Research Article

The Effect Of Problem-Based Learning In A Flipped Classroom Environment And Learning Motivation On Learning Independence And Problem Solving Skills

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ARTICLE INFO	ABSTRACT
	This study aims to determine the effect of problem-based learning in an inverted classroom environment and learning motivation on learning independence and problem solving ability. The type of research used experimental research with a 2x2 factorial design. The research subjects totalled 128 students, with details of 65 students in the experimental group and 65 students in the control group. Data were analysed using normality test with Kolmogorov-Spirnov, homogeneity test with Levene's and hypothesis testing with MANOVA. The results showed that both data were normally distributed and statistically homogeneous. Overall, the average of the experimental group was higher than the control group. MANOVA test results show results as follows: (1) There is an effect of problem-based learning in a flipped classroom environment on learning independence, (2) There is an effect of problem-based learning in a flipped classroom environment on problem solving skills, (3) There is an effect of learning motivation on learning independence, (4) There is an effect of learning motivation on problem solving skills, (5) There is an interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence, (6) There is an interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence and problem solving skills of students in the experimental group compared to the control group who applied the conventional learning model.

Introduction

The development of the 21st century supported by the existence of technology as a support provides many changes, especially in the field of education, these changes make many shifts in the dynamics of learning, both from the learning process, teachers, students and the educational environment. Technological changes provide many benefits and make it easier for us to act and interact at work, in education, and social life. This is supported by Klopfer et al., (2009) explaining that technological developments encourage educators to understand and utilise technology in learning and learning activities to create a dynamic learning environment. Another explanation according to Allen & Velden (2011) shows that this change is the driving force behind many other major changes, such as the emergence of 21st century skills that are considered important for the ability of individual learners to function and participate fully in today's world. In this case, current technological developments allow teachers to design and deliver learning materials to support and improve the quality of the learning process, especially in individual cognitive experiences and experiences from the social environment (Lu et al., 2021).

The development of technology has brought changes in the teaching and learning process, becoming a means of assisting in achieving learning objectives, developing learners' skills and abilities, can design a dynamic, responsive, interesting and active classroom atmosphere. It is argued that technology is a powerful tool for transforming learning, facilitating learners' acquisition of higher-order skills competencies and meeting their needs (Erstad & Voogt, 2018). Other literacies mention that most learners' higher-order skills can be developed because they are triggered by current technological advances (Oudeweetering & Voogt, 2018). The categories of higher-order skills such as critical thinking, creative thinking, independence learning, problem solving, communication skills are all called higher-order thinking skills (Almerich et al., 2018). Thus the role of this

technological development is very positive for teachers and students, therefore quick steps must be taken to immediately synergise together so that the quality of learning can be even better and can improve students' higher-order skills.

There are many other kinds of skills that develop in 21st century skills that can be trained and familiarised for learners, 21st Century skills are widely mentioned in several literacies consisting of 4C (Communication, Collaboration, Critical Thinking, Creativity) or communication, collaboration, critical thinking and creativity (Trinidad et al., 2013),(Erdogan, 2019). Other categories of 21st Century skills include critical thinking and problem solving skills, communication and collaboration skills, knowledge, media and technology literacy skills, social responsibility, cultural and universal awareness skills, career orientation skills, skills of using initiative and self-management, entrepreneurial and self-direction skills, change transformation leadership and innovation skills (Cevik & Senturk, 2019).

Other opinions are more specific to three types: learning skills (including: creativity and innovation, critical thinking, and problem solving; communication and collaboration); literacy skills (including: information literacy; media literacy; ICT literacy), and life skills (including: flexibility and adaptability; initiative and self-direction; social skills; productivity; leadership and responsibility) (Busch et al., 2008), (González-Pérez & Ramírez-Montoya, 2022). And other opinions mention these skills include basic academic skills such as reading, writing, and maths as well as new skills such as problem solving, critical thinking, communication, collaboration, creativity, digital literacy, and cultural awareness (Yurt, 2023). Based on the kinds of 21st century skills above, so much that must be prepared by students, it needs more attention so that these skills can be possessed by students.

Educational institutions as a place of learning need to prepare students to be able to develop academic values and skills according to their main needs that are currently needed in the 21st century(Efendi et al., 2023). Teachers as educators are expected to design learning activities that can accommodate in developing the needs of learners in the 21st century by utilising existing technological developments('azah et al., 2024). Supported by the explanation that this century requires a special learning environment that facilitates the acquisition of skills that the education system wants to develop among learners as part of their preparation to face "real life" in a dynamic, rapidly changing, and uncertain environment (Nissim et al., 2016). Thus, there needs to be a deeper analysis to prepare everything to support the development of 21st century skills in addition to determining the appropriate learning model, teachers are expected to plan learning activities well so that learning objectives are also well achieved.

In addition to preparing learning activities, teachers are also required to pay attention to the motivation of students to learn in order to remain, with the motivation in themselves will indirectly create satisfaction and pleasure in learning, and will make them realise the importance of learning in their lives(Sholeh, 2023). This is supported by the explanation in maintaining and increasing learners' motivation to learn is important, both for teaching and learning, whether to develop new knowledge or skills, because motivation will affect the way teachers and learners interact during teaching and learning activities (Hung et al., 2013). However, this will not be achieved if learners are not ready to learn, either from within themselves or external factors that affect them. Readiness to learn depends on strong motivation, so motivation is very important in motivating learners to learn, along with support from teachers and the environment.

Learning motivation is not something that is forced, but arises slowly from within students to carry out their learning activities thanks to encouragement either from themselves or there are external factors that influence them(Sholeh et al., 2024). The learning process can be said to be carried out well if it is also able to motivate students to actively participate in learning(Sanusi et al., 2024). Supported by an opinion that explains that with learning motivation, students will be more interested in engaging in the learning process (Rowell & Hong, 2013). Reinforced by other explanations that add aspects of motivation cannot be ignored because this also affects students' performance or achievement (Rafiola et al., 2020). Therefore, teachers must be able to condition their learning motivation to be maintained during the learning process, so that learning objectives are achieved and the delivery of material can also be conveyed properly and will provide good learning outcomes.

There are various learning models that are considered to accommodate the needs of the above. The existence of the internet also gives rise to a variety of innovative learning models, complementing and perfecting existing models(Sholeh, 2024). This is supported by the opinion that explains there are various learning models as a result of discovery or collaboration with the internet, Mentioned learning models that have used the internet include: online learning, open learning, web-based learning, computer-based learning, blended learning all of which have in common in terms of the ability to use computers connected to the network, which offers the possibility to learn from anywhere, anytime, at any rhythm (Cojocariu et al., 2014). Other explanations include problem-based learning, project-based learning, flipped classroom, blended learning and many other learning models that have been developed (Watted, 2023). Based on the explanation above, there are many mentions of learning models that are integrated with the internet and will certainly give rise to many new learning models in the future. The anywhere-anytime feature of internet-connected learning is very useful during crisis situations, for example, man-made disasters, natural disasters, or pandemics that we have been through. However, the selection of learning models must also consider the needs based on the characteristics of the

material, learners, learning objectives and the environment to determine what learning model will be implemented.

The above explanation shows that the need for implementing an internet-connected learning model is very important, combining the advantages of these two learning situations in the classroom and anywhere offers many positive values and allows teachers to choose or use any learning model that can support learning and develop 21st century skills and motivation and learning independence of learners, and also prepare them to explore the sea of digital information that is easily obtained. According to Eggen & Kauchack (2012), Teachers must be able to prepare their learners for life in the digital era, one of which is by using their knowledge of subject matter, learning and technology to facilitate more advanced learner learning experiences, creativity, and innovation in face-to-face situations and in face-to-face and virtual situations. One solution is to implement a problem-based learning model in a flipped classroom environment, or to combine two learning styles. This solution is expected to be an alternative to the existing problems.

Integrating problem-based learning with flipped classroom teaching mode is undoubtedly a more reasonable learning and is expected to solve the existing problems. This is supported by the explanation that problem-based learning model combined with flipped classroom is a combination model with problem-based learning activities conducted in a flipped classroom (Çakıroğlu & Öztürk, 2017). Another explanation says this combination allows learners to spend time outside the classroom to learn, and inside the classroom to solve problems (Chis et al., 2018). These two learnings complement each other in different locations and times with the advantages they both have in improving the quality of learning. With this explanation, it is expected that flipped classroom learning combined with problem-based learning can be a solution to the problems found during the research.

Empirical research showed that the combination of problem-based learning in a flipped classroom environment increases learners' knowledge and makes learning fun (Chis et al., 2018). The results showed that problem-based learning in a flipped classroom environment has an interaction effect with learning motivation (Sinmas et al., 2019). The results of research on the combination of problem-based learning in a flipped classroom environment make students enthusiastic, motivated and excited to take part in classroom learning (Ramadhani et al., 2019). The results showed that problem-based learning in a flipped classroom environment can be an alternative learning model to improve problem solving skills in learning Islamic Religious Education (Mudhofir, 2021). The results of research on the combination of problem-based learning in a flipped classroom environment can improve learning independence skills, cooperation communication, critical thinking and improve academic achievement (Chi et al., 2022). The results showed that problem-based learning in a flipped classroom environment can improve learning skills (Q. Wang, 2022). The results of research on the combination of problem-based learning in a flipped classroom environment can increase learning independence and teamwork (Li et al., 2023).

The weaknesses in flipped classroom and problem-based learning can both help each other and synergise to improve the quality of learning. This is supported by Chen (in Hu et al., 2019), flipped classroom can cover the shortcomings of problem-based learning such as hindering teaching progress due to the large amount of time spent in class to improve, think, solve, and discuss problems. Another literacy shows that flipped classroom learning can facilitate or fulfil the backgrounds, desires, and needs of individual learners, thus providing design variations in the group format in the process of problem-based learning activities (Al-Samarraie et al., 2020). Another explanation provides a review of an expectation that the combination of problem-based learning in a flipped classroom environment will further stimulate learner interaction, understanding and engagement so that learners are more eager to learn, share experiences and gain knowledge from each other (De Jong et al., 2022). And other literacies also provide information that flipped classroom when combined with problem-based learning, allows learning to complement each other (Palla et al., 2023).

Based on the description of the background of the problem above, research was conducted to determine whether or not there is an effect of problem-based learning in a flipped classroom environment and learning motivation on students' learning independence and problem solving skills in Fiqh subjects.

Literature Riview
Problem Based Learning

Problem-based learning is a learning model that encourages students' understanding by showing real problems equipped with their previous knowledge and insights, then associated with problems in the teaching material and will form new knowledge, experiences and insights. Supported by the explanation of problem-based learning is problem-based learning that is learner-centred and a form of problem-oriented teaching to be discussed with groups (Jones, 2006), (Chang et al., 2022). Another definition states that problem-based learning is a learning model that involves students to work in small groups and stimulates them to analyse, integrate, and use problems. Educators are facilitators who guide learners to express opinions and find solutions (Downing et al., 2011). Another opinion states that problem-based learning is learning based on the principle that problems can be used as a starting point for acquiring or combining new knowledge, the problem serves as a stimulus for students to identify what they need to learn to understand or solve. This is supported by the explanation that the use of problems as the focus of learning is supported by the principles of PBL (Hung et al., 2008), (Chang et al., 2022).

Problem-based learning is based on scenarios, which are in real or realistic situations with the introduction of problem variables, improving learners' communication skills and learning methods that enable the development of practical solutions related to problem situations (Gurses et al., 2015). Any problem-based learning process allows learners to understand new knowledge through collaboration and questioning to build their knowledge (Wyness & Dalton, 2018). The main purpose of problem-based learning is to pose problems, analyse problems and solve problems, including problem identification, problem discovery, self-learning, evaluation of new knowledge, thinking and feedback, and other basic steps (An, 2024).

That the use of problems as the focus of learning is supported by the principles of PBL (Hung et al., 2008). Other literacies mention problem-based learning assumes that learners will master the subject matter while solving meaningful problems (Jonassen, 2011). Supported by another opinion that problem-based learning is believed to create a learning environment where problems can encourage learning (Padmavathy, 2013). The problem to be solved should be interesting, but it should also address the issues required by the curriculum. Thus the problem becomes the learning objective. Problem-based learning is also an active way for learners to learn basic problem-solving skills and acquire knowledge through interaction with others, key skills demanded by almost all work environments. Learners learn in small self-directed groups to define and carry out specific tasks, both in learning activities and real life (Phungsuk et al., 2017). Any problem-based learning process allows learners to understand new knowledge through elaboration, collaboration, and questioning to build their knowledge (Wyness & Dalton, 2018).

Flipped Classroom

Flipped classroom means flipped classroom, a system of learning activities initially in the classroom in general and then carried out at home, activities that are at home are then carried out in the classroom. There are many explanations of the definition of flipped classroom from various opinions, including explaining that flipped classroom is defined as a change in the place of classroom practice and practice outside the classroom (Lage et al., 2000). Another explanation mentions the simplest definition of flipped classroom which means that activities that are usually in the classroom now take place outside the classroom and vice versa (Bishop & Verleger, 2013). Another explanation states that the flipped classroom is part of a broad educational movement that includes blended learning, inquiry-based learning, and other educational approaches and tools that connect learners in a flexible and efficient manner (Johnson et al., 2014). Another opinion explains flipped classroom is a learning that moves some formally designed learning activities outside the classroom to create opportunities for more learner-centred learning and meaningful inquiry during class time (Mazur et al., 2015). Flipped classroom is a type of rotation model which is one of the types of blended learning model. Blended learning model is a learning model that combines face-to-face learning with online learning, and other technology-assisted learning models to create the most efficient learning environment possible (El-Mowafy et al., 2013), (Parsad & Lewis, 2009). Flipped classroom is one of the types of blended learning model that belongs to the rotation model category (Staker & Horn, 2012) and (Graham et al., 2014). Because this type of model rotates learning activities from classroom to anywhere, with the help of information and communication technology that is developing today, it will greatly help the learning process to be even better.

Blended learning model is a combination of face-to-face and online learning to produce effective, efficient, and flexible learning (Stein & Graham, 2014). The blended learning model exists because most technology in education is now online, in practice, teachers strategically blend online components, such as web-based content, learning software, or activities such as collaboration or digital creation, with face-to-face learning components (Hughes & Roblyer, 2023).

The flipped classroom is part of the previously described rotation model that rotates the usual learning activities. There is literature that explains the term flipping comes from the idea of swapping homework for class work (Schmidt & Ralph, 2016). Another opinion added that the flipped classroom is a transformation of the teaching process from traditional learning as its main reference to be defined as a new model and process, meaning that students can review and understand the subject matter through electronic teaching materials before entering the classroom, they can learn independencely, can learn together with their friends (Zhang et al., 2021).

Another explanation mentions the flipped classroom in the delivery of learning by flipping, lectures in class and doing questions and at home everything is flipped (Kocour, 2019). Learners can deepen their understanding through teaching materials from the teacher in the form of recordings, reading assignments, videos and so on. Flipped classroom combines time in class with work at home. Learners work on assignments with teaching materials at home, while in class the teacher uses it to structure learning tasks or projects (Shamad & Wekke, 2019).

The implementation of flipped classroom learning has many views on the flow of learning and teaching activities. It is explained that during flipped classroom activities, learners acquire basic knowledge through independence learning before entering the classroom, learning materials are transferred from instructors to learners, learners then apply this knowledge and insight in the classroom (Pierce & Fox, 2012), (Sharma et al., 2015), (Rotellar & Cain, 2016). The same opinion from Bergmann and Sams (in Günbatar, 2021) explains that the flipped classroom process is based on the process of conducting classes at home and doing homework at school.

This is in line with the fact that in a flipped classroom, teachers provide various learning contents or materials electronically, learners study them using various digital media, such as their smart phones and notebooks, at their preferred time, space, and learning style; then learners participate in classroom discussions (Fulton, 2012), (Guy & Marquis, 2016), (Tang et al., 2017), (Persky & McLaughlin, 2017). Other mentions related to flipped classroom implementers have the following activities: content delivery in advance, educator concern for learner understanding, and high-level learning during face-to-face sessions (O'Flaherty & Phillips, 2015). All the explanations above, mainly outline the flow of activities (learning steps) implemented in flipped classroom learning activities

Learning Motivation

According to (Wiseman & Hunt, 2014), Motivation is an internal state that arouses learners to action, directs them to certain behaviours and assists them in maintaining that arousal and action by relating to behaviours that are important and appropriate to the learning environment. The motivational aspect cannot be ignored because it also affects students' performance or achievement (Rafiola et al., 2020). And another opinion states that motivation is the art of encouraging students to be motivated to carry out learning activities so that learning objectives are achieved (Metekohy et al., 2022).

Learning motivation is a set of efforts to condition a certain atmosphere so that someone wants and wants to do something in their learning. Learning motivation is a desire that arises from within learners or from outside to engage in the learning process so that the goal is achieved, namely the desired learning outcomes based on ambition, needs, expectations, appreciation, desire and learning environment (Farisi et al., 2023). If it feels inappropriate then it will eliminate the sense of inappropriate to be changed into a sense of appropriate, with learning motivation will improve the quality of learning and student learning outcomes. With learning motivation, learners will be more interested in engaging in the learning process (Rowell & Hong, 2013).

Learning motivation is divided into two types, namely intrinsic and extrinsic motivation. Intrinsic motivators include interest in the subject, a sense of its relevance to life and the world, a sense of achievement in mastering it, and a sense of calling to it (DeLong & Winter, 2002). Learners are intrinsically motivated, and engage in activities because of their internal interest, excitement and joy (Niemiec & Ryan, 2009). Any form of motive (energy/will/influence) within an individual that is active without external stimulation. Indeed, within a person there is already an urge to do something. Learners must be intrinsically motivated to successfully engage in self-directed learning (W. Hung, 2011)(Savin-Baden, 2014). Intrinsic motivation is the true drive within humans, which encourages individuals to seek out and face new challenges (Jen & Yong, 2013). Intrinsically motivated learners will use their own interest and sense of fulfilment to challenge themselves with a particular task (Raiyn & Tilchin, 2015). The premise is that the more control learners have over their own learning process, the greater their intrinsic motivation will be as demonstrated by their self-management in learning the subject matter (Douglass & Morris, 2014).

Extrinsic motivation is a stimulus that comes from outside the learner, and which encourages the learner in the learning process (Marsh, 1997). Extrinsic motivation drives effort and performance with rewards serving as positive reinforcers for desired behaviour (Bénabou & Tirole, 2003). Extrinsic motivation encourages learners to engage in academic tasks for external reasons (Jen & Yong, 2013). Extrinsic motivation according to Harmer (in Filgona et al., 2020) is caused by a number of external factors that may include the expectation of financial rewards; the need to pass exams or the possibility of future levels. Extrinsic motivation refers to individual drives that are fuelled by external influences (Subasi, 2023). Extrinsic motivation comes from factors outside the individual that encourage the individual to engage in the activity as a way to achieve a goal (Davidovitch & Dorot, 2023).

Learning Independence

The definition of learning independence according to (Meyer et al., 2008a) is to develop the values, attitudes, knowledge and skills needed by learners to make responsible decisions and take relevant actions related to their own learning, to be curious, confident and independence; to understand their own learning needs and interests; and to value learning "for its own sake". Learning independence is the process of learning in individuals and their efforts to achieve their learning goals are expected to always be active and not dependent on others, including with the teacher. Any learning activity that places learning independence as an important element in it will encourage the development of learners into lifelong learners (Egel, 2009). Learning independence is often associated with other learning approaches such as learner-centred or ownership learning (Meyer et al., 2008). An important driving factor in learning independence is the drive of interest and desire in learners to learn (Kopzhassarova et al., 2016).

Another opinion explains that learning independence is a learning activity carried out by an individual with his freedom in managing, sorting and determining his own needs from teaching materials, places, time and learning resources needed and needed (Aulia et al., 2019). Stephen Brookfield (In Laksana & Hadijah, 2019) suggests that learning independence is self-awareness, self-driven, the ability to learn to achieve goals. Another understanding states that learning independence is a learning process that occurs due to the influence of one's own thoughts, feelings, strategies, and behaviours that are oriented towards achieving goals. Another opinion

explains that learning independence is an ability possessed by a person in carrying out a learning activity independencely does not depend on others(Putra & Syelitiar, 2022).

Learners will be motivated to learn when the teaching is with interesting and meaningful content; when knowledge is useful and provides the means to achieve desired goals. It often arises in the context of important issues such as the role and relationship between teachers and learners, and the role of information and communication technology in learning. when reviewing the characteristics, it is important for a person who has learning independence that they are able to identify when they should seek the help of others, such as tutors, lecturers, or peers to support their learning (Qizi & Kobiljanovna, 2021).

Problem Solving Skill

Problem solving is a cognitive process in which knowledge, skills, and personal experience are mobilised to identify problems, find solutions, and resolve conflicts effectively (Wang & Chiew, 2010), (Hoi et al., 2018). Another explanation explains that problem solving is an activity that requires a person to choose a solution that can be done according to the abilities possessed by a person himself, meaning the movement between the current condition to the expected condition (Lucenario et al., 2016). So, problem solving is an individual cognitive activity directed at finding an answer solution in a situation that is not in accordance with his wishes in the form of a problem. Problem solving activities are carried out when students are faced with a problem or problem in which there are various possible answers that are used as solutions, the activity of finding possible answers is a form of problem solving process. Problem solving is a process that a person goes through in solving a problem (Helmon & Sennen, 2020).

Problem solving skills are a person's skills to try to find problems and solve them based on the information collected so as to get the right conclusion. Problem solving skills have a very important role in the world of education because one of the goals of education is to train individuals who can overcome the problems they face in real life (Memnun et al., 2012). This problem solving skill is a basic skill that a person must have that can be used in various fields in everyday life (Kaya et al., 2014). Problem solving skills are a skill of defining a problem, determining the cause of the problem, prioritising, selecting various solution options and implementing the solution (Dörner & Funke, 2017). Learners can use problem-solving skills to identify societal needs and develop innovative solutions to meet those needs (Kwangmuang et al., 2021).

Problem solving skills consist of several skills that are related to each other such as reasoning, planning, and decision making (Greiff et al., 2014). Problem-solving skills are important in various places and conditions to help deal with challenges and innovations. These challenges require them to be professional experts and skilled problem solvers (Özreçberoğlu & Çağanağa, 2018). Problem solving skills are skills based on the process of identifying problems, finding alternative solutions, and applying the best solution in a relatively new situation (Graesser et al., 2018), (Pinter & Čisar, 2018), (Araiza-Alba et al., 2021).

Methods

This design uses a quantitative approach, with the type of experimental research. The experiment research carried out is a quasi-experiment. The quasi experiment tests whether there is a causal relationship between the independence and dependent variables (Loewen & Plonsky, 2016). In simple terms, this quasi-experimental research leads to testing the independence variable as the influencing variable to the dependent variable as the affected variable. The form of quasi experimental design that was applied was nonequivalent pretest-posttest control group design. One of the most widely used experimental designs in educational research involves an experimental group and a control group given a pretest and posttest (Campbell & Stanley, 1966). This design empirically assesses differences in the two groups (Gribbons & Herman, 2019), namely the experimental group and the control group that has been divided, in the control group and the experimental group are groups that gather naturally such as classrooms not randomly, can be tested using a pretest, then given treatment to one group or the other under the control of the researcher, and after being given the treatment then tested again with a posttest. In the nonequivalent pretest-posttest control group design, the control group is not randomised, but is adjusted to the group given the intervention (e.g. with regard to type, number, etc.) (Miller et al., 2020).

The experimental class was given the treatment of problem-based learning in a flipped classroom environment, while the control class carried out learning activities with conventional learning. The research gave a pretest with the aim of knowing the initial skills of students in each class, both classes were given a pretest-posttest with the same test tool. This study aims to determine the effect of independence variables on dependent variables. The dependent variable is problem-based learning in a flipped classroom environment and learning motivation, while the independence variable is learning independence and problem solving skills.

The study used a 2x2 factorial design. The choice of factorial design is based on the implementation of research having two or more independence variables that affect the dependent variable (Fraenkel et al., 2012). The two variables together are also examined for their influence on the dependent variable, which is called interaction. Interaction is the cooperation or mutual influence (speeding up or slowing down) of two or more independence variables on one independence variable can affect the dependent variable depending on the level or level of other independence variables. The study applied a 2x2 factorial design because there were two independence variables, namely learning (problem-based learning in a flipped classroom environment and conventional

learning) and learning motivation with two dimensions of high learning motivation and low learning motivation. The dependent variables studied were learning independence and problem solving skills.

Finding/Result

Normality test was conducted on the data of the results of learning independence and problem solving skills. The normality test used the Kolmogorov-Smirnov test with the following detailed results:

Table 1. Normality Test

One-Sample Kolmogorov-Smirnov Test		Learning Independence	Problem Solving Skill
N		128	128
Normal Parameters[a,,b]	40.28	80.51	80.43
	7.103	8.438	8.442
Most Extreme Differences	.068	.117	.114
	.068	.110	.114
	-.059	-.117	-.113
Kolmogorov-Smirnov Z		.773	1.322
Asymp. Sig. (2-tailed)		.589	.061
a. Test distribution is Normal.			
b. Calculated from data.			

Based on Table 1, the data distribution is normal. It can be seen that the value of learning independence and problem solving skills obtained a significance value of 0.589 and 0.061, more significant than 5% significance or > 0.05.

Table 2. Homogenity Test

Levene's Test of Equality of Error Variances[a]	F	df1	df2	Sig.
Learning Independence	.220	3	124	.882
Problem Solving Skill	.721	3	124	.541

Based on Table 2, the data distribution is homogeneous. This can be seen in the value of learning independence and problem solving skills significance level of 0.882 and 0.541, more significant than 5% significance or > 0.05. After all data meets the requirements for normal and homogeneous distribution. Furthermore, the results of the MANOVA test (consisting of Tests of Between-Subjects Effects, average results, and relationship results between variables) are presented in Table 3.

Table 3. Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Learning Independence	3081.375a	3	1027.125	38.288	.000
	Problem Solving Skill	1267.773b	3	422.591	6.740	.000
Intercept	Learning Independence	207690.125	1	207690.125	7741.944	.000
	Problem Solving Skill	829633.008	1	829633.008	13232.776	.000
Learning	Learning Independence	903.125	1	903.125	33.665	.000
	Problem Solving Skill	508.008	1	508.008	8.103	.005
Level_of_Learning_Motivation	Learning Independence	903.125	1	903.125	33.665	.000
	Problem Solving Skill	431.445	1	431.445	6.882	.010
Learning * Level_of_Learning_Motivation	Learning Independence	1275.125	1	1275.125	47.532	.000
	Problem Solving Skill	328.320	1	328.320	5.237	.024
Error	Learning Independence	3326.500	124	26.827		
	Problem Solving Skill	7774.219	124	62.695		
Total	Learning Independence	214098.000	128			
	Problem Solving Skill	838675.000	128			
Corrected Total	Learning Independence	6407.875	127			
	Problem Solving Skill	9041.992	127			

| a. R Squared = .481 (Adjusted R Squared = .468) |
| b. R Squared = .144 (Adjusted R Squared = .123) |

Table 4. Mean Value of Learning on Learning Independence and Problem Solving Skills

Dependent Variable	Learning	Mean	Std. Error	95% Interval	Confidence
				Lower Bound	Upper Bound
Learning Independence	Problem Based Learning in a Flipped Classroom Environment	42.938	.647	41.656	44.219
	Convensional	37.625	.647	36.344	38.906
Problem Solving Skill	Problem Based Learning in a Flipped Classroom Environment	82.500	.990	80.541	84.459
	Convensional	78.516	.990	76.557	80.475

Table 5. Mean Value of Learning Motivation on learning independence and problem solving skills

Dependent Variable	Level_of_Learning_Motivation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Learning Independence	High	41.656	44.219	41.656	44.219
	Low	36.344	38.906	36.344	38.906
Problem Solving Skill	High	80.385	84.303	80.385	84.303
	Low	76.713	80.631	76.713	80.631

Table 6. Mean Value of Learning and Learning Motivation on Learning Independence and Problem Solving Skills

Dependent Variable	Learning	Level_of_Learning_Motivation	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Learning Independence	Problem Based Learning in a Flipped Classroom Environment	High	48.750	.916	46.938	50.562
		Low	37.125	.916	35.313	38.937
	Convensional	High	37.125	.916	35.313	38.937
		Low	38.125	.916	36.313	39.937
Problem Solving Skill	Problem Based Learning in a Flipped Classroom Environment	High	85.938	1.400	83.167	88.708
		Low	79.063	1.400	76.292	81.833
	Convensional	High	78.750	1.400	75.980	81.520
		Low	78.281	1.400	75.511	81.052

Discussion

1. The effect of problem based learning in a flipped classroom environment on learning independence

The difference in the average value of learning independence using problem-based learning in a flipped classroom environment and conventional learning can be seen in (table 4). The acquisition of the average value in the experimental group of (42.938) is greater than the acquisition of the average value of the control group of (37.625). The effect of problem-based learning in a flipped classroom environment on learning independence based on the test of between-subjects effects analysis in (table 3) which shows a significance value of 0.000 <0.050, it can be concluded that there is an effect of problem-based learning in a flipped classroom environment on learning independence.

2. The effect of problem based learning in a flipped classroom environment on problem solving skills

The difference in the average value of learning independence using problem-based learning in a flipped classroom environment and conventional learning can be seen in (table 4). The acquisition of the average value in the experimental group of (82.500) is greater than the acquisition of the average value of the control group of (78.516). The effect of problem-based learning in a flipped classroom environment on learning independence based on the test of between-subjects effects analysis in (table 3) which shows a significance value of 0.005 <0.050, it can be concluded that there is an effect of problem-based learning in a flipped classroom environment on learning independence.

3. The effect of learning motivation on learning independence and problem solving skills

The difference in the average value of learning independence with high and low levels of learning motivation can be seen in (table 5). The acquisition of the average value in the experimental group of (41.656) is greater than the acquisition of the average value of the control group of (36.344). The effect of learning motivation on learning independence based on the test of between-subjects effects analysis in (table 3) which shows a

significance value of 0.000 <0.050 can conclude that there is an effect of learning motivation on learning independence.

These results are in accordance with the results of previous studies which show that There is a positive and significant influence of learning motivation on learning independence (Yusuf et al., 2017). Another result show that learning motivation increases students' learning independence (Eriyanto et al., 2021). Another result show the learning motivation has a positive and significant effect on learning independence (Wulanningtyas & Fauzan, 2022). Another results there is a positive and significant influence between learning motivation on student learning independence (Rahmawati et al., 2023).

4. The effect of learning motivation on problem solving skills

The difference in the average value of problem solving skills with high and low levels of learning motivation can be seen in (table 5). The acquisition of the average value in the experimental group of (80.385) is greater than the acquisition of the average value of the control group of (76.713). The effect of learning motivation on problem solving skills based on the test of between-subjects effects analysis in (table 3) which shows a significance value of 0.010 <0.050, it can be concluded that there is an effect of learning motivation on problem solving skills.

These results are in accordance with the results of previous studies which show that learning motivation were significantly influenced by problem solving skill (Hutajulu et al., 2019). Another result show that the results indicated that one of the efforts to improve students' problem solving skills was to develop student learning motivation (Zubaidillah et al., 2022). Another result show that there is an influence of student learning motivation on students' problem solving skill (Asmar & Delyana, 2022). Another results show that the learning motivation had a effect on problem solving skill (Ayunia & Marlena, 2022).

5. The interaction of problem based learning in a flipped classroom environment on learning independence

Based on the calculation in (table 6). The acquisition of the average value in the group taught with problem-based learning in a flipped classroom environment on learning independence with high motivation of (48.750) is higher than the acquisition of the average value of students with low motivation of (37.125). While the group taught with conventional learning with high motivation of (37.125) is higher than the acquisition of the average value of students with low motivation of (38.125). The interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence based on the test of between-subjects effects analysis in (table 3) which shows a significance value of 0.000 <0.050, it can be concluded that there is an interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence.

In addition to learning models, learning motivation is also very necessary in learning activities. There are research results that learning motivation can also affect learning independence, the results showed that there is an effect of learning motivation on learning independence (Septiana & Sholeh, 2021), another results show that (Laili, 2021). Another results showed that learning motivation has a positive and significant effect on learning independence (Arista et al., 2022). And another results showed that there is a significant influence of learning motivation variables on student learning independence (Trisnawaty et al., 2022).

6. The interaction of problem based learning in a flipped classroom environment on problem solving skills

Based on the calculation in (table 6). The acquisition of the average value in the group taught with problem-based learning in a flipped classroom environment towards problem solving skills with high motivation of (85.938) is higher than the acquisition of the average value of students with low motivation of (79.063). While the group taught with conventional learning with high motivation of (78.750) is higher than the acquisition of the average value of students with low motivation of (78.281). The interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence based on the test of between-subjects effects analysis in (table 4.3) which shows a significance value of 0.024 <0.050, it can be concluded that there is an interaction of problem-based learning in a flipped classroom environment and learning motivation on problem solving skills.

These results are in accordance with the results of previous studies which show that the problem based-flipped classroom learning was effective in independent learning (Dhawo, 2019). Another results show there is an effect of problem based flipped classroom learning model on problem solving skills (et al., 2023). Another results show that problem-based learning integrated in a flipped classroom can improve problem-solving skills (Pimdee et al., 2024). In addition to learning models, learning motivation is also very necessary in learning activities. There are research results that students who have high learning motivation will have better problem solving skills than students who have low learning motivation (Harefa, 2018). Another results show that there is a significant influence between learning motivation on students' problem solving skill (Fatimah et al., 2018). And another results show that there is an effect of student learning motivation on problem solving skills (Pohan et al., 2020)

Conclusions

Based on the results of research and discussion, the results obtained are as follows: (1) There is an effect of problem-based learning in a flipped classroom environment on learning independence, (2) There is an effect of problem-based learning in a flipped classroom environment on problem solving skills, (3) There is an effect of learning motivation on learning independence, (4) There is an effect of learning motivation on problem solving skills, (5) There is an interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence, (6) There is an interaction of problem-based learning in a flipped classroom environment and learning motivation on learning independence and problem solving skills of students in the experimental group compared to the control group who applied the conventional learning model.

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