Pegem Journal of Education and Instruction, Vol. 12, No. 3, 2022 (pp. 130-143)

RESEARCH ARTICLE WWW.PEGEGOG.NET

The Effect of Collaborative Problem Solving & Collaborative Project-Based Learning Models to Improve The Project Competences of Pre-Service Teachers

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Abstract

This study aims to examine the effect of applying the Collaborative Problem Solving (CoLPS) and Collaborative Project-Based Learning (CPBL) models in improving the project competence of pre-service teachers students in microteaching classes. The research design used a quasi-experimental design with a non-equivalent control group design. The research subjects were 65 students of Islamic Religious Education (PAI) teacher candidates and were divided into two treatment groups, namely the experimental group (34 students) and the control group (31 students). The experimental group was taught using the CoLPS model and the control group was taught using the CPBL model. Data was collected using a product performance assessment rubric consisting of 6 competencies. The rubric was developed and validated by four experts consisting of two content experts and two design experts, and reliability tests were carried out using SPSS 20 software. Furthermore, the research data were analyzed using the independent sample t-test technique. The research findings show that the CoLPS model is very effective in improving the project competence of prospective PAI teacher students compared to the CPBL model. Students who are taught using the CoLPS model have better product quality than students who are taught using the CPBL model.

Keywords: Collaborative Problem Solving, Collaborative Project-Based Learning, and Project competence.Keywords: Committed teacher, Job satisfaction, Professional commitment.

Introduction

Recent studies examining trends in educational technology show that the teaching paradigm has changed, from knowledge-based teaching to competency-based teaching. This change is based on demand, were to face an increasingly complex world, students need additional abilities and skills from the main disciplines they learn in the classroom, such as problem-solving skills (Mohamed, *et al.,* 2010; Bialik & Fadel, 2015; Lee, *et al.,* 2019) and project skills (Lin, 2017). Project capability is an essential skill and is the most promising field of investigation in the context of the results of this study because it contains a variety of specific skills, such as creative-critical thinking skills and real-life problem-solving skills (Jaime *et al*., 2016). A project is defined as a short-term effort to produce a unique product or result (Andersen, 2006). In practice, project tasks are identified as complex tasks, because the complete process requires the integration of high-level knowledge, experience, and related cognitive skills (Yang *et al*., 2010; Stephenson & Isaacs, 2019).

Project competence is very important for future pre-service teacher to master. Given the main problem that has occurred so far is the performance of student performance is low and far from the maximum assessment standard when completing complex tasks in the form of the task of creating learning designs. Students have difficulty analyzing each component of the learning design and creating it into a comprehensive design, such as it is difficult to formulate Competency Achievement Indicators (CAI), analyze the sequence of materials, determine models, media, and formulate assessments. This condition is very unfortunate, because the requirement to become professional teachers is that they are required to be able to create learning designs that are in accordance with the theoretical framework of development and applicable curriculum provisions.

Looking at the complexity, we find that one of the main reasons is that students are not trained to apply their knowledge into real work, especially how to simulate project planning to concrete solutions. Indeed, designing a project task that includes all stages (such as planning, project ideas, and solutions) is not an easy task. Because every complex task/project has its own specifications and rules of completion

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How to cite this article: Rofik A, Setyosari P, Effendi M, Sulton (2022). Job Satisfaction among Early Childhood Female Teachers and its Impact on Professional Commitment. Pegem Journal of Education and Instruction, Vol. 12, No. 3, 2022, 130-143

Source of support: Nil

Conflict of interest: None.

DOI: 10.47750/pegegog.12.03.15

Received : 16.01.2022

Accepted : 11.03.2022 **Published:** 01.07.2022

(Jaime *et al*., 2016). In addition, teachers must also be able to make clear distinctions between tasks with knowledge and skills dimensions based on content characteristics and student profiles (Lin *et al*., 2015; Lamb *et al*., 2017). The fact is that teachers have a hard time designing assignment scenarios for a skill.

The supporting factor is learning disability, namely the inability to innovate in the field of learning strategies under government instructions (Kemendikbud) on the National Higher Education Standards (SN-Dikti). As a result, students miss opportunities to develop their skills. Students have difficulty when faced with complex tasks, such as the task of developing learning designs. Even in this context, students often tend to cheat by plagiarizing other people's work on the internet. This reality is because in the learning process students are not encouraged to "think", where the teacher dominates the course of learning with instructive tasks. While the use of strategies that are oriented towards problem solving, collaborative, discovery, structured project creation, and practical exercises through scenarios of multi-tasking tasks are hardly presented.

Because creating learning designs is an important competency, efficient project/employability skills - which are reflected in students' thinking habits, attitudes, and performance - are also important competencies (Orgoványi-Gajdos, 2016; Lin, 2017; Hanapi, *et al.,* 2020). To practice these skills, the best approach is to use the collaborative problem solving (CoLPS) model (Nelson, 1998; 2009). The CoLPS model is designed to help teachers identify the skill deficits of their students and provide the right assistance at the right time at the right level (Griffin & Care, 2014). When executed properly, the CoLPS model allows groups to make good decisions in improving the quality of their performance (Jhonson & Jhonson, 2013; Setyosari, 2009; Reigeluth, 2012; & Wiltshire *et al*., 2014). Through the CoLPS model, students have a more successful chance. because complex tasks can be assimilated through teamwork (Reigeluth, 1998).

CoLPS is the most recent model in the context of training student collaboration and problem-solving skills in learning (Graesser, et al., 2018). CoLPS is designed to bridge cohesive learning theory with classroom teaching practices (Nelson, 1998; 2009). The aim is to encourage the maximum possible natural and effective problem-solving process for learners and to encourage freedom of thought for them in displaying their best performance (Guan & Mikolaj, 2002; Ashworth, et al., 2012; and Lu & Lin, 2017).

In CoLPS, it is possible to make project simulations easier for students to do even in difficult circumstances. This is because the design of the task is well structured from simple to complex; task designs are presented in stages and according to the cognitive capabilities of learners (Perry & Ablon, 2019; Song, Park, & Park, 2020), so that they can lighten their cognitive load (Gauvain, 2018; & Susilowati, et al., 2019). However, the challenge is concerning the professional duties of the teacher to detail these tasks with effective instruction. Good assignment design will help students build a deep understanding of the completion of the complex tasks they will work on (Albay, 2019).

To solve this need, Nelson (1998; 2009) complements the CoLPS model with two integrated guides, namely a comprehensive guide and a processing activity guide. Comprehensive Guidelines are guidelines for organizing the entire learning process to its objectives, including teacher guides, student guides, teacher and student guides, and interactive method guides. While the process activity guide is a guideline to detail all problem-solving tasks in the learning process (Guan & Mikolaj, 2002). This guideline is also a learning syntax (Nelson, 2009). Explicitly, the principles of these two guidelines emphasize the importance of designing an authentic learning environment that can encourage the development of critical thinking, creative, and complex problem-solving skills in complex domains by taking into account the maturity of cognitive skills and students' social interactions. It is important to emphasize that this environmental design is fully within the control of the teacher as a learning facilitator. The teacher's job ensures that students are able to make meaning of what they learn and what they do as a team.

Finally, learning in the CoLPS setting must take place in the design of meaningful activities and directed at applicative goals (Griffin & Care, 2014; Harney, et al., 2015; Hesse, at al., 2015; & Gauvain, 2018), so that it is useful for students. In the professional world in the future. Therefore, to answer the problems and challenges above, we have designed a collaborative problem-solving task the scenario, in the form of a student project worksheet (LKPM) and five learning modules. Task scenarios are designed based on the collaborative problem solving (CoLPS) model adapted by Nelson (1998; 2009). This study was conducted in a lesson planning course, which requires prospective pre-service teacher to develop learning design products (blueprint) under the provisions of the 2013 curriculum. This course is categorized in a complex domain, therefore it is under the characteristics of the CoLPS model which requires complex domains (Guan & Mikolaj). , 2002). To successfully work on project assignments, students must optimize their knowledge in the team, combine various perspectives, and build effective communication with mutual responsibility. Furthermore, the products created by students were tested for quality using an expert-validated product performance assessment rubric.

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the problems and challenges above, we have designed a collaborative problem solving task scenario, in the form of a student project worksheet (LKPM) and five learning modules. The task scenario is designed based on two models (see table 1), namely the collaborative problem solving (CoLPS) model adapted by Nelson (2009) and the Collaborative Project-Based Learning (CPBL) model adapted by Grippa et al., (2009). LKPM and modules were developed before the research was conducted. To check the feasibility of LKPM and modules, researchers conducted a test of competent and experienced experts in the field of Educational Technology. The three expert tests consist of 1) content expert test, 2) media expert test, and 3) design expert test. While working on project assignments, students follow the scenarios that have been developed, both in the experimental class treated using the CoLPS model and the control class being treated using the CPBL model. Furthermore, the products created by the students were tested for quality using the product performance assessment rubric developed by the researchers. Before the rubric was used, the researcher conducted a series of item validity tests, namely; 1) test the validity of the items on the four experts (two content experts and two design experts), 2) test the validity on 26 students non-subject research, and 3) test the reliability using SPSS 20 software (see table 3).

Our study aims to explore more deeply how the design of project assignments designed based on the CoLPS model can improve the quality of student-teacher student project performance. The findings of this study are also very important to dissect the impasse in the literature and empirical studies regarding the application of the CoLPS model and solving problems that have tended to be separated from project competencies. Referring to the revised Bloom taxonomy of Anderson and Krathwohl (2001; 2002), problem-solving is identified as a project (product) competency. This reality is verified by the results of the Tarmizi & Bayat, (2012); Jaime, et al., (2016); Blomquist, et al., (2016); Boy, et al., (2016); and Lin, (2017) who emphasized that problem-solving competence is an abstract domain while project competence is a concrete domain. In other words, a project is a tangible form of the learner's cognitive processes when working on real-world problem-solving tasks. The hypotheses to be tested are: There is a significant difference in project competence between groups of students taught using the CoLPS model and students taught using the CPBL model in developing learning designs.

Methodology

Research design

The design of this study used a quasi-experimental study with a nonequivalent control group design (Creswell, 2009). The aim is to examine the effect of independent variables on the dependent variable (Kerlinger, 2000). The independent variable consists of two dimensions, namely the collaborative problem-solving learning model (CoLPS) and the project-based collaborative learning (CPBL) model. While the dependent variable is the learning outcomes of student project abilities.

The participants of the research was 65 students of 6th-semester teacher candidates in the Islamic Religious Education study program at Raden Rahmat Islamic University (Unira) Malang. The research object was divided into two treatment groups; one was made into the experimental group (34 Students) and the other was used as the control group (31 Students). The technique of determining the object uses cluster random sampling because it is not possible if it is done randomly (Setyosari, 2015).

This research was conducted on both treatment groups, namely the experimental and control groups. The experimental group was treated using the CoLPS model and the control group using the CPBL model. The treatment procedures for the experimental group and control group are presented in table 1. The study lasted for eight weeks, starting from February 13 to April 2, 2021. A total of eight treatments were carried out including one pre-test and one post-test (see table 2). Project materials provided include:

1) develop competency achievement indicators;
2) develop learning objectives;
3) develop learning materials;
4) develop learning strategies;
5) develop learning media;
6) develop a HOTS-based assessment.

Data Collection

This research data includes two types of data, namely the initial and final performance test data of learning design products that have been created by student teacher candidates. The data were collected using student performance tests developed by researchers and validated by experts (see Appendix for instrument). This technique is used because pencil and paper tests (such as multiple-choice tests) are not relevant to measure the quality of a product (Grondlund & Waugh, 2009) and the quality of performance / complex tasks (Moskal 2001; Varela & Giralt, 2016). This test scale consists of 40 assessment items with 6 competencies in the field of learning design, namely 1) competence to develop Competency Achievement Indicators (5 items), 2). competence to develop learning objectives (7 items), 3). competence to develop learning materials (8 items), 4) competence to develop learning strategies (9 items), 5) competence to develop learning media (4 items), and 6) competence to develop HOTS-based assessments (7 items). Furthermore, all test items were tested at the level of validity and reliability. The validity test was carried out on the four experts in the field of learning technology and non-treatment subjects. While the reliability test was carried out using SPSS software with the alpha Cronbach formula (α) at a coefficient level of 0.05%. The results of the reliability test are presented in Table 3.

Table 1: Treatment procedures in the experimental and control classes

Step	*Collaborative problem-solving (CoLPS)*	*Collaborative Project-Based Learning (CPBL)*
1	Lecturers build student learning readiness	Lecturers identify students' abilities in making projects
2	Lecturers form student study groups	Students analyze project problems and make project plans
3	The lecturer guides students to determine and define the preliminary problem	Students work on project assignments collaboratively
4	Students assign roles in groups to analyze project problems and solutions	Students complete project assignments
5	Students solve project problems collaboratively	Students discuss their projects and present them in front of the class.
6	Student completes project	
7	Students synthesize and reflect on their learning experiences in groups	
8	Lecturer conducts product assessment	
9	Lecturer closes the learning experience and appreciates student projects	

Table 2: Experimental and control class research implementation procedures

		Meetingto						
Weeks	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
	O1	*Experiment*						
Treatment	*Control*							O_2
Notes	:							
O1	:	initial product performance test (pretest)						
Experiment	:	Treatment with the CoLPS model						
Control	:	Treatment with the CPBL model						
O_2	:	Final product performance test (post-test)						

Data Analysis

The research data were analyzed using descriptive techniques and the Independent Sample T-Test technique. The aim is to determine the significance level of the influence of the independent variables (CoLPS vs CPBL models) on the dependent variable (project competence) by examining the difference in the average value of student project competency learning outcomes. However, before conducting this test, the researcher first conducts the prerequisite test of the research assumptions using the normality and homogeneity test, so that the data parameter assumptions are met. The normality test uses the Kolmogorov-Smirnov technique and the homogeneity test uses Levene's test technique. The research data were tested at a significance level of 5% (0.05) using the IBM SPSS statistical 20 programs

Results

Learning outcomes are the maximum abilities of learners that are achieved after learning. This ability is obtained as an effect of using a method under different conditions (Gredler, 1991; Degeng, 2013). In this study, the intended learning outcome is the student's maximum projectability to create learning design products after being assessed using the collaborative problem solving (CoLPS) model and the collaborative project-based learning (CPBL) model.

It is known that the mean value of the initial performance test results in the experimental group which was interpreted using the CoLPS model was 108.65 with a standard deviation of 14.004 and the mean value of the initial performance test in the control group was 107.87 with a standard deviation of 13.286. Furthermore, after the treatment the average value of the final performance test results in the experimental group was 138.12 with a standard deviation of 11,375 and the average

Table 3: Description of data reliability test results

No.	*Reliability test results*	*Cronbach's Alpha*	*Cronbach's Alpha Based on Standardized Items*	*No. of Items*
1	Expert reliability test	.980	.980	40
2	Object reliability test	.972	.972	40

Table 4: Description of the initial and final performance test results of student products

	Class	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Initial Performance Test	Experiment.	34	72	131	108.65	14.004
	Control	31	82	129	107.87	13.286
Valid N (listwise)		31				
Final Performance Test	Experiment.	34	115	157	138.12	11.375
	Control	31	114	149	132.16	8.564
Valid N (listwise)		31				

Table 5: The results of the normality test of initial and final product data

Tests of Normality							
		Kolmogorov-Smirnova			*Shapiro-Wilk*		
	Class	*Statistic*	*df*	*Sig.*	*Statistic*	*df*	*Sig.*
Initial Performance Test	Experiment.	.098	34	.200*	.968	34	.406
	Control	.095	31	.200*	.958	31	.263
Final Performance Test	Experiment.	.109	34	.200*	.964	34	.308
	Control	.103	31	.200*	.962	31	.320

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

value of the control group was 132.16 with a standard deviation of 8,564. Statistically, Table 4 shows that the two average values are not different significantly (homogeneous).

Table 4 shows that the distribution of data on the results of the initial and final performance test of learning design products created by students in the two treatment groups is not significantly different and relatively the same. Thus it can be tested the assumptions/prerequisites for further research.

Normality test

The data normality test was performed using the Kolmogorov-Smirnov and Shapiro-Wilk analysis techniques with a significance level of 5% (0.05). As a unit of analysis, it is important to test for normality to determine the normality of the data distribution obtained. The results of the data normality test are presented in Table 5 below:

The results of the normality test as shown in Table 5 above indicate that the distribution of data in the two treatment groups obtained a significance score above> 5% ($p = 0.05$). The results of the normality test at the time of the experimental group's initial performance test obtained a sig score. $p = 0.200$ (Kolmogorov-Smirnov) and the score is sig. p = 0.406 (Shapiro-Wilk). The control group obtained a sig score. $p = 0.200$ (Kolmogorov-Smirnov) and the score is sig. $p = 0.263$ (Shapiro-Wilk). Meanwhile, in the final performance test, the experimental group obtained a sig score. p = 0.200 (Kolmogorov-Smirnov) and the score is sig. p = 0. 308 (Shapiro-Wilk). The control group obtained a sig score. $p = 0.200$ (Kolmogorov-Smirnov) and the score is sig. $p = 0.\ 320$ (Shapiro-Wilk). This means, the distribution of data in the two treatment groups is normally distributed so that further statistical testing can be carried out.

Homogeneity Test

The homogeneity of the data was tested using Levene's test technique with a significance level of 5% (0.05). The homogeneity test data consists of the results of the initial and final performance tests of the learning design products that have been created by students, the results are presented in Table 6.

Table 6: Homogeneity test results data of students' initial and final designs

Levene's Test of Equality of Error Variancesa				
	F	*df1*	*df2*	*Sig.*
Initial performance	.077	1	63	.782
Final performance	.843	3	61	.476

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Class

The results of the homogeneity test in Table 6 show that the initial performance test data (pre-treatment) in the two groups obtained a significance value of 0.782 and the final performance test data (post-treatment) obtained a value of 0.476. Overall, the obtained value of the Levene's test results is greater than 0.05 ($P > 0.05$), this means that the variance of the student performance results from data is fairly homogeneous and can be subjected to further testing.

Hypothesis Testing

Hypothesis testing is the final test of a series of statistical tests that have been carried out. In this study, the hypothesis was tested using the Independent Sample T-Test technique (Santoso, 2014; Machali, 2016). The main objective is to test the difference in the average score of student project ability learning outcomes both before and after the assessment using the CoLPS and CPBL models. The results of hypothesis testing are presented in Table 7 below:

The results of the Independent Samples T-Test in Table 5 show that the calculated F value on the Equal variances assumed line is 4.176 with the Sig. (2-tailed) 0.021. The basis for decision making is centered on the assumption that the two data variants are the same. Because of the probability value <0.05, it is concluded that the two data variants are not identical (Ho is rejected). This means that "there is a significant difference in learning outcomes of project abilities between groups of students taught using the CoLPS model and students taught using the CPBL model". This data is also shown from the difference in the mean value of the two treatment groups, in which the experimental group obtained M = 138.12 and the

Table 7:The Independent Samples T-Test

		Levene's Test for Equality of Variances			*t-test for Equality of Means*			
F		*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	
Final performance	Equal variances assumed	4.176	.045	2.367	63	.021	5.956	2.517
	Equal variances not assumed			2.398	60.897	.020	5.956	2.484

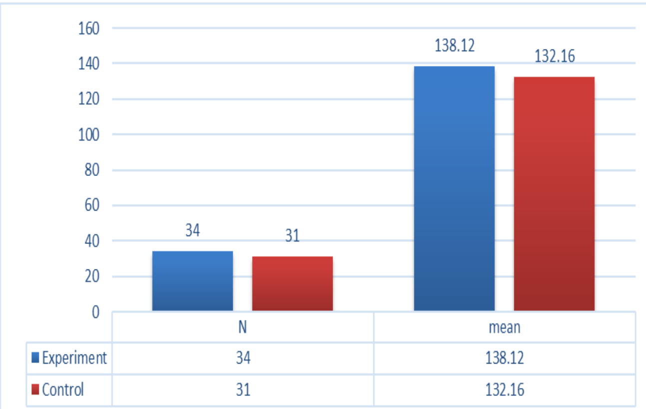

Fig. 1: Average grade of student project quality

control group obtained M = 132.16 with $T_{calculated}$ of 2,367. Because the value of $T_{calculated}$ in the Ho area is rejected, the average performance of students taught by the CoLPS and CPBL models is not the same. This means that the application of the CoLPS model is more effective in improving project skills that involve the cognitive aspects of learners.

Figure 1 shows that the difference in the average score for the quality of the projects created by students is very significant. Furthermore, this data is also corroborated by the difference in the average performance value of 5,956 with a value of $P = 0.021 < P = 0.05$ (see Table 5). This difference is very significant, which means that the collaborative problem-solving learning model in the experimental group is more effective than the project-based collaborative model in the control group. Apart from the statistical data above, the findings from the observations about the effectiveness of the two models are also discussed.

Discussions

The results of statistical tests show that the application of the CoLPS learning model has a significant effect on improving the project skills of prospective pre-service teacher. The CoLPS model is very effective at encouraging students to perform better when completing their project assignments. In general, it is known that the CoLPS learning setting can train students to construct their thinking flexibly with high-value quality performance. The design of the CoLPS learning environment allows students to be able to connect the various skills they have (such as cognitive and social) into new situations, so that they are more easily adapted to complex tasks whose completion requires special skills (Rosen *et al.*, 2009; Tarmizi, RA. & Bayat, S. 2012; Gauvain, 2018; Graesser *et al.*, 2018). This fact is of course inseparable from the characteristics of the CoLPS model which tends to make learners active agents/masters of their learning (Nelson, 1999). Students are designed to be independent individuals in learning. They are also supported in such a way as to be ready to learn, to participate actively, to understand each other, to be able to manage conflict within the team, and to be loyal in exchanging constructive ideas through intensive communication between learners (Hesse *et al.*, 2015; Graesser *et al.*, 2017).

Here a critical question arises about the CPBL model which is considered to have the same concept as the CoLPS model. Where in the CPBL setting, students are also positioned as masters of their learning (Grippa *et al.*, 2009). They are also encouraged to collaborate, exchange knowledge, solve problems, and develop various skills within the team (Bell, 2010; Dong & Warter, 2010; Avery *et al*, 2010). Several research results prove that the application of the CPBL model is very effective in developing student project skills, IT, and the integration of their IT skills into science (Baser *et al.*, 2017), including problem-solving in science practicum (Mustapha, *et al.,* 2019; Huysken, *et al.,* 2019). The results of Kim & Lim's research, 2017) also confirm that project-based collaboration scripts have a positive effect on increasing team metacognitive knowledge. However, Baser *et al.*, (2017) revealed that in a CPBL environment students tend to have difficulty adapting and have the potential to fail when facing complex tasks. Students have difficulty doing projects in a limited time and have difficulty understanding the contents of the project module (Mustapha et al., 2019). This is because the CPBL theory is not designed for complicated types of knowledge and only focuses on complex tasks.

In contrast to CPBL, the CoLPS model is specifically designed to solve complex tasks in complex domains by emphasizing the dimensions of students' readiness/awareness, so that solving complex problems occurs naturally (Nelson, 1999, 2009; Guan & Mikolaj, 2002). In addition to cognitive and social skills (Graesser, et al., 2018), students' awareness of learning is an important attribute in CoLPS (Yin et al., 2011). Because of how strong the teacher is to teach, if students are not ready, students will not learn (Reigeluth, 2012). This fact is the main reason why the CoLPS model is more effective than the CPBL model in the context of authentic task completion. The supporting factor is the design of project tasks designed systematically from simple to complex sequences. This design is in the form of a structured Student Project Worksheet (LKPM). Through LKPM, students are accustomed to analyzing content from various perspectives, exploring alternative problem solving by optimizing team resources, such as division of tasks, exchanging ideas, exploiting solutions, to decision making. Ideally, the CoLPS setting is more focused on the problem-solving process rather than content. While working on project assignments, students are trained to develop their skills until they are proficient and there is an association of simultaneous thinking. This makes it easier for students to learn to explore and apply their skills in a variety of situations. The CPBL model does not accommodate this need.

In his research, Reigeluth (2012) concluded that to facilitate students' success in doing complex tasks, their skills need to be automated through structured task exercises until an awareness of their cognitive processes for complex thinking emerges. Structured project task design (simple to complex) is an important key in CoLPS learning (Yang *et al*., 2010) and is proven to be effective in encouraging student success in working on a variety of complex tasks (Wiltshire *et al*., 2014; Harding, et al , 2017; Brilingaitė, Bukauskas, & Juškevičienė, 2018; Blankenstein *et al*., 2019). In this study, the results of statistical analysis showed that there were significant differences in the quality of performance between the experimental group and the control group. The experimental group taught using the CoLPS model had better product quality than the control group taught using the CPBL model. Students taught by the CoLPS model adapted very quickly to their learning environment, even they were very enthusiastic to immediately work on the next project task.

While working on project assignments, each group is directed to make a work of high quality but easy to do. Students are free to work, sharpen their creativity, and explore their thinking skills with the team with a simulation without feeling anxious and afraid of mistakes. This emphasis is very important in study groups because students who have a low understanding and minimum skills tend to be anxious when completing complex project tasks (Kim, 2005; Kulkarni *et al*., 2010). Ching (2020) also states that to encourage positive social interaction during collaboration, students must be placed in the right position so that they can reduce their negative alibis, such as anxiety, stress, and feelings of isolation. Students with low skills also have the potential to create projects. of high quality with effective instruction, centered on their experiences, and a structure of meaningful tasks that do not overwhelm them (Brilingaitė, Bukauskas, & Juškevičienė, 2018; Zakaria *et al*., 2019). Because without adequate instructions to assist their performance in collaborating, it is feared that they will fail when faced with more complex tasks (Wiltshire *et al*., 2014). Here, teacher skills to play a role are needed, such as classroom management skills, stimulating social interaction, and building their learning readiness (Hashim, *et al.,* 2019; Wu, 2019).

Another reason for the effectiveness of the CoLPS model is the existence of empirical evidence that integrating cognitive and social skills into a set of learning can build learners' readiness in terms of college and career (Rosen & Foltz, 2014). They are easier to adapt to new tasks and are easy to socialize in the world of work so that it becomes a distinct advantage for their future careers (Davis, Fidler, & Gorbis, 2011; Lin, *et al.,* 2015). In CoLPS, cognitive skills become basic knowledge to solve problems (Graesser et al., 2018). Mohamad et al. (2011) and Omar et al. (2019) also emphasized that students' mastery of problem-solving is constructed effectively through setting their cognitive strategies and learning styles. As a result, the higher the students' cognitive level, the easier it is for them to master knowledge in completing a task (Ariffin et al., 2020). Even though CoLPS is an effective strategy, it is in this context, teachers are also required to adjust the CoLPS course design according to student project competencies and curriculum objectives.

As mentioned above, the application of the CPBL model is also effective for project tasks of this kind, but statistically, the average value of the quality of student projects taught using the CoLPS model is superior. Empirical studies show that the CPBL model is very effective if it is applied to students with high academic abilities and has experience running previous projects (Lin, 2017). Meanwhile, for beginner students with low academic abilities, CPBL requires a lot of significant adjustments to learner characteristics. On the one hand, the CPBL model is not equipped with comprehensive guidelines for managing team interaction patterns, so knowledge sharing between groups is less than optimal. The availability of comprehensive guides is very important, considering that not many students are ready to study.

Our observations found that the CPBL model is very effective in dealing with task difficulty, but is less able to facilitate teamwork readiness, especially in complex domains where the solution does not only require aspects of skills but also emotion (intrinsic). Completing complex team-based tasks requires the integration of knowledge and skills with a complex level of needs analysis, such as the need to recruit teams, manage team resources, ensure teamwork ethic, etc. (Kluge, 2006). In a CPBL environment, students seem confused when suddenly asked to do project tasks without paying attention to the team structure. This confirms that in collaborative learning, meaningful team interactions are challenging, and to make it happen students must struggle (Harney *et al*., 2015; Tawfik *et al*., 2018) and trying to understand each other so that the process of thesis ideas runs optimally (Boy *et al*., 2016). Therefore, solving complex scientific problems collaboratively requires a good mental representation of the team so that it can accommodate problem-solving. provides a gap for us and future researchers to carry out further research involving more complex variables.

Conclusion

This study seeks to find empirical evidence about the effectiveness of the CoLPS learning model in improving the project competence of prospective pre-service teacher in the field of learning design. Based on the results of statistical tests, it was found that the CoLPS model was very effective in improving student project competencies. The group of students taught using the CoLPS model has better product quality than the group of students taught using the CPBL model. In the CoLPS environment, students adapt very quickly to their learning environment and are very enthusiastic about their work. This is because the task design is well structured from simple to complex sequences. As long as they are involved in project tasks, they are not burdened and instead are challenged to immediately finish their next project.

Overall, the results of this study support the growing empirical evidence that the CoLPS model is very effective in improving the quality of student performance by making project and simulation tasks the main media to practice their problem-solving skills. Finally, the experience of running projects in a team is a matter of pride for students. Through an easy and structured task design and supported by an environmental design that frees them to express themselves, making their skills grow organically. This fact is what makes the CoLPS model more effective than the CPBL model, especially for beginner students with low skills.

It is important to note that the research results that have been discussed are in the first year of research and are only focused on finding empirical evidence about the effectiveness of the CoLPS and CPBL models in improving student project competence in teams. For now, the preliminary findings of this study are very important, given that the empirical evidence specifically testing the two models is still minimal and has received little attention from researchers. Therefore, internal and external factors that are thought to be influential need to be considered, such as achievement motivation factors, collective self-efficacy, Project Management Self-Efficacy (PMSE), cognitive style, academic retention, etc. By involving more complex variables, the explanation of team performance in the CoLPS and CPBL environments will be more comprehensive.

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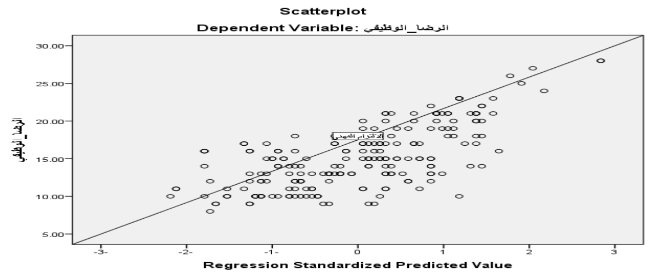

Fig. 2: Linear regression line

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Appendix

Performance Assessment Instruments

STUDENT PRODUCTS

Name	:	….......................	Semester	:	….............................
NIM	:	….......................	academic year	:	2021/2022

Description

Instrument to measure the ability of prospective PAI teacher students in creating learning designs.

A. Hint

1. Use the following instrument to assess the quality of learning designs that have been created by prospective students of Islamic Religious Education teachers.
2. Please choose one of the five categories for each of the learning design quality indicators in the format provided.
3. For each of the indicators of learning design quality listed in the left column, circle one of the four categories in the right column that reflects your assessment of the level of quality of learning designs created by students;
4. At the bottom of the format, please provide comments on aspects that in your opinion need to be considered because they have special strengths or problems.
5. The assessment criteria use the following rating scale:

Scoring scale

STS	:	Very Incompatible
TS	:	Not suitable
S	:	Appropriate
SS	:	Very Appropriate

Thank you for your cooperation.

B. Product Performance Assessment Instrument

		Score			
No.	*Description*	*Sts*	*Ts*	*S*	*Ss*
	Student's ability to formulate Competency Achievement Indicators				
1.	Student's ability to formulate Competency Achievement Indicators				
	The indicator formulation is in accordance with KD, KI, and SKL	1	2	3	4
	The indicator formulation shows the achievement of KD at KI-1, KI-2, KI-3, and KI-4.	1	2	3	4
	Operational verbs (KKO) in the indicator formula show measurable low-level (LOTS) and high-level (HOTS) thinking skills.	1	2	3	4
	The use of operational verbs in the indicators is in accordance with the competencies being measured.	1	2	3	4
	The indicator formulation shows the achievement of SKL in the form of attitudes, knowledge, and skills that can be measured.	1	2	3	4
2.	Students' ability to formulate learning objectives				
	Operational Verbs in the formulation of objectives reflect measurable learning outcomes	1	2	3	4
	The learning material in the formulation of objectives is clearly described	1	2	3	4
	The conditions under which the results will be assessed are clearly described in the formulation of objectives	1	2	3	4

2	The criteria that will be used to assess the quality of the results are clearly described in the formulation of objectives	1	2	3	4
	Formulation of learning objectives according to the model/approach used	1	2	3	4
	Learning objectives are formulated using the ABCD rumus formula	1	2	3	4
	Formulation of objectives in accordance with KD, KI, GPA, and SKL	1	2	3	4
3.	The ability of students in selecting and developing learning materials				
	Learning materials are relevant to the learning objectives	1	2	3	4
	The sequence of learning materials is consistent to achieve learning objectives	1	2	3	4
	The scope of learning materials is sufficient to achieve the learning objectives.	1	2	3	4
	The presentation of learning materials is well organized and in accordance with the development model used.	1	2	3	4
	Learning materials are well described.	1	2	3	4
	The coverage of KD in the material is clearly organized and presented.	1	2	3	4
	Learning materials developed in accordance with the principles of development include the principles of relevance, consistency, and adequacy.	1	2	3	4
	Development of learning materials in accordance with the format of teaching materials used.	1	2	3	4
4.	Students' ability in choosing learning models/strategies				
	The learning model/strategy is suitable for achieving the objectives, considering the characteristics of students and the context that allows the learning process and performance to take place	1	2	3	4
	Learning models/strategies allow for optimizing students' learning abilities	1	2	3	4
	The components of the learning model/strategy can be implemented easily because the steps are clearly written	1	2	3	4
	Student participation activities are clearly described	1	2	3	4
	Time allocation in learning activities is clearly illustrated	1	2	3	4
	Delivery strategy according to the context of learning and performance	1	2	3	4
	Selection of models/strategies in accordance with the demands of the content of the material, student learning, and the demands of 21st century learning	1	2	3	4
	The selection of the model/strategy is in accordance with a scientific approach that is oriented towards the scientific process	1	2	3	4
	The design of learning activities is clearly described in accordance with the number of meetings and contains a presentation of preliminary, core, and closing activities.	1	2	3	4
5.	The ability of students in selecting and developing learning media				
	Learning media relevant to content	1	2	3	4
	Learning media facilitates the learning process and performance/competence	1 1	2 2	3 3	4 4
	Learning media can be used in the learning process and in accordance with the learning context	1	2	3	4
	Effective learning media to help achieve learning objectives	1	2	3	4
6.	Students' ability to develop HOTS-based assessments				
	Assessment techniques in accordance with learning objectives	1	2	3	4
	The test item accurately measures the type of behavior described in the behavior on the learning objectives	1	2	3	4
	The performance required in the test items is truly authentic to measure learning performance	1	2	3	4
	Learning materials are presented clearly in the test items	1	2	3	4

	The assessment instrument describes a HOTS-based assessment	1	2	3	4
	The assessment instrument is in accordance with authentic assessment techniques and forms.	1	2	3	4
	The assessment instrument developed represents the achievement of learning competencies clearly and precisely.	1	2	3	4
Achievement Score					
Maximum Score					
Results					