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# Enhancing Students' Future Problem-solving Skills for Educational Internship Preparation

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**Abstract**

The goal of this study was to assess the future problem-solving skills of students as they prepare for an educational internship program. The research used an experimental design and involved five universities in Indonesia. There were a total of 10 class groups, with five acting as control groups and five as experimental groups. The study included 300 students and five prerequisite course lecturers, and a random sampling technique was employed. Three instruments—a problem-solving test, a future problem-solving test, and a standardized achievement test—were administered to all participating students. The results indicated that the design of educational internship prerequisite courses with a future problem-solving approach significantly impacted students' ability to come up with original problems. However, it did not improve the contextuality, complexity, and diversity of issues proposed. The study focused on designing, implementing, and evaluating prerequisite courses for educational internships to improve problem-solving skills, future problem-solving skills, student beliefs about the physical education and health teaching profession, and attitudes toward posing academic problems as future educators. Additionally, the study developed a framework for teaching and assessing problem submission.

## 1. Introduction

We face problems of one kind or another every day of our lives. Two-year-olds have trouble climbing out of their bed without help. Teenagers need help living with less pocket money than all their friends. Problems come in all shapes and sizes, from small and simple to large and complex, as well as from small and complex to large and simple (Robertson, 2017). The types of problems we face vary in the amount of structure they provide. Problems are often represented in a continuum from well-structured to moderately structured to unstructured. The position of the problem on this continuum determines how it is taught and learned (Foshay & Kirkley, 1998).

Problem-solving is an activity in which a learner perceives a discrepancy between the current state and the desired state of the goal, recognizes that this discrepancy has no clear or routine solution, and then tries to act according to the situation at hand to achieve that goal. This is accompanied by several mental and behavioral processes that may not necessarily be sequential but can run in parallel. One approach to conceptualizing this idea has been taken by the PISA group in their problem-solving framework (Care et al., 2018).

Problem-solving has become a trend in education, even today. In physical education learning with outdoor activities and exploration, there is no requirement to develop a creative approach. Students should use problem-solving skills, which are very different from the creative process (Lavin, 2008).

Problem-solving has received wide public attention as an important competency in modern society. In large-scale assessments, paper-based pencil-based analysis is first included (e.g., Program for the Assessment of International Students, PISA 2003) (Greiff et al., 2013). With increasing interest in more complex situations, the focus has shifted to solving interactive problems (e.g., PISA 2012) that require the identification and control of complex systems. Going forward, collaborative problem-solving is the next step in assessing problem-solving abilities. These findings show that problem-solving skills themselves continue to develop along with the increasingly complex problems that exist in the real world.

As the nation's next generation, students must solve current problems and identify, analyze, recognize, and formulate creative solutions to future problems, for example, problems in 10 or 20 years. The idea of understanding contextual insights is highlighted to better direct higher education to meet the specific needs that Industry 4.0 presents to education today (Ritter, 2021). The term future problem-solving (FPS) is known to facilitate this in learning. According to research conducted by Dwiyogo (2014) on 466 respondents (lecturers and teachers), the majority of respondents (62%) had integrated FPS into their learning through questions about the realities that exist in everyday life.

Teachers' abilities to use facilitation skills during the small group learning process determines the quality and success of any educational method that aims to (1) develop students' thinking or reasoning skills (problem-solving, metacognition, critical thinking) as they learn and (2) help them become independent and independent learners (learn to learn, learning management). Guidance is a teaching skill centred on problem-based independent learning (Rovai, 2004). Problem-solving plays an essential role in all scientific disciplines, and solving problems can reveal essential concepts that underlie those disciplines. Thus, problem-solving serves both as a common tool and as a desired outcome in many science classes (Frey et al., 2022).

Problem-solving styles represent consistent differences in the way individuals generate and solve problems. This includes the individual's disposition toward problem-solving, influenced by mindset, engagement, and attitude. The cognitive style includes nearly a century of research into how creativity is defined, and individuals navigate the problem-solving process. Three constructs of learning style, cognitive style, and psychological type are derived from the literature as key components underlying the problem-solving style dimensions (Main et al., 2019). Problem-solving can be modeled as where one traverses the "problem space" (Stockdill et al., 2021). The problem solver tries to achieve the goal by applying the current state of affairs. Problem-solving skills have an impact on their ability to navigate the problem space, and they have control over the problem space so they can solve it appropriately (Kiong et al., 2022). However, by choosing an effective representation, the solution to the problem space can be encouraged better if the solver is an expert.

To present problem-solving skills better and more precisely, most educators use a problem-solving-based learning approach. Educators use problem-solving procedures in discussing the material presented. The problem-based learning approach is very focused on solving the problems faced at that time with a series of systematic procedures. On the other hand, every step taken in solving problems has consequences in the future, which is often forgotten in problem-solving-based learning.

In this study, the problem-solving process is not just a procedure for critical thinking, systematic and limited to certain problems, but is equipped with a problem-solving support application. Many programs and methods support the educational application of the creative problem-solving process. Torrance and Torrance established FPS as a national program with interscholastic competition and a curriculum project that integrates CPS (creative problem-solving) and future studies (Torrance et al., 1976). One of the components of FPSPI is Global Issues Problem-solving (FPSPI-GIPS). Students are given complex problems and asked to gather facts and ideas to address specific problems involving business and economics, science and technology, or social and political themes. The aim is to develop critical and creative thinking skills so that students can better tackle the topic throughout their lives (Main et al., 2019).

FPS is an international educational program for students of all ages from P-12 to develop creative thinking skills. Future problem-solving is also one of the innovations in education in its various forms, both in the form of model structures and future problem-solving skills (Cramond & Fairweather, 2013). In particular, this FPS focuses on problem identification skills and positive solutions to those problems. Moreover, FPS aims to provide youth with the skills to design and promote a positive future for the communities in which they live (Future Problem Solving Program International, n.d.). The goal of Future Problem-solving is basically to develop critical, creative, and futuristic thinking skills. It challenges students to apply their imagination and thinking skills to some of the significant problems facing the world today. In the future, they will have the skills and vision needed to anticipate, understand, and solve problems associated with these issues, helping them achieve a positive impact on the future society.

The results of several intervention studies on the application of future problem-solving in various learning or training activities have shown positive results both in the long-term and short-term outcomes of students, especially in future careers (Main et al., 2019; Cramond & Fairweather, 2013; Azevedo et al., 2019; Gerlach et al., 2011; Kale & Whitehouse, 2012; Kurtzberg & Kurtzberg, 1993; Noreen et al., 2015; Treffinger et al., 2012).

Future problem-solving is offered as a program that can be incorporated into existing content to support the learning of academic content, introduce and strengthen critical skills, address social and emotional needs, and encourage innovative thinking tendencies as well (Cramond & Fairweather, 2013). The main purpose of developing a learning model is to make students learn. Learning is the acquisition of new mental schemas, knowledge, abilities, skills, and skills, which can solve potentially more successful problems and further experiential decision-making, which enhances "doing" to achieve an effective understanding of knowledge (Alonso et al., 2005).

Learning models can increase interaction, an important element of any learning environment (face-to-face classroom-based education, online synchronous/asynchronous, or mixed models), in addition, utilizing technology in certain learning models is believed to be able to improve the quality of interaction in learning (Woo & Reeves, 2007). However, the learning system has different interaction patterns in various learning models, both passive and active models. In research conducted by Carlson and Falk, a series of active and passive learning models have been used to develop third-level interactive videodiscs for core education and college in-service in the human service profession (Carlson & Falk, 1990). This means that the help of technology allows diverse patterns of interaction in learning. Active and passive learning models can also be integrated into one learning model. However, until now, there are still very few references regarding future problem-solving-based learning designs for undergraduate students in Indonesia. So, this research aims to find out future problem-solving-based learning designs that are appropriate and capable of developing problem-solving abilities in students.

## 2. Materials and Methods

This study uses a research and development procedure developed by Borg and Gall with ten steps of development: 1) the collection of information; (2) planning, designing, and developing the program; 3) product/model/program tryout; (4) product/model/program improvement; 5) try out; 6) improvement; 7) operational try out; 8) product/model/main program improvement; 9) final revision; 10) product/model/program distribution and development (Borg & Gall, 1984). The researcher modified this step into three stages to facilitate the implementation of the research. The first stage is collecting and preparing materials, the second stage is the development of designs and supporting devices, and the third stage is implementation.

The first stage aims to identify goals and conduct a literature study used as the basis for preparing the learning design that will be used. The formulation of learning objectives at this stage is carried out by analyzing learning, including the environment and students, and the expected performance goals based on literature studies related to the curriculum and the concept of visionary-related competencies (1st steps).


**Fig. 1** *Framework related to global issues*

The second stage is to develop a learning design and its supporting devices (learning resources), which can realize the achievement of the learning objectives formulated in the first stage. At this stage, we used a development method with learning design products that related experts validate (2nd step). Figure 1 is a learning design framework based on future problem solving, which refers to Global Issues Problem Solving (Future Problem Solving Program International, 2023). The third stage is to apply the results of the development in the second stage, using the true experiment (two-group pretest-posttest with control group design). Researchers apply the learning design to the assessment stage (3rd – 10th Steps).

## 2.1 Participant

The lecture program takes place in 10 classes consisting of 5 control classes and five experimental classes with 300 students (mean age = 21 years) from five universities in West Java and North Sumatra. Five classes in each university were designated as experimental classes, and another five classes, with 30 students per class, acted as control groups. The sampling technique used to determine the subjects of this research was the random sampling technique. Participants were taken in this research using random sampling techniques. The number of students with a field-independent cognitive style is 65.625%, while those with a field-dependent cognitive style are 34.375%. Five experimental lecturers with approximately 20 years of teaching experience and five control class lecturers with approximately 19 years of teaching experience participated in this program. Each of them is responsible for one class, and their duties include teaching the prerequisite courses for an internship and some day-to-day managerial duties. Before participating in this study, the students had some occasional experience in problem-solving activities, as some problem-solving situations arose in several other courses to fulfill the problem-solving objectives described in the Indonesian Curriculum Standards for Education.

## 2.2 Instrument

To establish construct validity, the scale was carried out on a sample of 50 students from different universities. The researcher calculated the correlation coefficient between the study dimensions, which showed that the correlation coefficient between the dimensions was high and there was statistical significance at the level ($\alpha \leq 0.05$). Before and after the intervention, three instruments—a problem-solving test, a future problem-solving test, and a standardized achievement test—were administered collectively in all participating classes. The first two instruments were administered in two sessions on two consecutive days, just before and after the intervention, and each session lasted approximately 65 minutes. In the first session, the experimental and control classes were given a cognitive style questionnaire, and in the next session, a future problem-solving worksheet was given. Standard achievement is the result of student learning in completing the final lecture exam given to students as a final exam in the first semester carried out in each place. The calculations indicated that the scale's construct validity was acceptable. This is also consistent with the purpose of the study, which measures students' future problem-solving skills. The reliability coefficient was calculated using a retest within two weeks of applying the test to the sample to verify the reliability scale. Reliability ranges from (0.82–0.94), an appropriate value for this study.

## 2.3 Procedure

The problem-solving-based learning approach needs to be strengthened with future orientation, and this is accommodated in the future problem-solving-based learning model conducted in this study. In previous studies, the problem-solving environment became the appropriate methodology for computational science. Problem-solving is often an iterative process involving changes to specifications, strategies, and objectives (Houstis & Rice, 2000). Computational science presents the characteristics of a structured problem (well-structured), meaning that the goals and ways to achieve them are clear. However, in social sciences, such as education, some of the problems are well-structured and ill-structured (obvious goals, but the means used to achieve goals can be very diverse). Therefore, in this study, researchers present supporting features that can stimulate other problem-solving skills found in future problem-solving.

The implementation process of FPS steps is as follows: 1) identify challenges related to the topic or future scene; 2) select an underlying problem; 3) find solutions to the underlying problem; 4) generate and select criteria to evaluate solution ideas; 5) evaluate solution ideas; 6) develop an action plan (Future Problem Solving Program International, n.d.).

## 2.4 Hypothesis

We predict that in the experimental group, having the ability to solve future problems, beliefs, attitudes, and final exam results of students who have better scores—compared to the control group—there will be a much greater improvement from the pretest to posttest.

## 2.5 Data Analysis

After getting the results on the paired t-test, analysis of the data in this study involved calculating FPS skills before and after treatment on each independent variable using IBM SPSS Modeler 16.0. Then, a comparison between the two treatments was carried out to determine which results were more influential between the traditional model class and the class with the FPS model using an independent t-test. The relationship between variables is said to be significant when the value of sig (2-tailed) is less than 0.050 or 0.010 vulnerable. Meanwhile, when the value of sig (2-tailed) is more than that range, the relationship is said to be meaningless.

# 3. Results

The training program's impact on student outcomes on the three assessment instruments was analyzed by independent sample t-test, and an alpha level of 0.050 for all statistical tests was used. The results of this analysis are presented below.

## 3.1 Prerequisite Test Results

All tables should be numbered with Arabic numerals. Every table should have a caption. Headings should be placed above tables. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded into the text and not supplied separately. Below is an example which the authors may find useful.

**Table 1** *Normality test output table data on the future problem-solving ability of the experimental group and the control group*

| Tests of Normality | | | | | | |
|---|---|---|---|---|---|---|
| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Pretest Experiment 1 | .093 | 30 | .200* | .985 | 30 | .934 |
| Pretest Experiment 2 | .089 | 30 | .200* | .980 | 30 | .787 |
| Pretest Experiment 3 | .074 | 30 | .200* | .966 | 30 | .404 |
| Pretest Experiment 4 | .101 | 30 | .200* | .972 | 30 | .558 |
| Pretest Experiment 5 | .101 | 30 | .200* | .972 | 30 | .558 |
| Pretest Kontrol 1 | .106 | 30 | .200* | .972 | 30 | .562 |
| Pretest Kontrol 2 | .111 | 30 | .200* | .975 | 30 | .647 |
| Pretest Kontrol 3 | .111 | 30 | .200* | .956 | 30 | .217 |
| Pretest Kontrol 4 | .111 | 30 | .200* | .947 | 30 | .121 |
| Pretest Kontrol 5 | .111 | 30 | .200* | .947 | 30 | .121 |

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

Based on the output of paired sample statistics in Table 2, the following results are obtained. For the initial test scores, the average initial test results of the experimental group 1 or Mean were 26.906, posttest experimental 1 was 30.406, pretest experiment 2 was 34.468, and posttest experiment 2 was 37.937. While the average value of pretest experimental group 3 is 27.1250, posttest experiment 3 is 28.687, the average value of pretest experimental group 4 is 27.125, posttest experiment 4 is 28.687, pretest experimental 5 is 31.812, and posttest experiment 5 of 34.187. The subjects used as research samples were 150 students consisting of 30 experimental group students at five universities. For the value of the Standard Deviation in the initial test, each of 3.83834 for experiment 1; 4.499 for posttest experiment 1; 6.435 for pretest experiment 2; 6.122 for posttest experiment 2; 4.085 for pretest experiment 3; 4.665 for posttest experiment 3; 4.085 for experimental pretest 4; 4.665 for posttest experiment 4; 0,694 for pretest experiment 5; 0.695 for experiment 5.

**Table 2** *Output "paired samples statistics"*

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | Pretest Experiment | 26.906 | 30 | 3.838 | .678 |
| | Posttest Experiment | 30.406 | 30 | 4.499 | .795 |
| Pair 2 | Pretest Experiment | 34.468 | 30 | 6.435 | 1.137 |
| | Posttest Experiment | 37.937 | 30 | 6.122 | 1.082 |
| Pair 3 | Pretest Experiment | 27.125 | 30 | 4.085 | .722 |
| | Posttest Experiment | 28.687 | 30 | 4.665 | .824 |

| | | | | | |
|---|---|---|---|---|---|
| Pair 4 | Pretest Experiment | 27.125 | 30 | 4.085 | .722 |
| | Posttest Experiment | 28.687 | 30 | 4.665 | .824 |
| Pair 5 | Pretest Experiment | 31.812 | 30 | 6.944 | 1.227 |
| | Posttest Experiment | 34.187 | 30 | 6.958 | 1.230 |

Because the average value of the initial test results in experimental group 1 is 26.9063 < the final test 30.4063, descriptively, there is a difference in the average results of the initial test with the final test in the experimental group. However, to prove the difference between the experimental and control groups, it will be interpreted based on the "Independent t-test" output table. Furthermore, to find out the significance of the differences in the results of the initial and final tests for each group, it will be interpreted based on the following table of independent t-test output.

## 3.2 Independent t-Test Results

The following is the output table of the Independent Sample Test statistical test results on the variable of students' future problem-solving ability skills in the experimental and control groups (Table 3).

**Table 3** *Group FPS ability statistics*

| | Group | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Future Problem-Solving Skill Result | Experiment | 150 | 30.406 | 4.499 | .795 |
| | Kontrol | 150 | 28.687 | 4.665 | .824 |

Based on the output table of Table 3, the final test results for future problem-solving abilities of the experimental group students are 150 students, and in the control group are 150 students. The average value of future problem-solving ability final test results in the experimental group was 30.4063, while for the control group, it was 28.6875. Thus, statistically descriptive, it can be concluded that there is a difference between the results of the final test of future problem-solving abilities in the experimental group and the control group. Furthermore, to prove whether the difference is real (significant) or not, it will be interpreted through the following Independent Samples Test (Table 4).

**Table 4** t-*Test Results Independent samples test the future problem-solving abilities of the experimental group and the control group*

| | | 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 | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Posttest Future Problem Solving Ability | Equal variances assumed | 0.095 | 0.759 | 1.5 | 62 | 0.029 | 1.718 | 1.145 | -0.571 | 4.009 |
| | Equal variances not assumed | | | 1.5 | 61.919 | 0.029 | 1.718 | 1.145 | -0.571 | 4.009 |

### 3.2.1 Hypothesis Formulation

Ho : There is no significant difference in the average future problem-solving ability final test results between the experimental group and the control group.
Ha : There is a significant difference in the average future problem-solving ability final test results between the experimental group and the control group.

### 3.2.2 Decision-making

1. If the value of Sig. (two-tailed) < 0.05, then Ho is rejected, and Ha is accepted
2. If the value of Sig. (two-tailed) > 0.05, then Ho is accepted, and Ha is rejected

Based on the output table above, it is known that the value of Sig. Levene's Test for Equality of Variances is 0.759 > 0.05, which means that the data variance between the experimental group and the control group is homogeneous or the same, so the interpretation of the output table above is guided by the values contained in the "Equal Variances Assumed" table.

Based on Table 4 in the "Equal Variances Assumed" section, the Sig value is known. (two-tailed) of 0.029 <0.05, so as a basis for decision-making in the independent samples t-test, it can be concluded that Ho is rejected and Ha is accepted. Thus, it can be concluded that there is a significant difference in the final test results of future problem-solving abilities between the experimental group and the control group.

The results of the Independent Sample Test statistical test on the variable results of the student final exam are presented in Table 5.

**Table 5** *Final examination statistics group*

| | Group | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Posttest final exam | Experiment | 150 | 37.937 | 6.122 | 1.082 |
| | Kontrol | 150 | 34.187 | 6.958 | 1.230 |

Based on Table 5, the number of final exam results for the experimental group students was 150 students, and in the control group, there were 150 students. The average value of the final exam results of students in the experimental group was 37.937, while for the control group, it was 34.187. Thus, statistically descriptive, it can be concluded that there is a difference between the final exam results in the experimental group and the control group. Furthermore, to prove whether the difference is real (significant) or not, it will be interpreted through the following Independent Samples Test (Table 6).

**Table 6** *T-Test results independent samples test the future problem-solving ability of the experimental group and the control group*

| | | 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 | 95% Confidence Interval of the Diff. | |
| | | | | | | | | | Lower | Upper |
| Posttest final exam | Equal variances assumed | 1.303 | 0.258 | 2.289 | 62 | 0.026 | 375.000 | 163.836 | 0.47496 | 702.504 |
| | Equal variances not assumed | | | 2.289 | 61.011 | 0.026 | 375.000 | 163.836 | 0.47391 | 7.02609 |

## 3.2.3 Hypothesis Formulation

Ho : There is no significant difference in the average final exam results between the experimental group and the control group.

Ha : There is a significant difference in the average final exam results between the experimental group and the control group.

## 3.2.4 Decision-making

1. If the value of Sig. (two-tailed) < 0.05, then Ho is rejected, and Ha is accepted
2. If the value of Sig. (two-tailed) > 0.05, then Ho is accepted, and Ha is rejected

Based on the output table above, it is known that the value of Sig. Levene's Test for Equality of Variances is 0.258 > 0.05, which means that the data variance between the experimental group and the control group is homogeneous or the same, so the interpretation of the output table above is guided by the values contained in the "Equal Variances Assumed" table.

Based on the "Independent Samples Test" output table in the "Equal Variances Assumed" section, the Sig value is known. (two-tailed) of 0.026 <0.05, so as a basis for decision-making in the independent samples t-test, it can be concluded that Ho is rejected and Ha is accepted. Thus, it can be concluded that there is a significant (significant) difference in the final exam results between the experimental group and the control group.

## 4. Discussion

The structure of the learning model at least consists of approaches, strategies, methods, techniques, and tactics. The learning model provides an overview of the learning environment design that the lecturer wants to create. The learning model regulates various learning activities that will be carried out with certain rules to be able to achieve the specified learning objectives. The structure of the learning model has four special characteristics: 1) theoretical and logical rationale compiled by educators; 2) learning objectives to be achieved; 3) teaching steps that will be used so that the learning model can be implemented optimally; 4) learning environment created so that learning objectives are achieved (Al Khosim, 2017). This research has met the criteria for the implementation of ideal learning, namely conducting theoretical studies, environmental analysis, determining learning objectives, collecting materials, and learning designs using future problem-solving to implement strict evaluations.

This learning design is designed to provide various student learning experiences in solving various problems, especially task-oriented problems, and their roles in the future. Problems are something that can never be separated from life. Each problem has its characteristics, and each solution can vary. It becomes a problem when there is a discrepancy between the desired and the actual condition. Because of the complexity of the problems in life, it is necessary to have effective, efficient, creative, and correct problem-solving skills that students must possess. In learning, these skills are assisted by a problem-based learning model. Learning has a close relationship with problem-solving; "problem-solving and learning are tightly linked, and both are driven by impasses" (Langley & Choi, 2006). Learning and problem-solving have in common that something that hinders achieving the goal, whether it comes from yourself or from outside.

Problems are very easy to find in life, whether internal or global in scale. Internal problems include finding a job, getting a decent salary, finding a life partner, completing work assignments, and others. While global problems, such as prevention of globalization, humanitarian crises, religious tolerance, environmental pollution (water, land, air), and others. However, there must be room for finding a solution to every problem that arises. Optimism to find the right and creative solution to a problem is very important for everyone to have. According to Mayer, a problem occurs when, under certain circumstances, a goal state needs to be achieved, and there is no routine solution method available. In the learning design used in this study, researchers used examples of problems classified within the boundaries of the educational profession, more specifically, as a physical education teacher. This means problems that are relevant to the duties and roles of physical education teachers in the classroom and outside the classroom. The problems presented in the learning consist of problems related to teacher competence, problems related to teacher professionalism, problems related to continuous self-development, and problems related to changes in competence and global characteristics (Mayer, 2004).

Problem-solving is a basic skill required by today's students. Guided by the latest research in problem-solving, changing professional standards, new job demands, and new changes in learning theory, educators and trainers are revising the curriculum to include an integrated learning environment that encourages learners to use higher-order thinking skills, and in particular, problem-solving skills (Foshay & Kirkley, 1998). A learning environment with problem skills is known as problem-based learning (PBL). This study showed that during the learning process, most of the students already had a future design; however, they had never designed and put it in a written draft. Through the worksheets developed in this study, although it took a relatively long time, students could express their vision and ideas in writing with future problem-solving steps.

Future Problem-solving is a program in which students learn to tackle the complex scientific and social problems of the future through creative and comprehensive thinking processes. FPS takes students beyond rote memorization. This process challenges students to apply the information they gain through research to some of society's most complex problems. They are asked to think, make decisions, and, in some cases, implement solutions. The results showed that by guiding students to solve problems using worksheets, students were able to construct various alternative solutions, categorize and assess the most relevant solutions to be used as good action plans. They present their action plans confidently so that they get the maximum final score, not only in terms of academics but also in their attitude. They also show that they are getting better and more cohesive among group members and respect each other.

Although many scenarios are faced exclusively in the future, the problem-solving methods used are equally applicable to many of the complexities faced in today's world. FPS allows a wide scope for creative and futuristic thinking and encourages students to analyze and synthesize the information they had before them and express their ideas cohesively and fluently. In FPS, teamwork, critical thinking, decision-making, and time management are vital skills, skilled learn–how–to–learn (Alonso et al., 2005).

Moreover, to improve the competence and competitiveness of graduates, educational systems and practices in higher education must be designed to produce visionary university graduates. During their college years, students must experience how to deal with their problems effectively. Students also need to develop information literacy and use it to solve their problems, especially in an era where global citizens become e-citizens who need to equip themselves with e-learning skills. Students also need to be responsive to the problems that occur in society and have the know-how to focus on the problem areas they are most likely to solve without excluding the possibility of working interdisciplinary with other professionals from other relevant fields.

Learning models can increase the interactions that occur during the learning process, given that interaction is an important element of any learning environment (face-to-face classroom-based education, online synchronous/asynchronous, or mixed models). Also, utilizing technology in certain learning models could improve the quality of interaction in learning (Woo & Reeves, 2007). However, the learning system has different interaction patterns in various learning models, both passive and active models. In research conducted by Carlson and Falk, a series of active and passive learning models have been used to develop third-level interactive videodiscs for core education and college in-service in the human service profession (Carlson & Falk, 1990). This means that technology allows diverse patterns of interaction in learning. Active and passive learning models can also be integrated into one learning model.

Learning approaches can be integrated into a learning model in a certain way. The concept of a comprehensive approach centered on lecturers, students, and learning resources in collaboration with the concept of future problem-solving that demands the performance of hard skills and soft skills reflects the characteristics of modern, visionary learning. The collaboration between the two becomes a learning model framework that will greatly help lecturers develop quality and meaningful learning processes.

Based on the findings in this previous study regarding the process of solving future problems (FPS) for students, a theoretical model of the problem-solving process for FPS for undergraduate students was found. FPS comprises six steps: (1) identifying challenges, (2) determining the underlying problem, (3) finding a solution, (4) determining the criteria for achieving a solution, (5) resolving urgent problems, (6) developing an action plan.

The FPS process starts with reading the student worksheet (LKM) carefully. Students carry out a search process in their cognitive structure to understand the student worksheet (LKM) that will be realized in sentences at each step, which consists of classifying, differentiating, comparing, and selecting relevant information. The cognitive structure consists of two types, namely (facts, concepts, and principles) and activities (if...then...). The two cognitive structures are called declarative knowledge and procedural knowledge. The search process carried out includes activities to understand and compare terms, variables, facts, and relationships in the student worksheet (LKM) with students' cognitive structure. The LKM is structured to systematically direct the use of both declarative and procedural cognitive structures simultaneously. This is because LKMs are structured to present patterns of both ill-structured and well-structured problems. Suppose students have sufficient declarative and procedural knowledge to answer problems at each step. In that case, students will make internal and external representations to transform their understanding of problems in the LKM into a pattern of FPS. Internal representations cannot be described because they are abstract in students' minds. Meanwhile, external representations can be described through the results of student LKM work in the form of images, symbols, or other real objects around them.

## 5. Conclusion

The structure of the learning model at least consists of approaches, strategies, methods, techniques, and tactics. The learning model provides an overview of the learning environment design that the lecturer wants to create. The learning model regulates various learning activities that will be carried out with certain rules to be able to achieve the specified learning objectives. The structure of the learning model has four special characteristics: 1) theoretical and logical rationale compiled by educators; 2) learning objectives to be achieved; 3) teaching steps that will be used so that the learning model can be implemented optimally; 4) learning environment created so that learning objectives are achieved. This research has met the criteria for the implementation of ideal learning, namely conducting theoretical studies, environmental analysis, determining learning objectives, collecting materials, and learning designs using future problem-solving to implement strict evaluations.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

The authors confirm contribution to the paper as follows: ***comseptualization:*** *Yusmawati and Moh. Fathur Rohman;* ***methodology:*** *Yusmawati and Moh. Fathur Rohman;* ***data curation:*** *Yusmawati and Moh. Fathur Rohman;* ***viasualization, validation, and investigation****: Dinsin Abidin;* ***draft manuscript preparation:*** *Yusmawati, Moh. Fathur Rohman, and Moch. Asmawi;*

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