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Comparison and Correlation Between Students' Cognitive Competency in Regular Physics and Teaching and Learning Course

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Abstract: Students learn exact and non-exact subjects in the biology education department. Lectures are required to be carried out using the case method. This research aims to determine differences in students' cognitive competence through the implementation of the case method in General Physics and Teaching and Learning courses and to determine the relationship between students' cognitive competence in General Physics and Teaching and Learning courses. This research is a correlational descriptive study carried out in June-July 2023. This research involved 32 biology education students as the research sample. Research data was collected using tests. Data were analyzed descriptively and using Spearman Rank. The results show that students' cognitive competence in the Teaching and Learning course is higher than in General Physics course. This is due to differences in the level of difficulty in studying lecture material. The research results also show a strong positive correlation between students' cognitive competence in exact courses (General Physics) and non-exact courses (Teaching and Learning). Further research is still needed to find other variables that can explain the relationship between these two variables because students' cognitive competence in exact courses cannot fully be used to indicate students' cognitive competence in non-exact courses.

Keywords: cognitive competency, case method, regular physics, teaching and learning

INTRODUCTION

Education in the 21st century places a strong emphasis on learning that fosters a wide range of skills. These skills are crucial for equipping students to tackle the diverse global challenges of our time (Kennedy & Sunberg, 2020). Among the key skills required to confront these challenges are communication, collaboration, critical thinking, problem-solving, and creativity, collectively known as the 4C skills. This research delves into the realm of cognitive competency, a fundamental aspect of these skills, and its correlation with the case method in General Physics and Teaching and Learning Courses. One way to internalize 21st-century skills in students is by implementing a learning model. The development of 21st-century skills impacts how the learning model is applied (Rochmawati & Ridlo, 2020; Wrahatnolo & Munoto, 2018; Yulianto et al., 2019). Not only developing 21st-century skills, an appropriate model will also improve students' cognitive competence (Sailer & Homner, 2020; Supena et al., 2021).

The application of learning models to improve students' cognitive competence is not only limited to primary and secondary education but also to higher education. Among the methods that are highly recommended to be applied in lectures is the case solving method. The application of this method is also one of the University's Main Performance Indicators (IKU) in the aspect of implementing collaborative and participatory classes (IKU-7) (Dirjen Dikti, 2021). The application of the case method at universities can not only improve students' cognitive competence but also improve 21st-century skills (Andayani et al., 2022; Fauzi et al., 2022; Haerullah et al., 2022; Syam, 2022).

The Faculty of Teacher Training and Education (FKIP) is one of the faculties found in several universities in Indonesia, including Universitas Maritim Raja Ali Haji (UMRAH) which is located in Tanjungpinang City. The department at FKIP is to prepare prospective teachers, not only equipped with the knowledge that will be taught to students but also equipped with teaching skills. For this reason, in the departement at FKIP, there are courses related to science that will be taught to students and also educational courses which aim to equip prospective teachers with the basics of education and teaching skills.

One of the departments at FKIP UMRAH is Biology Education. As is known, biology is part of the natural sciences which are part of the exact sciences (Agustina et al., 2021; Oghly, 2023). The courses in the Biology Education department are not only courses related to the exact sciences of biology or natural science but also non-exact courses related to educational sciences.

Students who are in their first year of study must take basic courses before moving on to more in-depth courses, whether related to biology or science or related to pedagogical aspects. Among the basic courses that must be taken by Biology Education students are General Physics and Teaching and Learning. These two courses are taken in the Even semester. These two courses have contrasting differences because General Physics is a course whose field of study is included in the exact sciences while Teaching and Learning is a course whose field of study is included in the non-exact sciences. The problem found in these two courses is that so far, the courses are often taught using lecture and presentation methods and rarely involve students in case-solving discussions. This causes a lack of student independence in learning and a lack of student skills in solving problems. Of course, this will have an impact on students' cognitive competence.

Implementing the case method is a form of lecturer participation in increasing the university's IKU. More than that, applying the case method can also familiarize students with solving various cases related to everyday life (Farikah et al., 2022; Hodijah et al., 2022). Several research results show that applying the case method has an impact on increasing students' cognitive competence (Fauzi et al., 2022; Syam, 2022). But what about cognitive competence through the application of the case method in exact and non-exact courses? So is there a relationship between students' cognitive competence in exact and non-exact courses? To answer this question, researchers want to make a comparison of students' cognitive competence in General Physics and Teaching and Learning courses through the application of the case method. Apart from that, researchers also want to know the relationship between students' cognitive competence in exact courses, which in this case is General Physics, and students' cognitive competence in non-exact courses, which in this case are Study and Teaching, which are both taught using the case method.

METHODS

This research was conducted in June-July 2023 at the Biology Education Department at FKIP UMRAH. This research is descriptive correlational research with a quantitative approach. This research is said to be descriptive correlational because this research aims to describe the comparison between students' cognitive competence through the implementation of the case method in the General Physics Course and The Teaching and Learning Course. This research also aims to see the relationship between students' cognitive competence in the General Physics course and the Teaching and Learning Course.

The population in this research were 65 first-year students of the Biology Education Department of FKIP UMRAH for the 2022.2023 academic year (2 classes). The sample in this research consisted of 32 students (1 class) selected using the cluster random sampling method. Research data was collected using tests. Data were analyzed descriptively to find out the comparison between students' cognitive competence in General Physics and Teaching and Learning courses and using Spearman Rank to see how the relationship (Sugiyono, 2015) between students' cognitive competence in exact courses (General Physics) and non-exact courses (Learning and Learning). For two correlated variables, the correlation coefficient is interpreted based on Table 1 below (Ali & Al-Hameed, 2022).

Table 1. Interpretation of Spearman Rank correlation coefficient

Value of correlation coefficient	**The meaning**
1	Completely correlated
0.70-0.99	Strong correlation
0.50-0.69	Average correlation
0.01-0.49	Weak correlation
0	Not correlated

FINDINGS AND DISCUSSION

The results of this research will be presented in two parts.

Comparison of Student Cognitive Competencies in General Physics and Teaching and Learning Subjects

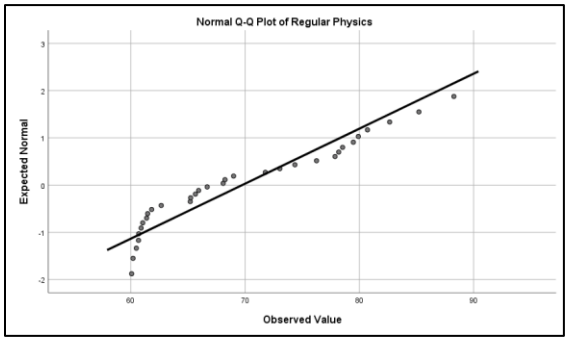
To see what student competency is in the General Physics and Teaching and Learning courses, a number of data are presented in Table 2. In this table it can be seen that there are significant differences in students' cognitive competence in the General Physics and Teaching and Learning courses. Judging from the average, minimum score and maximum score, it can be seen that students have better cognitive competence in the Study and Learning Subject compared to General Physics.

Table 2. Descriptive Statistics of Student Cognitive Competence in General Physics and Study and Learning Subjects

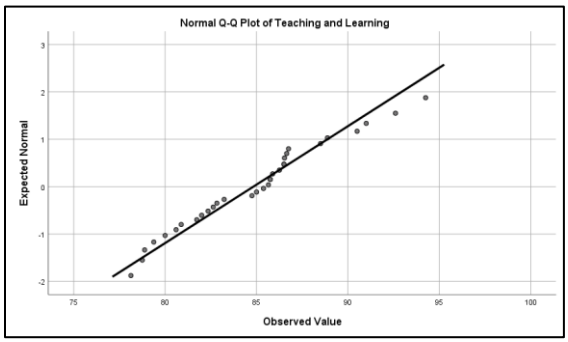
No.	Statistics	Regular Physics	Teaching and Learning
1	Mean	69.74	84.83
2	Std. deviation	8.591	4.054
3	Minimum	60.07	78.13
4	Maximum	88.27	94.25

In Table 2, you can also see Standard Deviation (SD) information. Simply put, SD gives an idea of how accurate the mean is in explaining research sample data (Lee et al., 2015). The research results show that the SD of cognitive competence in general physics courses is higher than in the SD of Teaching and learning courses. This provides information that the distribution of cognitive competency scores in the General Physics course is much larger, or it could be said that many scores are spread far from the average value compared to Cognitive Competency in the Teaching and Learning course. This result is also strengthened by the Normal Plot image shown in Figure 1, where the distribution of points far away from the straight line in the General Physics Course is much greater than in the Teaching and Learning Course.

Even though the cognitive competencies being compared come from the same students taught through the application of the case method, the differences in these results are also influenced by course characteristics. Even though biology is part of the exact sciences, it is characteristically different from other courses, such as physics and chemistry, where mathematics is more dominant than biology. Biology requires more memorization, just like studying and learning subjects. Of course, these results align with several previous studies which found that prospective biology teachers had difficulties in solving physics problems (Sarkity et al., 2022; Sarkity & Sundari, 2020, 2022). One of the difficulties experienced by students in learning physics is the use of mathematics in solving problems (Herawaty et al., 2020; Munfaridah et al., 2021; Widada et al., 2020).



(a)



(b)

Figure 1. Normal Plot of Cognitive Competency in (a) General Physics courses and (b) Teaching and Learning courses

Courses through implementing the case method are carried out by providing cases related to the course topic, and then students discuss in groups to find solutions to the cases. General physics courses with lower cognitive competency statistics than teaching and learning courses must be supported by strengthening mathematical abilities (Herayanti et al., 2020; Jensen et al., 2017). But in its application, mathematical skills must also be accompanied by good concept mastery to be able to solve physics problems (Lestari et al., 2021; Maknun, 2020; Sarkity et al., 2018; Simanjuntak et al., 2021).

Relationship between student cognitive competence in General Physics and Teaching and Learning courses

In this second results section, we will explain the relationship between students' cognitive competence in exact courses, which in this case is General Physics, and non-exact

courses, which in this case is Teaching and Learning. Data analysis used the Spearman Rank based on the normality test results. The normality test using Shapiro-Wilk shows that the student cognitive competency data in the General Physics course was not normally distributed (p = 0.005), and the student cognitive competency data in the Teaching and Learning course was normally distributed (p = 0.407). Data is normally distributed if the p-value is > 0.05. The results of this normality test are also confirmed by the normal plot in Figure 1.

One of the data was not normally distributed, so it was analyzed using a non-parametric method, namely Spearman Rank. The results of the Spearman Rank test on research data using SPSS can be seen in Figure 2. Judging from the results in Figure 2, it can be seen that there is a relationship between students' cognitive competence in exact and non-exact courses (p = 0.000) because the p-value < 0.05.

Nonparametric Correlations

Correlations

			Regular Physics	Teaching and Learning
Spearman's rho	Regular Physics	Correlation Coefficient	1.000	.753**
		Sig. (2-tailed)	.	.000
		N	32	32
	Teaching and Learning	Correlation Coefficient	.753**	1.000
		Sig. (2-tailed)	.000	.
		N	32	32

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 2. Screenshots of Spearman Rank test results using SPSS

In Figure 2, it can also be seen that the correlation coefficient between the two research variables is 0.753. This shows that students' cognitive competence in exact and non-exact courses strongly correlates. These results are also strengthened by research results by Rizkiyah & Alfin (2023), which show that by applying the same self-regulation, the results obtained by students in exact and non-exact courses are almost the same or stable. This can also be related to this research whereby implementing the case method in both courses (exact and non-exact), assuming other factors remain the same, the cognitive competencies obtained also tend to be stable. Even if the grades obtained are different, this is due to the different difficulty levels of the courses.

Students' cognitive competence is influenced by various things, including learning models (Garad et al., 2021) and teacher competency (Liu et al., 2022). In this research, both General Physics and Teaching and Learning courses are taught similarly by implementing the case method. With a coefficient of determination of 56.70%, students' cognitive competence in exact courses cannot be fully used to indicate students' cognitive competence in non-exact subjects. There are still 43.30% other factors that still need further research. This could be the lecturer's competency or other things.

CONCLUSION

Based on the research conducted, it was found that through the implementation of the case method in General Physics and Teaching and Learning courses, it was found that students' cognitive competence in Teaching and Learning courses showed better results seen from the mean, maximum and minimum values. This result is partly due to the characteristics of the course, where General Physics tends to be considered difficult by students, one of which is due to the need to master mathematics. The correlation test results show a strong positive correlation between students' cognitive abilities in exact courses (General Physics) and non-exact courses (Teaching and Learning). However, the relationship between students' cognitive abilities in exact and non-exact courses still needs to be researched further to find other factors that can explain the correlation between these two variables.

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