

Motivational profiles of prospective mathematics teachers based on different types of personalities

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Abstrak Motivasi dan kepribadian siswa merupakan dua aspek penting dalam pembelajaran matematika. Kedua aspek tersebut dapat dijadikan salah satu landasan bagi pendidik matematika untuk merancang strategi pembelajaran. Namun, bagaimana motivasi siswa berdasarkan tipe kepribadian yang berbeda belum banyak terungkap. Penelitian kualitatif ini bertujuan mengungkap profil motivasi mahasiswa calon guru dengan kepribadian introver dan ekstrover dalam pembelajaran matematika. Partisipan dipilih dengan menggunakan instrumen tes kepribadian, kemudian dilakukan wawancara. Hasil penelitian menunjukkan, secara umum profil motivasi calon guru introver berbeda dengan yang memiliki kepribadian ekstrover. Pengalaman sukses masa lalu dan kepercayaan diri tentang kemampuan diri menjadi faktor penting dalam motivasi calon guru introver. Sedangkan untuk calon guru ekstrover, teman dan interaksi dalam suatu kegiatan menjadi faktor motivasi dalam belajar matematika. Implikasi hasil penelitian ini akan dibahas lebih lanjut dalam artikel ini.

Kata kunci *Motivasi, Calon guru matematika, Tipe kepribadian, Introver, Ekstrover*

Abstract Students' motivation and personality are two important aspects of mathematics learning. Both aspects can be used as one of the bases for mathematics educators to design learning strategies. However, students' motivation for different personality types has not been widely revealed. This qualitative research aims to uncover prospective mathematics teachers' (PMT) motivation with introverted and extroverted personalities in mathematics learning. The participants were selected using a personality test and then an interview was conducted. The findings show that, in general, the motivation profile of introverted PMT is different from the extroverted one. Past experiences of success and self-efficacy became essential factors in the motivation of introverts. As for extroverts, friends and interactions in an activity become a motivating factor in learning mathematics. Implications of the findings will be further discussed.

Keywords *Motivation, Prospective mathematics teachers, Personality types, Introvert, Extrovert*

Introduction

In learning mathematics, motivation becomes one aspect that concerns mathematics educators. Motivation has an essential role in learning activities because it encourages students. In turn, a lack of motivation will discourage them. Motivation is an absolute requirement in learning. Many studies have found that students' motivation has a significant impact on their academic success (Aunola et al., 2006; Marsh et al., 2005; Smith et al., 2012). For example,

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Aunola et al. (2006) discovered a correlation between first-grade students' arithmetic achievement and motivation, with strong math achievement and motivation also predicting students' performance in subsequent school years. Köller et al. (2001) reported that interest had a significant impact on achievement and those high achievers had a higher level of interest than low achievers.

Motivation is a capacity to guide behavior built into the emotion-controlling system, and it can present itself in cognition, emotion, and behavior (Hannula, 2004). There are several types of motivation. Some researchers differentiated intrinsic and extrinsic motivation (Goodchild, 2001; Holden, 2003; Middleton & Spanias, 1999). Furthermore, motivational beliefs (Kloosterman, 1996; Op't Eynde et al., 2002) and interest (Köller et al., 2001; Schiefele & Csikszentmihalyi, 1995) have been also used to describe students' motivation.

In addition to paying attention to students' motivation in learning, educators must also pay attention to aspects of students' personalities. Personality is one of the major variables that educators should consider when teaching students because personality can predict cognitive skills in individuals (Homayouni, 2011). A person's personality, in addition to cognitive abilities and attitudes toward mathematics, is reliably related to student achievement in mathematics (e.g., Heaven & Ciarrochi, 2012; Poropat, 2009). Personality traits are good indicators of mathematics learning and academic achievement in students, and they can be linked to effective and satisfying learning (Daezadeh et al., 2014). Therefore, the impact, when educators recognize and understand students' personalities, is that the learning process will improve. However, this is not easy to do because students' personalities are unique. Each student can have a different personality type. Each personality type also has its advantages and disadvantages. If this can be utilized well by the teacher, then the objectives of the learning process can be achieved better.

One of the most highlighted personality types in the learning process is introvert and extrovert (Rohmah, 2020). This personality type tends to be easy to find in the classroom. There is a significant difference in academic performance between students who exhibit extroverted and introverted characteristics, as well as between students' academic performances related to personality type (Apeh & Ezemaduka, 2015). Awuondo et al., (2019), who studied introverted-extroverted personality types, discovered that extroversion was the only personality trait that had a significant relationship with achievement, with students who were more extroverted scoring higher on the test. While Samuel and Ravid (2016) conducted research that contributed to the fact that extroverts have problems in the classroom. One of the reasons for the necessity for a more in-depth investigation of this type of personality type is the difference between the outcomes of the study on introverted and extroverted participants.

Considerable literature on mathematics teaching pays little attention to personality factors, even though personality accounted for significantly in undergraduates' achievement (Alcock et al., 2014). Even when personality factors appear to be important, they are sometimes overlooked because the emphasis seems to be far more on cognitive issues, for example, existing research emphasizes creativity and problem-solving abilities (Khalid et al., 2020), mathematics reasoning and proofing (Zayyadi & Kurniati, 2018), or other cognitive issues. Furthermore, there has been limited research into student attitudes toward these learning experiences, including about personality (Russo & Minas, 2020). In reality, personality is one of the characteristics that have a strong correlation with student achievement, and this might influence how well the learning process goes (Rabae'i, 2014). In mathematics education research, the personality factor must also be taken into account. Therefore, this research aims to investigate the motivational profile of prospective mathematics teachers based on their personalities.

Theoretical Review

Motivational profiles

For decades, psychologists and educational psychologists have examined academic motivation. Motivation was once thought to be an inner drive. However, with Atkinson's (1957) explanation of motivation as the result of anticipation of success on a task and the perceived value of completing the task, it has been increasingly considered a consequence of cognitive decision-making. Individuals put forth effort only when they believe it will lead to fulfilling their objectives. According to attribution theory (see Graham & Weiner, 1996), self-worth theory (e.g., Covington, 1992) and goal-orientation theory (e.g., Ames, 1992; Blumenfeld, 1992; Graham & Weiner, 1996) there is no adequate general model of motivation in mathematics (Carr, 1996).

Motivation is assumed to be a cognitive activity in which students make explicit judgments about how and when they apply effort to learning (Kloosterman, 1996; Stipek, 1996). These decisions are influenced by students' beliefs, which are described as unique ideas that mediate action. A student believes that everything she/he understands or feels affects effort, such as mathematics effort in this case. Thus, what a person believes will have to do with someone's motivation to do something. For example, when a person believes that he has the ability in a field, people's motivation to strive in that field tends to be greater.

Some mathematics researchers refer to students' motivation as motivational beliefs (Kloosterman, 1996; Op't Eynde et al., 2002). Previously, Kloosterman (1998) researched motivational beliefs focused on eleven categories: (1) background in mathematics, (2) feelings about school and mathematics, (3) effort in mathematics, (4) non-school influences, (5) self-confidence in mathematics, (6) natural ability in mathematics, (7) goal orientation and effort, (8) study habits in mathematics, (9) specific mathematics content, (10) assessment practices, and (11) teachers influenced motivation and work habits in mathematics classes. In this research, we focused on the first five categories. Meanwhile, the other six categories have been discussed in another article (Kurniawati et al., *in press*).

Personality types

People differ in their personalities, which have long been acknowledged. Attempts to understand the nature and effects of these differences have resulted in theoretical models and research on personality traits and their impact on the teaching-learning process (Zeichner, 2019). This diversity of personality variations is referred to by Blau and Barak (2012) as "style differences," and they recognize a variety of styles, including learning styles, cognitive styles, leadership styles, and psychological character. According to Al-Dujaily et al. (2013), there are three basic approaches to understanding the nature and effects of personality differences: cognition-based, learning-based, and personality-based. A few models have been developed as part of the cognitive style approach, including impulse versus reflex, analytical versus global (Cain, 2013), and field-dependent versus non-field-dependent. Kolb (1984), who established four learning types: converging vs diverging and assimilating versus accommodating, was a pioneer in the method that focused on learning styles. The third approach, which focuses on personal characteristics, is based on Jung's (1971) work and is mostly represented by other scholars (Eysenck & Eysenck, 1976; Myers & Myers, 1984).

Jung (1971) classed two personality types: extroverted and introverted. Personality types such as introverts and extroverts play a significant role in the learning environment and feedback effects (Zeichner, 2019). Extrovert characters are sociable, but introvert characters are private. The extrovert's action is perceived as directed toward the outside world, whereas the introvert's behavior is regarded as directed inward on himself or herself (Zafar and Meenakshi, 2012). Extroverts are frequently successful and assertive, surrounded by many friends, seeking the company of people, acting impulsively, seeking thrills, taking risks, being adventurous, and taking the initiative (Zeichner, 2019). Extroverts prefer to direct their energy outward, interacting with people and objects. They place such a high value on external experience (such as talking and acting) that they frequently begin activities with little preparation and rely on trial and error to accomplish them. They think more clearly and produce more ideas in action or in a discussion because they spend more time dealing with outer experience rather than inner experience (i.e., reflecting and observing) (Boroujeni et al., 2015). On the other hand, the introvert is reserved and trustworthy, prefers books to people, prefers studying alone rather than in a group, favors order and preplanning, does not exhibit emotions, and avoids social activities (Zeichner, 2019). Furthermore, introverts tend to direct their energies inside, thinking and contemplating. They are warier of the outside environment, anticipating and reflecting before taking action in order to avoid mistakes. They think best and produce more ideas when they are alone and unaffected by others or events (Boroujeni et al., 2015).

Teachers' personalities are related to their evaluated teaching performance (Klassen & Tze, 2014). Furthermore, Tonelson (1981) and Aydin (1998) claim that teachers' personalities have an impact on their students' learning outcomes and play an essential role in their success, with no exception for prospective mathematics teachers. Chan (2002) discovered that teachers with a high extrovert personality were more effective in the classroom. Students in extraverted teachers' classrooms perform better academically than students in introverted teachers' classrooms. In the fields of reading and math, extraverted teachers would score higher than more introverted teachers on a self-reported measure of teacher effectiveness (Garrett, 2009). Therefore, the results of previous studies indicate that it is important to investigate the teacher's personality or PMT in order to implement effective teaching strategies and behaviors.

Learning success is influenced by personality variations (Zeichner, 2019). An introvert is considered more suited to the learning environment than an extrovert, so introverts are easier to achieve high achievements than extroverts (Al-Dujaily et al., 2013). The extrovert character has an advantage in the social arena and learning achievement during the initial primary school years when adjustment to school is very much social-involvement-related. When the emphasis on personal drive outweighs the relevance of social successes in higher grades, the introvert persona gains the upper hand. Introvert characteristics such as self-discipline, steadiness, and consistency contribute to higher learning outcomes.

Methods

This study followed a qualitative approach that resulted in motivational profiles of prospective mathematics teachers based on extrovert and introvert personality types.

Participants

Research participants were determined using an extrovert-introvert personality type questionnaire (Eysenck's Personality Inventory) adapted from the questionnaire (Lestari, 2016).

The questionnaire was administered to 80 prospective mathematics teachers (PMT). The chosen PMT is a second-year student majoring in mathematics education. Second-year students are selected on the grounds that they have gained enough experience and courses related to mathematics education. From the results of the questionnaire, two groups of PMT with different personality types were obtained. Based on the personality measurement of the Eysenck Personality Inventory, if the respondents get 0-12 score, they are categorized as an introvert, and if the respondents get 13-24 score, they are categorized as an extrovert (Ahmar & Sugiyanta, 2021). Furthermore, two PMT, consisting of one student with an extrovert personality and one student with an introvert personality, were selected based on the consideration of scores obtained when filling out the questionnaire. The PMT with the highest score is selected as an extroverted subject (SE), and the subject with the lowest score is selected as an introverted subject (SI). The participants with the highest and lowest scores were taken on the grounds that in order for the striking personality differences represent the type of personality they had.

Instrument

The instruments used in this study were a questionnaire to capture participants based on introvert-extroverted personality type and an interview guideline used to dig into the motivational profiles of introverted and extroverted PMT.

The questionnaire used refers to the lean personality measuring tool, namely the Eysenck Personality Inventory (EPI), which measures the tendency of extroverted and introverted personality types. EPI consists of three major dimensions, namely psychoticism, extraversion, and neuroticism (Eysenck, 1991). Because this study focuses on determining the personality of introverted-extroverted students, the question items used are questions on the extraversion dimension only. The indicators used in the extraversion dimension and the item number are described in Table 1 below.

Table 1. Indicators and item numbers of the Eysenck Personality Inventory (EPI)

Indicators	Item Number	Question	Total Item
Sociable	2	Are you usually indifferent?	3
	7	Generally, do you prefer reading to meeting people?	
	9	Do you prefer to have few but special friends?	
Lively	10	When people shout at you do you shout back?	4
	14	If there is something you want to know about, would you rather look it up in a book than talk to someone about it?	
	24	Do you like playing pranks on others?	
	19	Do you like talking to people so much that you never miss a chance of talking to a stranger?	
Active	8	Do you like going out a lot?	2
	17	Do you like doing things in which you have to act quickly?	
Assertive	3	Do you stop and think things over before doing anything?	3
	4	Do you generally do and say things quickly without stopping to think?	
Sensation seeking	6	Do you often do things on the spur of the moment?	3
	16	Do you hate being with a crowd who play jokes on one another?	
	18	Are you slow and unhurried in the way you move?	

Indicators	Item Number	Question	Total Item
Carefree	23	Can you easily get some life into a dull party	3
	1	Do you often long for excitement?	
	11	Can you usually let yourself go and enjoy yourself a lot at a lively party?	
Dominance	13	Are you mostly quiet when you are with other people?	2
	20	Would you be very unhappy if you could not see lots of people most of the time?	
	22	Do you find it hard to really enjoy yourself at a lively party?	
Surgent	12	Do other people think of you as being very lively?	2
	21	Would you say that you were fairly self-confident?	
Venture some	5	Would you do almost anything for a dare?	2
	15	Do you like the kind of work that you need to pay close attention to?	
Total item			24

The questions were translated into Indonesian and disseminated to the respondents. Respondents were asked to answer the question by selecting "yes" or "no". The answers of the respondents are then matched with the predetermined answer key and given a score of 1 for the questions answered according to the answer key.

Another instrument used in this study is the interview guidelines. The interview questions are based on Kloosterman (2002). The questions posed to the participants were limited to 5 focuses, namely general background in mathematics, feelings about school and mathematics, effort in mathematics, non-school influences, and self-confidence in mathematics. Some sample questions for each question focus used are shown in Table 2 below.

Table 2. Sample questions on each focus in the interview guidelines (Kloosterman, 2002)

Question Focus	Sample Questions
General background in mathematics	What other high school math courses have you taken? What grades did you get in those math courses? What plans do you have when you leave high school (4-year college, 2-year college, job, join the army, etc.)? Be as specific as you can.
Feelings about school and about mathematics	What words would you use to describe college? How much do you like math? Are there some parts of math you like and some you don't? Please explain.
Effort in mathematics	How hard do you work in math class? Do you always do everything the teacher assigns? Do you always do your homework? How much time do you spend on homework each day? If you don't do your homework, why don't you do it?
Non-school influences	Do you sense that your parents use mathematics very much? How do they use it? Do your parents want you to do well in college?
Self confidence in mathematics	How good are you in math? How do you know? Are you better at some kinds of math than others?

Table 2 shows some sample questions used to extract information from participants. Because the interviews conducted in this study are semi-structured interviews, the sample questions can develop according to the participants' answers when interviewing.

Data collection and analysis

Questionnaires in this study were filled out online by the research participants. Questionnaires were distributed to research subjects within a period of two weeks. Interviews are conducted on introverted and extroverted subjects. The interview process was conducted twice. The interview process was conducted by telephone. Each subject was interviewed with a period of 30-60 minutes. The interview format in this study is a semi-structured interview. The interviews were carried out one by one because it was not possible to conduct them simultaneously during the pandemic. The first interview is done to dig up preliminary information, while the second interview is done to confirm the data of the first interview results (triangulation). Time triangulation is done to compare the interview results of each subject. Furthermore, when data collection is still in the pandemic period, the data is collected online without face-to-face meetings, namely by telephone.

The interview data were analyzed through data reduction, presentation, and conclusion drawing and verification (Miles et al., 2018). In the first data analysis stage, we grouped the answer interview subject based on five focuses. Two external coders coordinate the coding for about one month and a half. The inter-coder reliability was calculated using the Holsti formula (Mao, 2017), with a minimum reliability score of 70% or 0.70. The inter-coder reliability for general background in mathematics is 0.81, for feelings about school and about mathematics is 0.85, for effort in mathematics is 0.79, for non-school influences is 0.91, for self-confidence in mathematics 0.94. The inter-coder reliability numbers showed that the two coders were more reliable than the Holsti formula's minimum requirement. After the data was grouped, it was presented in the form of a narrative story. We write and narrate a story that describes the motivational profile of prospective teachers with introverted and extroverted personalities in learning mathematics. So, the qualitative data analysis is in the form of story descriptions. In the last stage, the participants' answers in the first and second interviews were then compared to see the consistency. If the results were the same, then the conclusion was drawn.

Findings

The following are the results of motivational profile analysis based on the personality types of the two PMTs based on interviews.

Description of PMT's motivational profile with introvert personality (SI)

This section presents the answers of the introverted subject at the time of the interview on each of the focuses discussed.

General background

In the past, I participated in mathematics competitions in junior and senior high school, then continued to follow ONMIPA in college and entered the top 10. Then, after graduating later, I want to continue my studies in mathematics education.

However, I want to be a math teacher first. When I'm in college, I often choose valuable activities, such as going to the library with friends.

SI's previous experience of participating in mathematics competitions at the school level made her find fun in mathematics and continue her study on mathematics education. Although the grades obtained in other lessons are pretty good, it does not cover her desire to work as a math teacher after graduation. On-campus, in addition to studying mathematics, SI more often participates in activities that are considered beneficial, such as spending time in the library with friends when it comes to college free time.

Feelings about school and about mathematics

College is the responsibility of learning. We have to do it seriously. In addition to getting new experiences, I also got inspiration from lecturers. In addition to the experience, insights, and new knowledge I also get, it is beneficial to supply me to be a professional math teacher later. I love math materials like basic math and school math. It does not require as much abstraction as real analysis.

For SI, college is learning responsibility. Therefore, SI feels the need to take this seriously when doing assignments as a student. In addition to gaining new experiences, SI lecturers provide inspiration that makes her interested in learning mathematics. According to SI, lectures became a place to learn and prepare to become a professional math teacher. Her fun in mathematics has also begun since she attended elementary school. Although SI felt that subjects needing abstraction, such as real analysis and number theory, confused her, other topics such as elementary mathematics and school math could get her back interested in studying mathematics.

Effort in mathematics

If I have difficulty learning the material, I try to read it repeatedly. If that does not work, I ask a lecturer or friend. I also try to find questions and answers on the internet. About the task, I always try to do the lecturer's work. If I forget, I am in a hurry to do it when I remember. College, for me, is not a joke. It should be severe for parents to be proud. Studying mathematics increased my sensitivity of thinking and logic. I also felt challenged to work on math problems.

SI overcomes its difficulty in understanding some courses by studying the material repeatedly. Not infrequently, she asked the lecturer or discussed with his close friend. If the effort is unsuccessful, SI tries to find examples of similar problems that its solution has accompanied on the internet. Although sometimes SI forgets the task given by the lecturer, she will immediately do the task as best she can when she remembers, despite having to hurry. The seriousness of learning for SI is based on her belief that college is her opportunity to learn before later interacting with her students when she becomes a teacher. In addition, SI's firm intention to provide the best for her parents became one of her passions to keep trying when experiencing difficulties in learning materials. In addition, compared to other lessons, mathematics has been his favorite lesson since childhood. For SI, mathematics can increase the sensitivity of thinking and reasoning. This fact is one of the reasons why working on math problems is considered by SI a challenge.

Non-school influences on motivation

My father works in finance. He needs math. My father and mother supported and encouraged me, asking how the score or obstacles I faced while studying. In the first semester, I was a math tutor and shop steward. Both jobs require math. My sister is also a math teacher. Sometimes I ask my sister if I have any difficulties. In addition, the more I studied mathematics, the more I became aware of the greatness and usefulness of mathematics in our lives. When it comes to the influence of friends, yes, sometimes I am affected. For example, I participate in their studies when I see them studying when going to the exam.

SI's parents support SI, especially in learning facilities and infrastructure. Not only that, SI's parents often pay attention to the SI's courses by asking about how the score or obstacles that SI encounters on campus. Regarding the usefulness of mathematics in her life, SI felt mathematics was indispensable. Her experience as a tutor and shop steward convinced SI that mathematics is close to human life. Any job, according to SI, will always use mathematics. From some of the side jobs she has been doing, SI found comfort when she became a math tutor, underpinning her to take her goals as a math teacher more seriously. In addition to the parents who supported him, SI's sister, who has become a math teacher, also supported her. This fact further strengthens SI's desire to become a math teacher like his sister. According to SI, the more she studied mathematics, the more she learned the greatness and usefulness of mathematics. Thus, her love of mathematics grew and made her eager to learn seriously. SI argues that friends may positively or negatively influence learning, but all final decisions lie with us.

Self-confidence in motivation

My ability in mathematics is moderate. I feel pretty proficient in math material, primarily material that does not require much abstraction skills. There are still many other friends who are easier to understand the material than I am. On the other hand, I once got a positive comment from a lecturer when I solved the problem given. In addition, my lecturer once invited me to join the research team of lecturers. I am considered a student who dares to try and learn new things.

Regarding personal ability, SI feels that her knowledge in mathematics is classified as moderate. This feeling is based on her assumption that her friends understand the material faster than she does. However, SI admitted that her experience in the competition and managing to be in the top 10 became her pride. In addition, SI has also been involved in lecturer research projects because SI is considered a student who has the spirit of trying and learning new things. Positive comments from lecturers when SI successfully solves the questions given by lecturers make SI confident that she is capable in mathematics. Furthermore, SI felt she was more adept at solving algebraic and arithmetic than real analysis and complex functions.

Description of PMTs' motivational profile with extrovert personality (SE)

This section presents the answers of the extroverted participant at the time of the interview on each of the focuses discussed.

General background

I was once in a math course but never entered a math competition. Later, after graduating from college, I plan to work first. There is a desire to continue studying

but see the need for work later. On campus, I follow many organizations and extracurricular activities.

SE has experience taking math courses even though she has never attended a math competition before. SE gets good grades in classes other than mathematics regarding the grades obtained. Her dream after graduation is to work. Continuing education is one of SE's wishes but in consideration of the needs of job qualifications. SE has plans to continue studying in education majors but does not specialize in mathematics education.

Feelings about school and about mathematics

College was exhausting but fun. Participating in many activities and developing soft skills becomes a fun thing. When it comes to courses, it's boring, and I feel less excited. Soft-skill is essential, and when I went to college, I learned a lot about soft-skill through various activities. My numeracy skills also improved. I prefer logic and geometry.

According to SE, college is a tiring but also fun activity. The fun thing that SE meant was the many activities that she could participate in on-campus, organizing, and the opportunity to develop soft skills through organizational and extracurricular activities on campus. Lecture materials become something that SE feels like a boring thing. However, subjects such as logic and geometry can attract learning interests. SE feels challenged when faced with logic and geometry questions. Furthermore, SE realized that studying in mathematics education majors was also helpful, significantly improving her numeracy skills.

Effort in mathematics

If there is a complex material, I invite friends to discuss or search for information on the internet and then work with friends. My task is always to get the course done on time. I would not say I like math. I prefer other lessons with many practices, unlike math which is a lot of theory and a little practice.

When SE has difficulty understanding lecture materials, SE invites friends to discuss and work together. In addition, she also tried to search for information on the internet and ask her seniors. Regarding the task given by the lecturer, SE always tries to do it without thinking about the results she will get. The task she did was because of self-awareness to finish college on time, not because of her love of mathematics. When compared to other lessons, SE prefers other lessons. Many other lessons she likes, especially if they involve practice. For SE, mathematics is full of theory and minimal practice.

Non-school influences on motivation

I think everyone uses math, including my parents. When I used to be a private tutor and selling online, I also used math. In addition, I also feel that my parents supported me in college. If there is a task, I'm trying to work on it. Although not every day of studying mathematics, I usually spend time studying when there is an exam. When I see my friends studying, I am also affected to learn.

SE feels that everyone uses mathematics, albeit in a simple form, such as measuring an object. SE's experience as a private teacher and selling online convinced her that mathematics was always used in any job. In addition, SE's parents support her learning, such as funding math

courses. When there is free time, SE uses it to play with friends. Although it does not study math every day, SE usually takes the time to study when there is an exam. The friend factor also influences SE's efforts to understand the material. When SE sees another friend doing well, she will be influenced to try to be more persistent. According to SE, one's assumption of mathematics can cause a person to try to learn mathematics.

Self-confidence in motivation

I do not have good skills in math. My test results used to be ugly. I have trouble understanding the material. My grades are even worse than my friends'. My lecturers also often comment negatively on my abilities. I am weak in calculations and prefer analysis.

According to SE, she does not have good skills in mathematics. This feeling is realized by SE when she often has difficulty understanding math materials compared to other courses. In addition, the experience of conducting potential ability tests in the past reinforces SE's perception that she is weak and low-skilled in mathematics, which is a numeracy ability. SE assessed and realized her low numeracy skills when comparing her grades with her friends' scores and getting negative comments from her lecturers. On the other hand, SE felt that his low numeracy ability led her to prefer courses that needed more analysis than calculation.

Discussion

The two PMTs are very different, and the reasons that proved to be important in motivating them are distinct. SI has motivation from within. Intrinsic motivation boosts academic performance significantly (Liu and Hou, 2018). Other researchers pointed out that intrinsic motivation is linked to academic accomplishment and students' emotions since intrinsically driven students are more likely to enjoy the learning experience, increasing their accomplishment (Corpus et al., 2009). Intrinsic motivation and academic achievement are thought to be developmentally linked; intrinsic motivation is at the heart of self-directed action and is connected to achievement in a familiar way (Ryan & Deci, 2000). This motivation makes SI continue to strive to learn and understand mathematics to become a professional mathematics teacher. Students who are confident in their abilities to perform mathematical activities are more likely to choose jobs that require a higher level of mathematics knowledge (Stevens et al., 2004). Positive past mathematics experiences have increased SI's interest in studying mathematics education. In reality, positive learning experiences play an essential role in the teaching and learning process because they lay the groundwork for students to enhance their knowledge and understanding of the subject, as well as their confidence and employability skills, which are influenced by cultural variables (Code et al., 2016; Casinillo et al., 2020). SI tends to study the material independently before discussing it with friends, either by repeatedly studying it or searching the internet for information. SI's perception of his ability is quite positive, which further fosters SI's motivation to obtain good results in mathematics. The individual's assessment of his or her current competence at a specific task is defined by ability beliefs, which encompass notions such as confidence, self-efficacy, and self-concept (LaForce et al., 2017). Academic self-efficacy has been shown to increase academic aspirations and pro-social behavior, promoting academic accomplishment (Bandura et al., 1996). Bandura (1997) discovered that students with higher self-efficacy cooperate more in educational tasks than students with lower self-efficacy (Pintrich & Schunk, 2002). Self-efficacy beliefs can also predict student performance in

mathematics, such as mathematics problem solving, self-concept, self-regulatory, and anxiety reduction (Pajares & Miller, 1994). It has also been shown that self-efficacy increases problem-solving efficiency through strategic performance rather than faster solution times than students with low self-efficacy (Hoffman & Schraw, 2009). Perceived effort was substantially connected to accomplishment goals, epistemic and self-efficacy beliefs, and previous mathematical accomplishments. However, the time spent learning mathematics was linked to consciousness and accomplishment of goals (Rovan, 2012). Furthermore, previous experience and self-assurance are essential elements in increasing SI motivation. Past experiences of students have a substantial impact on student outputs (Nilsen et al., 2016).

Unlike SI, SE's interest in mathematics is not so great. Whereas, like other motivation elements, interest manifests itself in both a short-term and long-term manner (Hannula et al., 2016). SE does not like mathematics compared to other lessons. Her desire to study and 'dive' into mathematics was not because she wanted math but because her friends influenced her. SE's motivation in mathematics is extrinsic. Extrinsic motivation, also known as instrumental motivation, refers to the extrinsic motivations that drive an activity (e.g., fear of parental chastisement, career aspirations, etc.) (Ryan & Deci, 2000; Taylor et al., 2014). Extrinsic motivation actions are not carried out with enthusiasm but rather for the benefits they are thought to be associated with (Wrzesniewski et al., 2014). Extrinsic motivation is frequently seen as less desirable than intrinsic motivation; however, studies suggest it impacts adolescent academic success (Herges et al., 2017). SE's desire to go to college was not merely to study mathematics but rather the desire to join the extracurricular organization and develop soft skills. SE has a negative self-perception about her ability in mathematics. In two longitudinal research, researchers looked at whether mathematics self-perception (self-concept and self-efficacy) predicted achievement beyond what could be expected by prior accomplishment (Skaalvik and Skaalvik, 2006). Negative self-perception led SE to believe that her ability was low, resulting in SE's lack of motivation to learn mathematics. Motivation and performance are badly affected when individuals believe that ability is fixed and do not have much of it (Graham & Weiner, 1996). Furthermore, negative learning experiences result in poor academic performance and even failure in mathematics disciplines (Casinillo, 2019). In the case of SE, the influence of friends and activities that require interaction becomes a factor that improves motivation in mathematics. Extrovert personalities have an easier time making friends and creating social contacts, making it easier for them to build mathematical communication abilities than introvert students (Yukentin et al., 2018). Teachers should set aside a portion of class time to do activities that foster mathematical enthusiasm, increasing students' drive to learn mathematics (Yunus and Ali, 2009)

Conclusion, Implication, and Limitation

In this paper, we investigated the motivational profiles of PMT based on introvert-extrovert personality. The most relevant conclusion is that there is a difference in motivation between introverted and extroverted PMT. The PMT, with an introverted personality, has intrinsic motivations. Past experiences of success and self-confidence about self-ability became essential factors in motivation. As for PMT with an extroverted personality, friends and interactions in an activity become a factor in motivation in mathematics. Therefore, PMT with extroverted personalities tends to have extrinsic motivations.

The importance of increasing the motivation of PMT, who ideally will become a teacher is expected to become a highly motivated teacher and will later have an impact on students' growth. It is very important to create an environment for learning mathematics in which PMT who will become teachers are expected to actively encourage positive attitudes and motivation of children towards mathematics. PMT that has a high level of motivation will affect the factors of student involvement and learning, classroom management techniques, students' cognitive problems, and students' perceptions of support when asking for help. Furthermore, learning activities that are accompanied by motivation will produce good achievements, especially in learning mathematics, because the stronger the motivation is given, the more successful the teaching will be.

These findings can be used as consideration for PMT as future teachers in designing learning that pays attention to the personality type of students. For example, the learning model designed by PMT as a future teacher emphasizes positive reinforcement can be done in introverted groups. In contrast, learning models that emphasize group work in extrovert groups may optimize learning goals. Personality traits are significantly related to students' problem-solving ability when learning mathematics. These personality traits will influence the thought process. Therefore, understanding the personality of an individual can be more easily determined so that a deeper understanding can be obtained to facilitate better mathematics learning.

Finally, while the findings of this study suggest important implications for mathematics instruction, we must point out a limitation. The prospective teachers in this study are all from the same university's mathematics education department. As we all know, various universities' mathematics education departments may provide a variety of math courses and curricula. As a result, the motivational beliefs of prospective teachers may differ depending on the university (Safrudiannur et al., 2021). Comparing prospective teachers from other colleges may thus provide us with more information about their motivational beliefs about mathematics.

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