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EXPLORING STUDENTS' PROFICIENCY THROUGH PERSONAL CHARACTERISTICS IN MATH LOGIC COURSES USING PEER TEACHING FLIPPED CLASSROOM

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Abstract

Students must understand the concept of mathematical logic before they can apply it to solve problems. On the other hand, students are divided into two major personality types: extroverts and introverts. Students' personality types influenced their study process. This study was carried out to examine the impact of students' personality types on their conceptual understanding abilities. Where questionnaires for personality examinations and tests for understanding concepts were employed as research instruments. This is identified as correlational research. This research was conducted on students in math logic courses from either the mathematics education department at Universitas PGRI Sumatera Barat. The research representative sample was 40 students, whereas 20 students in peer teaching flipped classroom (PTFC) and 20 in conventional class. This research was conducted in September-December 2022. According to research findings, in using the peer teaching flipped classroom model, students' conceptual understanding in math logic courses is strongly affected by personality category. The results of experiments such as peer teaching flipped classrooms exhibit that extrovert students have better conceptual understanding skills than introvert students. On the other hand, students who use the PTFC model are better than students who learn using the conventional models. Creating videos and organizing class discussions has a big impact on students who are outgoing. They can improve their skills while also sharing their knowledge and information with their classmates.

Keywords: Math logic courses; peer teaching flipped classroom; personal characteristics; students' proficiency.

Abstrak

Siswa harus memahami konsep logika matematika sebelum mereka dapat menerapkannya untuk memecahkan masalah. Di sisi lain, siswa dibagi menjadi dua tipe kepribadian utama: ekstrovert dan introvert. Tipe kepribadian siswa mempengaruhi proses belajar mereka. Penelitian ini dilakukan untuk menguji pengaruh tipe kepribadian siswa terhadap kemampuan pemahaman konsep mereka. Dimana angket untuk pemeriksaan kepribadian dan tes pemahaman konsep digunakan sebagai instrumen penelitian. Ini diidentifikasi sebagai penelitian korelasional. Penelitian ini dilakukan pada mahasiswa mata kuliah logika matematika baik dari jurusan pendidikan matematika Universitas PGRI Sumatera Barat. Sampel penelitian yang representatif adalah 40 siswa, dimana 20 siswa di kelas eksperimen dan 20 di kelas konvensional. Penelitian ini dilaksanakan pada bulan September-Desember 2022. Berdasarkan hasil penelitian, dalam menggunakan model peer teaching flipped classroom, pemahaman konsep siswa pada mata kuliah logika matematika sangat dipengaruhi oleh kategori kepribadian. Hasil eksperimen seperti peer teaching flipped classroom menunjukkan bahwa siswa ekstrovert memiliki kemampuan pemahaman konsep yang lebih baik daripada siswa introvert. Sebaliknya, siswa yang menggunakan model PTFC lebih baik dibandingkan siswa yang belajar dengan menggunakan model konvensional. Membuat video dan mengatur diskusi kelas berdampak besar pada siswa yang kreatif. Mereka dapat meningkatkan keterampilan mereka sambil juga berbagi pengetahuan dan informasi dengan teman sekelas mereka.

Kata Kunci: *Mata kuliah logika matematika; model PTFC; karakteristik pribadi; kemahiran siswa.*

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INTRODUCTION

According to Maulyda (2020), all students should be taught mathematics since it can help pupils acquire logical, analytical, systematic, critical, and creative thinking skills. In alliance with this, (Ozdamli & Asiksoy, 2016) asserts that as mathematics has the potential to anticipate and various forecasting, it needs to be taught in a way that connects it to regular living. Student is expected to comprehend the issue and implement mathematical understanding to resolve it. At several educational levels, mathematical logic is a required study. The art of thinking is mathematical logic (Fezile, Kocakoyun, Sahin, & Akdag, 2016; Kurtz, Tsimerman, & Steiner-Lavi, 2014). The way that mathematical logic is taught in schools also affects pupils' thought processes (Muttakhidah, 2015). A branch of cognitive science that is extremely relevant to daily life is mathematical logic. To be able to apply mathematical logic in solving problems in everyday life, students must first understand the concept of mathematical logic.

Students' conceptual understanding is measured by their capacity to define, comprehend, restate, and apply particular ideas to effectively solve mathematical problems. Personality types can have an impact on how well students learn mathematical concepts, and these personality variations have an impact on how well students understand and evaluate circumstances (Desriyanto, Yunita, & Muslim, 2020). Eysenck (Ramadoni & Mustofa, 2022) contended that personality affects IQ as well. This intelligence refers to the pupils' comprehension of the topic being taught or their aptitude for problem-solving. Extrovert and introvert personality types had an impact on students' conceptual understanding, verified this (Moffett & Mill, 2014; Uzunboylu & Karagozlu, 2015).

The characteristics of students with introverted personalities include being calm, anxious, favouring to be by themselves, savouring reading, having a tendency to plan ahead, being considerate, and controlling their impulses. They are also less aggressive, trustworthy, pessimistic, and have high standards of ethics. Students who have an extrovert personality tend to be very sociable, have many friends, need someone to talk to, dislike reading, seek out excitement, changeable, unpredictable actions, and are typically impulsive. They also enjoy light humor, are cheerful and optimistic, enjoy laughing and having fun, are active and involved in lots of activities, and have a tendency to be aggressive (Tanner & Scott, 2015; Ulwiyah & Djuhan, 2021).

Flipped classrooms, which incorporate peer teaching, have become popular in recent years as a method for assisting students to better understand the concepts being taught (Ramadoni & Mustofa, 2022; Sukma, Ramadoni, & Suryani, 2022). Before class and during class are the mainly two learning phases of the peer teaching flipped classroom. Learners construct instructional videos, evaluate videos, and also provide feedback before class. The phases that occure in class are numbering, submitting, thinking, responding, assessing, and reaching a conclusion. From then, the researcher used the peer teaching flipped classroom model in the mathematics logic courses that were being evaluated depending on the students' personalities (Ramadoni & Chien, 2023).

The difference from the previous studies is that while the research sub-

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jects still focus on calculus courses, this time the focus is on research on math logic courses. Alongside other studies that simply explore the impact of peer teaching flipped classrooms on conceptual- understanding, this study explores personal characteristics of introvert and extrovert students' learning outcomes.

METHOD

This is identified as correlational research. This research was conducted on students in math logic courses from either the mathematics education department at Universitas PGRI Sumatera Barat. The research representative sample was 40 students, whereas 20 students in peer teaching flipped classroom (PTFC) and 20 in conventional class. To establish the personality of the student, a specific personality questionnaire was adminis-tered. In the meantime, students' performance were derived from assessments of students' conceptual understanding of math logic courses. The test analysis technique was carried out using an analytic rubric with a scale of 0 – 4, and the student's total score was calculated. The student personality type questionnaire was administered in the form of a closed questionnaire and was scored. The data analysis technique used is factorial design.

RESULTS AND DISCUSSIONS

Based on the data obtained from the questionnaire given, the results obtained were that 9 students were included in the introvert category and 11 students were included in the extrovert category in PTFC Class. While in the conventional class there are 10 introvert students and 10 students were extrovert category. As a whole from the two sample classes obtained data that there were 19 extrovert students and 21 introvert students. A conceptual comprehension test was then administered, and hypothesis testing was performed using SPSS. This can clearly be seen in Table 1.

Table 1. Students' personalities categories and learning models

		Group	***n***
Personality	1.00	Extrovert	19
	2.00	Introvert	21
Learning	1.00	PTFC	20
Models	2.00	Conventional	20

* p-value< .05. ** p-value< .01.

Based on Table 1, it can be seen that the proportion of extroverted and introverted students in the two sample classes is balanced. To review further, let's look at the Table 2.

Table 2. Descriptive statistics

Personalities	**Learning Models**	**M**	**SD**	***n***
Extrovert	PTFC	84.22	16.69	9
	Conventional	53.60	26.44	10
	Total	68.10	26.84	19
Introvert	PTFC	62.27	19.94	11
	Conventional	64.90	21.54	10
	Total	63.52	20.53	21
Total	**PTFC**	**72.15**	**21.26**	**20**
	Conventional	**59.25**	**24.18**	**20**
	Total	**65.70**	**23.40**	**40**

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Based on the Table 2, it can be seen that the understanding of the concept of extrovert students in the PTFC class (M=84.22) is higher than the understanding of the concept of extrovert students in conventional classes (M=53.60). On the other hand, the conceptual understanding of introverted students in the conventional class (M=64.90) was higher than the conceptual understanding of introverted students in the PTFC class (M=62.27).

In further review, when compared to extrovert students and introvert students in the PTFC class, it can be seen that extrovert students' conceptual understanding (M=84.22) is higher than introvert students' conceptual understanding (M=62.27). On the other hand, when compared to extrovert students and introvert students in conventional classes, it can be seen that introvert students' conceptual understanding (M=64.90) is higher than introverted students' conceptual understanding (M=53.60).

To further test the hypothesis with a factorial design, but previously carried out a homogeneity test as shown in the Table 3

Table 3. Levene's test of equality of error variance

		Levene Statistic	df1	df2	*P*
Logics_	Based on M	.75	3	36	.527
Test	Based on Mdn	.70	3	36	.557
	Based on Mdn and with adjusted df	.70	3	33.61	.557
	Based on trimmed M	.77	3	36	.517

Based on the Table 3, there was homogeneity of variances for engagement scores for extrovert-introvert and PTFC-Conventional assessed by Levene's test for equality of variances (p = .527). Then, it can be concluded that the data has a homogeneous distribution, so that it can be continued with a factorial design test.

Table 4. Tests of Between-Subjects Effects

Source	Type III SS	df	MS	F	*p*
Corrected Model	4687.36a	3	1562.45	3.37	.029
Intercept	174673.62	1	174673.62	377.20	.000
Personalities * Learning Models	2749.93	1	2749.93	5.94	.020
Personalities	282.12	1	282.11	.61	.440
Learning Models	1949.45	1	1949.45	4.21	.048
Error	16671.04	36	463.08		

Based on Table 4, it is concluded that there is a significant effect of learning models with F (1,36) = 4.21, p=.048<.05. The learning models used is a factor that increases conceptual understanding significantly. The data in the table above reveals that the mean of PTFC is higher than the mean of conventional, and the learning models provides a significant effect. Thus, it can be concluded that the PTFC class is better than the conventional class in increasing students' conceptual understanding. Furthermore, interaction occurred in the factorial design test with F (1.36), p=.02<.05. This means that

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there are differences in the results between the two learning models and personalities, where extrovert students tend to be taller using the PTFC model, while introvert students tend to be taller using conventional models. Data can be seen in the Table 5.

Table 5. Personalities * learning models

Personalities	Learning Models	M	SE	95% CI
Extrovert	PTFC	84.22	7.17	[69.67, 98.77]
	Conventional	53.60	6.81	[39.80, 67.40]
Introvert	PTFC	62.27	6.49	[49.11, 75.43]
	Conventional	64.90	6.81	[51.10, 78.70]

Based on table 5, it is known that extrovert students like the PTFC model because they are given the opportunity to make videos, teach peers, discuss and present the results of their discussions, on the other hand introvert students tend to be more passive and prefer to receive knowledge from the teacher alone and introvert students prefer to study alone rather than learn group.

Table 6. Personalities

Personalities	M	SE	95% CI
Extrovert	68.91	4.94	[58.89, 78.93]
Introvert	63.59	4.70	[54.05, 73.12]

Based on table 6, it is known that, there is no significant difference between extrovert and introvert students with F (1,36) =.609, p=.44>.05. Although the average extrovert student (M=68.91) is higher than introvert student (M=63.59), it is not significantly different. Data can be seen in Table 7.

Table 7. Univariate tests for personalities

	SS	df	MS	F	p
Contrast	282.11	1	282.11	.609	.440
Error	16671.04	36	463.08		

Based on table 7, it is known that, a review of the comparison of the two learning models used in the study will be carried out, as shown in the Table 8.

Table 8. Learning models

Learning Models	M	SE	95% CI
Extrovert	73.25	4.84	[63.44, 83.06]
Introvert	59.25	4.81	[49.49, 69.01]

Based on table 8, it is known that, there is significant difference between PTFC models and conventional models with $F(1,36) = 4.21, p = .048 < .05$. This is indicated by average PTFC models (M=73.25) is higher than conventional models (M=59.25), it is significantly different. Data can be seen in the Table 9.

Table 9. Univariate Tests for learning models

	SS	df	MS	F	p
Contrast	1949.45	1	1949.45	4.21	.048
Error	16671.04	36	463.08		

Based on the Table 9, using the peer teaching flipped classroom model in math logic courses, it was discovered that the extrovert student's understanding of the concept was significantly better than the introverted student, with a p-value of.019. Extrovert students have an average score of 80.22, while introvert students have a score of 58.45. Furthermore, the standard deviation of introvert students is greater than that of extrovert students, indicating that the range of scores

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among introvert students is greater when compared to extrovert students.

This is due to the fact that extrovert students prefer the stages of creating videos to introvert students during the peer teaching flipped classroom process. As shown in Figure 1.

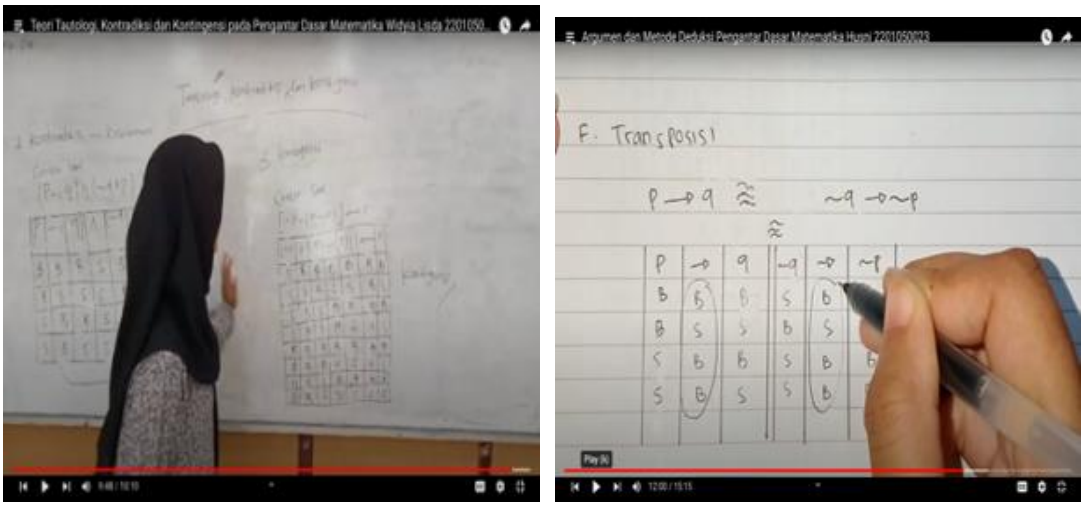

Figure 1. Students extrovert videos

Based on the Figure 1, when compared to introverted students, extrovert students are better at explaining. They teach material in a similar way that teachers teach their students. Extrovert students are more skilled at explaining than introvert students. Meanwhile, introverted students are more inclined to read only the powerpoint slides they generate. Students with extroverted personalities are more open, sociable, and have the ability to communicate (Prayitno & Ayu, 2018). In Figure 2, readers can see an example of an introverted student video.

Figure 2. Students Introvert Videos

The Figure 2 demonstrates that students with introverted personality types only read out their own powerpoints. However, a closer examination reveals that introverted students are much more capable of utilizing technology than extrovert students.

Peer teaching flipped classroom can improve students' conceptual understanding abilities and student

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learning outcomes (Ramadoni & Chien, 2023). There are differences in understanding the concepts and learning outcomes of extrovert students and introvert students. Another uncovering gleaned from field notes was that extrovert students were preferable at discussing during group class discussions. In-class student interactions differ depending on the student personality type(Ozdamli & Asiksoy, 2016; Widya Zulfa Ulwiyah & Muhammad Widda Djuhan, 2021). Introvert personalities are quiet and reserved and only want to be listeners, resulting in them being less able to train than extrovert personalities(Kurtz et al., 2014; Uzunboylu & Karagozlu, 2015). Extrovert students work well in groups, whereas introvert students prefer to work independently and passively. Extrovert also have a higher probability than introvert students to present the results of their discussions in front of the class, whereas introvert students tend to be quiet and reserved and hesitant to explain in front of the class. The introvert personality is self-conscious and finds it challenging to adapt to new situations (Moffett & Mill, 2014; Ramadoni & Mustofa, 2022). Students with introverted personalities generally struggle with verbal communication, specifically expressing what is in their hearts, as opposed to extroverted personalities (Meika & Sujana, 2017; Zubaidah, 2018). Extrovert personality traits involve being more open and sociable (Azizah & Maulana, 2018). These two major factors have a significant impact on students' conceptual understanding in math logic courses using the peer teaching flipped classroom model.

CONCLUSSIONS AND SUGGESTIONS

In accordance with research findings, personality category influence students' conceptual understanding in math logic courses when using the peer teaching flipped classroom model. Such as using peer teaching flipped classrooms, the results indicate that extrovert students have better conceptual understanding skills than introvert students. On the other hand, students who use the PTFC model are better than students who learn using the conventional models. Creating videos and getting class discussions has a big impact on students with extroverted personalities. They can enhance their abilities while also discussing knowledge and information with their classmates. Suggestions for the future are for teachers or researchers to consider learning models and student personality categories in developing their understanding of the concept.

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