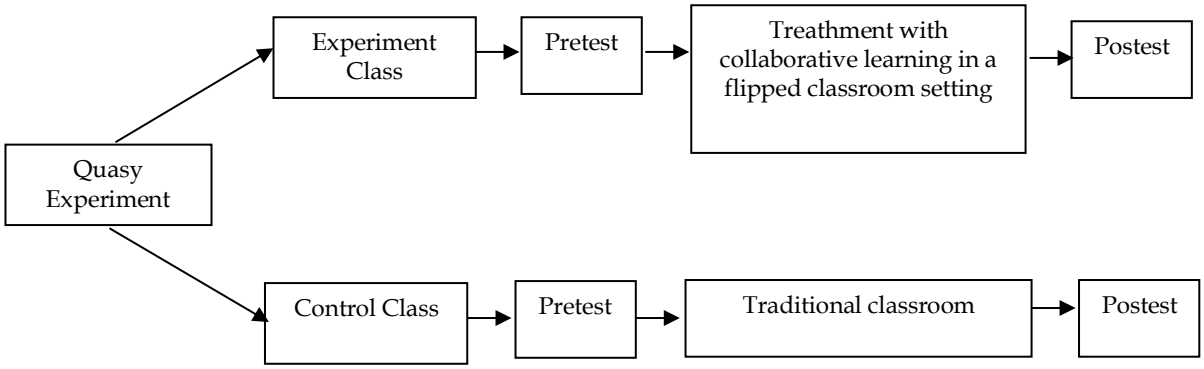

Figure 1: Research Design

The participants' socio-cognitive aptitude was assessed using a questionnaire with a graded scale. The instrument was structured as a series of 50 statements. The questionnaire statements were constructed based on four socio-cognitive domains: cognitive regulation, self-regulation, emotional regulation, and social regulation. The questionnaire used the Likert scale. It was derived from a variety of previously produced theories and instruments. Metacognitive skills were measured using a modified version of Corebima's (2017) higher-order thinking test.

The study was done across eight meetings in the odd semester and included a pre-test, treatment sessions, and a post-test. The pre-test activity was conducted during the first week, with students completing the socio-cognitive questionnaire and answering questions regarding metacognitive skills. Following that, treatment was administered to both the experimental and control groups.

The Kolmogorov-Smirnov test was performed to determine whether the data were normally distributed. The test was then followed with Levene's test to determine the degree of variance homogeneity between treatment groups. The normality and homogeneity of variance tests indicated whether the parametric test could be employed. Finally, ANOVA was used to conduct parametric testing with the assistance of SPSS.

Result and Discussion

The Results of the Assumption Tests

Prior to analyzing the data using the inferential statistics, assumption tests were conducted. The data analysis consisted of normality test, homogeneity of variance test, and ANOVA test.

Normality Test Result

Normality test was conducted to examine whether the research data were distributed normally. Normality test was conducted using Shapiro-Wilk test, where data distribution was claimed normal if the significance value was bigger than 0.05.

Table 1: Normality Test Result

Variable	Group	Shapiro-Wilk		
		Statistics	Sig.	Remarks.
Treatment Group				
Metacognitive skills	Experimental	0.963	0.366	Data distributed normally
	Control	0.967	0.463	Data distributed normally
Socio-cognitive ability				
Metacognitive Skills	High	0.967	0.297	Data distributed normally
	Low	0.965	0.646	Data distributed normally

Normality test on the effect of Collaborative Flipped Learning on metacognitive skills showed a significance value of 0.366 for the experimental group and 0.463 for the control group. These values are bigger than the referred significance value of 0.05. Therefore, it was claimed that the data were distributed normally.

Normality test on the effect of socio-cognitive ability on metacognitive skills showed a significance value of 0.297 for high socio-cognitive ability and 0.646 for low socio-cognitive ability. These values are bigger than the referred significance value of 0.05. Therefore, it was confirmed that the data were distributed normally.

Homogeneity of Variance Test Result

Homogeneity test was conducted to determine whether the variance between treatment groups were homogeneous or not. Levene's test was run to examine data homogeneity, where variance was claimed homogeneous if the significance value was bigger than 0.05.

Table 2: Homogeneity of Variance Test Result

Variables	Levene's Statistics	Sig.	Remarks
Treatment Groups Metacognitive Skills	0.035	0.852	Homogeneous variance
Socio-Cognitive Metacognitive Skills	0.561	0.457	Homogeneous variance

Homogeneity test showed a significance value of 0.852 for Collaborative Flipped Learning on metacognitive skills and 0.457 for socio-cognitive ability on metacognitive skills. These values are bigger than the referred significance value of 0.05. Therefore, it was confirmed that the variance between treatment groups was homogeneous. were distributed normally.

Descriptive Statistics Analysis

A descriptive test was used to determine the overall description of the research data, by examining the mean and standard deviation of students' metacognitive skills based on the Collaborative Flipped Learning strategy and socio-cognitive ability.

Table 3: Descriptive Statistics Analysis

Variable	Group	Socio-Cognitive	Mean	St.dev
Metacogni-tive Skills	Experimental	High	65.45	3.14
		Low	56.00	2.83
	Control	High	59.15	4.49
		Low	55.10	4.89

Descriptive statistics showed a mean score of 65.45 for the experimental group with high socio-cognitive ability (standard deviation of 3.14), and 56.00 for the experimental group with low socio-cognitive ability (standard deviation of 2.83). The analysis further showed a mean score of 59.15 (standard deviation of 4.49) for the control group and high socio-cognitive ability and 55.10 (standard deviation of 4.89) for the control group and low socio-cognitive ability.

Hypothesis Testing

Hypothesis testing in this study was performed using ANOVA. The hypothesis testing aimed to test the effect of Collaborative Flipped Learning strategy and socio-cognitive ability on metacognitive skills.

Table 4: ANOVA Test Result

Hypothesis	F hit	Sig.	Remarks
Learning strategy on metacognitive skills	11.299	0.001	Significant
Socio-cognitive ability on metacognitive skills	39.724	0.000	Significant
Interaction between learning strategy and socio-cognitive ability on metacognitive skills	6.356	0.015	Significant

Effect of Flipped learning strategy on metacognitive skills

Hypothesis testing showed F-calculated of 11.299 and a significance value of 0.001 for the effect of Collaborative Flipped Learning (CFL) strategy on metacognitive skills. Since sig < 0.05, it was concluded that Collaborative Flipped Learning (CFL) strategy had a significant effect on metacognitive skills, or in other words the alternative hypothesis was accepted. The findings of this study are related to the active engagement of students. The students studied self-taught material outside of class before engaging in face-to-face instruction or participating in constructivist discussions in class with their classmates. Moreover, they collaborated to plan and design a small experiment, conduct the experiment, collect supporting evidence, and communicate the results through reports. According to some scholars, student-centered learning, such as collaborative work and meaningful exchange of ideas, can foster positive attitudes and improve higher order thinking skills (Mathabathe & Potgieter, 2017). Additional empirical data from collaborative flipped learning corroborated the findings of this study. Flipped learning has a significant impact on the affective domain of science learning outcomes (González-Gómez et al., 2016). In comparison to conventional instruction, flipped learning (FL) promotes a more dynamic learning environment. Research on the integration of FL strategy into classroom instruction was also conducted by (Jong et al., 2019). They found that FL which was integrated with Inquiry (Flipped Issue-based Inquiry Ride) had a positive influence on students' academic achievement.

Metacognitive skills play a critical role in the development of pupils' thinking ability and cognitive processes (Amin et al., 2020). Collaborative Flipped Learning (CFL) enables students to assimilate content by watching videos and participating in various classroom activities such as discussions, collaborations, quizzes, and projects (Kim et al., 2014). The Flipped Classroom Strategy can provide students entire control over the time and pace of their learning, allowing them to save and review learning materials frequently, so increasing the success of learning strategies (Alebous, 2021).

Effect of socio-cognitive ability on metacognitive skills

Hypothesis testing showed F-calculated of 39.724 and a significance value of 0.000 for the effect of socio-cognitive ability on metacognitive skills. Since sig < 0.05, it was concluded that socio-cognitive ability had a significant effect on metacognitive skills, or in other words the alternative hypothesis was accepted. An

analysis of the pretest and posttest mean metacognitive scores revealed that students with strong socio-cognitive (SC) ability fared much better than students with weak SC abilities. Students with high SC were more proactive and conscientious in their task completion. They demonstrated greater emotional control and were more receptive to completing learning tasks. They appeared to be sincere in their desire to succeed. In conclusion, the SC factor has a considerable effect on students' metacognitive skills.

This finding is consistent with other prior research demonstrating the positive influence of socio-cognitive functioning components, such as emotional regulation, self-regulation, and motivation, on academic achievement (Edosa et al., 2018; Mega et al., 2014). Modifications to one self-regulatory system can influence the development of another (Blair, 2002). This condition indicates that when learners regulate their emotional states, they are better able to rule their conduct to connect to others and to make use of their cognitive knowledge to accomplish learning goals.

Learners who can manage their behavior are more focused and in control of their learning process, which influences their learning outcomes (Blair & Cybele Raver, 2015). In other words, students who exhibit a high level of sociocognitive behavior are more passionate about completing their assigned activities than students who exhibit a low level of SC. Socio-cognitive skills can assist pupils in regulating their own reality, encoding information, and fostering more positive interpersonal relationships (Govindaraju, 2021).

Effect of the tnteraction between learning strategy and socio-cognitive ability on metacognitive skills

The interaction effect of learning and socio-cognitive ability on metacognitive skills was identified by comparing the interactions between the group taught Collaborative Flipped Learning (CFL) strategy and the group taught Conventional learning (CL) and between the group with high socio-cognitive ability and low socio-cognitive ability. Statistical analysis showed F-calculated of 6.356 and a significance value of 0.015, which is less than 0.05. Therefore, it was concluded that the interaction between Collaborative Flipped Learning (CFL), Conventional learning (CL), high socio-cognitive ability and low socio-cognitive ability had a significant effect on students' metacognitive skills.

These findings corroborate recent studies by Rorimpandey (2019) and Sukmawati et al. (2019), which highlight the interaction effect of learning approaches and behavioral variables such as self-efficacy and social skills on conceptual understanding. Students who participate in cooperative learning can increase metacognitive skills, particularly in the monitoring component (Pesout & Nietfeld, 2020). Additionally, this study's findings indicate that social contexts in the classroom and social environment influence the development of students' metacognitive skills, particularly in terms of motivation. This bolsters the notion that intrinsic motivation is a necessary component of learning.

In essence, many people rely on metacognition in order to engage in active learning (ALshammari, 2015). The metacognitive approach enables students to assess their learning progress and consequently provides useful recommendations (Herrera et al., 2011). Socio-cognitive information can influence how students metacognitively evaluate their own assumptions, which has an effect on the self-regulation process and on how they perceive their competences (Schnaubert et al., 2021).

Conclusion

Based on the findings and discussion above, some conclusions. There was a substantial difference in metacognitive skills between students taught with Collaborative Flipped strategy (experimental group) and those taught with conventional strategy (control group); the experimental group achieved better than the conventional group in terms of a metacognitive test. Besides that, there was a significant difference in metacognitive skills between students with high socio-cognitive ability and those with low socio-cognitive ability. Students with high socio-cognitive ability performed better than students with low socio-cognitive ability in terms of metacognitive skills. The interaction between learning strategy (CFL or conventional) and socio-cognitive ability (high or low) had an effect on students' metacognitive skills.

Acknowledgements

This study was sponsored by the Indonesian Ministry of Religion. The authors would like to express their gratitude to the Republic of Indonesia's Ministry of Religion for funding this research. We also would want to show our thanks to everyone who contributed to this research.

References

Akçayir, G., & Akçayir, M. (2018). The Flipped Classroom: A Review of its Advantages and Challenges. *Computers & Education*, *126*, 334–345. https://doi.org/10.1016/j.compedu.2018.07.021

Alebous, T. (2021). The Effect Of The Flipped Classroom Strategy on Developing Scientific Literacy And Decision-Making Skills Among Students of the Chemical and Physical Concepts Course. *Multicultural Education*, *7*(7), 605–620. https://doi.org/10.5281/zenodo.5148818

ALshammari, M. K. (2015). The Effect of Using Metacognitive Strategies For Achievement and the Trend Toward Social Studies for Intermediate Schools Students in Saudi Arabia. *Journal of Education, Learning and Development*, *3*(7), 47–54.

Amin, A. M., & Adiansyah, R. (2018). Lecturers' Perception on Students' Critical Thinking Skills Development and Problems Faced by Students in Developing their Critical Thinking Skills. *Jurnal Pendidikan Biologi Indonesia*, *4*(1), 1–10. https://doi.org/10.22219/jpbi.v4i1.5181

Amin, A. M., Corebima, A. D., Zubaidah, S., & Mahanal, S. (2017). The Critical Thinking Skills Profile of Preservice Biology Teachers in Animal Physiology The Critical Thinking Skills Profile of Preservice Biology Teachers in Animal Physiology. *Advances in Social Science, Education and Humanities Research*, *128*(September), 179–183. https://doi.org/10.2991/icet-17.2017.30

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/10.12973/eu-jer.9.1.143

Amin, A. M., & Rosmiaty, E. (2017). Improving Students' Characters, Cognitive Achievement, and Attention span through RQA (Reading, Questiong and Answering) Strategy on Cell Biology Subject. *Prosiding International Conference on Mathematics and Science Education*, 881–887.

Bevins, S., & Price, G. (2016). Reconceptualising Inquiry in Science Education. *International Journal of Science Education*, *38*(1), 17–29. https://doi.org/https://doi.org/10.1080/09500693.2015.1124300

Blair, C. (2002). School Readiness: Integrating Cognition and Emotion in a Neurobiological Conceptualization of Children's Functioning at School Entry. *American Psychologist*, *57*(2), 111–127. https://doi.org/10.1037//0003-066X.57.2.111

Blair, C., & Cybele Raver, C. (2015). School Readiness and Self-Regulation: A Developmental Psychobiological Approach. *Annual Review of Psychology*, *66*, 711–731. https://doi.org/10.1146/annurev-psych-010814-015221

Clark, R. C., & Mayer, R. E. (2012). *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning (4th ed.)*. Wiley.

Cole, J. E., & Kritzer, J. B. (2009). Strategies for Success: Teaching an Online Course. *Rural Special Education Quarterly*, *28*(4), 36–40. https://doi.org/10.1177%2F875687050902800406

Dillenbourg, P. (1999). *What do you Mean by Collaborative Learning?* 16.

Edosa, T. T., Jo, Y. H., Keshavarz, M., & Han, Y. S. (2018). Biosurfactants : Production and Potential Application in Insect Pest Management. *Trends in Entomology*, *14*, 79–87. https://doi.org/10.31300/TENT.14.2018.79-87

Estes, M. D., Ingram, R., & Liu, J. C. (2014). A Review of Flipped Classroom Research, Practice, and Technologies. *International HETL Review*, *4*. Retrieved from https://www.hetl.org/feature-articles/a-review-of-flipped-classroom-research-practiceand- technologies.

González-Gómez, D., Jeong, J. S., Rodríguez, D. A., & Cañada-Cañada, F. (2016). Performance and Perception in the Flipped Learning Model: An Initial Approach to Evaluate the Effectiveness of a New Teaching Methodology in a General Science Classroom. *Journal of Science and Education Technology,* *25*(3), 450–459. https://link.springer.com/article/10.1007/s10956-016-9605-9

Govindaraju, V. (2021). *A Review Of Social Cognitive Theory From The Perspective Of Interpersonal Communication*. *7*(12), 488–492. https://doi.org/10.5281/zenodo.5802235

Herrera, S. G., Holmes, M., & Kavimandan, S. (2011). *Crossing the Vocabulary Bridge: Differentiated Strategies for Diverse Secondary Classrooms*. Teachers College Press.

Howland, J., Jonassen, D., & Marra, R. (2014). *Meaningful Learning with Technology (4th ed.)*. Pearson Education.

Jong, M. S. yung, Chen, G., Tam, V., & Chai, C. S. (2019). Adoption of Flipped Learning in Social Humanities Education: the FIBER Experience in Secondary Schools. *Interactive Learning Environments*, *27*(8), 1222–1238. https://doi.org/10.1080/10494820.2018.1561473

Khosa, D. K., & Volet, S. E. (2014). Productive Group Engagement in Cognitive Activity and Metacognitive Regulation during Collaborative Learning: can it Explain Differences in Students' Conceptual Understanding? *Metacognition and Learning*, *9*(3), 287–307. https://doi.org/https://doi.org/10.1007/s11409-014-9117-z

Kim, S.-H., Park, N.-H., & Joo, K.-H. (2014). Effects of Flipped Classroom based on Smart Learning on Self-directed and Collaborative Learning. *International Journal of Control and Automation*, *7*(12), 69–80. https://doi.org/10.14257/ijca.2014.7.12.07

Mathabathe, K. C., & Potgieter, M. (2017). Manifestations of Metacognitive Activity during the Collaborative Planning of Chemistry Practical Investigations. *International Journal of Science Education*, *39*(11), 1465–1484.

https://doi.org/10.1080/09500693.2017.1336808
Mayer, R. (2009). *Multimedia Learning (2nd ed.)*. Cambridge University Press.
Mega, C., Ronconi, L., & De Beni, R. (2014). What Makes a Good Student? How Emotions, Self-Regulated Learning, and Motivation Contribute to Academic Achievement. *Journal of Educational Psychology*, *106*(1), 121–131. https://doi.org/10.1037/a0033546
O'Flaherty, J., & Phillips, C. (2015). The use of Flipped Classrooms in Higher Education: A Scoping Review. *Internet and Higher Education*, *25*, 85–95. https://doi.org/10.1016/j.iheduc.2015.02.002
Pesout, O., & Nietfeld, J. (2020). The Impact of Cooperation and Competition on Metacognitive Monitoring in Classroom Context. *Journal of Experimental Education*, 1–22. https://doi.org/10.1080/00220973.2020.1751577
Prensky, M. (2016). *Education to better their World: Unleashing the Power of 21st-Century Kids*. Teachers College Press.
Schnaubert, L., Krukowski, S., & Bodemer, D. (2021). Assumptions and Confidence of Others: the Impact of Socio-Cognitive Information on Metacognitive Self-Regulation. In *Metacognition and Learning* (Vol. 16, Issue 3, pp. 855–887). https://doi.org/10.1007/s11409-021-09269-5
Schwarzenberg, P., Navon, J., Nussbaum, M., & Pérez-Sanagustín, M Caballero, D. (2018). Learning Experience Assessment of Flipped Courses. *Journal of Computing in Higher Education*, *30*(2), 237–258. https://doi.org/10.1007/s12528-017-9159-8
Sumadi, S., Degeng, I. N. S., Sulthon, S., & Waras, W. (2017). Effect of Ability Grouping in Reciprocal Teaching Technique of Collaborative Learning on Individual Achievements and Social Skills. *International Journal of Evaluation and Research in Education (IJERE)*, *6*(3), 216. https://doi.org/10.11591/ijere.v6i3.6565
Van Aalderen-Smeets, S. I., & Van der Molen, J. H. W. (2015). Improving Primary Teacher' Attitudes toward Science by Attitude Focused Professional Development. *Journal of Research in Science Teaching*, *52*(5), 710–734. https://doi.org/10.1002/tea.21218
Van den Bossche, P., Gijselaers, W. H., Segers, M., & Kirschner, P. A. (2006). Social and Cognitive Factors Driving Teamwork in Collaborative Learning Environments: Team Learning Beliefs and Behaviors. *Small Group Research*, *37*(5), 490–521. https://doi.org/https://doi.org/10.1177/1046496406292938.
Ye, S. H., Hsiao, T. H., & Sun, C. T. (2018). Using Commercial Video Games in Flipped Classroom to Support Physical Concept Construction. *Journal of Computer Assisted Learning*, *34*, 602–614. https://doi.org/10.1111/jcal.12267