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THE INFLUENCE OF THE PROBLEM-BASED LEARNING MODEL WITH PORTFOLIO ASSESSMENT OF SCIENTIFIC WRITING ABILITY BY STUDENTS' COGNITIVE STYLE CONTROL

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Abstract. This research aims to determine the Influence of the Problem-Based Learning Model (PBM) with portfolio assessment on the ability to write scientific writing with variable cognitive style. The study employs an experiment with a posttest-only control group design. The sample is 66 students; it is taken randomly based on class. The research instrument is a test (rubric) of work performance and cognitive style. It is analyzed in one-way ANOVA. This research finds that 1) H_1 is accepted because F_{count} 22,964 (0,00) <0,05. It means there is a difference in the capability in scientific writing between the students who join the PBM model with portfolio assessment compared to those who join the conventional learning model; 2) H1 is accepted because F_{count} 6,756 (0,012) <0,05. It means that after co-variable cognitive is controlled, there is a difference in scientific writing ability for those students that join the PBM Model with portfolio assessment compared with the students that join the conventional learning model; 3) H_1 is accepted because F_{count} 27,512 (0,000) <0,05. It means that covariable cognitive style significantly contributes to the capability in scientific writing at 30,1%. The rest is 69,9, which is contributed to another variables beyond this study

Keywords*: *problem-based learning model, portfolio assessment, cognitive style, scientific writing

INTRODUCTION

Nowadays, the world of education is stricken by many demands and society's requirements. At the same time, the world of education is in demand to answer the complicated local and global problems, which are growing massively. The exchange and the difficulties encountered involve all the dimensions of human life, such as the unstoppable development of science, technology, art, and culture. Indonesia is part of a global community that is in demand to improve the quality of human resources to answer all the needs of exchange and the global problem that might go along and compete with other nations (Darling-Hammond et al., 2020; Nanotek & Benu, 2022). Constitution article number 12 in 2012 explains that to improve the competition between the nations, higher education is required to enhance the knowledge and technology to produce creative and innovative scientists for Indonesia's future. The data proves its presence in creating the country through the curriculum program.

Scientific writing is an intuitional subject that aims to prepare students to know and develop skills related to scientific writing. Writing skills are required for the student's

final task (such as thesis) (Natonis et al., 2024) and referring to research findings that should be communicated to others in written text (Ngongo & Benu, 2020). Writing is a skill everyone should master, particularly those who work in the academic field (students and lecturers). However, writing is a serial, repeating activity as the expression of thought in written text. Besides, scientific writing is a systematic and scientific composition (Benu et al., 2022). Thus, it is understandable that scientific writing is a continuous process. This constant process can help the individual student become proficient in writing. The output composition or writing is organized systematically, logically, and rationally (Nenotek et al., 2024). The teaching of scientific writing is aimed to form the skill or proficiency in students' scientific writing according to the correct chosen learning model.

These days, the instruction expert offers many innovative learning models to be applied in the learning process—the problem-based subject is one of the creative learning models (Pashler et al., 2009; Anggreni et al., 2023). Problem-based subjects are a set of teaching models that use problems as the focus to develop problem-solving skills, material, and self-control (Simatupang et al., 2023; Arifin et al., 2024). Furthermore, the problem-based subject model has three characteristics as follows: (1) The subject is focused on problem-solving, (2) the responsibility to solve the problem relies on students, (3) The teacher or the lecturer supports the process at the time of the students to solve the problem.

Applying a problem-based subject model in classrooms will make the learning process meaningful because the learners are required to be able to solve the problem, including in scientific writing (Gebrekidan & Zeru, 2023). Two ideas related to the aim of learning. *First*, the learners must solve the specific problem and understand the related material. *Second*, the learners must improve their ability to solve the problem and become independent learners (Muhadharah et al., 2018; Megawati & Nursalam, 2022; Lelapary, 2022). The way to help the learner fulfil these aims is through the problem-based learning model, which is divided into four phases: 1) Phase 1: Review and present the problem. This is the phase where the teacher or lecturer is tasked to review the required knowledge in solving the problem and give the learner a specific and concrete problem to solve. Phase 2: Arrange the strategy. In this phase, the learners are assigned to arrange the plan to solve the problem, and the teacher gives the strategy feedback. Phase 3: Strategy Application. The learners apply their strategies when the teacher or lecturers supervise their efforts and provide feedback. Phase 4: Discussion and result evaluation.

The teachers or lecturers lead the discussion about the learners' efforts and their results. There are three prominences of the problem-based learning model: 1) Learning problems are designed to help the learners develop their thought skills, problem-solving skills, and sharpen intellectuality skills; 2) Problem-based learning model motivates the learner to have a mature role as well as to keen social skills; 3) Problem-based learning model create the learners become independent and autonomy (Kurniawati et al., 2023; Islamiati et al., 2024).

In the university context, the problem-based learning model is suitable for use in the learning process (Dharma & Adiwijaya, 2018; Nisa et al., 2023; Paramitha et al., 2023). If it is seen as characteristic of the problem-based learning model, it also

becomes a characteristic process in the university, such as independent study by structured assignment (Wenno et al., 2021). Giving assignments helps the learning process become exciting, effective, and efficient. Giving the assignment might allow the students to get new information, apply, analyze, or even evaluate the information. In addition, the assignment will help the students to think creatively. The other privilege of giving assignments is to create students centred in the learning process.

To improve students' ability to write scientific writing, the students are not only by the choice of the precise learning, but also the correct assessment influences it. One of an accurate assessments of scientific writing is a portfolio assessment (Ngui et al., 2022). The portfolio is the collection of individual work, which is a collection of artefacts (work evidence/activity/data) as evidence to show progress and achieve a program (Halim et al., 2019; Hakim & Srisudarso, 2020). Portfolios have been used in evaluation, particularly in language education. Lately, by the curriculum orientation in basic competence, portfolio assessment become the excellence in class basic assessment. Furthermore, it can be said that portfolio assessment contains three main elements, those are: (1) a work sample of the learners, (2) self-evaluation, and (3) an open and transparent criteria of assessment (Ngui et al., 2022; Wijaya, 2022).

Thus, it is understandable that the portfolio assessment is used precisely to measure the student's ability to compose scientific writing (Kuswardani et al., 2022; Ngui et al., 2022). A work performance test (rubric) based on the three essential elements of the portfolio is used to assess the student's ability in scientific writing. Besides the learning model factor and the kind of assessment, another factor influences students' ability to write scientific writing, such as cognitive style. Cognitive style is one variable that affects students' learning choices, which is how people arrange what is seen, remembered, and thought (Abu Bakar & Ali, 2018; Margunayasa et al., 2019). Cognitive style, the individual characteristic that differentiates individuals, is shown by organizing and managing information and personal experiences (Arifin et al., 2020; Tambi, 2021; Zulfahmi & Melani, 2024). Cognitive style is the student's specific way of learning, either related to acceptance and information management, the attitude towards the information, or the habit related to the learning environment (Rahayu et al., 2021; Anggreni et al., 2023). The cognitive style is the individual characteristic of thinking, feeling, memory, solving problems, and making decisions (Safaruddin et al., 2020; Cai et al., 2021). The variation in cognitive style is differentiated into dimensions those are 1) The different dimensions of the psychology aspect consisting of Field Independent (FI) and field dependent (FD); 2) the Time dimension of concept understanding that contains impulsive style and reflective style (Septantiningtyas & Subaida, 2023). Based on the explanation above, cognitive style can be said to be the student's particular way of achieving, managing information, and responding to stimuli in the learning environment, which is influenced by the dimension of physiology.

Based on the background, the problems of the present study are: (1) Is there any difference in scientific writing ability between the students who follow the problem-based learning model with portfolio assessment and those who conventionally follow the learning model? (2) After giving the cognitive style treatment, is there any difference in the capability of scientific writing between the students who follow the based learning model with portfolio assessment and those who conventionally follow the learning

model? (3) How is the contribution of cognitive style towards the ability to write scientific writing for the students? This research aims at (1) To find out the different scientific writing abilities of the students that follow the variables in the conventional assessment.; (2) To find out the different scientific writing abilities between the students that follow the problem-based learning model with portfolio and the students that follow conventional lecturing with conventional assessment, which is controlled by covariable of cognitive style; (3) To find out the contribution covariable of cognitive style towards scientific writing ability of students.

METHOD

This research is categorized as a deceptive experiment (quasi-experiment). The experiment design is a "post-test *only control group design".* There were 173 students in the Theology Education Study Program at a university in Kupang, Indonesia. The sample in this research is probability sampling, which means there is a chance or equal possibility for each individual to be the sample of the population. However, the selection of sampling is not taken randomly for individuals (Creswell & Creswell, 2018). Class is chosen naturally, without the interference of the researcher, so there is the possibility that the subjects do not realize that they are being involved in this experiment so that this research will show the result of the treatment given. On the other hand, the researcher does not have the authority to change the class to a new class, so for the sake of this research, random sampling is taken for class, not for individuals.

The research variable conceptually is defined as all the phenomena the researcher decides to study to gain information about those phenomena and then draw a conclusion. Thus, it can be concluded that a variable is an attribute or the nature of the object, person, or activity that has a particular variant determined by the researcher to study and take the conclusion. This research has three variables those are (1) an independent variable, (2) *a* dependent variable, and a control variable or co-variable. The Independent variable for this research is the learning model with portfolio assessment. The learning model variable contains two levels: the problem-based learning model with portfolio assessment applied in the experiment class and the conventional learning model with conventional assessment conducted in the control class. The data collected in this research is the scientific writing ability, measured by test work performance (rubric) and a cognitive style test.

The present study employed a descriptive analysis and Anacova one-way, one covariable. Descriptive analysis describes the average score and standard deviation of scientific writing ability. Before the hypothesis test, the norm is to spread the data using statistics, chi-square, and the Kolmogorov–Smirnov technique using SPSS-10 for Windows. The homogeneity test between groups uses the Bartlet test, and simple regression is used for the linearity test.

RESULTS AND DISCUSSION

The research results show that the first hypothesis test is Fcount gain 22,964 with the significant 0,00 which is smaller than 0,05. Thus, the Null hypothesis is rejected, and the alternative hypothesis is accepted. It can be concluded that there is a significant difference in scientific writing ability between the students who follow a

problem-based learning model with portfolio assessment and the students who follow a conventional learning model.

The research finding shows that the alternative hypothesis (H1) is accepted. It states that there is a significant difference in the scientific writing ability of the students who follow the problem-based learning model with portfolio assessment and those who join the conventional learning model with conventional assessment. Lecturing with a problem-based learning model with portfolio assessment is excellent and can improve scientific writing ability, unlike the conventional learning model with conventional assessment.

Those are supported by mark 81,67, which is the average score of scientific writing ability for the students that follow lecturing in problem-based learning model with portfolio assessment; the average score of the students that follow the conventional learning model with conventional assessment is 70,05. Therefore, it can be said that the scientific writing ability of students who follow the problem-based learning model with portfolio assessment is better than that of those who follow the conventional learning model with conventional assessment.

It is stated that problem-based learning is excellent for improving students' scientific writing ability because the students participate directly in the learning process, from problem-finding and problem formulation to problem-solving. This process is suited to Problem-based learning model syntax, such as identifying the problem, formulating the problem, collecting and analyzing the data, assessing hypotheses, and making generalizations.

Problem-based learning encourages students to sharpen their critical thinking ability, solve problems, and study independently. These circumstances go along with three main characteristics of problem learning, namely 1) to encourage the students to sharpen their opinion skills and solve the problem, 2) to assist the students in performing the various situations of real life, and to learn the adult roles, 3) to assist the students become independent learner, and self-regulated.

Learning processes that involve the students actively possess strong roots in pedagogy (Darling-Hammond et al., 2020). The teacher or lecturer is encouraged to enrol the students in every problem-oriented project, which helps them observe various social problems and the importance of intellectuality. Furthermore, the learning process in school must be purposeful and not abstract. Purposeful learning should be accomplished well by giving orders to students in small groups to handle their projects of interest (Beeh & Baun, 2022). The student's intention to explore mean personal situations supports the vision of learning in purposeful and problem-centred.

In addition, research findings show that collaboration with the problem-based learning model and portfolio assessment enables students to be active and excited, sharpen critical thinking skills, and solve problems through scientific writing. It means that portfolio assessment influences a positive and meaningful learning process. Understandably, portfolio assessment can evaluate the process and learning outcome. Portfolio assessment is not as the collected works of students, there are three evaluations in Portfolio assessment, namely (1) the learner portfolio sample, (2) self-evaluation, and (3) open and transparent criteria.

The students' portfolios demonstrate the process approach to learning writing. The students must complete writing assignments based on every step of scientific writing so there is proof of their work (portfolio). Thus, in the writing process, the students produced three samples of portfolios: introduction, theoretical review, and research method.

The work samples are used as a draft, and the students can continue revising them to have a better portfolio sample. The process of a portfolio should refer to four criteria of scientific, namely 1) The structure of the presentation, 2) the component and substance of scientific writing, 3) the writer's attitude, and 4) the language accuracy. Those criteria are used as guidance for the students to assess the sample of students writing. It will lead to self-evaluation. When the students evaluate themselves, they will find the excellence and weaknesses that are applied in their portfolio. Then, these weaknesses will be the basis for them to make the corrections.

Based on those processes, the students tend to be more responsible in the portfolio writing process or outcome (Hakim & Srisudarso, 2020). Assessment is not only to make students more responsible but also to have a sense of ownership; that is, their work is helpful. Assessment is the key to applying portfolio assessment because it can measure all the dimensions of assessment, such as cognitive dimension, affective, and phsycomotoric, whereas multidimensional assessment because of the ability to assess the completion of students' competence. Portfolio assessment uses open and transparent evaluation criteria. This differs from conventional assessment, in which the criteria are secret for the lecturer. In portfolio assessment, the students should know the criteria, which consist of the procedure and the standard evaluation related to the aim of learning.

The second hypothesis test results show that the F_{count} is 6,756 with a significance 0,012 which is smaller than 0,05. Thus, the Null hypothesis is rejected, and the alternative hypothesis is accepted. Therefore, it can be concluded that there is a significant difference in the scientific writing ability between the students who follow the based learning model with portfolio assessment and those who join the conventional learning model after controlling cognitive style.

The research finding shows that the alternative hypothesis (H_1) is accepted, which states that after the variable of cognitive style is controlled, there are differences in the scientific writing ability of the students that join the problem-based learning model with portfolio assessment with students that follow the conventional lecturing model with conventional assessment (Guo et al., 2020). The problem-based learning model with portfolio assessment is excellent and can improve scientific writing ability compared to the lecturing model with conventional assessment (Gebrekidan & Zeru, 2023). It is supported by the average score of scientific writing ability of the students that follow the problem-based learning model with portfolio assessment is 81,67, and the average score of scientific writing ability of the students that follow the lecturing model with conventional assessment is 70,50. So, it can be concluded that after being controlled by the variable of cognitive style, the scientific writing ability of the students who follow the based learning model with portfolio assessment is better than that of students who join the conventional lecture model with conventional assessment.

Research findings are similar to the theoretical construction that the insertion of a controlled variable aims to lower the *error variance* by omitting the influence of that variable. The way to lower *error variance* is to insert cognitive as co-variable to be controlled, so the treatment variable genuinely influences the variable of students' scientific writing ability, that is, the problem-based learning model with portfolio assessment.

The third testing hypothesis results in a value of Fcount of 27,512, with a significance of 0.000 lower than 0,05. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted. So, it can be concluded that cognitive style contributes to scientific writing ability, which is 0,301 x 100% = 30,1%. The rest is 69,9%, attributed to another variable not included in this research.

The research finding shows that the alternative hypothesis (H_1) is accepted; co-variable cognitive style significantly contributes 30,1% towards scientific writing ability. The remaining 69,9% is contributed by another variable such as learning modal, motivation, desire, learning style, and another psychological dimension. It is supported by 81,67, the average score of scientific writing ability of students who follow problem-based learning models with portfolio assessment, and 70,05, the average score for students who follow the lecturing model with conventional assessment.

The highlight idea based on the finding above is that scientific writing ability is not influenced by one factor. However, it is convincing that cognitive style variables make significant contributions, as mentioned above. Many other factors contribute to the better ability of students' scientific writing, although that is an unidentified variable and an unknown contribution (Gebrekidan & Zeru, 2023).

The research findings have broad implications for learning and evaluation from various perspectives. *First*, from the learner's perspective (students), the problem-based learning model helps the learner to reach three aims in the learning process, those are: (1) to improve thinking skills, the skills to solve problems, to sharpen intellectual skills; (2) to motivate the learne to study to be mature enrol as well as to sharpen social skill; (3) to enable learner (students) become independent and autonomy individual (Septantiningtyas & Subaida, 2023). Portfolio assessment helps learner to collect their portfolio from their studies, self-evaluate and formulate the aim of the revision, and the value their learning learning process. Cognitive styles scaffolds the learner to identify and formulate the relevant learning needs and reach the optimum learning achievements (Cai et al., 2021). *Second*, based on the trainer's perspective (lecturer), the lecturer must understand the learning design and help lay the learning aim as the coordinate and final orientation of the learning activity. That is why the learning model must reach the aim of learning. Besides, the chosen particular model must consider the characteristics of the subject's content and the students. Choosing a precise, innovative learning model can create a compelling and meaningful learning process. Based on this rational, the problem-based learning model becomes a choice for the lecturer to use as a learning model in class, and it is precisely used for writing subjects (Dharma & Adiwijaya, 2018).

The kinds of assessments used also influence process quality and the result of learning. Many kinds of authentic assessments are believed to be able to observe the quality of the process and the outcome of students' learning. A portfolio assessment is

included in the authentic assessment that can precisely assess students' competence, making it the lecturer's choice. This research finding also suggests that combining an innovative learning model with authentic assessment can improve the quality of the process and learning outcomes.

CONCLUSION

Based on the result of data analyses, it is found that: 1) first, the value of the test hypothesis of F_{count} is 22,964 with a significant 0,00 lower than 0,05. Thus, the null hypothesis is rejected, and the alternative hypothesis is accepted. Therefore, there is a significant difference in the scientific writing ability of students who follow the problem-based learning model with portfolio assessment and those who follow the conventional lecturing model. 2) The second hypothesis test, the value of F_{count} is 6,756 with a significant 0,012 lower than 0,05. So, the null hypothesis is rejected, and the alternative hypothesis is accepted. That is why there is a significant difference in the scientific writing ability of the students who follow the problem-based learning model with portfolio assessment and those who follow the conventional lecturing model under a controlled cognitive style. 3) In The third hypothesis test, the value of F_{count} is 27,512 with a significant 0,000 lower than 0,05. That is why the null hypothesis is rejected, and the alternative hypothesis is accepted. Therefore, cognitive style contributes towards scientific writing ability with the contribution 0,301 x 100% = 30,1%. The rest is 69,9%, which is contributed by another variable not included in this research.

There some conclusions regarding the findings are as follows: 1) The problem-based learning model with portfolio assessment has a positive effect and is significant to improving learning scientific writing and improving students' ability in scientific writing; (2) Covariable cognitive style gives a positive effect and significant in learning scientific writing as well as to progress students' ability in scientific writing; (3) Cognitive style as one of students psychology dimension that should be considered to set up the lesson plan. The reason is that cognitive style is effective and can significantly contribute to students' capability in scientific writing.

Based on those conclusions, there are some suggestions to the related authority relating to this research as follows: *First*, it is suggested that the lecturer use a problem-based learning model in writing lessons or another subject to solve the problem, improve cognitive and problem-solving skills, and sharpen students' intellectual skills. Also, portfolio assessment can be used in learning writing and other valuable subjects to observe the process and outcome of learning. Combining the problem-based learning model and portfolio assessment in the writing learning process and another subject whose main characteristic is solving the problem is also possible. *Second,* the students are recommended to learn processes relating to the problem-based learning model because it helps identify their weaknesses and superiors and formulate the steps for revision. To collect the best portfolio as the outcome of the learning. Additionally, the cognitive style should be optimized as the individual modality to reach the optimal outcome. *Third,* for further research, it is advised to analyze another variable and dimension, which is not the focus of this research.

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