The Effect of Students' Prior Knowledge and Instruction Models on Academic Achievement

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Abstract*—The heterogeneous level of students' prior knowledge and differences in the application of instruction models have an impact on students' academic achievement. These study aims are: (1) to explain the differences in the students' academic achievement in different levels of students' prior knowledge, (2) to explain the differences in the students' academic achievement in different instructional models, and (3) to explain the effect of instruction models and students' prior knowledge to the academic achievement. The experimental research design uses quasi-experimental with a nonrandomized control group pretest-posttest. The variable in this study is (1) academic achievement, (2) prior knowledge, and (3) instructional model. The total samples are 209 students, and each treatment decided on 25 subjects as an analysis unit. The data analysis technique used descriptive and inferential statistics and all hypotheses were tested by ANOVA. The results of the study are: (1) there is a significant difference in the academic achievement in different levels of students' prior knowledge, (2) there is a significant difference in the academic achievement in different instructional models, and (3) there is a significant interaction effect of instructional models and students' prior knowledge to academic achievement.

Keywords*—prior knowledge; instruction models; academic achievement

I. INTRODUCTION

Quality human resources are the main assets of a nation. The world of education must be able to play its role as a provider of quality and professional human resources. Human resource development is a shared responsibility and lifelong process covering various areas of life. Ref. [1] further argues that the development of quality human resources is a contextual process so that human resource development through education is not limited to preparing humans who master knowledge and skills but also humans who are able, willing, and ready to learn for life. In the era of globalization with massive changes in various fields, eliminating the boundaries between the physical, digital, and biological worlds [2]. This condition requires the education sector to make breakthroughs in various innovations in order to prepare intelligent, quality, and competitive human resources. In an effort to prepare human resources that are able to compete in the era of globalization, a quality education system is needed [3]. In this case, it is very necessary to master 21st century skills which consist of critical thinking and problem-solving skills, creativity and innovation, collaboration, and communication [4]. Dissatisfaction from the industry towards educational outcomes triggers the world of education to self-evaluate and make changes to the learning process. The government has made various efforts to improve the quality of national education, including through curriculum renewal, improving the quality of the learning process, and the effectiveness of learning models. The educational curriculum must be comprehensive, responsive to social dynamics, relevant, and able to accommodate technological advances. The quality of learning must be improved in order to improve the quality of the output. On a micro basis, effective and efficient learning models must be found to empower students' potential. The educational paradigm must be emphasized learning how to learn, not learning what to be learned. The problem is how to package the learning process to facilitate students to construct a complete understanding and open up diverse thinking insights from all students.

The role of educators as a source of scientific authority has shifted as a mediator. In addition, there needs to be a shift from teaching as a burdensome process to a negotiation process [5]. Education practitioners must address this paradigm shift wisely, especially in learning accounting courses at the fundamental level. If students' understanding is not adequate at this level, it will impact higher levels. This condition often occurs because there are more and more accounting concepts and principles that students must understand. The logical consequence is that learning fundamental accounting courses must lead to a complete understanding, starting from the recording stage to reporting.

Based on observations and experiences, the learning of subjects at this level tends to be teacher centered. In this kind of learning, students tend to be passive. Various efforts have been made, but the academic achievement has not been as expected. The average course value in each batch for the last three years is still in the range of 7.0 grades in the "good" category. The problems encountered, in addition to the low creativity and ability of students to record transactions, the lecturers ignore the prior knowledge. Students' prior knowledge (SPK) has a strategic position for practitioners and educational theorists in designing and implementing learning. Ref. [6] stated that the crucial factor that influences student learning is what they have understood before. [7] say that

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humans try to make sense of their world by converting new experiences into prior knowledge. [8] conducted research on relevant prior knowledge. The results of his research show that, elaboration is helpful for students with more prior knowledge, but harmful for students with less prior knowledge. Prior knowledge is believed to be a determinant of success in learning. Higher prior-knowledge learners outperformed their lower prior-knowledge peers on performance measures [9].

The learning process has not entirely led to the ability to solve problems innovatively and collaboratively. The learning setting focuses on the demands of memorization and competitive nuances. For underprivileged students, the competitive situation affects their motivation and their psychology [10]. Therefore, education practitioners should create a tolerant classroom atmosphere with collaborative learning designs. One instruction model with a collaborative aspect is the cooperative learning model [10]. Cooperative learning is needed in accounting learning to increase creativity and the ability to record transactions.

Based on this, one strategy to improve academic achievement is redesigning learning from conventional learning to the Group Investigation (GI) type of learning. Students need the correct type of learning so that learning becomes more meaningful. GI learning type refers to the constructivist view. In constructivist learning, knowledge is not received passively but is actively built by the learner. Based on this, one strategy to improve academic achievement is redesigning learning from conventional learning to GI. Educators cannot put their ideas into students' heads. In this case, students who build meaning on sensory input received in their environment are under their prior knowledge. Several studies have been conducted on implementing the constructivist learning model. Ref. [5] conducted a study by applying the constructivist learning model in learning the concepts of energy, work and temperature. The findings of this study indicate that the constructivist learning model has a comparative advantage over the conventional learning model. Ref. [11] conducted a study on the effect of the learning model and setting on the remediation of misconceptions, concept understanding, and learning outcomes. The findings of this study indicate that learning using the GI type is more effective than using MURDER and STAD learning settings in achieving student learning outcomes. Ref. [12] conducted a study that showed an increase in critical thinking skills by applying the group investigation model. Other studies have shown, the students' self-regulation skills improved after the implementation of the GITTW learning strategy [13].

Thus, the Group Investigation (GI) learning type is set in a quasi-experimental study to improve academic achievement by paying attention to Students' Prior Knowledge (SPK). This type of learning is expected to facilitate students to optimize their abilities in carrying out transactions ranging from transaction analysis, recording transaction, classifying transaction to reporting so that academic achievement can be improved as expected. Based on the description and problems that have been identified, the objectives of this research are: (1) to explain the differences in the academic achievement between those with high prior knowledge and low prior knowledge; (2) to explain the difference in the academic achievement between those who follow the GI and the conventional learning type; (3) to analyze the interactive effect between the type of learning and prior knowledge on academic achievement.

II. Research Methods

A. Research Design and Sampling Technique

This experimental study uses a two-factor measurement technique in the 2×2 factorial version. The experimental design used was the Nonrandomized Control Group Pretest-Posttest Design [14]; [15]; [16]. The design of this research analysis is a treatment-by-level design. The disaggregating factor is the moderator variable prior knowledge. Sorting is divided into two levels, namely high prior knowledge and low prior knowledge. The population is all members of a well-defined class of people, events or objects [17]. The access population in this study were all first-semester students for the 2021/2022 academic year, with the unit of analysis being students studying accounting fundamentals. The total population is 209 students. Determination of the sample using the Cluster Random Sampling technique. The number of samples in each cell uses a referenced criterion. Each group is divided into two, namely a group consisting of students who have high prior knowledge and a group composed of students who have low prior knowledge.

B. Data analysis Technique

The instruments in the form of a test are used to measure the moderator variable and the dependent variable. The variables of this study are academic achievement, SPK, and model of instruction. SPK is collected through a prior knowledge test. The ideal minimum score is 0, and the ideal maximum score is 150. The data is obtained through tests to get data about the SPK and directly as an initial academic achievement. The data analysis technique used descriptive and inferential statistics. All hypotheses were tested by ANOVA and statistical analysis using SPSS 20.00 program. Each treatment cell consisted of 25 subjects. All null hypothesis testing was carried out at a significance level of 5%.

III. Results and Discussion

A. Results

The learning process is based on the constructivist theory of Piaget and Vygotsky. The stages of developing this learning model are very concerned with SPK. The initial identification of the intuitive ideas that students have in describing their environment is captured to discover the possibilities for the emergence of misconceptions afflicting students' cognitive structures.In this study, identification was made by giving a pretest to students. The results of the pretest are presented in Table I.

Based on Table I and the Bali State Polytechnic education guidelines, it can be explained that the mean of academic achievement who has high prior knowledge is in the score range of 83-91 with the "enough" category. In contrast, students who have low prior knowledge are in the score range

of 62-82 with the "less" variety. However, generally, the pretest scores of students taking GI learning type were higher than conventional ones, although they were still in the same score range as the "less" category. After being given treatment (posttest) can be explained that the posttest scores of all groups of students are in the score range of 98-112 with the "good" category except for the group of students who have high prior knowledge who take GI learning type which is in the score range 113-121 with the category "very good".

TABLE I. ACADEMIC ACHIEVEMENT

Students' Prior Knowledge	**Mean**		
	Instructional model	***Pretest***	***Posttest***
High	GI	89,04	113,68
	Conventional	91,44	103,92
	Average	90,24	108,80
Low	GI	75,36	103,44
	Conventional	72,60	104,04
	Average	73,98	103,74
Average	GI	82,20	108,58
	Conventional	82,02	103,98

The assumption test was conducted to obtain empirical facts about the normality of the data distribution and the homogeneity of variance between groups before proceeding to hypothesis testing. The normality test used the statistics of the Kolmogorov-Smirnov Test and the Shapiro-Wilks Test. Data normality analysis was carried out on the whole unit of analysis, namely four groups consisting of two investigation groups and two conventional groups. The statistical values of the Kolmogorov-Smirnov Test and the Shapiro-Wilk all show a significance value greater than 0.05. Therefore, as a whole, the dependent variable data is considered to be normally distributed. The homogeneity test of variance between groups was carried out to test that each group being compared had the same variance. Levene's Test of Equality of Error Variances was used to test the homogeneity of variance between groups. The homogeneity test of variance was carried out in two grouping categories. First, grouping based on learning type (GI and conventional) with 50 units of analysis each. Second, grouping based on prior knowledge (high prior knowledge and low prior knowledge) with 50 units of analysis each. In this study, three research hypotheses were tested using 2×2 factorial ANOVA. The analysis was carried out with the help of the SPSS 20.0 for the windows program. A summary of the test is presented in Table II.

The interpretation of the analysis results presented in Table II can be explained. First, the source of the influence of student' prior knowledge (SPK) on the dependent variable academic achievement appears that the statistical value of F = 10,693 with a significance of 0.001. The significance number is smaller than 0.05. These results indicate that there is a significant effect between SPK on academic achievement. Second, the source of the influence of the learning model on the academic achievement variable obtained a value of F=8.761 and a significance of 0.004 (less than 0.05). These results indicate that the learning model variable significantly influences the academic achievement variable. Third, from the source of the interactive influence between the DSS and the learning model, the F value = 11.207 with a significant number of 0.001 (smaller than 0.05). That means that the SPK variable and the learning model interact significantly with academic achievement.

TABLE II. SUMMARY OF ANOVA ANALYSIS

Source	***Mean square***	***F***	***Sig.***
PK	640.090	10.693	0.001
IM	524.410	8.761	0.004
PK*IM	670.810	11.207	0.001

Academic achievement can be achieved higher for groups of students with high prior knowledge if applying the GI type of learning. Meanwhile, there is a decrease in academic achievement for the group of students with low prior knowledge when using the GI type of learning. That means that the GI learning type is more appropriate to be programmed for groups of students who have high prior knowledge. In contrast, the conventional learning type is more suited to be implemented for students who have low prior knowledge.

B. Discussion

Learning outcomes are abstracted as changes in mental structures that are often displayed in the form of changes in intellectual knowledge (cognitive), attitudes (affective), and skills (psychomotor) [11]. This study focuses more on learning acquisition at the cognitive level, which includes academic achievement, because so far, academic achievement is often used as the ultimate goal of learning and is allegedly not maximized. One of the contributing factors is that the learning that has been applied so far tends to tolerate rote learning [18]. In this study, academic achievement is full of concepts that students must fully understand. Understanding the concepts is the basis for achieving learning outcomes. Besides that, it is also the basis for attaining academic achievement. Complete understanding of concepts in students if students are given the most comprehensive opportunity to construct knowledge based on their cognitive structure. Thus, it can be assumed that the GI learning type is easier to accommodate the achievement of adequate academic achievement compared to conventional ones. Based on these issues, this study examines the effect of GI versus conventional learning types on academic achievement. The results showed that the GI and conventional learning types significantly differed in academic achievement, with a significance of 0.004. Academic achievement facilitated by the GI type of learning is higher than using the conventional learning type. The results of this study are consistent with the

results of previous studies conducted by [11], which showed that GI learning type could improve learning outcomes. However, some questions require further discussion related to academic achievement, namely, why is the achievement of academic achievement facilitated by the GI learning type higher than the conventional? The discussion on these questions departs from the theoretical and empirical operational comparison between GI type learning and conventional type learning. Theoretically, the GI uses a constructivist paradigm that focuses on constructing the meaning of knowledge based on SPK. GI accommodates SPK as the basis for constructing knowledge. The syntax of GI learning type starts from (1) dividing into small groups, (2) lecturers and students planning learning procedures, assignments, and learning objectives, (3) students implementing the plans they developed in the investigation phase, (4) students writing reports and preparing presentation materials, (5) certain groups present the results of their discussions and other groups as active participants, and (6) lecturers evaluate the process and results of student activities. The conventional type of learning combines cooperative techniques with individual techniques. The application of this technique is quite effective in overcoming the weaknesses of individual learning. In the learning process, students are responsible for checking their friends' assignments, helping friends with problems, and encouraging each other to excel. The syntax of this type is: (1) students are divided into small groups of 5-6 people, (2) the lecturer presents the core and objectives of the lecture, (3) students work in pairs in their groups, and students ask the lecturer if they have difficulties in their group, (4) the lecturer gives an evaluation at the end of the lecture. Operationally empirically, both types of learning use the same job sheet and learning materials. However, the orientation of the job sheet applied is different. The first job sheet model applies the GI syntax. In contrast, the second model is oriented to the demands to answer the questions on the job sheet. Theoretically and empirically, the GI type of learning is more accommodating to academic achievement than the conventional type of learning.

Based on the pretest, it was found that several things happened at the recording stage. The implementation of debit and credit rules must be well understood by students. This rule is implemented across accounts classification (assets, liabilities, equity, income, expenses). At the recording stage, the ability of students to record transactions in journals is very diverse. Some students recorded transactions not according to the debit and credit rule. In their minds, all types of transactions that affect income and expenses are recorded in the “equity” accounts either as an increase or as a deduction in equity. The same thing happens to "withdrawal" accounts and they are recorded by debiting the equity accounts. At the reporting stage, it was found that students still had difficulty in adjusting accounts. Prepaid expenses and unearned revenues accounts are the accounts that most often cause problems. This condition is understandable because the ability to make adjustments is highly dependent on their ability to understand the approach used when recording. From this discussion, it can be said that SPK profiles vary widely, and students already have a cognitive structure that is obtained from events that are built from previous experiences. This is in line with the opinion of [19], which states that the formation of knowledge according to the constructivism model views active subjects as creating cognitive structures in their interactions with the environment. Cognitive interaction will occur as long as reality is structured through the cognitive structure created by itself. The same thing was also expressed by [20] that every organism organizes its experience by creating mental structures and applying them in learning. The student constructs meaning, seeks meaning and tries to discover the regularity and order in the events of the world in situations where the information is incomplete. [19], understanding is a process of intellectual adaptation in which new experiences and ideas are interacted with what is already known by a person who is learning to form a new understanding. Piaget argued that in a person's mind, there is a structure of SPK, and through contact with new experiences, a person's prior knowledge structure can develop. Ref. [6] also suggests three interrelated assumptions, namely (1) prior knowledge is an essential variable, (2) the degree of prior knowledge must be known and measured to improve learning achievement optimally, and (3) learning should optimally relate to the degree of prior knowledge. Measurement of prior knowledge not only serves as an appropriate predictor of learning but also provides a more useful basis for learning [11]. SPK is a barrier to achieving deep understanding in learning. That means that the SPK of accounting must be considered in planning and implementing learning to achieve better academic achievement. Learning oriented to prior knowledge will impact the process and acquisition of adequate learning [21]. From the constructivist point of view, SPK is a springboard for learning acquisition. SPK at least serves as an initial teaching provision in achieving academic achievement. In line with this issue, this research has revealed that SPK significantly affects academic achievement. The research results related to the role of SPK on learning acquisition revealed in this study were in line with the results of previous studies. Ref. [22] concluded that prior knowledge contributed significantly to posttest scores. Learning that uses prior knowledge as a starting point shows that the variance of learning outcomes can be explained by the variance of initial knowledge of 42%. Ref. [11] also found that the variance of prior knowledge can explain the variance of students' perceptions of learning messages by 20.8%, and the effective contribution of prior knowledge to learning outcomes is 25.31%. The findings of this study have the following implications. First, the exploration of students' prior knowledge of accounting concepts is quite essential to do to package a more meaningful learning design. Second, the design of accounting learning should strive to use prior knowledge as an alternative footing in formulating learning achievement indicators. Third, learning facilities are oriented to provide opportunities for students to select and organize new scientific concepts and integrate them into their SPK. Students with high prior knowledge are easier to relate what they have understood to what the teacher has learned as new knowledge compared to students with low prior knowledge. Furthermore, students who have high prior knowledge will more quickly understand concepts and generalizations as a whole through the process of social-academic accommodation [23]. Based on the conceptual basis, it is suspected that a high prior knowledge will achieve higher academic achievement than the low prior knowledge group. The results of this study indicate a significant difference between high prior knowledge and low prior knowledge in the

achievement of learning outcomes with a significance of 0.001. The results of this study are in line with theoretical expectations. Conceptually, groups of students with a high prior knowledge are expected to achieve higher academic achievement than those with low prior knowledge.

Theoretically, conventional learning refers to the behavioristic paradigm. This paradigm is oriented to the pattern of knowledge transmission as the basis for learning and behavior change due to the process. Learning that is oriented to the target of mastery of the material is only proven in the ability to remember short-term. It is assumed that knowledge can be transferred completely from the teacher's mind to the student's mind [11]. In this learning type, the learning process often ignores prior knowledge. On the other hand, the GI learning type focuses on constructing the meaning of knowledge based on prior knowledge. In this study, students have accommodated prior knowledge as the basis for constructing new knowledge. Ref. [24] stated that the quality of student input, the school environment, and the future-oriented field of work have a significant positive effect on accounting competence. The students' input quality in the accounting department is a representation of the quality of the teaching and learning process that occurred from the previous level.

In the practice of learning in the classroom, learning is a process of forming understanding and experiences in relation to students' prior knowledge. Learning is a process of constructing knowledge by students as a giver of meaning to sensory data concerning their prior knowledge. Based on this thought, this study examines the interactive effect between the instructional model and the SPK on academic achievement. The results showed that the SPK and the instructional model interacted significantly with a significance of 0.001. Suggests that SPK and the instructional model show an interaction profile. The results of this study seem to be in line with theoretical expectations. Conceptually, the relationship and suitability between the two types of learning models and the two levels of SPK applied in this study is estimated to be an interaction. The difference in academic achievement between the two groups prior knowledge is because the group of students who follow the GI learning type and have high prior knowledge occurs a meaningful learning process, namely through a complete understanding of the concept. Understanding the concept as a whole is done by accommodating the concepts from what they already have with something that has just been learned. Meanwhile, in the group of students who follow the conventional learning type, the learning process occurs with a transfer pattern, so that understanding of the concept as a whole will occur more slowly [18]. Students in this group only memorize concepts so that if there is doubt about a concept, they will not be able to accommodate it wholly and quickly. For students who have low prior knowledge, the process of meaningful learning will be slower, considering that this group of students is slower in their ability to accommodate the stages of recording and reporting. If a group of students who have low prior knowledge participate in GI and conventional learning types, the learning outcomes will be different. The difference is due to the group of students who take conventional learning type and have low prior knowledge, a complete understanding occurs, namely through concept accommodation from formal concepts to concrete concepts. On the other hand, in the group of students who participated in the GI learning type and had low prior knowledge, the memorization process continued. In this study, the instructional model and SPK are two variables that affect the academic achievement of students. The two variables influence each other in the sense that the effect of the type of learning on learning achievement depends on the level of SPK. From the discussion above, it seems that the GI learning type is only programmed for groups of students who have high prior knowledge. Meanwhile, groups of students who have low prior knowledge are still programmed with conventional learning types. In connection with the application of the GI learning type, which seems relevant only to groups that have high prior knowledge, it is necessary to carry out special treatment for certain groups of students. Groups of students who have low prior knowledge are given special treatment, such as providing longer study time. In accounting, learning not only learns about facts and principles but also how students arrive at general principles that describe a complete understanding of various types of transactions. Accounting requires the ability in terms of recording to reporting stages. In accounting, students need the freedom to learn by involving mental and practical activities. Students work collaboratively to solve the problems. In this case, a lecturer must be able to manage the class in various dimensions of class management so that the learning process runs in a conducive, effective, and productive manner.

IV. Conclusion

Based on the discussion, it can be concluded, (1) there is a significant difference in academic achievement between the group of students taking GI and those taking conventional. The academic achievement who take the GI learning type is higher than students who take conventional learning type, (2) there is a significant difference in academic achievement between groups of students who have high prior knowledge and those who have low prior knowledge. Academic achievement who have high prior knowledge is better than the group of students who have low prior knowledge, and (3) there is an interactive effect between the instructional model and SPK in achieving the academic achievement of students. Students with high prior knowledge are better at participating in GI than conventional learning. Groups of students who have low prior knowledge are better given the conventional type of learning.

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