

# Effects of Inverted Classroom and Self-Regulated Learning on Conceptual Learning

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Research on inverted or flipped classrooms concludes that the inverted classroom learning model is more effective than traditional learning. However, many researchers have not revealed that the inverted classroom is influenced by student conditions, such as self-regulation and self-efficacy. This study examines the effect of inverted classrooms on conceptual cognitive learning outcomes, by attending to self-regulated learning (SRL). This study is quasi-experimental research with pre-test / post-test control group design. There were 78 Indonesian Catholic University students participating in the research. The experimental class (39 students) used scaffolding, while the control class (39 students) was without scaffolding. We collected research data using questionnaires and tests. The data was analysed by two-ways ANOVA. The results concluded that inverted classroom and SRL affected conceptual cognitive learning outcomes positively, although neither had an interaction effect on learning achievement.

**Key words:** *Inverted classroom, self-regulated learning, cognitive learning achievement, scaffolding, and millennial learners.*

## Introduction

Information and communication technology (ICT) has influenced human life in many aspects, including education. In the Industrial Revolution 4.0 (Popkova, et al., 2019), the internet is very important, more than just for information delivery. Therefore Wang and Zhu (2019) refer to the third millennium as the 'Internet +' era. The Inverted or Flipped Classroom (IFC) is one of the innovative learning models (Schlingensiepen, 2014) that apply the internet. It is a form of blended learning (Staker & Horn, 2012; Davis, 2013; Lopes &



Soares, 2018). As blended learning, it uses the internet, both as a media and learning resource. As a media and learning source, inverted learning 'forces' educators (teachers, lecturers, instructors) to move on from traditional learning. ICT helps teachers solve problems in the classroom (Ojha, 2016). Therefore, one dysfunction in the teacher's role when implementing quality education is the distortion of traditional roles (Rogach, et al., 2018).

As a relatively new learning model, IFC has been extensively researched since 2007, when Jonathan Bergmann and Aaron Sams were the first to promote and implement IFC in high schools in Woodland Park, USA (Tucker, 2012). Every year researchers from various countries are constantly researching this learning model. Research on the IFC learning model continues even now. Generally, studies compare IFC learning with traditional classes, and most conclude that its model is more effective than traditional learning, especially in relation to student participation, satisfaction levels, and students' thought processes (Strayer, 2012; Mason, et al., 2013; Moranski & Henery, 2017; Foster & Stagl, 2018). It has not been widely revealed that the effectiveness of IFC is influenced by student conditions, such as self-regulation and self-efficacy, which greatly influence the process and learning outcomes (Schunk & Zimmerman, 2007; Chen, 2009; Koksal & Yaman, 2012; Maftoon, 2014; Kim & Nor, 2019).

This study aims to examine the effect of IFC on learning outcomes, by attending to self-regulated learning (SRL) aspects as a moderator variable (not treated). The learning achievement measured is conceptual cognition. According to Anderson and Krathwohl (2001) conceptual cognition is knowledge about categories, classifications, and relationships between two or more categories, or a classification of knowledge that is more complex and organised. Thus, the learning achievement measured in this study is students' mastery of concepts, principles and generalisations, approaches, and models for curriculum development. In this study, we modified the concept of "inverted or flipped". Inverted does not only "reverse" the time for implementing assignments (assignments are done at home if using traditional classes, and carried out in class if using inverted / flipped classes). If instructors want their students to be able to complete assignments in depth, then doing that in class is not enough, as criticised by Schlingensiepen (2014). Therefore, we offer that tutorial material and deepening assignments are done and discussed by students before class (online learning session). At the same time, we provide scaffolding in the form of textual hints (specifically for the experimental class). Face-to-face learning is used intensively to deepen learning material through cooperative-collaborative discussions and reinforcement material from lecturers.

## **Inverted Classroom as a Blended Learning Model**

IFC as one blended learning model includes two meanings; namely students do independent learning before class and instructors use discussion to replace one-way teaching in the classroom (Tucker, 2012; Herold, et al., 2012; Davis, 2013; Schlingensiepen, 2014). Handke (2016) and Lopes and Soares (2018) describe three stages of activities in IFC: (1) delivery of learning material before class (online session); (2) deepening of the material and problem-solving through discussion during class (face-to-face session); and (3) development of class discussion after class (online and face-to-face). Students study learning material before class (for example: reading modules, tutorial materials, and linking materials, watching learning videos, listening to audio recordings, making summaries, making questions, etc.). Then they deepen the understanding of subject matter in class through collaborative discussions, laboratory practices, and instructor explanations (Bates & Galloway, 2012). Based on these ideas, IFC is defined as a pedagogical effort by instructors to create active learning through "inverted" procedures from traditional classroom learning, using appropriate media and learning resources.

One of the advantages of the IFC learning model is that it uses a student-centered learning approach (Stayer, 2012; Mubayrik, 2018; Wang & Zhu, 2019). This is based on active learning theory. The theory was born from dissatisfaction with conventional learning, which tends to be teacher-centered, where students are as learning objects. Active learning positions students as learning subjects in a variety of educational interactions (Holtzman, 2005).

As a relatively new learning model, IFC has been widely researched. Generally, the studies that have been conducted conclude with three points: (1) IFC is joyful learning for students; (2) IFC uses a student-centered approach; and (3) IFC has a positive impact on learning outcomes.

### ***IFC as Joyful Learning***

Many studies invest students' perceptions of IFC implementation. Research reveals that IFC can make students feel satisfied, happy, and comfortable during the learning process (Mason, et al., 2013; Moranski & Henery, 2017; Foster & Stagl, 2018). IFC is appreciated by students as a learning model that allows them to concentrate more and interact throughout the learning process (Brösner, et al., 2015), making it easier for them to gain knowledge from teachers, electronic learning resources, and peers (Montoya & Hernández, 2016). Handke's research (2016) has revealed that although IFC learning forces students to study harder, most of them (67.15%) choose IFC learning over conventional learning. Wang and Zhu (2019) report that 80% of students rated IFC as able to increase positive and pleasant interactions between teacher and student, and among students.

### ***IFC as Student-Centered Learning***

Research reveals that the implementation of IFC can encourage students to make learning activities richer, more flexible, and to use more time to learn (Gannod et al., 2008; Herold et al., 2012; Bates & Galloway, 2012). Through IFC learning, students can make a review of lecture material before and after class, conduct more discussion and dialogue, conduct collaborative learning and online discussion (Gannod et al., 2008), motivate students to be fully involved in learning and use time in a fully effective manner (Nouri, 2016); construct knowledge, practice critical thinking, solve problems better (Davis, 2013); enhance students' self-efficacy and self-regulated learning (Lai & Hwang, 2016; Lin, et al., 2018).

Stayer (2012) has reported that plenary activities, assignment exercises and quizzes by students in class have made them more involved in learning, improved communication skills, and more open to cooperative learning. Through quizzes, collaborative discussions, and reinforcement by instructors on face-to-face learning (during class), instructors can ensure the truth of what students have learned in pre-class (Herold et al., 2012).

Research conducted by Li et al. (2013) reports that IFC can increase student learning participation, depth and breadth of learning, and that student learning autonomy is improving, through the habit of asking questions, discussing, and posting assignments. In his research, Murphree (2015) concluded that IFC is a learning model that improves student performance in learning, but its effectiveness depends on instructor management and student acceptance.

A recent study was carried out by Wang and Zhu (2019). They analysed the effectiveness of learning IFC based on MOOCs (Massive Open Online Courses) on traditional university students in China. They have reported that, although there were no changes in self-efficacy and self-regulated learning, both in the experimental and the control class, most students in the inverted class performed better than those in the traditional class. There were 90% of students commenting during the discussion, 80% of students spent outside face-to-face learning to watch micro lectures, and 70% of students believed that the IFC learning model enabled them to learn more actively.

### ***IFC and Learning Outcomes***

Research results on aspects of perceptions and learning activeness in IFC are relatively homogeneous, as explained above. But reports of research findings on the impact of IFC for student 'learning outcomes' are quite varied. Research conducted by Thomas and Philpot (2012) and Cruzado and Román (2015) revealed that, although IFC can encourage student participation, it does not have a significant effect on improving learning outcomes. These

studies contradict Gannod's (2007) research, and subsequent studies such as Bates and Galloway's (2012), Schlingensienpen (2014), Kim, et al. (2014), Lin, et al. (2018), etc.

Gannod (2007) reported that IFC impacts on improving student learning outcomes. Research by Bates and Galloway (2012) revealed that the use of IFC can increase 89% of students' graduation in examinations; an achievement that is unprecedented in a traditional class on the same subject. Schlingensienpen's (2007) research supports Bates and Galloway's research. He involved 440 college students, four tutors, and four professors. He uses YouTube videos for pre-class learning. The failure rate of students in examinations reduced from between 31.5% to 45%. Kim, et al., (2014) have reported relatively similar results. At the end of the semester, 83% of inverted class students were graded 'C' or better, while the traditional class was only 56%.

Reyneke and Fletcher (2014) researched students of statistics at the University of Pretoria, South Africa, using YouTube videos. They reported that IFC not only increases student activity during the learning process, but can also get students used to answering questions in difficult tests. Although not yet compared to conventional classes, research by Brösner, et al. (2015), involving 17 medical students at the University of Marburg, found that IFC learning suitable for not only practice-based learning and difficult material, but it is also significant in students get good post-test results. The results of this study were also confirmed by Kong (2014) and Lin, et al. (2018).

### **Self-Regulated Learning as Factors of Learning Conditions**

Self-regulated learning (SRL) is a condition variables considered in the learning design. Self-regulation is the degree to which students are 'metacognitively, motivationally, and behaviourally active participants in their own learning process' (Zimmerman & Schunk, 1989, p.1). Self-regulation by students depends on the dimensions of motivation, methods, and time to achieve their learning goals (Zimmerman & Schunk, 1989). Generally, there are three elements forming SRL: (1) metacognitive, namely an element that enables individuals to plan, set goals, organise, monitor, regulate, and evaluate their learning, manipulate, control cognitive efforts; (2) motivation, namely encouraging students to make the necessary learning efforts, including monitoring and controlling the learning process; (3) learning strategies, namely mental activities used by students in learning to help them obtain, organise, and remember new knowledge more efficiently (Chen, 2002; Maftoon, 2014; Pintrich, 2000). By these three elements, students can actively participate in the learning process, both psychologically and physically (Zimmerman, et al, 2002). Zimmerman and Schunk (1989) divide SRL into two categories: high and low SRL. In other contexts, SRL can be categorised into three levels: high, medium, and low (Shih, et al., 2010; González-Pienda1, et al., 2014).

As an influence upon student learning habits and learning outcomes, SRL is continuously researched by educators and researchers. Generally, studies have answered the question ‘how do students become masters in their own learning processes?’ (Nejabati, 2015). Chen (2002) reports that self-regulation is more effective at mastering concepts than peer learning. Self-regulation efforts are needed, especially for students without study habits. That means that the condition of SRL owned by students is not innate, but trained and familiarised. Schunk and Zimmerman's (2007) research has reported that efforts to improve students' self-observation, self-judgment, self-reflection, build their self-regulation and self-efficacy skills. Similarly, research conducted by Aksan (2009) has concluded that epistemological beliefs and SRL provide the positive epistemological beliefs about the individual's own ability, the value of learning, the factors affecting learning, guessing the result of activities, concentrating on instruction, etc. Similar findings were revealed in the study of Koksall and Yaman (2012). They explored the relationship between SRL and epistemological beliefs in 116 students. The results have shown that epistemological beliefs encourage students to struggle to have SRL.

In addition to epistemological beliefs, other party interventions (such as teachers, parents, and peers) influence the improvement of students' SRL. This was revealed in the study of González-Piendal, et al. (2014). They reported that the intervention effectively increases students' level of SRL, especially those with a low SRL. Interventions in the form of task instructions to students who have self-regulation can improve their understanding of reading material (Maftoon, 2014).

Except for Yukselturk and Safure (2009), previous studies have revealed that SRL has a significant effect on improving learning outcomes, some of which can be explained in this paper. Soureshjani (2011) has found that students who have high self-regulation and learning motivation show better writing performance than students who do not have self-regulation and low learning motivation. Koksall and Yaman (2012) have revealed similar things in their research. They have found that SRL and inborn characteristics (such as intelligence and ability) largely determine student learning success.

The positive influence of SRL on learning outcomes was also revealed in Cazan's (2014) study. He studied 80 undergraduate students in the Faculty of Psychology and Educational Sciences, Transilvania University, Brasov, Romania. Students with higher levels of self-regulation and self-efficacy get higher learning outcomes at the end of the semester than students who have low self-regulation and self-efficacy. Maftoon (2014) has conducted research on 149 students in Tehran, who took English courses as a Foreign Language. In his research, he grouped students into the experimental class (given task instructions) and the control class given direct teaching. The results have shown that self-regulation accompanied

by task instructions positive impacts students' understanding of reading material, which they shown by acquiring higher post-test scores at the end of the program.

The positive influence of SRL on the learning process and outcomes was shown in the literature above. We use it as a moderator variable, and it is thought to have influenced the cognitive conceptual learning outcomes.

## **Method**

### ***Research hypothesis***

Based on our literature review, three hypotheses are formulated:

- 1) There is a significant effect of application inverted classroom strategies on conceptual learning achievement;
- 2) There is an effect of self-regulated learning on conceptual learning achievement;
- 3) There is an interaction effect of inverted classroom model and self-regulated learning on conceptual learning achievement.

### ***Research design***

This study is quasi-experiment research with pre-test / post-test control group design. Both the experimental and control classes were given prior knowledge and SRL tests. There are three variables, namely an IFC variable with two variations (scaffolding and without scaffolding) as an independent variable, SRL as a moderator variable, and conceptual cognitive learning achievement as a dependent variable. High and low conceptual cognitive learning achievement is the effect of different treatments. The design shows that both the experimental and control groups were both given material pre-test and post-test. Conceptual relationships between researches variables are shown in figure 1. The pre-test and SRL test aim to determine the students' abilities and their SRL conditions. Thus, the differences in learning achievement obtained by students at the end of the experiment are considered as the effects of the treatment given. At the end of the experiment both groups were given a post-test to determine the impact of treatment on the students' conceptual cognitive learning achievement.

### ***Participants***

The participants of this study were Students of Elementary School Teacher Education study programs, in the Faculty of Education at the Catholic University Indonesia of Ruteng, Indonesia. They were third semester students, who take courses in Curriculum Development. They were divided into experimental and control classes. Their gender, age, and place of residence varied. The participants' study is shown in Table 1.

### ***Data collection***

Data collection used questionnaires and tests. Questionnaires measure SRL, which substantively includes metacognitive, motivational, and learning strategies (Zimmerman, et al., 2002; Soureshjani, 2011; Baar & Wijnia, 2018). Meanwhile, tests measured learning achievement. The test used a multiple-choice question. Before use, the questionnaire and test were themselves assessed for validity and reliability. Both questionnaires and test questions were valid, because the correlation coefficient is greater than 0.3, and reliable because the coefficient of Cronbach is greater than 0.7 (Cohen, 1988).

### ***Procedure***

There were three stages in this study. The first was the Pre-experimental stage (1). In this stage, the activities were: a) surveying students' online and electronic media habits; b) development of learning materials as research content and validation of learning materials (by two experts); c) developing research instruments and validity-reliability tests; d) performing the pre-test measure of students' SRL; (e) testing of students' prior knowledge and SRL. The second stage was the Experimental stage (2). In this stage, the activities were: a) make an online group, consisting of two groups (experimental class and control class); b) learning processes that use the inverted classroom strategy. The experimental class used scaffolding in the form of textual hints, while the control class was without scaffolding. Learning materials, tutorial materials, and material links are delivered by online. Textual hints were delivered before class meetings. The deepening, development and strengthening of class discussions were delivered (all classes) after two days of class meetings. The process of implementing inverted learning used a design recommended by Davis (2013, p. 251). The experiment was conducted for ten meetings (face to face session). The third was the Post-experimental stage (3). The researcher took measurements of learning achievements through a post-test.

### ***Data Analysis***

The data analysis technique used two ways ANOVA. Before being analysed, the data fulfilled the assumptions of data normality and variance homogeneity. Data is normally distributed if the 'tests of normality' significance value is greater than alpha. The variance variables is homogeneous if the 'test of homogeneity of variances' indicated that the significance value is greater than alpha. The strong and weak effect of the independent and moderator variables, and the effect of the interaction of the two variables on the dependent variable, depends on the result of the 'eta squared' value ( $\eta^2$ ).

## Findings

### *Descriptive statistics*

According to the number of research variables, there are two types of data presented, namely SRL and conceptual cognitive learning achievement (pre-test and post-test). First, SRL. The condition of students' SRL is measured using a questionnaire (Likert scale, range 1-5), consisting of 36 item statements. The condition of SRL students is divided into three categories (high, medium, low). SRL in a high category gets a mean score of 3.6 to 4.3. A medium category scores 3.2 to 3.5, and a low category scores 2.7 to 3.1. Each category consists of 13 students. The summary data is in Table 2. Based on Table 2, it can be explained that mathematically, SRL of the experimental class has a lower mean score (0.1) than the control group (see Table 2, column 2), but statistically there is no difference mean score ( $P = 0.631$ ).

The second type of data is conceptual cognitive learning achievement (pre-test and post-test). The number of questions to measure pre-test and post-test is 25. The correct answer is given a score one and the wrong answer is given a zero score. Descriptive statistics of pre-test and post-test data are shown in Table 2. Thus: (1) mathematically, mean score pre-test the experimental class is greater (0.51) than the control class (see Table 2, column 5), but statistically there is no difference mean score ( $P = 0.826$ ). (2) Mean score post-test experimental class has a greater than control class (see Table 2, column 8); the significance of the differences between the two classes will be tested statistically. (3) There are a few differences in the pre-test mean values between the experimental and control class, but the difference mean values in the post-test between the experimental and control class is quite large (see Table 2, columns 5 and 8).

Mean score values of post-test base on SRL level are shown in Table 3. Based on Table 3, it can be said that students as grouped by a high SRL category (both experimental and control classes) obtain a mean score greater than the medium category, and students grouped by a medium category obtain a mean score greater than the low category (see Table 3, column 3).

### *Test of hypothesis*

The alpha level ( $\alpha$ ) used for the statistical test is 0.05. The partial eta squared value ( $\eta^2$ ) greater than 0.06 is considered to have an effect. ANOVA analysis fulfils the assumption of data normality and homogeneity of variance. Through the tests of normality using the Kolmogorov-Smirnov technique, the results show that both the experimental and control classes get a P-value (sig.) greater than alpha. P-value of the experimental class is 0.155 and control class is  $P = 0.220$ . Thus, the data of the two groups is normally distributed. Furthermore, the homogeneity test of variance, using Levine's technique, shows that the

variance between homogeneous variables due to obtaining P-value is greater than alpha. The result of the variance homogeneity test is  $P = 0.527$ . Thus, the data of the two groups are homogeneous. After fulfilling the assumption, a hypothesis test can be done. Two-ways ANOVA analysis obtained the results of 'tests of between-subjects effects' as shown in Table 4.

Based on Table 4, P-value (sig.) of 'class' and 'SRL' are 0.000 and P-value of 'class \* SRL' is 0.394. P-value of 'Class' and 'SRL' are less than alpha ( $0.00 < 0.05$ ), but P-value of 'class \* SRL' is greater than alpha ( $0.394 > 0.05$ ). Thus, (1). First hypothesis (there is a significant effect of application inverted classroom strategies on conceptual learning achievement) is accepted. The partial eta squared value ( $\eta^2$ ) is 0.195. It is strong category because it exceeds 0.14 (Cohen, 1988; Müller & Seufert, 2018). (2). Second hypothesis (there is an effect of SRL on conceptual learning achievement) is accepted. The partial eta squared value ( $\eta^2$ ) in the 'SRL' is 0.333. It is a strong category because it exceeds 0.14. (3). Third hypothesis (there is interaction effect of inverted classroom strategies and SRL on conceptual learning achievement) is rejected because the p-value is greater than alpha ( $0.395 > 0.05$ ). The partial eta squared value ( $\eta^2$ ) in 'class \* SRL' is 0.026. It is a very weak category ( $0.026 < 0.06$ ), so it is ignored.

## Discussion

Statistical testing found a great effect on the application of the IFC learning model on conceptual learning achievement. Therefore, the study supports several previous studies and provides solutions to problems in similar studies. Brösner, et al. (2015) found that besides being suitable for practice-based learning and difficult material, IFC use could also help students to high test scores. The implementation of IFC can help students pass examinations, carry out deep learning, solve difficult examination questions, reduce students' failure rates in examinations, and increase the percentage of students graduating from examinations (Schlingensienpen, 2014; Dahan, et al., 2018; Dehghanzadeh & Jafaraghaie, 2018).

The optimal learning is the impact of a quality learning process that is shown in the IFC. This model can have numerous benefits. It can raise student learning participation, develop the depth and breadth of learning, improve learning autonomy, implement self-regulated learning as well (Foster & Stagl, 2018), allow students more time to interact educatively (Brösner, et al., 2015); allow students more advanced knowledge construction (Koh, et al., 2010; Dahan, et al., 2018), facilitate critical thinking exercises, better problem solving, and finally, enhance more learning and variety such as reading, constructing, and discussing material, class plenary, peer instruction (Davis, 2013; Schlingensienpen, 2014). Quizzes in class would help students ensure what they have been learning before, and then the instructor will give reinforcement (Schlingensienpen, 2014; Hwang & Chen, 2019). These activities can

increase students' mastery of learning content, because learning materials are not only obtained through lecturer tutorial, but discussed and constructed among students.

In addition to the quality of educative interactions, the effectiveness of the application of IFC is also due to the willingness, reactivity, various ways of learning students in the entire learning process, both before, during and after the class (Foster & Stagl, 2018). Students' interest in this learning model was revealed in Pfennig's study (Pfennig, 2016). He found that although students felt that the IFC model forced them to study harder and invest more time, most preferred to study through inverted classroom strategies rather than conventional classes.

Besides supporting a number of previous studies, as explained above, the results of this study also rejected the study by Thomas and Philpot (2012) and Cruzado and Román (2015). Both of these studies did not find differences in learning achievement, between IFC and conventional classes. The ineffectiveness of the IFC model as to learning achievement (as found in the two studies) is suspected because the implementation was not assisted scaffolding that guided student learning.

Why are hints needed in learning, especially through online media? The amount of material that students must learn before class (online) can cause cognitive load for students. Cognitive load can be in the form of a task load, which relates to teaching materials and mental load, namely the efforts of students to learn or master teaching material (Sweller, et al., 1998).

The IFC learning model allows instructors to deliver more material to students (Mason, et al., 2013) because the material is not disseminated in the classroom. When students learn complex topics by computer-based learning environments, they show poor ability to organise their own learning and fail to gain understanding of conceptual topics (Azevedo & Hadwin, 2005). Hsieh, et al. (2013) found that one of the problems for students studying online was the presence of cognitive load.

This study founded the use of scaffolding (textual hints) is more effective than teaching without scaffolding. This is because the amount of information students receive at the same time can make them quickly forget orally delivered hints. Hints as a form of visual presentation can improve students' learning achievement (Rusli, et al., 2014). Through scaffolding (textual hints), students are guided to use smartphones and or the internet as a media and learning resource, in learning (Ulfa, 2013; Kuswandi, et al, 2017). By using scaffolding, it can answer the problem of disorientation learning, learning control, and cognitive load experienced by millennial students (Hsieh, et al., 2013).

This study also found that students with a high SRL level get a higher mean score of post-test than students with a low SRL level. This is acceptable because inverted learning provides opportunities to learn independently before and after class (Davis, 2013; Schlingensiepen, 2014). Students optimise learning through the use of scaffolding, which leads to more focus on learning, to achieve self-regulated learning (Müller & Seufert, 2018). Very prior knowledge at pre-test increased by 42.7 points (for experimental class) and 36.5 points (for control class) at post-test (see Table 2, column 5 and 9), revealing the effectiveness of using the IFC learning model as supported by SRL conditions.

The absence of an interactions effect, between independent and moderator variables on student learning, reveals that each variable can improve learning achievement without having to be used collectively. However, based on the result of post-test from groups of students who have a low level of SRL, more urgent scaffolding is definitely required for them, as recommended by Raes, et al. (2012).

## Conclusions

Based on the hypothesis, analysis and discussion, the study conclusions are: (1) there is a strong effect of inverted classroom and SRL on student conceptual learning achievement. Based on the acquisition of the partial eta squared value, SRL is greater than the inverted classroom model. Post hoc tests show that students who have 'high SRL level' have a significant difference in test scores, from students with 'low SRL level', but students who have 'medium SRL level' have not a difference in test scores from students who have 'high SRL level'. (2) Inverted classroom and SRL strategies impact on student conceptual learning achievement, but they do not have a collective interaction effect on learning achievement.

Based on these conclusions, it is suggested that: (1) the absence of the influence of interactions between inverted classroom and SRL on learning achievement shows that there are other variables that need to be observed in the following research, such as learning styles. Learning styles related to this study are visual and additive learning styles. It can occur when students learned by using textual hints guidelines that mostly have a visual learning style. (2) This study found that the SRL as a learning condition variable was more influential than the inverted classroom model as a method variable, in improving student learning achievement. Therefore, the practice of learning needs to analyse the factors of learning conditions before using certain strategies or models.

## Acknowledgements

This study was supported by the foundation of the Saint Paul Ruteng, Indonesia who has funded this study. The authors would like to specifically thank to Dr. Hendry Prahedhiyono and Dr.Sihkabuden who has reviewed teaching materials as a content, design, and media experts.

**Table 1:** Participants' study for experimental (N=39) and control (N=39) classes

| Group              | Gender      |               | Age (year)   |              |           | Residence             |               |
|--------------------|-------------|---------------|--------------|--------------|-----------|-----------------------|---------------|
|                    | <i>Male</i> | <i>Female</i> | <i>18-19</i> | <i>20-21</i> | $\geq 22$ | <i>Boarding house</i> | <i>Family</i> |
| Experimental class | 25.6%       | 28.2%         | 25.6%        | 69.2%        | 5.1%      | 60.2%                 | 30.8%         |
| Control class      | 75.4%       | 71.8%         | 15.4%        | 79.5%        | 5.1%      | 66.7%                 | 33.3%         |

**Table 2:** Descriptive Statistics of SRL, pre-test and post-test for experimental (N=39) and control (N=39) classes

| Group              | SRL (range 1-5) |           |            | Pre-test (range 0-100) |           |            | Post-test (range 0-100) |           |            |
|--------------------|-----------------|-----------|------------|------------------------|-----------|------------|-------------------------|-----------|------------|
|                    | <i>M</i>        | <i>SD</i> | <i>SEM</i> | <i>M</i>               | <i>SD</i> | <i>SEM</i> | <i>M</i>                | <i>SD</i> | <i>SEM</i> |
| Experimental class | 3.4             | 0.412     | 0.066      | 33.64                  | 11.04     | 1.77       | 76.41                   | 8.350     | 1.337      |
| Control class      | 3.3             | 0.449     | 0.072      | 33.13                  | 9.49      | 1.52       | 69.64                   | 8.884     | 1.423      |

Information: M (mean), SD (Standard deviation), SEM (Standard Error Mean)

**Table 3:** Mean score values of post-tes base on SRL level

| Class              | <i>SRL</i> | <i>M</i> | <i>SD</i> | <i>N</i> |
|--------------------|------------|----------|-----------|----------|
| Experimental class | High       | 84.6     | 4.574     | 13       |
|                    | Medium     | 74.2     | 6.243     | 13       |
|                    | Low        | 70.5     | 6.641     | 13       |
| Control class      | High       | 74.8     | 8.7       | 13       |
|                    | Medium     | 68       | 7,303     | 13       |
|                    | Low        | 66       | 8,944     | 13       |

**Table 4:** The results of tests of between-subjects effects

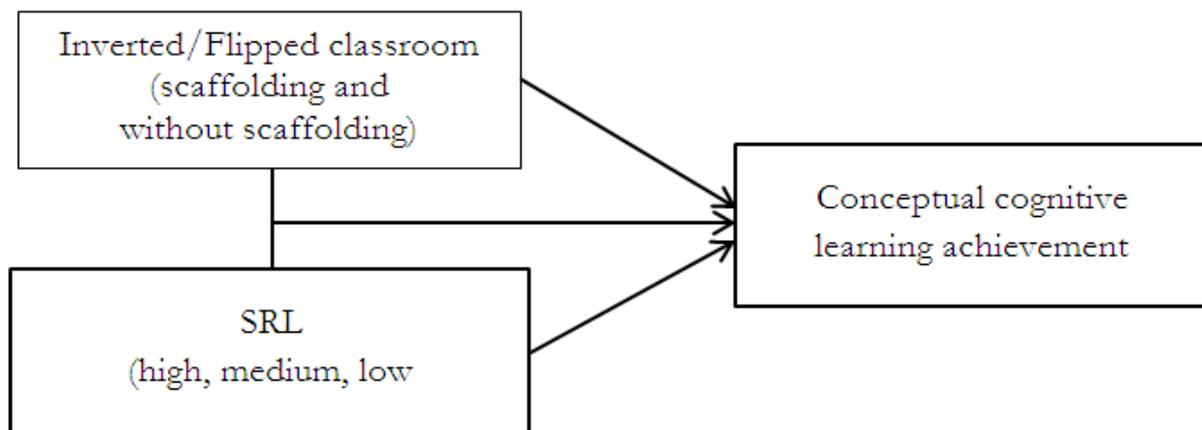
| Source          | df | Mean Square | F         | P    | $\eta^2$ |
|-----------------|----|-------------|-----------|------|----------|
| Corrected Model | 5  | 571.538     | 10.955    | .000 | .432     |
| Corrected Model | 5  | 571.538     | 10.955    | .000 | .432     |
| Intercept       | 1  | 415.662.000 | 7.967.309 | .000 | .991     |
| Class           | 1  | 907.128     | 17.388    | .000 | .195     |
| SRL             | 2  | 926.000     | 17.749    | .000 | .330     |
| Class * SRL     | 2  | 49.282      | .945      | .394 | .026     |
| Error           | 72 | 52.171      |           |      |          |
| Total           | 78 |             |           |      |          |

Information:  $\eta^2$  (partial eta squared value).

**Table 5:** The significance of multiple comparisons between SRL categories

| Dependent Variable   | (I) SRL | (J) SRL | MD (I-J) | P    |
|----------------------|---------|---------|----------|------|
| Cognitive conceptual | high    | medium  | 8.62*    | .000 |
|                      |         | low     | 11.46*   | .000 |
|                      | medium  | high    | -8.62*   | .000 |
|                      |         | low     | 2.85     | .479 |
|                      | low     | high    | -11.46*  | .000 |
|                      |         | medium  | -2.85    | .479 |

**Figure 1.** Relationship between research variables



## REFERENCES

- Anderson, O.W., & Krathwohl, D. R. (Eds.). (2001). *A Taxonomy For Learning, Teaching, and Assesing: A Revision of Bloom's Taxonomy of Educational Objective*. New York: Logman.
- Azevedo, R., Hadwin, A.F. (2005). Scaffolding Self-Regulated Learning and Metacognition – Implications for The Design of Computer-Based Scaffolds. *Instructional Science*, 33, 367–379.
- Baar, M. & Wijnia, L. (2018). The Relation Between Task-Specific Motivational Profiles and Training of Self-Regulated Learning Skills. *Learning and Individual Differences*, 64(5), 125-137.
- Bates, S., & Galloway, R. (2012). 'The inverted classroom in a large enrolment introductory physics course: a case study' Paper presented at HEA STEM Conference, London, United Kingdom, 12/04/12-13/04/12 . Retrieved from [https://www2.ph.ed.ac.uk/~rgallowa/Bates\\_Galloway.pdf,diakses](https://www2.ph.ed.ac.uk/~rgallowa/Bates_Galloway.pdf,diakses), accessed March 16, 2018.
- Brösner, S., Pickert, J.&Stibaner, T. (2015). Teaching Differential Diagnosis in Primary Care Using an Inverted Classroom Approach: Student Satisfaction and Gain in Skills and Knowledge. *BMC Medical Education*, 15 (63), 1-7.
- Cazan, A. M. (2014). self-regulated learning and academic achievement in the context of online learning environments. *The 10<sup>th</sup> Internastional Scientific Conference eLearning and Software fo education Bucharest, April 24-24*, 90-95.
- Chen, C. S. (2002). Self-regulated Learning Strategies and Achievement in An Introduction to Information System Course. *Information Technology, Learning, and Performance Journal*, 20 (1), 11-25.
- Chen, C.-M.(2009). Personalized E-learning SystemWithSelf-regulated Learning AssistedMechanisms for PromotingLearning Performance. *Expert Systems With Applications*, 36, 8816–8829.
- Cohen, J(1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd Ed.). Lawrence Erlbaum Associates,New York.
- Cruzado, I. & Román, M.E. (2015). Inverted classroom and its influence on students' attitudes across learning styles. *Transportation Research Record: Journal of the Transportation Research Board*, 2480 (pp. 38–44). Transportation Research Board, Washington, D.C.

- Dahan, D., Mirit, G. & Katzir, T. (2018). The flipped classroom: A review of Its Advantages and Challenges. *Computers & Education*, 126, 334-345.
- Davis, C. (2013). Flipped or Inverted Learning: Strategies for Course Design. In Smyth E. & Volker, J. (Eds.), *Enhancing Instruction with Visual Media: Utilizing Video and Lecture Capture* (pp. 241-265). PA: IGI Global, Hershey.
- Dehghanzadeh, S. & Jafaraghaie, F. (2018). Comparing The Effects Of Traditional Lecture and Flipped Classroom on Nursing Students' Critical Thinking Disposition: A Quasiexperimental Study. *Nurse Education Today*, 71, 151-156.
- Foster, G. & Stagl, S. (2018). Design, Implementation, and Evaluation of An Inverted (Flipped) Classroom Model Economics for Sustainable Education Course. *Journal of Cleaner Production*, 183, 1323-1336.
- Francl, T. J. (2014). Is Flipped Learning Appropriate. *Journal of Research in Innovative Teaching*, 71, 119–128.
- Gannod, G.C, Burge, J.E. & Helmick, T.M. (2008). Using the inverted classroom to teach software engineering. ICSE'08 Preceding of The 30th International Conferences on Software Engineering May 10–18 (pp. 777-786). Leipzig, Germany.
- González-Pienda, J.A., Fernández, E., Bernardo, A., José, C. Núñez, J.C., & Rosário, P. (2014). Assessment of a Self-regulated Learning Intervention. *Spanish Journal of Psychology*, 17 (e12), 1–9.
- Handke, J. (2016). The Inverted Classroom Mastery Model – A Diary Study. In Handke, J, Kiesler, N & Wiemeyer, L (Eds.). *The Inverted Classroom Model (The 2nd German ICM-Conference – Proceedings)*, 15-34.
- Herold, M.J., Lynch, T. D., Ramnath, R., & Ramanathan, J. (2012). Student and instructor experiences in the inverted classroom. *Frontiers in Education Conference Proceedings - Student and instructor experiences in the inverted classroom at Seattle, WA, USA October 3-6*, 1-6.
- Holtzman, M. (2005). Teaching Sociological Theory through Active Learning: The Irrigation Exercise. *Teaching Sociology* 33(2):206-12.
- Hsieh, T.-C., Lee, M.-C. & Su, C.-Y. (2013). Designing and Implementing A Personalized Remedial Learning System For Enhancing The Programming Learning. *Educational Technology & Society*, 16(4), 32-46.



- Hwang, G.-J. & Chen, P.-Y. (2019). Effects of A Collective Problem-Solving Promotion-Based Flipped Classroom on Students' Learning Performances and Interactive Patterns. *Interactive Learning Environments*, 27, 1-16.
- Kim, G. J., Patrick, E. E., Srivastava, R., & Law, M. E. (2014). Perspective on Flipping Circuits I. *IEEE Transactions on Education*, 57(3), 188–192.
- Kim, S.K. & Nor, M.M. (2019). The Effects of Self-Regulated Learning Strategies on Preschool Children's Self-Efficacy and Performance in Early Writing. *Indonesian Journal of Education*, 11(2), 99-108.
- Koh, L.H.J, Herring, C.S.& Hew, F.K.(2010). Project Based Learning and Student Knowledge Construction During Asynchronous Online Discussion. *Internet and Higher Education*, 13,284-291.
- Koksal, M. S. & Yaman, S. (2012). An investigation of the epistemological predictors of self-regulated learning of advanced science students. *Winter*, 21(2), 45-54.
- Kong, S. C. (2014). Developing Information Literacy and Critical Thinking Skills Through Domain Knowledge Learning In Digital Classrooms: An Experience of Practicing Flipped Classroom Strategy. *Computers & Education*, 78(9), 160–173.
- Kuswandi, D., Praherdhiono, H. & Toenlio, A.J.E. (2017). Synectics Learning and “Tringo” Model for Blended Learning System Application. *3rd International Conference on Education and Training: Advances in Social Science, Education and Humanities Research*, 28, 126-131.
- Lai, C. L. & Hwang, G. J. (2016). A Self-Regulated Flipped Classroom Approach To Improving Students' Learning Performance in A Mathematics Course. *Computers & Education*, 100(9), 126-140.
- Li, K.-H., Lou, S.-J., Tseng, K.-H., & Huang, H.C. (2013). Preliminary Study on the Facebook-Based Learning Platform Integrated with Blended Learning Model and Flip Learning for Online and Classroom Learning. *Lecture Notes in Computer Science Advances in Web-Based Learning (ICWL)*. Verlag Berlin Heidelberg: Springer, 8167, 172-183.
- Lin, Y. N., Hsia, L. H., Sung, M. Y. & Hwang, G. H. (2018). Effects of Integrating Mobile Technology-Assisted Peer Assessment Into Flipped Learning on Students' Dance Skills And Self-Efficacy. *Interactive Learning Environments*, 4, 1–16.
- Lopes, A.P. & Soares, F. (2018). Flipping A Mathematics Course, A Blended Learning Approach. *Proceedings of INTED2018 Conference*, 3844–3853.



- Maftoon, P. (2014). Using self-regulation to enhance efl learners' reading comprehension. *Journal of Language Teaching and Research*, 5 (4), 844-855.
- Mason, G.S, Shuman, T.R.& Cook, K.E.(2013). Comparing The Effectiveness of An Inverted Classroom to A Traditional Classroom in An Upper-Division Engineering Course. *IEEE Transactions on Education*, 56(4), 430-435.
- Montoya, M.S.R. & Hernández, D.del C. R. (2016). Inverted learning environments with technology, innovation and flexibility: student experiences and meanings. *Journal of Information Technology Researc*, 9 (1),18-33.
- Moranski, K. &Henery, A. (2017). Helping leaners to orient the inverted or flipped language classroom: mediation via information video. *Foreign Language Annals*, 50 (2), 285-305.
- Mubayrik, H.B. (2018). The Present and Future State of Blended Learning at Workplace-Learning Settings in Adult Education: A Systematic Review. *Journal of Social Studies Education Research*, 9(4), 247-273.
- Müller, N.M. & Seufert, T. (2018). Effects of Self-Regulation Prompts in Hypermedia Learning on Learning Performance and Self-Efficacy. *Learning and Instruction*, 58, 1–11.
- Murphree, D. (2015). Flippng the history classroom with and embededwritting consultant: synthesizing inverted classroom and WAC paradigms in a university history survey. *The Social Studies*, 106, 218-225.
- Nejabati, N. (2015). The effects of teaching self-regulated learning strategies on efl students' reading comprehension. *Journal of Language Teaching and Research*, 6 (6), 1343-1348.
- Nouri, J. (2016). The Flipped Classroom: For Active, Effective and Increased Learning – Especially for Low Achievers. *International Journal of Educational Technology in Higher Education*, 13(1), 1-10.
- Ojha, L.K. (2016). Using I.C.T. in Chemistry Education. *International Journal of Innovation, Creativity and Change*, 2(4), 156-64.
- Pfennig, A. (2016). Inverting the Classroom in An Introductory Material Science Course. *Procedia-Social and Behavioral Sciences*, 228, 32-38.
- Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Education Psychology*, 92 (Issue 3), 544-555.



- Popkova, E.G., Ragulina, Y.V. & Bogoviz, A.V. (2019). *Industry 4.0: Industrial Revolution of the 21st Century*. Springer International Publishing.
- Raes, A., Schellens, T., Wever, B.De., Anderhoven, E. (2012). Scaffolding Information Problem Solving In Web-Based Collaborative Inquiry Learning. *Computers & Education*, 59(1), 82–94.
- Reyneke, F., & Fletcher, L. (2014). The impact of an inverted traditional teaching model on first level statistics students. *Proceeding of the Ninth International Conference on Teaching Statistics (ICOTS9) July*, Flagstaff, Arizon, USA.
- Rogach, O.V., Frolova, E.V., Tatyana, M. & Ryabova, T.M. (2018). Modern School Role in Human Potential Development. *European Journal of Contemporary Education*, 7(4), 804-812.
- Rusli, M., Ardhana, I.W., Degeng, I.N.S., Kamdi, W. (2014). The Effect of Presentation Strategy on Multimedia Learning-Animation Vs. Static Visualization and Learning Style to Learning Result. *Academic Research International, Part-II: Social Sciences and Humanities*, 5(1), 216-226.
- Schlingensiepen, J. (2014). Innovation In Distance, E-and Blended Learning In Education Mass Production Using Inverted Classroom Model (ICM). *Procedia, Social and Behavioral Science*, 140, 393-398.
- Schunk, D. H. & Zimmerman, B.J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modeling. *Reading & Writing Quarterly*, 23 (1), 7-25.
- Shih, K.-P., Chen, H.-C., Chang, C.-Y. & Kao, T.-C. (2010). The development and implementation of scaffolding-based self-regulated learning system for e/m-learning. *Educational Technology & Society*, 13 (1), 80–93.
- Soureshjani, K.H. (2011). Self-Regulation and Motivation Reconsideration Through Persian EFL Learners' Writing Achievement. *Journal of Research Humanities*, 11, 55-80.
- Staker, H & Horn, MB (2012). *Classifying K-12 Blended learning*. Retrieved from <https://files.eric.ed.gov/fulltext/ED535180.pdf>.
- Strayer, J.F. (2012). How Learning in An Inverted Classroom Influences Cooperation, Innovation, and Task Orientation. *Learning Environ Research*, 15(2), 171–193.
- Sweller, J., Merriënboer, J.J.G.V. & Paas, F.G.W.C. (1998). Cognitive Architecture And Instructional Design. *Educational Psychology Review*, 10(3), 251–296.



- Thomas, S.J.& Philpot, A.T. (2012). An inverted classroom model for mechanics of material Course. *American Society for Eengineering Education* (full paper). URL: [www.asee.org/.../2012\\_ASEE\\_-\\_Final\\_-\\_An\\_Inverted\\_Classroom\\_Model\\_for\\_a\\_Mec...](http://www.asee.org/.../2012_ASEE_-_Final_-_An_Inverted_Classroom_Model_for_a_Mec...) (Online), Accessed on March 12 2018.
- Tucker, B. (2012). The Flipped Classroom, Online Instruction at Home Frees Class Time For Learning. *Education Next*, 12(1), 81-83.
- Ulfa, S. (2013). Implementing Mobile Assisted Language Learning in Rural Schools for Enhancing Learning Opportunity. *Official Conference Proceedings, The Asian Conference on Education 2013*, Osaka Japang. pp.1-8.
- Wang, K. & Zhu, C. (2019). MOOC-based flipped learning in higher education: students' participation, experience and learning performance. *International Journal of Educational Technology in Higher Education*, 16, 1-16.
- Yukselturk, E. &Safure, B. (2009). Gender differences in self-regulated online learning environment. *Educational Technology& Society*, 12 (3), 12–22.
- Zimmerman, B., Bonner, S. & Kovach, R. (2002). *Developing Self-Regulated Learners: Beyond Achievement to Self-Efficacy*. American Psychological Association, Washington, DC.
- Zimmerman, B.J.& Schunk, D.H. (1989). *Self-regulated Learning: From Teaching to Self-Reflective Practice*. Guilford, New York.



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