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Nomophobia as a Possible Mental Health Disorder in Gauteng Secondary Schools*

Renier Jacobus BOTHA*, Julie MATWADIA**

Abstract: To mention some**, e**ducators and learners use their mobile phones to access resources for schoolwork, and to keep in touch with family and friends. Despite the positive advantages brought by communication technologies in simplifying human life, currently it also conveyed a problem of addiction to videogames, internet and mobile phones. Specially, mobile phone addiction which is commonly termed as nomophobia is emerging as a mental health disorder due to overdependence people have shown on it. Having this in mind, the researcher was initiated to determine whether educators and learners do suffer from nomophobia (the irrational fear of not having access to their mobile phones and the capabilities on their mobile phones), and to define whether nomophobia may be considered as a mental health disorder or not, as well. In this study, an explanatory sequential mixed research design was used. In line with the notion of this design, quantitative and qualitative data were collected and analysed sequentially. A mixed methods single case research (MMSCR) was adopted. In the first phase of the quantitative study, data were collected from 620 respondents' of educators and learners using a questionnaire. Whereas in the second phase of qualitative study, data were collected from six educators and 15 learners (a total of 21 participants) using a semi-structured interview in face-to-face interaction. The results obtained from the quantitative phase of the study revealed the prevalence of mild, moderate and severe nomophobia. It also found that educators displayed a higher level of nomophobia as compared to learners. By complementing the results obtained in phase one's study, the findings of the qualitative phase confirmed that educators do feel uncomfortable without access to the information that they regularly check up on and by their own admission do spend a lot of time on their mobile phones. Furthermore, the study found that learners have an affinity for games and admit their addiction to it. Based on the findings, the researcher has recommended for the development of a policy that governs mobile phone usage at schools so as to increase instructional benefits obtained through proper usage and also to minimize the negative effect it has in distracting students from learning when it is used unwisely.
Keywords: *Nomophobia, Mobile Phones, Educators, Learners, Addictions.*

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Introduction

Mobile phones have become a necessity for many people throughout the world. The ability to keep in touch with family, business associates, and access to email are only a few of the reasons for the increasing importance of mobile phones. Today's technically advanced mobile phones, referred to as smartphones, which have the functionality of computers (or mini-PCs), are capable not only for receiving and placing phone calls, but also for storing data, taking pictures, and can even be used as walkie talkies, to name just a few of the available options (Kingston, 2020).

Davie and Hilber (2017) succinctly put it, "*New technologies have brought new forms of addiction with them*" (p. 100). Traditional addictions to alcohol, drugs or gambling have now been joined by addictions to videogames, the internet and even mobile phones. Mobile phone addiction is commonly termed nomophobia (Wikipedia, 2016; Petter, 2018; Webster, 2019). Nomophobia is the irrational fear of being without your mobile phone or being unable to use your phone for some reason, such as the absence of a signal or running out of minutes or battery power (Rouse, 2013). A phobia is by definition an irrational fear (Webster, 2019). In the case of nomophobia, the events that the user fears are not terribly unlikely, so that part of it is not irrational; what is irrational is the degree of discomfort the users feel at the thought of being separated from their smartphones.

Certainly, nomophobia is one of the newest forms of digital addiction and as such has been less researched than other forms, such as internet addiction, for example. However, researchers in South Korea (Kim, 2013; Kwon, 2013; Jena, 2015) have found that levels of mobile phone addiction are even higher than internet addiction. One of the causes posited for this was the convenience of mobile devices. Suitability of phone devices makes mobile learning so interesting and useful, and may therefore also be leading to a dangerous addiction. Educational institutions which have actively encouraged students to make use of mobile devices should be prudent to investigate this topic before further expanding the use of mobile learning.

It is evident that new technologies create opportunities as well as challenges for teachers and learners. The use of the mobile phone in the classroom, has been the subject of educational and media scrutiny. Research shows that mobile phones serve as distractions in the classroom setting and impair learning (Mendoza et al., 2018). The research on teacher nomophobia is scarce. However, Moreno-Guerrero, et al. (2020) have conducted research on the impact of cell phone use on pre-service teachers, and their findings highlight that it is necessary to make educational interventions with regard to mobile phone usage and to promote education for the responsible and critical use of media and technologies. Thus, teaching and learning can be severely compromised if learners and teachers alike have mobile phone addictions or nomophobia.

Research Questions and Objectives

With the above in mind, the problem statement of the study was phrased as follows: Should nomophobia be regarded as a mental health disorder in Gauteng secondary schools?

The objective of this study was to distinguish whether nomophobia should be considered as a mental health disorder in Gauteng secondary schools; and discuss how nomophobia as a mental health disorder can be treated and managed to improve the quality of teaching and learning in Gauteng secondary schools.

Literature Review

The Concept of Nomophobia

Nomophobia has been proposed by psychiatrists as a specific phobia that is a rising trend among high school learners (Cambridge, 2020). Nomophobia (short for 'no mobile phobia') is a word for the fear of, or anxiety caused by, not having a working mobile phone. It has been considered a symptom or syndrome of problematic digital media use in mental health, the definitions of which are not standardized (Webster, 2019). Furthermore, the fear of being without a mobile phone leads to anxiety and panic attacks in people.

According to Ali et al. (2017) psychological factors are involved in the overuse of a mobile phone. These could include low self-esteem (when individuals looking for reassurance use the mobile phone in inappropriate ways) and extroverted personality (when naturally social individuals use the mobile phone to excess). It is also highly possible that nomophobic symptoms may be caused by other underlying and pre-existing mental disorders, with likely candidates including social phobia or social anxiety disorder, social anxiety and panic disorder.

Nomophobia and Mental Disorders

The Diagnostic and Statistical Manual of Mental Disorders (DSM) is considered to be the gold standard manual for assessing psychiatric diseases. The DSM-5 is the product of more than 10 years of effort by hundreds of international experts in all aspects of mental health. Their dedication and hard work have yielded an authoritative volume that defines and classifies mental disorders in order to improve diagnoses, treatment, and research (Jibson & Seyfried, 2016).

The DSM-5 Anxiety Work Group has put forward recommendations to modify the criteria for diagnosing specific phobias (Bragazzi & Del Puente, 2014). They propose to consider the inclusion of nomophobia in the DSM-5, and make a comprehensive overview of the existing literature, discussing the clinical relevance of this pathology, its epidemiological features, the available psychometric scales, and the proposed treatment. Even though nomophobia has not been included in the DSM-5 (Davies, 2018), much more attention is paid to the psychopathological effects of the new media, and the interest in this topic will increase in the near future, together with the attention and caution not to hyper-codify as pathological normal behaviours.

The term nomophobia is constructed on definitions described in the DSM-5, it has been labelled as a "phobia for a particular/specific thing" (Bhattacharya, Bashar, Srivastava & Singh, 2019, p 1298). Bhattacharya et al, (2019) explain that it is very difficult to differentiate whether a patient becomes nomophobic due to mobile phone addiction or existing anxiety disorders manifest as nomophobic symptoms. Nomophobia may also act as a proxy to other disorders. They caution that we have to be very judicious regarding its diagnosis. Some mental disorders can precipitate nomophobia also and vice versa. The complexity of this condition is very challenging to the patients' family members as well as for the physicians as nomophobia shares common clinical symptoms with other disorders. That's why nomophobia should be diagnosed by exclusion. We have to stay in the real world more than the virtual world. We have to re-establish the human-human interactions and face to face connections. So, we need to limit our use of mobile phones rather than banning it because we cannot escape the force of technological advancement. Bragazzi and Del Puente (2014) propose that the effects and symptoms of nomophobia can range from psychological, physical, emotional and social effects and symptoms.

Criteria to Determine Nomophobia

Patel (2015) stated that to be nomophobic four or more of the following signs and symptoms are thought to comprise criteria for cell phone addiction. The problematic cell phone overuse must cause significant harm in the individual's life. These signs and symptoms may include: a need to use the cell phone more and more often in order to achieve the same desired effect; persistent failed attempts to use the mobile phone less often; preoccupation with mobile phone use; turns to mobile phone when experiencing unwanted feelings such as anxiety or depression; excessive use characterized by loss of sense of time; has put a relationship or job at risk due to excessive mobile phone use; decreased tolerance and a need for newest mobile phones, more applications, or increased use; and withdrawal, when mobile phone or network is unreachable, which results in anger**.**

While a mobile phone can be a hugely productive tool, compulsive use of this device can interfere with work, school, and relationships (Ali et al., 2017). When you spend more time on social media or playing games than you do interacting with real people, or you can't stop yourself from repeatedly checking texts, emails, or apps—even when it has negative consequences in your life—it may be time to reassess your technology use (Bahl & Deluliis, 2019). Mobile phone addiction, sometimes colloquially known as 'nomophobia' (fear of being without a mobile phone), is often fuelled by an Internet overuse problem or Internet addiction disorder. After all, it's rarely the mobile phone itself that creates the compulsion, but rather the games, apps, and online worlds it connects us to (Battacharya et al., 2019).

Despite the fact that people can experience impulse-control problems with a laptop or desktop computer, the size and convenience of mobile phones means that we can take them just about anywhere and gratify our compulsions at any time. In fact, most of us are rarely ever more than five feet from our mobile phones. Like the use of drugs and alcohol, they can trigger the release of the brain chemical dopamine and alter your mood. You can also rapidly build up tolerance so that it takes more and more time in front of these screens to derive the same pleasurable reward (Davie & Hibber, 2017). Heavy mobile phone use can often be symptomatic of other underlying problems, such as stress, anxiety, depression, or loneliness (Davie & Hibber, 2017). At the same time, it can also exacerbate these problems. If you use your mobile phone as a 'security blanket' to relieve feelings of anxiety, loneliness, or awkwardness in social situations, for example, you'll succeed only in cutting yourself off further from people around you. Staring at your phone will deny you the face-to-face interactions that can help to meaningfully connect you to others, alleviate anxiety, and boost your mood. In other words, the remedy you're choosing for your anxiety (engaging with your mobile phone), is actually making your anxiety worse (Battacharya et al., 2019).

Research Methodology

This study adopted a mixed methods single case study research (MMSCR) design. Gray (2014) highlights that, in a mixed methods research study, quantitative and qualitative data are collected and involve the integration of data at one or more stages in the process of the research. These approaches are complementary since, as McMillan and Schumacher (2014) aver that qualitative findings usually inform and support the quantitative results. The explanatory, sequential research design ably assisted the researcher to use the qualitative data in elucidating matters in finer detail to add meaning to the quantitative results (Creswell, 2014). For this mixed-methods single case study research, the explanatory sequential research design was used. The research design in this study involved two distinguishable, but complementary phases:

- Phase 1: The researcher collected quantitative data and analysed it statistically (Creswell, 2014). Thus, Phase 1 assisted in determining whether teachers and learners perceive themselves to suffer from nomophobia. Phase 1 also determined if teachers and learners perceive that nomophobia has an impact on the quality of teaching and learning. Phase 1 oftentimes also expedites the selection of appropriate questions for Phase 2.
- Phase 2: The results of Phase 1 were refined and built on by employing a qualitative approach (Creswell, 2014). Furthermore, in Phase 2 teachers and learners made recommendations on how to manage the impact of nomophobia on the quality of teaching and learning.

Methodology

The focus of the study was to investigate whether nomophobia should be considered as a mental health disorder in Gauteng secondary schools, and thus the Pragmatic paradigm was adopted (Kivunja & Kuyini, 2017). What was needed was a worldview which would provide methods of research that were seen to be most appropriate for studying the phenomenon at hand. This approach allowed a combination of methods that in conjunction could shed light on the actual behaviour of participants, the beliefs that stand behind those behaviours and the consequences that are likely to follow from different behaviours (Martens, 2015; Kivunja & Kuyini, 2017). This paradigm advocates a relational epistemology (i.e. relationships in research are best determined by what the researcher deems appropriate to that particular study), a non-singular reality ontology (that there is no single reality and all individuals have their own and unique interpretations of reality), a mixed methods methodology (a combination of quantitative and qualitative research methods), and a value-laden axiology (conducting research that benefits people) (Kivunja & Kuyini, 2017). The pragmatic paradigm is normally associated with the mixed methods research approach (Creswell, 2014). Reality is socially constructed and therefore multiple mental constructions can be apprehended, some of which may be in conflict with one another. Furthermore, perceptions of reality may change as concepts of nomophobia and the concept of mental health disorders are socially constructed phenomena that mean different things to different people (Mertens, 2010; Daniel & Harland, 2018).

Population and Sampling

South Africa has more than 25,000 schools, 23,000 of which are public schools that cater for more than 12-million learners (Passmark, 2018). A complete coverage of the theoretical population would be difficult. The researcher has selected one school (the single case) from all the Gauteng public, secondary schools that have a ban on the use of mobile phones in the classroom. This sets boundaries between the schools in Gauteng that allow the use of mobile phones in classrooms and those that do not. This school was selected for the case because it has the setting of boundaries on the study units that possess specific characteristics in the theoretical population, and it is a typical case in the theoretical population. The researcher opted for a census approach within the case for the quantitative phase (Phase 1) and purposive sampling for the qualitative phase (Phase 2) of the study.

The Quantitative Sample

For this study, a census sampling approach was used for the collection of data in the quantitative phase (Phase 1). The school that is used for the case has a population of 42 educators and 1020 learners. The entire school of 42 educators and 1020 learners were given a questionnaire. In a census sampling method, the results are reliable and accurate (Surbhi, 2017).

The Qualitative Sample

For the qualitative phase (Phase 2), a total of twenty-one participants (n=21) were interviewed. The participants for the qualitative phase of the study were made up of 15 learners

(3 learners from each grade starting from grade 8 to grade 12) and 6 educators that were part of the case study. The researcher undertook purposive sampling to select learners and educators at a Gauteng school. Purposive sampling has the benefit of being less costly and time consuming, has an ease of administration, usually assures a high participation rate and it is possible to generalise similar subjects (McMillan & Schumacher, 2014).

Data Collection

The type of research approach adopted in this study informed the research instruments that were used. Both qualitative and quantitative research instruments were used to collect data for this study. Quantitative data are collected by adapting the Nomophobia Questionnaire (NMP-Q) (Yildirim & Correia, 2015) which uses scaled items, and closed form items. The qualitative data were collected via face-to-face interaction by using semi-structured interview questions which were conducted with educators and learners at the purposefully selected Gauteng school (the case). A cell phone was used to record each interview, which was later transcribed using MS Word processing software and a computer.

Data Analysis

In Phase 1 of this study, once data has been collected through the use of questionnaires, the IBM SPSS software has been used to capture, analyse and interpret the data. The quantitative data were presented using tables, graphs and statistical numbers (Creswell, 2013; McMillan & Schumacher, 2014). A total of 620 out of 1062 valid questionnaires were received and analysed. Specifically, out of the 620 questionnaires 587 were completed by learners while 33 were filled by educators.

The qualitative data were collected using face-to-face, semi-structured interviews and were transcribed into MS Word format. The results obtained from the interviews have been arranged in sequence with the responses received from the questions in the interviews. The sequential order of the questions has been adhered to as far as possible. These were organised into data segments, which contained similar comprehensive and relevant ideas.

Results

Results obtained from Quantitative Data Analysis

The quantitative phase (Phase 1) measures respondents' perceptions to scrutiny whether they suffer from nomophobia or not and to level out its extent if there is any. Respondents were asked to rate 20 statements pertaining to their perception on their personal mobile phone usage. A seven-point Likert-type scale was used to rate the statements, where 1 = strongly disagree, 2 = disagree, 3 = partially disagree, 4 = neutral, 5 = partially agree, 6 = agree and 7 = strongly agree. Higher levels of agreement with a statement would be associated with higher levels of mobile phone usage, while disagreement would be associated with less or no mobile phone usage. There is a substantial difference between adult and adolescent thinking. Adult thinking differs in three ways from adolescent thinking: Practical, cognitive flexibility and dialectical thinking. Adults have more flexibility in their thought patterns, understanding that there are multiple opinions on issues, and that there is more than one way to approach a problem. Furthermore, the difference between young adolescents and adult reasoning is particularly obvious when it involves reasoning requiring the conjunction of emotion and logic (Icenogle et al., 2019). The researcher thus feels it is necessary to differentiate between the responses of educators and learners. The results that are presented show the responses of educators and learners separately. The researcher gives a breakdown of the scores which gives the interpretation of the extent of nomophobia among respondents in Table 1.

Table 1
Interpretation of nomophobia scores

Score	Interpretation
20	Absence of nomophobia
21-59	Mild level of nomophobia
60-99	Moderate level of nomophobia
100-140	Severe nomophobia

Table 1 shows the range of scores derived from the adapted NMP-Q that will determine whether respondents display an absence of nomophobia, a mild level of nomophobia, a moderate level of nomophobia or severe nomophobia.

The results of a univariate analysis of the constructs determined are shown in Table 2 for educators. Furthermore, the scores of the items were added to determine the extent of nomophobia of respondents.

Table 2
Descriptive statistics of educators responses to constructs from nomophobia questionnaire (n=33)

Construct	M	95% CI Upper bound	95% CI Lower bound	5% Trimmed mean	Median	Variance	SD
Not being able to access information	4.992	4.531	5.454	5.047	5.250	1.697	1.303
Giving up convenience	4.049	3.543	4.553	4.058	4.200	2.030	1.425
Not being able to communicate	4.994	4.425	5.464	4.982	5.167	2.149	1.466
Losing connectedness	3.474	2.942	4.016	3.474	3.600	2.295	1.514
Nomophobia questionnaire sum	87.27	79.28	95.26	87.09	88.00	507.89	22.53

The results from Table 2 and Table 3 are discussed together after the presentation of Table 3, since they are interlinked. The results of a univariate analysis of the constructs determined are shown in Table 3 for learners. Furthermore, the scores of the items were added to determine the extent of nomophobia of respondents.

Table 3
Descriptive statistics of learners responses to constructs from nomophobia questionnaire (n=587)

Construct	M	95% CI Upper bound	95% CI Lower bound	5% Trimmed mean	Median	Variance	SD
Not being able to access information	4.703	4.600	4.811	4.767	5.000	1.765	1.329
Giving up convenience	4.322	4.212	4.432	4.339	4.400	1.840	1.357
Not being able to communicate	4.682	4.560	4.804	4.735	4.833	2.286	1.512
Losing connectedness	3.746	3.620	3.872	3.728	3.600	2.149	1.555
Nomophobia questionnaire sum	87.25	85.34	89.16	87.74	88.00	553.83	23.53

Table 2 and Table 3 reveal that it is more important for educators to have access to information (M= 4.992; SD= 1,303) than it is for learners (M= 4.703; SD= 1.329). Educators also find the need to communicate (M= 4.994; SD= 1.466) more essential than learners (M= 4.682; SD= 1.555). The nomophobia questionnaire sum reveals that on average educators (M= 87.27; SD= 22.53) and learners (M= 87.25; SD= 23.53) have a moderate level of nomophobia.

A two-sample t-test was performed to compare the level of nomophobia among educators and learners. There was not a significant difference in the levels of nomophobia between educators (M= 87.27, SD= 22.53) and learners (M= 87.25, SD= 23.53); t (618) = 0.05, p= 0.996). The results as reported indicate that nomophobia levels seemed to be consistent across educators and learners with no significant differences reported in mean levels (p >0.05).

Table 4 reveals the breakdown of the actual numbers and percentages of educators and learners and their levels of nomophobia as calculated. It also highlights the levels and extent of the nomophobia among educators and learners. The results are illustrated in **Error! Reference source not found.**. Table 4 reveals the extent of nomophobia perceived by educators and learners.

Table 4
Breakdown of extent of nomophobia among educators and learners

Score	Level of nomophobia		Educator	Learner	Total
20	Absence of nomophobia	n	0	0	0
		%	0.0%	0.0%	0.0%
		Lower 95% CL			
		Upper 95% CL			
21-59	Mild level of nomophobia	n	5	76	81
		%	15.2%	12.9%	13.1%
		Lower 95% CL	6.0%	10.4%	10.6%
		Upper 95% CL	30.1%	15.8%	15.9%
60-99	Moderate level of nomophobia	n	17	318	335
		%	51.5%	54.2%	54.0%
		Lower 95% CL	34.9%	50.1%	50.1%
		Upper 95% CL	67.8%	58.2%	57.9%
100-140	Severe nomophobia	n	11	193	204
		%	33.3%	32.9%	32.9%
		Lower 95% CL	19.2%	29.2%	29.3%
		Upper 95% CL	50.3%	36.8%	36.7%

The global prevalence of nomophobia by severity revealed that the prevalence of moderate to severe nomophobia is 70.76%. The prevalence of severe nomophobia is approximately 21% in the general adult population (Humood et al,. 2021). Interestingly in this study none (0.0%) of the respondents reported an absence of nomophobia. More educators have severe nomophobia (33.3%; 95% CL 19.2%; 50.3%) than learners (32.9%; 95% CL 29.2%; 36.8%). On average, about a third of respondents suffer from severe nomophobia (32.9%; 95% CL 29.3% ;36.7%), which is higher than the global prevalence of severe nomophobia (20.8%; 95% CL 15.45%; 27.43%). This is of grave concern to the researcher.

Figure 1 gives a graphical representation of the results obtained in Table 4.

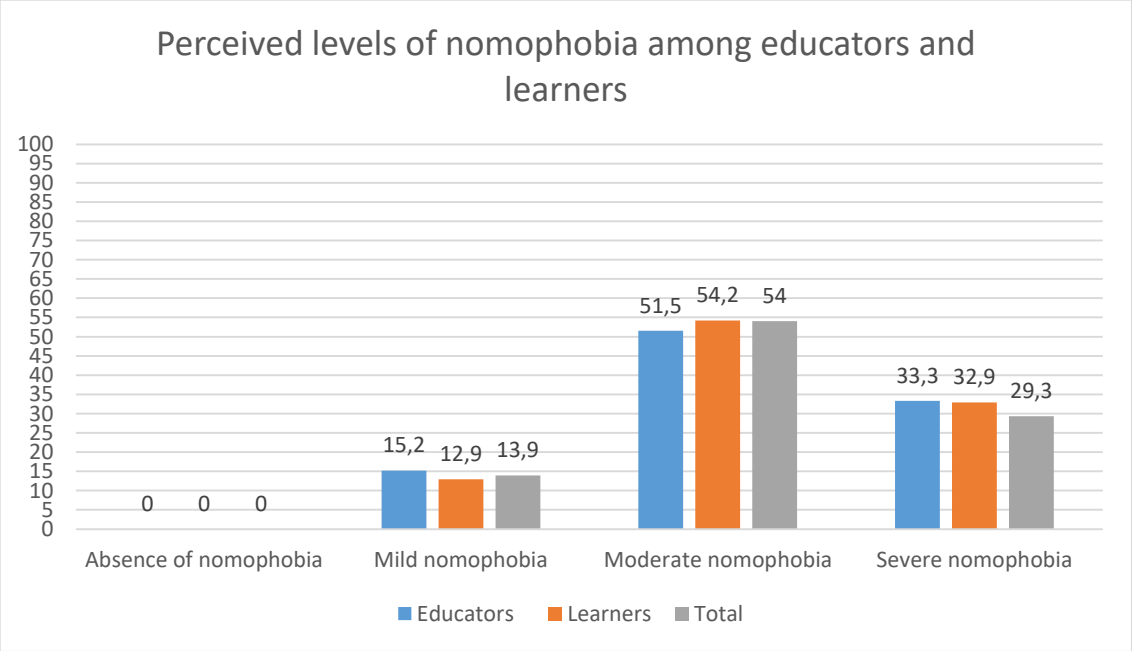

Figure 1 Perceived levels of nomophobia among educators and learners

Figure 1 reiterates the results obtained from Table 4. The graphical representation allows readers to visualise the perceived levels of nomophobia among educators and learners.

The distribution of the summated average score for nomophobia is shown in Figure 2 for educators.

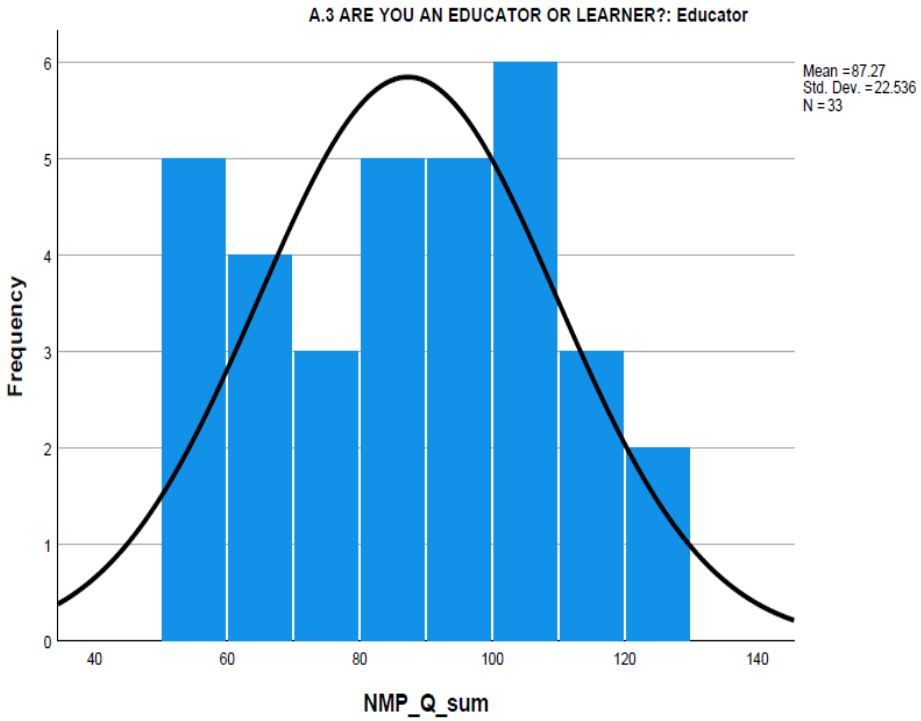

Figure 2 Distribution of summated average score for nomophobia (Educators) (n = 33)

For educators, a mean of 87.27 was reported, with a standard deviation of 22.53. It is therefore evident from these statistics and the histogram that educators generally reported a moderate level of nomophobia.

The distribution of the summated average score for nomophobia is shown in Figure 3 for learners.

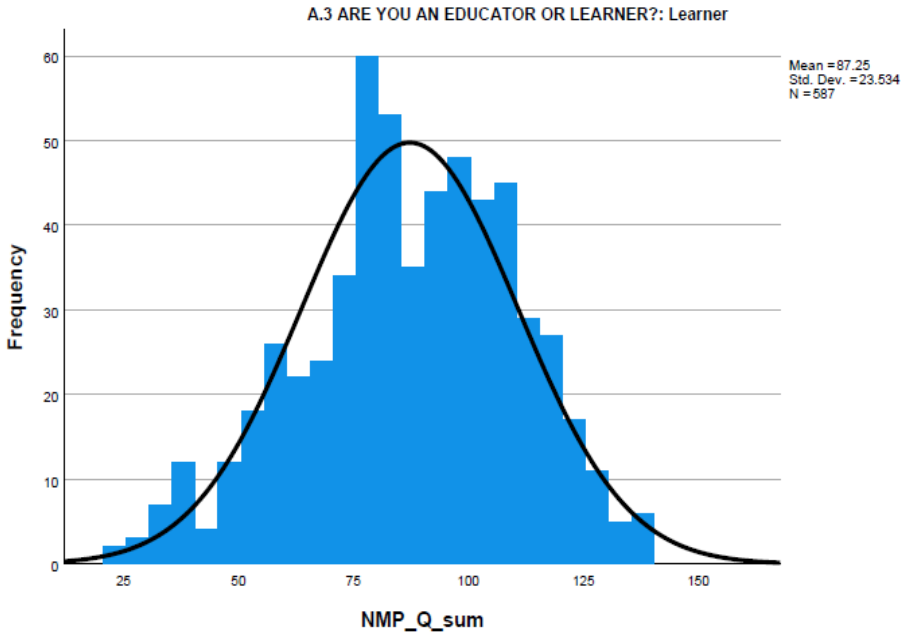

Figure 3 Distribution of summated average score for nomophobia (Learners) (n = 587)

A mean of 87.25 and a standard deviation of 25.53 were reported for learners. It is therefore evident from these statistics and the histogram that learners generally reported a moderate level of nomophobia.

Findings Obtained from Qualitative Data Analysis

In this qualitative case study, the researcher applied both template and editing strategies to conduct data analysis. This approach allowed the researcher to use both predetermined and non-predetermined categories during the ongoing process of data analysis. The data segments with same meanings were grouped to form codes based on similarities in sentences or phrases. The sentences and phrases with the same meaning were grouped to represent the main themes and categories.

It emerged from the data collected during the interviews that all educators' use their mobile phones to access work related information. Mobile phones allow them to stay in touch with people from work, their families and friends. Educators do not feel comfortable without access to the information they regularly check up on and they spend a lot of time on their mobile phones. Learners spend a considerable amount of time on their mobile phones. Furthermore, unlike educators, learners have an affinity for games and spend a lot of time playing these games. When I enquired further, Learner 01, Learner 02, Learner 10 and Learner 11 admitted to being addicted to these games. Learner 10 used the words '*I am hooked on Criminal Case.'* They explained that the games are designed to improve their own scores or take them to the next

level, so it is very difficult to leave the game. Learner 15 said, *'I was addicted to these games at some point in my life, but currently I stopped since I started with grade 12.'*

Learner 04 said he found it relaxing to play games but stressed the importance of discipline, '*I find it relaxing to play FIFA, and although it is distracting, I am disciplined enough to stop when I need to.'* Learner 05 said, *'The games refresh my mind,'* Learner 11 said, '*it relieves stress,'* and Learner 15 said, *'it calms you down.'* These were the expressions used by learners to justify the playing of games. Learner 06 reminds me that learners have a life outside school and interests outside of school subjects and curriculum, *'The nice thing about having a cell phone is that you can still do things that are outside school but that are still informative. I am a person who is interested in the moon, space and the whole universe.'* Learners used their mobile phones to access resources for schoolwork, and to keep in touch with family and friends.

Educators were vocal about the fact that discipline is a key to an excellent quality of education, *'Discipline is very important for me'* (Teacher A); *'Discipline. If a school has good discipline all other things will fall into place'* (Teacher C); 'also revealed that , *if learners display good manners.'* (Teacher F). Furthermore, educators have indicated that assessment results and high-stake exams like matric results are important factors in determining if a school is a good school (Teacher B, Teacher C, Teacher D and Teacher F). Good educators who have access to resources and plan their lessons are important for a good quality of teaching (Teacher A, Teacher C and Teacher F). All the educators agreed that being able to use a mobile phone in the classroom can improve the quality of the lesson. Teacher A warns that there must be proper controls in place while Teacher D warns that educators must know what they are doing and how to use technology. The educators were clear that using the internet in lesson preparation and delivery was vital for the teaching profession. Teacher B says that if educators' usage of their phones is geared towards education and not socialising then it can be beneficial to improving the quality of lessons.

Other important factors that learners cited for a good quality teaching were focus on the part of the learners; preparedness of educators; good matric results indicated a good school; educators must know their work; access to information and resources; educators' interaction with the learners; educators' understanding of the learners; dedication of the educator and having an engaged class. Learners were not in agreement whether using mobile phones for teaching would improve the lessons. Learners were concerned that constant checking of the mobile phone by the educator would break the flow of the lesson. Some learners felt that educators would be distracted by phone calls and messages, while others felt that educators would exercise self-control. Learner 13 sums it up nicely, *'As much as learners can be distracted, so too can teachers. It differs from individual to individual.'*

All educators agreed that if learners were allowed mobile phones in the classroom, the quality of learning would improve and that there are benefits of using mobile phones in the classroom. Teacher F said, '*I'm a huge advocate for the use of cell phones in the classroom. We need to equip our learners with the skills needed for the future.'* Educators were vocal about restrictions that needed to be imposed.

Learners held the same opinion as teachers and said that the quality of education is dependent on the amount of discipline that learners have. Learners used the following phrases and words to expand on discipline, *'Focused'* (Learner 01 and Learner 03); *'Self-motivated'* (Learner 02); *'Pay attention'* (Learner 03, Learner 08 and Learner 10); *'Sit still and listen'* (Learner 06); *'Dedicated'* (Learner 13) and *'Make an effort'* (Learner 14).

Discussions

According to the findings of this study nomophobia (short for 'no mobile phobia') is the fear of, or anxiety caused by not having a working mobile phone. The anxiety of not having a working mobile phone can lead to panic attacks and other psychological disorders. Nomophobia has been referred to as dependence on mobile phones or an addiction to mobile phones. It is defined as the feelings of discomfort, anxiety, nervousness or distress that result from being out of contact with a mobile phone. Nomophobia is the irrational fear of being without a mobile phone or being unable to use a mobile phone for some reason. The DSM-5 Anxiety work group has proposed to consider the inclusion of nomophobia in the DSM-5. Nomophobia can be considered an addiction which is used to refer to a chronic condition where there is an unhealthily powerful motivation to engage in a particular behavior. The size and convenience of mobile phones means that they can be taken anywhere and gratify compulsions at any time.

The quantitative phase (Phase 1) of the study revealed that prevalence level of nomophobia among educators and learners was 0 % for absence of nomophobia, 15.9 % of respondents displayed a mild level of nomophobia, 57.9 % of respondents displayed a moderate level of nomophobia and more than one third of respondents (36.7 %) displayed severe nomophobia. The global prevalence of nomophobia by severity revealed that the prevalence of moderate to severe nomophobia is 70,76%. The prevalence of severe nomophobia is approximately 21% in the general adult population (Humood et al,. 2021)The quantitative phase (Phase 1) further revealed that educators displayed higher levels of nomophobia as compared to learners.

The qualitative phase (Phase 2) elaborated on and gave meaning to the quantitative phase (Phase 1). The qualitative phase (Phase 2) indicated that educators use their mobile phones for work related information. Mobile phones allow them to stay in touch with people from work, their families and friends. Educators do feel uncomfortable without access to the information that they regularly check up on and by their own admission do spend a lot of time on their mobile phones.

Unlike educators, learners have an affinity for games and spend a lot of time playing these games. Learners admitted being addicted to the games. Furthermore, learners used their mobile phones to access resources for schoolwork, and to keep in touch with family and friends.

The quantitative phase (Phase 1) of the study revealed that more than 75% of educators (75,8%) agreed with the statement 'Teachers can improve the lesson if they can use their mobile phones in the classroom' compared to the percentage of learners that agreed with the statement (54,9%). Approximately half of the teachers (51,5%) agreed with the statement 'I feel teachers would be distracted with a mobile phone in the classroom' as compared to learners (46,2%). This indicates that educators and learners feel that a mobile phone in the classroom can be a useful educational resource, but they also seem to be weary of the fact that there can be distractions that emanate from the use of mobile phones in the classroom. It is therefore evident from the statistics that respondents generally reported a moderate level of acceptance for the use of mobile phones in the classroom to improve the quality of teaching.

The quantitative phase (Phase 1) also revealed that less than half of the teachers (45,5%) agreed with the statements 'If learners are allowed to have mobile phones in the classroom it can improve the quality of learning", and the statement 'If learners have mobile phones in the classroom, it will encourage sharing of knowledge' (45,5%). This is in comparison to learners where almost two third of the learners agreed with these statements (62,0% and 67,6%). More than half of the teachers (54,5%) and more than three quarters of learners (76,5%) agreed with the statement 'If learners have mobile phones in the classroom extension activities can be given from websites.' It is therefore evident from the statistics that

respondents generally reported a moderate to high level of level of acceptance for the use of mobile phones in the classroom to improve the quality of learning. The results as reported indicated that the usage of mobile phones in the classroom and the quality of learning seemed not to be consistent across educators and learners with significant differences reported in mean levels.

The quantitative phase (Phase 1) of the study merely suggested whether distractions caused by mobile phones in the classroom can be managed. It was revealed that more than half the educators (54.5%) agreed with the statement 'Distractions caused by mobile phones in the classroom can be controlled,' while almost two-thirds (63.4%) of the learners agreed with the statement. It is therefore evident that respondents generally reported a high level of acceptance for managing the impact of mobile phone distractions in the classroom. The results as reported indicated that managing the impact of mobile phone use in the classroom seemed to be consistent across educators and learners.

Furthermore, the quantitative phase (Phase 1) indicated that as educators' personal perceptions of nomophobia increase, the use of mobile phones on the quality of learning decreases. Also, as educators' personal perceptions of nomophobia increase, managing the impact of mobile phone use decreases. However, learners felt that the use of mobile phones on the quality of learning increases as managing the impact of mobile phone use in the classroom increases.

The qualitative phase (Phase 2) of the study gave meaning to the quantitative phase (Phase 1). The qualitative phase (Phase 2) of the study revealed that educators acknowledged that mobile phones have an important role to play in education, but they all stressed the importance of having proper protocols in place for the use of mobile phones to be beneficial in education. Learners, however, were not too keen on having mobile phones in the classroom. Learners reiterated that if mobile phones are used in the classroom there must be controls over access to certain websites. Learners mentioned having a limited amount of time spent on mobile phones in the classroom. Once again, learners and educators spoke about self-discipline when managing the use of mobile phones in education.

Recommendations

Nomophobia might not yet be classified as an official mental health condition, however, experts agree this issue of the technology age is a growing concern that can affect mental health. A phobia can be treated by a therapist using:

- **Cognitive behavioral therapy –** this can help a person to manage negative thoughts and feelings that arise when a person thinks about not having their mobile phone.
- **Exposure therapy –** this can help a person to face their fears through gradual exposure to it. If a person has nomophobia, they will slowly get used to the experience of not having their phone. This may seem frightening at first, especially if one needs their phone to stay in touch with loved ones, but the goal of exposure therapy isn't to completely avoid using one's mobile phone; instead, it helps one learn to address the extreme fear that one experience when one thinks about not having one's phone. Managing this fear can help a person use their phone in healthier ways.

A person can also take steps to cope with nomophobia on their own by trying the following (Munoz, 2018; Legg & Raypole, 2019; Cherry, 2020):

- Mobile phones should be switched off at night to get more restful sleep. If an alarm is needed to wake up, keep the phone at a distance, far enough away that it can't easily be checked at night.

- Try leaving mobile phones at home for short periods of time, such as when you make a grocery run, pick up dinner, or take a walk.
- Spend some time each day away from all technology. Try sitting quietly, writing a letter, taking a walk, or exploring a new outdoor area.

It is evident from the findings that educators and learners do suffer from mild, moderate and severe nomophobia. Nomophobia affects the quality of work delivered by both educators and learners. The Department of Education must recognize that nomophobia does affect teaching and learning and must provide counselling therapists for educators and learners alike. Furthermore, a policy for the use of mobile phones must be introduced for both educators and learners.

The framework policy for educators must be designed to inform all educators of expectations regarding the use of mobile phones during working hours. It is intended to offer guidance to educators with regard to what constitutes appropriate (and inappropriate) use of mobile phones within the workplace. There must be consequences if educators breach the mobile phone policy, and this would include being invited to an investigatory meeting to ascertain the facts and details about the incident. Thereafter, disciplinary measures will be taken.

Developing a mobile phone policy at school is essential to ensure learners and educators are able to enjoy the instructional benefits associated with using mobile phones, while also ensuring the mobile phones don't become a distraction from learning. The policy for learners must be designed to inform all learners of expectations regarding the use of mobile phones in the classroom. It is intended to offer guidance to learners with regard to what constitutes appropriate (and inappropriate) use of mobile phones within the school.

If learners violate the school's mobile phone policy, the following may occur:

- First offense: The learner's mobile phone will be confiscated by a staff member and held in the main office until the end of the school day. Before being allowed to pick up their phone at the end of the day, learners must discuss and review the mobile phone policy with a staff member.
- Second offense: The learner's cell phone will be confiscated and held in the main office until the end of the school day. The learner's parents will be contacted and informed of the refusal to follow the school's mobile phone policy. Learners may pick up their phones following after-school detention.
- Third offense: The learner's mobile phone will be confiscated and held in the main office until the learner's parents are able to come to pick it up. The learner will receive after-school detention and will be prohibited from bringing their mobile phone back on school grounds for two weeks.

The school administration will reserve the right to adjust these consequences on a case by-case basis if needed. For example, extreme behaviours that break the law or engaging in bullying or harassment of other learners may result in suspension or expulsion.

Limitations of the Study

The study is not without limitations. It took place at one selected public secondary school in Gauteng (the case); thus, the results may not be generalizable to other public secondary schools in Gauteng or in South Africa. The study did ignore the context of real life and it must be made clear that participants cannot be studied meaningfully by ignoring the social, economic and political structures that continue to affect all aspects of education.

Even though anonymity was assured to all learners, learners' parents and educators, some may have felt uneasy about rating their observation regarding the negative aspects of nomophobia and the quality of teaching and learning. Hence, they may have demonstrated subject effects, which behaviors that may not reflect the practical situation. This situation may have caused errors in the results.

All educators and learners were from a single case. It must be noted that educators and learners from different schools may have differing views on the impact of nomophobia on the quality of teaching and learning.

Conclusion

Attempts to ban or limit student use of cell phones in schools are likely to be controversial, to say the least. Even so, school officials can prevail and limit the amount of time spent policing learners with regard to mobile phone policies by taking the time to plan carefully. This study revealed that educators and learners are all prone to some extent of nomophobia, however, a noteworthy fact is that almost one third (32.9%) of respondents displayed severe nomophobia. The aspect of great concern is that the school at which the research was conducted had a ban on the use of mobile phones in the classroom. This indicates that educators and learners are spending a lot of their time outside school on their mobile phones. This time can be used constructively for improving the quality of teaching and learning. Monitoring the learners smuggling mobile phones in the classroom poses more discipline problems for the school staff. School staff has to police learners on the use of mobile phones in the classroom when mobile phones are actually banned.

Educators and learners alike feel that mobile phones should be used for educational purposes in the classroom. Educators and learners were vocal that mobile phones can be brought into school with certain controls and restrictions. This study further looked at creating a framework for a mobile phone policy for educators and a mobile phone policy for learners that would allow educators and learners to use their mobile phones in school with some provisions. This framework for a policy will allow educators and learners to have some introspection regarding their personal mobile phone usage.

Moving forward, educators and learners must be given support if indeed they do suffer from severe nomophobia. This support must be provided by the Department of Education as they do with other mental disorders. Controlling the use of mobile phones in general can improve the quality of teaching and learning and create a pleasurable work environment.

In sum, the cumulative evidence of the risks and detrimental impact of mobile phones on learners learning, well-being, and safety suggests that educators must address these devices' presence and roles in schools more seriously and systematically than has been the case to date. While some educators and learners believe that mobile phones can be used to enhance and boost instruction, others fear that the negative effects of their use in class clearly outweigh the potential benefits. Finding the right balance for learner mobile phone use in schools is a daunting challenge calling for a community-wide approach involving learners, parents, educators, school governing bodies, the Department of Education, and broader social awareness about the effects of mobile phones on youth achievement and well-being. Consistency, and follow-through, in expectations is of fundamental importance if learners are to respect rules limiting their freedom and if learners are unlikely to abide by rules that are not consistently enforced. Consensus on the appropriate role of mobile phones in schools is unlikely to emerge in the near future. Even so, creating policies and procedures regulating educator and learner use

of mobile phones in schools is an important step in addressing and ameliorating the growing concerns about their misuse in and around schools, their effects on mental health, and maintaining schools as safe and orderly places for teaching and learning in which all learners can succeed.

References

Ali, A., Muda, M., Ridzuan, A. R., Nuji, M. N., Izzamuddin, M. H., & Latiff, D. I. (2017). The Relationship Between Phone Usage Factors and Nomophobia. *Advanced Science Letters, 23*(8), 7610-7613.

Bahl, R. R., & DeIuliis, D. (2019). Nomophobia. In I. R. Association (Ed.), *Substance Abuse and Addiction: Breakthroughs in Research and Practice* (pp. 295-306). Hershey, PA: IGI Global.

Bhattacharya, S., Bashar, M. A., Srivastava, A., & Singh, A. (2019). NOMOPHOBIA: No Mobile Phone Phobia. *J Family Med Prim Care, 8*(4), 1297-1300.

Bragazzi, N. L., & Del Puente, G. (2014). A proposal for including nomophobia in the new DSM-V. *Psychology research and behavior management, 7*, 155-160.

Creswell, J. W. (2014). *Research design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Los Angeles: SAGE.

Davie, N., & Hilber, T. (2017). *Nomophobia: Is smartphone addiction a genuine risk for mobile learning?*. https://files.eric.ed.gov/fulltext/ED579211.pdf

Davies, N. (2018). *Nomophobia: The Modern-Day Pathology*. https://www.psychiatryadvisor.com/home/topics/anxiety/nomophobia-the-modern-day-pathology/

Dictionary, C. (2020). *Nomophobia*. https://dictionary.cambridge.org/dictionary/english/nomophobia

Gray, D. E. (2014). *Doing Research in the Real World* (3rd ed.). Thousand Oaks, London: Sage Publications, Inc.

Humood, A., Altooq, N., Altamimi, A., Almoosawi, H., Alzafiri, M., Bragazzi, N., Jahrami, H. (2021). The Prevalence of Nomophobia by Population and by Research Tool: A Systematic Review, Meta-Analysis, and Meta-Regression. *Psych, 3*(2), 249-258.

Jena, R. K. (2015). Compulsive Use Of Smartphone and its Effect on Engaged Learning and Nomophobia. *SMART Journal of Business Management Studies, 11*(1), 42-51. http://indianjournals.com/ijor.aspx?target=ijor:sjbms&volume=11&issue=1&article=005

Jibson, M. D., & Seyfried, L. S. (2016). *Diagnostic and Statistical Manual of Mental Disorders -American Psychiatric Association* (5th ed.). Michigan: Academic Psychiatry.

Kim, H. (2013). Exercise rehabilitation for smartphone addiction. *Journal of Exercise Rehabilitation, 9*(6), 500-505.

Kingston, K. (2020). *The importance of cell phones in modern society*. https://www.streetdirectory.com/travel_guide/153893/cell_phones/the_importance_of_cell_phones_in_modern_society.html

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational context. *International Journal of Higher Education, 6*(5), 26-41.

Kwon, M. (2013). The Smartphone Addiction Scale: Development and Validation of a Short Version for Adolescents. *PLoS ONE, 8*(12).

Legg, T. J., & Raypole, C. (2019). *Afraid of Losing Your Phone? There's a Name for That: Nomophobia*. https://www.healthline.com/health/anxiety/nomophobia

McMillan, J. H., & Schumacher, S. (2014). *Research in Education: Evidence Based Inquiry*. (Seventh Edition. ed.). Pearson Education Limited.

Mendoza, J. S., Benjamin, C. P., Lee, S., Minsung, K., & McDonough, I. M. (2018). The effect of cellphones on attention and learning: The influences of time, distraction, and nomophobia. *Computers in Human Behaviour*, *86*, 52-60.

Moreno-Guerrero, A. J., López-Belmonte, J., Romero-Rodríguez, J. M., & Rodríguez-García, A. M. (2020). Nomophobia: impact of cell phone use and time to rest among teacher students. *Heliyon-Science Direct*, *6*(5), 1-8.

Munoz, K. (2018). *Nomophobia — 5 Steps to Ending Your Smartphone Addiction*. https://draxe.com/health/nomophobia/

Passmark. (2018). *How big are South African schools*. https://passmark.org.za/howbig/

Patel, R. (2015, June 17). *Cell Phone use before bedtime might impact sleep, and daytime tiredness*. https://u.osu.edu/emotionalfitness/2020/09/27/cell-phone-use-before-bedtime-might-impact-sleep-and-daytime-tiredness/

Petter, O. (2018). *'Nomophobia' crowned word of 2018, but what does it mean?* https://www.independent.co.uk/life-style/nomphobia-word-of-the-year-2018cambridge-dictionary-smartphone-anxiety-a8705106.html

Rouse, M. (2013). *Definition Nomophobia*. https://whatis.techtarget.com/definition/nomophobia

Surbhi, S. (2017). *Difference between Census and Sampling*. https://keydifferences.com/difference-between-census-and-sampling.html

Webster, M. (2019). *Nomophobia*. https://www.merriamwebster.com/dictionary/nomophobia#:~:text=%2Db%C4%93%2D%C9%99%20%5C,Definition%20of%20nomophobia,or%20being%20without%20their%20phone.

Webster, M. (2019). *phobia*. https://www.merriam-webster.com/dictionary/phobia

Wikipedia. (2016). *Nomophobia*. https://en.wikipedia.org/wiki/Nomophobia

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Ethical Research Principles: Documenting Latin American Faculty Perspectives Through Q-sort*

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Abstract: The ethical principles in research are universal and serve as a humanizing guide throughout the research process. Their application requires keeping in mind the local health, socio-cultural, and economic conditions where research is conducted. Higher education institutions and researchers share the responsibility of ensuring application of ethical research principles in science, technology, and innovation activities. This article reports findings from a mixed methods study on the perspectives of university faculty regarding the application of research ethical principles to research endeavors. Utilizing a Q-method approach to capturing subjectivity, 52 faculty-researchers participated in an online Q-sort exercise which also included an open-ended questionnaire. The study looked at similarities and differences in viewpoints regarding the application of ethical research principles. The study research questions included: (1) what are the participants' perspectives applying research ethical principles? (2) what are the similarities and differences in viewpoints when looking at the participants' years of research experience, research ethics preparation, and field of expertise? This article presents the results analyzing the responses of the participating faculty researchers. Similarities and differences of their perspectives were documented by looking at years of research experience, research ethics background, and field of expertise. Study findings point to the need to offer more opportunities for training to better prepare experienced and less experienced researchers on how to anticipate and plan for ethical dilemmas that may arise while conducting research. Emerging and experienced researchers can benefit from such training and self-awareness.

Keywords: Q-sort, Ethical Research, Ethical Dilemmas, Scientific Research, Faculty Perspectives.

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Introduction

Ethics refers to standards of human conduct that distinguish appropriate from inappropriate behavior (Espinosa & Alger, 2014). Research ethics seeks to reflect on social responsibility, relevance, scientific integrity, and techno-scientific quality in science, technology, and innovation activities (Departamento Administrativo de Ciencia, Tecnología e Innovación, 2018). Research ethics has been generally oriented towards respect and protection of individuals (Guraya, London, & Guraya, 2014); however, the relationship with the environment and the care for life from different scientific fields have established an ethic of life that goes beyond the exclusive relationship with human beings or bioethics.

Research ethics emerged in the context of biomedicine after World War II, as a response to the abuses committed by the Nazi regime in the name of science. Cases such as the Tuskegee Syphilis study and Willowbrook Hepatitis provoked greater awareness and regulation of the protection of the rights, dignity, and welfare of research participants, and were crucial to the creation of universal ethical codes, the development of modern research ethics and the flourishing of public health ethics (Gallardo Miranda et al., 2008). Today, research ethics is applied to all fields of science and education.

The Nuremberg Code of 1947 was the first document to establish fundamental ethical principles such as informed consent and researcher qualification. The Helsinki Declaration of 1964 prioritized the interests of the research subject and the benefit/risk balance centered on the principle of beneficence. The Belmont Report of 1979 provided an ethical framework for both research and clinical bioethics based on three fundamental principles: respect for persons, beneficence and justice (Gallardo Miranda et al., 2008). It is important to clarify that research ethics is not limited to the biomedical field, but also encompasses other scientific disciplines, and involves not only the formulation of research but also its implementation, data management, and publication (Stepke, 2002). Thus, ethical considerations should be considered in all steps and phases of the research process from beginning to end.

Based on the ethical principles established in the Nuremberg Code, the Declaration of Helsinki, the Belmont Report, and the UNESCO Universal Declaration on Bioethics and Human Rights, ethics committees built a normative framework that seeks to limit and control abuse in the use of science and technologies associated with biotechnologies, limit invasive market trends, and promote and protect the fundamental rights of individuals (Zavala & Mantilla, 2011). These ethics committees aim to protect life and human rights, as well as promote good research practices.

There are many reasons why researchers avoid requesting approval from their institutions to conduct research. As Domenech-Rodríguez et al. (2017) explain, “lengthy forms may be dismissed as tedious, or they may be considered a great support to ensure a thorough review of the research activities” (p. 83). Therefore, gaining an understanding of researchers’ perspectives of ethical responsibility while investigating, collecting data, and disseminating research results is paramount.

A recurrent issue relates to the lack of awareness of the procedures and rules governing the requirements established by the Institutional Review Board (IRB) or Independent Ethics Committee (IEC) at the faculty member’s institution. Likewise, misunderstanding the role of IRB committees creates distrust and adds confusion to the IRB review process. This can also be aggravated by a lack of knowledge regarding ethical research principles that a researcher must follow while conducting research. Having clarity and conviction, as well as understanding the importance of applying these principles, are crucial to research integrity. As an example, Christians (2000) states that “ensuring that data are accurate is a cardinal principle in social

science codes. Fabrications, fraudulent materials, omissions, and contrivances are both unscientific and unethical" (p. 140). Fabrication of data and results which may not reflect the reality of the setting and/or participants or that do not contribute to solving a previously identified problem can certainly be issues of concern. Misrepresentation of the reality and setting when the object of study is other than human subjects (e.g., environmental research, animals and plants, and technology) is certainly a possibility. Therefore, the reliability and validity of the data are at risk when the principles of ethical research are not applied. In addition, receiving financial support or pressure related to social practices and politics can create a conflict of interests for the researcher.

Institutions that generate knowledge through research, and their researchers, are responsible for enforcing scientific integrity (Consejo Nacional de Ciencia, Tecnología e Innovación Tecnológica, 2019). This implies promoting good research practices, training ethical researchers, ensuring quality and credibility of results, and adopting a system that allows for filing grievances on violation of ethical research principles (Departamento Administrativo de Ciencia, Tecnología e Innovación, 2018). Researchers must be aware of the consequences and impact of their actions.

According to Drane (2004), the history of research ethics shows us that transgressions did not occur only because of a lack of standards, but also because of the loss of the researcher's moral character and lack of commitment to ethical principles. Therefore, it is necessary to foster a culture of ethics that promotes research integrity, researcher responsibility, and respect for human subjects, plants, animals, and all living organisms.

Ethical Regulations and Research Principles

The Nuremberg Code (Nuremberg International Military Tribunal, 1947), internationally recognized, is the pioneer document in regulating experimentation on human beings and in pointing out the obligation to have the consent of the patients. Subsequently, the Declaration of Helsinki (1964) clarifies aspects of biomedical research on human subjects and establishes ethical guidelines for the evaluation of projects by RECs (WMA, 2013). Due to the little impact of these regulations in the medical community, the Belmont Report (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1978) showed the need to establish universal ethical principles to guide the development of research with human subjects and ensure their protection. The UNESCO Declaration on Bioethics (2005) included new topics related to the development and the protection of human rights, such as the environment, equity, justice, and peace, among others.

The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research was created as a result of the National Research Act of 1974. The role of the Commission was to identify basic ethical principles (e.g., protect the rights of research participants, enhance research validity, maintain scientific and academic integrity) that should underlie the implementation of biomedical and behavioral research involving human subjects. The Commission also established guidelines to ensure that research is conducted in accordance with these principles. In addition, Christians (2000, pp. 138-140) describes four guidelines to apply the codes of ethics. These are: Informed consent for research participants, deception as morally unacceptable, safeguards to protect people's privacy and confidentiality, and ensuring the accuracy of data.

Conducting Ethical Research

Scientific integrity involves promoting good research practices. Thus, researchers should be aware of research pitfalls to prevent them and achieve credibility; they should follow

ethical research guidelines established by their institutions. Institutional Review Boards (IRBs) are charged with the task to approve research procedures and safeguard the appropriate implementation of ethical research principles as well as regulatory norms for the protection of human subjects and institutions from harm. "Modern-day IRBs function as independent bodies for research review and oversight. Many IRBs are affiliated with universities, medical centers, and research centers" (Domenech-Rodríguez et al., 2017, p. 78). Each institution, where research is a required activity, has its own procedures in place to monitor and approve research activities.

The work of researchers such as Creswell (2016), Domenech-Rodríguez et al. (2017), Lincoln and Guba (1985), and Shenton (2004) are helpful to explain the measures researchers must take to ensure ethical considerations and accountability in research with human subjects. Thus, Creswell (2016) provides suggestions on how to anticipate ethical issues during each phase of research such as thinking of issues that can arise before, during, and after the research is finished since ethical issues can also arise during the publication process. Domenech-Rodríguez et al. (2017) describe IRB officials as allies, collaborators, and expert consultants in the research enterprise: "Researchers and IRB staff/members are working different pieces of the same common goal to "do good" (p. 83). In turn, Lincoln and Guba (1985) recommend qualitative researchers in pursuit of a trustworthy study to observe the following four constructs: (a) credibility (internal validity), (b) transferability (external validity and generalizability), (c) confirmability (objectivity), and (d) dependability (reliability). Shenton (2004) suggests provisions that the qualitative researcher may employ to meet these four criteria. His article provides a robust list of strategies that may be adopted by investigators in response to these issues.

According to Fuentes-Delgado et al. (2020), during the COVID-19 pandemic, research ethics committees faced two major challenges. One of the challenges was related to implementing remote operational processes such as collecting and protecting data, using technology, and including contactless human interaction. The second challenge had to do with making sure that the rights of the participants were not being violated in any way, as to protect their integrity and provide humane treatment in the social context of the pandemic. Thus, during and after the pandemic, technology and world events have had an impact on how ethical research principles are implemented.

There is plenty of research documenting the measures that researchers must follow to conduct ethical and high-quality research. However, research documenting how researchers adhere to ethical research principles is scarce. This is the gap in the literature that the present study aims to address.

Methodology

Q-methodology, also known as Q-sort, is the systematic study of people's viewpoints. The goal is to investigate the perspectives of research participants who represent different stances on an issue, by having them sort and rank a series of statements that focus on the same topic. Q-sort is a set of connected techniques that allow the systematic study of subjectivity - people's viewpoint, opinion, beliefs, or attitudes (Brown, 1996). In a Q-sort exercise, people are presented with a carefully selected sample of statements about a topic. Individually, they rank-order the statements according to some preference, judgment, or feeling about them, mostly using a quasi-normal distribution. Through this process people assign their meaning to the statements and reveal their subjective viewpoint or personal profile (Brown 1996, Cross, 2005). Once they are done sorting and raking the statements, they answer open-ended questions to

explain their decisions and viewpoints. Thus, Q-sort combines quantitative and qualitative tools to study the subjective views of those directly involved in a topic.

Utilizing referrals and snowball sampling (Patton, 2002), nearly 200 researchers from several Latin American countries were invited to participate in the study and 52 complete survey responses were collected. Thus, faculty researchers from five Latin American countries participated in an online Q-sort exercise which also included an open-ended questionnaire. The research questions guiding the overall study included:

1. What are the participants' perspectives applying research ethical principles?
2. What are the similarities and differences in viewpoints when looking at the participants' years of research experience, professional credentials, and field of expertise?

Participants

Latin-American university faculty involved in conducting research at their respective institutions were invited to participate in the study. Participants were recruited by sending an email to directors of research centers and research groups in different public and private universities. To become a study participant, an important requirement was to have at least 3 years of experience conducting research. In addition, referrals and snowball sampling strategies were utilized to reach a larger pool of potential participants.

Data Collection

Qualtrics®, an online data collection tool, was utilized to create a mixed methods instrument, which was split into four sections: (1) Introduction to the study, (2) demographic questions, (3) Q-sort exercise, and (4) open-ended questions. To be able to gather enough responses, data were collected for a period of six months.

First, the introduction included an explanation of the purpose of the study and a request for consent to participate. Participants were reminded that taking part in the study was voluntary.

Second, the participants were presented with a few demographic questions to gather data on their years of experience conducting research, credentials or training related to ethics and ethical research, and their area of expertise. However, to protect confidentiality, no personal identifiable information was collected.

Third, the Q-sort exercise presented the participants with 23 statements (Q-set) to sort and rank order according to their professional opinion. Participants classified the statements into five categories: Strongly Agree, Agree, Neutral/Indifferent, Disagree, and Strongly Disagree. They dragged each statement to the respective box labeled with the selected category. The focal question guiding the Q-sort exercise was: To what extent do you agree with the list of statements as they relate to conducting ethical research? (see Appendix A). The Q-set represented a wide range of viewpoints and covered the application of ethics and ethical principles at different stages of the research process (design, implementation, results, and publication). The Q-set came from a larger number of statements lifted (and polished) from journal articles and book chapters related to the topic. Once the Q-set (23 statements) was ready it was sent to a couple of experienced researchers to pilot for clarity. Their feedback was incorporated to reexamine and edit the statements for meaning and relevance and were tested a second time before sending the survey to actual research participants.

Fourth, the last section of the survey presented the participants with five open-ended questions to elaborate on their Q-sort responses. These questions invited them to explain their

choices and viewpoints when sorting and ranking the Q-set statements. There was no time limit to complete the online survey. However, they could only submit their responses once to avoid duplicates.

Ethical Considerations

IRB approval (protocol number 7784) was granted by the Institutional Review Board at Texas State University. An email with details related to scope, purpose, objectives of the study, as well as the nature of their participation was sent to potential participants. They were debriefed on the nature and purpose of the study as well as the voluntary nature of their participation. Consent was established by clicking on the survey link and by submitting their survey responses. They were presented with the following two sentences: "If you would prefer not to participate in the study, please stop here. If you consent to participate, please complete the survey by clicking on the following link." All references to potentially identity-revealing details were removed from the data and the Qualtrics® survey was submitted anonymously.

Limitations

Administering the Q-sort exercise online via a survey platform was a limitation to collecting richer qualitative data. Not having face-to-face contact or an interview with the participants limited the explanations of their choices when conducting the Q-sort exercise. In addition, the survey platform also presented limitations in the tools it has available to design the Q-sort exercise to make it more user-friendly. For example, sorting and ranking 23 statements can be a difficult exercise depending on the size of the computer screen, or the device selected by the participant (tablet or a cell phone) to complete the survey.

Analysis of Data

The Qualtrics platform allowed for easy retrieval and organization of data. The respondents' rankings of the Q-sort statements were subject to Q-factor analysis and the resulting factors indicated segments of subjectivity. Correlation between participant profiles indicated similar viewpoints or segments of subjectivity. By correlating people's responses, Q-factor analysis provided information about similarities and differences in viewpoint on the topic at hand (Brown 1996, Cross, 2005). It was important to examine the impact that being a novice or experienced researcher had on the participants' responses.

The qualitative data collected (the open-ended questionnaire responses) were coded using conventional content analysis (Hsieh & Shannon, 2005). This analysis included reading the data repeatedly to make sense of the whole, coding for key concepts, and grouping codes into categories to come up with meaningful clusters. Knowledge generated from content analysis is based on participants' unique perspectives and grounded in the actual data (Hsieh & Shannon, 2005, p. 12). Several tables and visuals were created to summarize and synthesize the findings.

Findings

Study findings are organized according to the research questions formulated for the study. Thus, the first section presents the participants' perspectives in applying research ethical principles and discusses three major findings: ethical dilemmas, participants' concerns, and conflictive views. The second section illustrates the similarities and differences in viewpoints

when looking at the participants' years of research experience, professional credentials, and field of expertise.

RQ#1
What are the Participants' Perspectives Applying Research Ethical Principles?

Ethical Dilemmas

62% of the participants disagreed that "conducting ethical research implies bending the rules sometimes." However, 68% are "willing to compromise certain ethical principles if it means saving a life or protecting a human being from harm." In the open-ended questionnaire, only 40% of the survey respondents provided examples of ethical dilemmas and the remaining 60% expressed denial or reported not having faced ethical dilemmas while conducting research. For example, 28% of the participants agreed that "my research topic is straightforward. I do not anticipate any ethical issues." Only 40% of the faculty researchers reported taking measures to prepare and anticipate ethical dilemmas to occur and how to resolve them. To summarize, the participant responses revealed that the Q-statements related to ethical dilemmas resonated with them. Yet, analysis of the Q-sort responses indicated contradictions pointing to lack of understanding of what constitutes or has potential to become an ethical dilemma.

Participants' Concerns

Truth in research, consent, and ethical obligation were the most relevant concerns identified by the study participants. 46% believed that conducting research will allow them to report on the participants' truth. 64% worried that the participants will not tell the truth. 79% agreed that being honest and defending the truth is their main goal as researchers. Concerning consent, 18% agreed and 71% disagreed that "the consent process is a formality, what counts is that participants understand the research goals." Only 7% agreed that "emphasizing the right to withdraw participation makes them feel nervous because study participants may see it as their first option." 50% disagreed with that statement and 43% did not see it as a concern. Regarding ethical obligation, 93% stated that "obtaining IRB approval is important but, in the end, the researcher is responsible for ethical research implementation." 93% agreed that "upholding individuals' rights to confidentiality and privacy are central to ethical research." 61% agreed that "even if required, reporting confidential information to courts can also cause moral dilemmas." 39% agreed that "moral duty and personal viewpoint can be stronger than legal requirements." In conclusion, the Q-sort responses pointed to participants' concerns about reporting the truth, defending the truth, and gathering truthful data when conducting research. Emphasizing the voluntary nature of participation was not a concern for most, and the majority were aware of their ethical obligation to protect the participants' confidentiality and privacy.

Conflictive Views

75% disagreed that "research is a complex process and ethical principles are just a small part of it." 39% agreed that "planning on how to address potential ethical dilemmas is a big concern" 43% did not see this as part of the study design process, prior to conducting research. 29% agreed that "research benefits are difficult to predict during the study design phase" and 25% said this was not a concern for them. In the open-ended questionnaire, participants were asked to describe ethical dilemmas they had faced in their research practice. Out of 52, only 29 of the respondents answered this open-ended question, and out of those 20 (29%) provided examples of ethical dilemmas that they have faced. However, most responses attributed responsibility to the institution, the state, or the research sponsor for why they had faced an

ethical dilemma in the past. Sixteen (31%) of survey respondents denied having faced any ethical dilemmas. To summarize, analysis of the Q-sort and open-ended questionnaire responses suggests that study participants need to gain knowledge, develop a higher level of awareness, and plan for ethical dilemmas that may arise in the process of designing, conducting, and reporting research.

RQ#2

What are the Similarities and Differences in Viewpoints When Looking at the Participants' Years of Research Experience, Professional Credentials, and Field of Expertise?

Table 1 shows that 56% of the study participants were experienced researchers with 5+ and 10+ years of research experience. Table 2 describes the participants' research ethics credentials. Table 3 illustrates study participants' field of expertise.

Table 1

Years of research experience

Experience	%
3 years	17%
3+ years	27%
5+years	29%
10+ years	27%

Table 2

Ethics preparation

Research Ethics Credentials	%
Took at least one university course where topics related to ethical research were discussed	40%
Participated in professional development related to ethical research	30%
Took courses on ethical research as a requirement to obtain IRB approval	10%
None of the above	20%

Table 3

Field of expertise

Faculty Researchers' Fields	%
Agronomy & Veterinary Medicine	13%
Education	22%
Social Science & Humanities	27%
Accounting & Business Administration	20%
Mathematics & Science	11%
Engineering	7%

Results of the Q-factor analysis revealed the participants' similarities and differences in viewpoints. Thus, when comparing results illustrated in Figure 1 (responses of less experienced researchers, 3-5 years of research experience) and Figure 2 (responses of experienced researchers, 5+ and 10+ years of research experience) statements 11, 19, and 21 show differences in opinion.

11. My research topic is straightforward. I do not anticipate any ethical issues
19. Planning on how to address potential ethical dilemmas is a big concern of mine
21. Even if required, reporting confidential information to courts can also cause ethical dilemmas

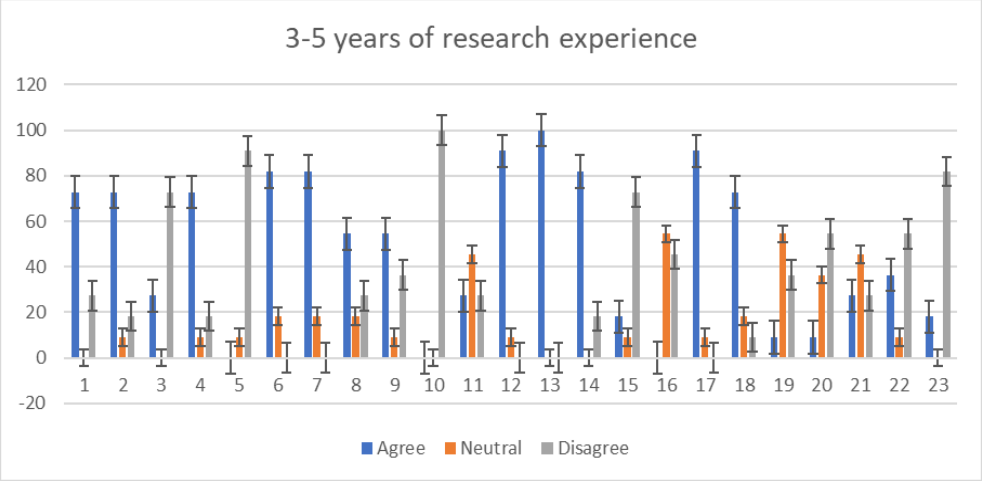

Figure 1. Responses of Less Experienced Researchers

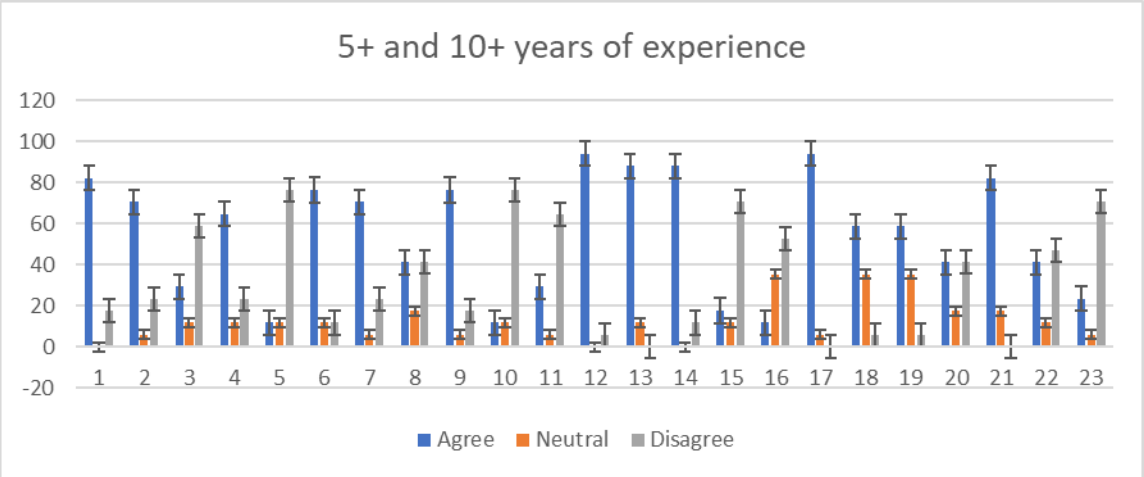

Figure 2. Responses of Experienced Researchers

For statement 11 (My research topic is straightforward. I do not anticipate any ethical issues), 53% of seasoned researchers (5+ and 10 + years) agreed with the statement, whereas 45% of the less experienced researchers (3-5 years) sorted it as Neutral/Indifferent.

Regarding statement 19 (Planning on how to address potential ethical dilemmas is a big concern of mine), 59% of the experienced researchers agreed and 55% of the less experienced researchers classified it as Neutral/Indifferent.

For statement 21 (Even if required, reporting confidential information to courts can also cause ethical dilemmas), 82% of the experienced researchers agreed and 45% of the less experienced researchers sorted it as Neutral/Indifferent.

To summarize, experienced researchers reported stronger beliefs regarding ethical dilemmas while conducting research. Opinions of experienced and less experienced researchers were split. However, both groups should gain better understanding of what constitutes ethical dilemmas and the importance of preparing for facing and resolving them during the different stages of the research process (i.e., research design, data collection, and publication of results).

Next, Figures 3 and 4 illustrate similarities and differences in viewpoints in connection to the participants' research ethics preparation or lack thereof.

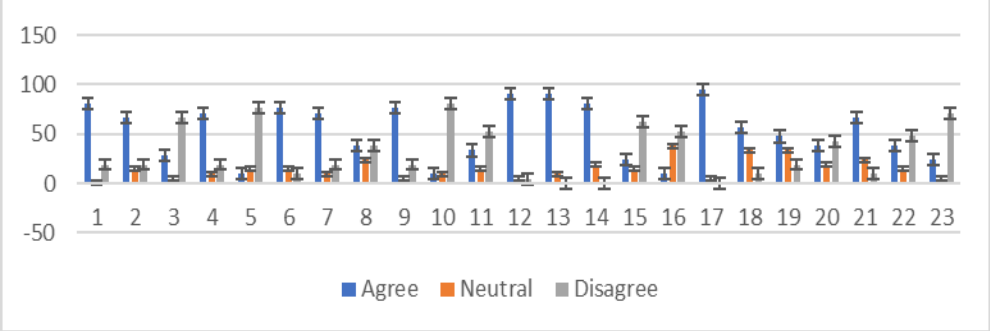

Figure 3. Responses of Participants with Research Ethics Credentials/Preparation

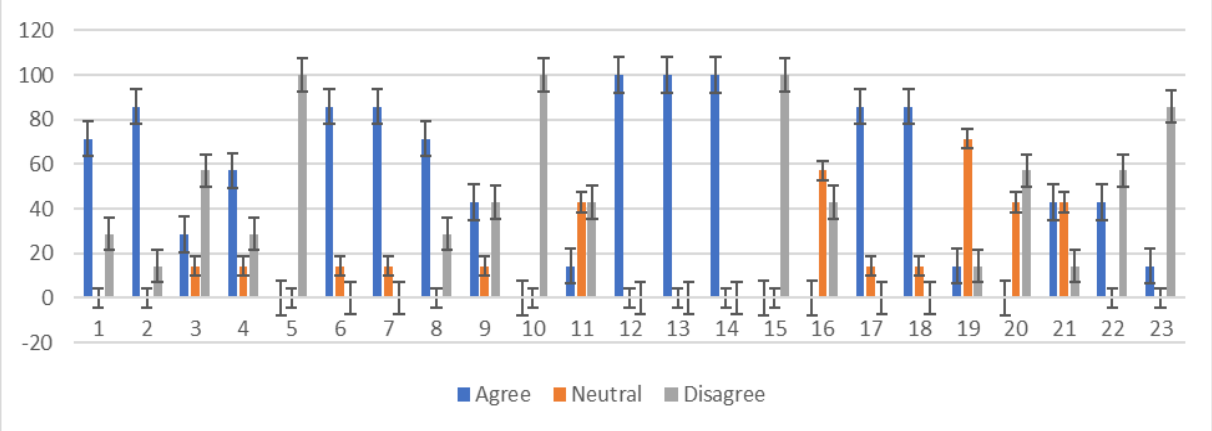

Figure 4. Responses of Participants with No Research Ethics Credentials/Preparation

Comparing results illustrated in Figures 3 and 4, statements 16 and 19 show differences in opinion. For statement 16 (Emphasizing the right to withdraw participation makes me feel nervous that participants may see it as their first option), 52% of the participants with research ethics preparation/credentials disagreed with the statement and 57% of the participants with no research ethics preparation classified the statement as Neutral/Indifferent. This result suggests a similar opinion between both groups.

Concerning statement 19 (Planning on how to address potential ethical dilemmas is a big concern of mine), 48% of the participants with research ethics preparation/credentials agreed with the statement and 71% of the participants with no research ethics preparation sorted the statement as Neutral/Indifferent. This result indicates a different viewpoint between both groups of participants. It also suggests that less experienced researchers need to gain a better understanding of the importance of planning for ethical dilemmas and how to resolve them before, during, and after research implementation.

Conclusions

The main goal of the study was to document the perspectives of Latin American university faculty regarding the application of research ethical principles to research endeavors.

Analysis of the data collected were presented by discussing ethical dilemmas, participants' concerns, and conflictive views. Similarities and differences of their perspectives were documented by looking at years of research experience, research ethics background, and field of expertise.

Regarding ethical dilemmas, the data revealed that both sets of participants, experienced and less experienced researchers, need to participate in further training to be better prepared to anticipate and plan for ethical dilemmas that may arise during the different stages of the research process. Developing an ability to anticipate and plan for how to face ethical dilemmas is crucial for researchers from all fields of expertise. Creswell (2016) highlights the importance of anticipating ethical issues during each phase of the research process, even after study results are published. Study findings stress the importance of recognizing ethical dilemmas as inevitable while conducting research.

Participants' concerns included the study participants' preoccupation with reporting the truth, defending the truth, and gathering truthful data when conducting research. As Meriam (2009) explains, a key concern is understanding the phenomenon of interest from the participants' perspectives, not the researcher's (p. 14). This was a point of agreement for study participants. They were convinced that research results should report on the truth as it is presented by the research subjects. In addition, emphasizing the voluntary nature of participation was not a concern for most, and the majority were aware of their ethical obligation to protect the participants' confidentiality and privacy. However, as Patton (2002) states, informed consent does not automatically mean confidentiality; it can mean that participants understand the risks and benefits of participation. A few respondents were concerned about disclosing the voluntary nature of participation; but for the most part they did not see this as an issue. Christians (2000) speaks to these issues: "Subjects must agree voluntarily to participate - that is, without physical or psychological coercion...their agreement should be based on full and open information" (pp. 138-139). Christians further states that research participants must be told about the duration, methods, possible risks, purpose, and aim of the study in which they are expected to take part.

In relation to conflictive views, a large percentage of study participants (43%) did not see ethical dilemmas as an aspect of the research design process, prior to conducting research. Their views regarding what constitute an ethical dilemma were split. Some of them even denied having faced any ethical dilemmas while conducting research. Others did not see this as part of their responsibility as researchers and attributed this duty to the institution, the state, or the research sponsor. However, dealing with people in the real world, all kinds of complications can arise (Patton, 2002, p. 407). Ethical dilemmas can arise from the least expected circumstances. Shenton (2004) speaks directly to those who teach research courses compelling them to prepare future researchers to be cognizant of the provisions which can be made to address matters such as credibility, transferability, dependability, and confirmability. So that "prospective researchers can then assess the extent to which they are able to apply these generic strategies to their particular investigation" (p. 73). Shenton provides examples and strategies on how to plan and implement high-quality research that keeps ethical considerations in mind.

Clarity and conviction upholding ethical research principles are crucial to research integrity. Gaining understanding of researchers' perspectives of ethical responsibility collecting data and disseminating research results is paramount. Thus, the information presented in this article is beneficial to all scholars and researchers, not just the population sample who participated in the study. Bringing attention to the complexities that researchers face when applying ethical research principles is a must for the different disciplines where they conduct research. Being prepared to respond to challenges posed by ethical dilemmas impacts both qualitative and quantitative researchers.

Recommendations

Study findings point to the need to provide more preparation on ethical research principles at different stages of the researcher's career. Undergraduate and graduate programs preparing future researchers should offer more options and credentials to prepare future researchers. Institutions and organizations requiring their employees to conduct research should continue to offer training on ethical research principles to be applied before, during, and after the implementation of research. Carefully studying ethical principles and examining scenarios of unethical behavior can sensitize emergent and seasoned researchers to situations in which ethical issues arise. This practice may help them identify the extent of their ethical obligations.

Research involving human subjects should be people-oriented, not process-centered. In other words, research participants should be debriefed on all the specifics of a study prior to asking them to participate in research. Thus, obtaining informed consent is crucial to the investigation, it is not a formality. Obtaining consent is not just about informing participants of the goals of the study; it is also about clearly identifying risks and benefits of participation.

No research study is 100% safe for human subjects. Some degree of risk and vulnerability is always possible. As an example, anonymity is difficult to achieve. Therefore, the researcher should take great measures to protect study participants' identities and data. Risk can manifest at different levels, emotional, professional, psychological, physical, just to mention a few examples. Thus, it is important that researchers spend more time planning and identifying possible ethical issues and risks during the entire research process, data collection, analysis, and dissemination of findings.

References

Brown, S. R. (1996). Q-methodology and qualitative research. *Qualitative Health Research*. 6, 561-567.

Christians, C. G. (2000). Ethics and politics in qualitative research. In N. K. Denzin & Y. S. Lincoln, Eds. *Qualitative Research* (2nd ed.) pp. 133-155.

Consejo Nacional de Ciencia, Tecnología e Innovación Tecnológica. (2019). *Código Nacional de la Integridad Científica* . Lima: Concytec.

Creswell, J. W. (2016). *30 Essential skills for the qualitative researcher*. Sage.

Cross, R.M. (2005). Exploring attitudes: The case for Q-methodology. *Health Education Research*. 20(2), 206-213. https://doi.org/10.1093/her/cyg121

Domenech-Rodríguez, M. M., Corralejo, S. M., Vouvalis, N. & Mirly, A. K. (2017). Institutional review board: Ally not adversary. *Psi Chi, The International Honor Society in Psychology*, 22(2), 76-84. https://doi.org/10.24839/2325-7342

Departamento Administrativo de Ciencia, Tecnología e Innovación. (2018). *Política de Ética de la Investigación, Bioética e Integridad Científica.* Bogotá, D. C.

Drane, J. F. (2004). The Ethıcs as Character and Medıcal Research. *Acta bioethica*, *10*(1), 17-25. https://dx.doi.org/10.4067/S1726-569X2004000100003

Espinosa, E., & Alger, J. (2014). Integridad Científica: Fortaleciendo la investigación desde la ética. *Revista Médica Hondureña, 8*(3), 126-128. https://doi.org/10.5377/rmh.v88i1.11597

Fuentes-Delgado, D., Minaya, G., & Angulo-Bazán, Y. (2020). Rol de los comités de ética en investigación durante la pandemia por COVID-19. Acta Médica Peruana, *37*(2), 236-238. https://dx.doi.org/10.35663/amp.2020.372.954

Gallarado Miranda, A., & Collado Torres, F. (2008). Ética en la investigación médica. *Revista de la Sociedad Andaluza de Traumatología y Ortopedia*, *26*(1/2), 119-22.

Guraya, S. Y., London, N., & Guraya, S. S. (2014). Ethics in medical research. *Journal of Microscopy and Ultrastructure*, *2*, 121-126. https://doi.org/10.1016/j.jmau.2014.03.003

Hsieh, H., & Shannon, S. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288. https://doi.org/10.1177/1049732305276687

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. Jossey-Bass.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, Department of Health, Education, and Welfare (1978). The Belmont Report. Washington, DC: United States Government Printing Office.

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Sage.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*, 65-75. https://doi.org/10.3233/EFI-2004-22201

Stepke, F. L. (2002). Pautas éticas internacionales para la investigación biomédica en seres humanos. *Consejo de Organizaciones Internacionales de las Ciencias Médicas (CIOMS). Ginebra*.

Zavala, S., & Mantilla, J. A. (2011). Ética e investigación. *Revista Peruana de Medicina Experimental y Salud Pública, 28*(4), 664-669.

Appendix A
Q-Sort Exercise

To what extent do you agree with the following statements as they relate to conducting ethical research?

1. Ethics are the moral principles that a person must follow, irrespective of the place or time.
2. Research ethics focus on the moral principles that researchers must follow in their respective fields of research.
3. Conducting ethical research implies bending the rules sometimes.
4. I am willing to compromise certain ethical principles if it means saving a life or protecting a human being from harm.
5. All types of research involve some degree of deception of participants.
6. Being honest and defending the truth is my main goal as a researcher.
7. Research ethics promote mutual respect and fairness between researchers and participants.
8. By conducting research, I will be able to report on the participants' truth.
9. Research is a necessary evil in academia.
10. It is OK to break the rules from time to time if it benefits the majority.
11. My research topic is straightforward. I do not anticipate any ethical issues.
12. Obtaining IRB approval is important but in the end the researcher is responsible for ethical research implementation.
13. Even the best plans can go wrong because people look at the same situation differently.
14. Researchers also need to meet ethical obligations once the research is published.
15. The consent process is a formality, what counts is that participants understand the research goals.
16. Emphasizing the right to withdraw participation makes me feel nervous that participants may see it as the first option.
17. Upholding individuals' rights to confidentiality and privacy are central to ethical research.
18. Research participants may not tell the truth and that makes me feel uncomfortable.
19. Planning on how to address potential ethical dilemmas is a big concern of mine.
20. Research benefits are difficult to predict when creating a hypothesis, especially in qualitative research.
21. Even if required, reporting confidential information to courts can also cause ethical dilemmas.
22. Moral duty and personal viewpoint can be stronger than legal requirements.
23. Research is a complex process and ethical principles are just a small part of it.

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Pre-service Mathematics Teachers and Undergraduate Mathematics Students' Metaphorical Perceptions of the Concept of Mathematics*

Bedirhan TEKE**

***Abstract*:** This study aims to compare the metaphors developed by the students of the Pre-service Mathematics Teachers (PMT) and the students of the Undergraduate Mathematics (UM) regarding the concept of mathematics and to determine how the metaphors are distributed as to the variables level of class and the department. For this purpose, hermeneutic phenomenology was used as a type of phenomenology design- one of the qualitative research methods. This study was conducted during the 2021/22 academic year with a total of 57 UM students studying at the Faculty of Arts and Sciences of a public university in the Southeastern Anatolia Region, and a total of 68 PMT students studying at the Faculty of Education at the same university. Data was collected through an interview form and analysed with content analysis. It was concluded that many metaphors are necessary in order to explain the concept of mathematics in a holistic way and that the respondents considered mathematics with its positive and negative aspects, as well as embracing it in daily life. It was also observed that the respondents' perceptions of mathematics differ depending on the level of class and the department. For example, while the PMT students approached mathematics with a more concrete viewpoint, the UM students adopted an abstract mind-set. The reason for this result is believed to be related to the fact that the curricula applied for the PMT students contains less abstract expressions and theoretical lessons than that of the UM students, and also makes students active, offers a constructivist learning environment, and aims to train mathematics teachers rather than training them to become mathematicians.

Keywords: Metaphor, Mathematics education, Phenomenology, Pre-service mathematics teachers, Undergraduate mathematics.

*A part of this study was presented as an oral presentation at the Eurasia 10th International Applied Sciences Congress between 7-9 August 2022.

The Kilis 7 Aralık University Ethics Committee was applied on 25.04.2022 for research compliance, which was then accepted with the decision number 2022/10, dated 10.05.2022.

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Introduction

Throughout history, humanity has defined mathematics in many different ways according to the problems of its age. Although mathematics was once defined as "something to be learned", it still referred to many other things, varying from the necessity of measuring due to the Nile's flooding, to counting and specifying quantities in line with needs (Başıbüyük, 2018), a collection of numbers and operations together with operational calculations (Toluk, 2003), a system that prompts people to think logically through generalizations in daily life (Baykul, 1999), a tool to overcome the difficulties encountered (Altun, 2001), and a thinking activity used to come up with a solution to a problem (Altun, 2008). Today, the relevant literature has failed to answer the question: "What is mathematics?" However, Göker (1997) provided more than one explanation as an answer to this question, though it has been regarded that there is no single answer to such a question (Nasibov & Kaçar, 2005). From this standpoint, it can be argued that mathematics is generally life itself and an abstract branch of science. However, due to being an abstract branch of science, mathematics can be perceived by students as a boring subject (Uçar et al., 2010; Çalışıcı & Sümen, 2019), which is also disliked and avoided (Yetim Karaca & Ada, 2018), and challenging (Dede & Argün, 2004). In addition to the implications developed specific to mathematics, environmental experience and the attitudes and beliefs of the educators are also likely to be influential on such perceptions of students (Uçar et al., 2010; Yetim Karaca & Ada, 2018). In this sense, educators should be aware of their impact on students and act accordingly (Uçar et al., 2010).

The relationship between teachers and students plays a critical role in the positive or negative behaviour of students in lessons (Yetim Karaca & Ada, 2018). Considering this issue in relation to mathematics lessons, it is essential that teachers, in particular, should have a positive attitude, since they play a significant role in developing positive attitudes towards mathematics as a subject (Çalışıcı & Sümen, 2019). It is also known that the attitudes of educators in departments where mathematicians are trained exert a great impact on students' perceptions of mathematics. For this reason, determining the perceptions, beliefs and tendencies of prospective teachers and students of the Undergraduate Mathematics throughout their education process is likely to positively affect their professional development (Noyes, 2004). In this connection, metaphors are often used to identify these perceptions and to identify the underlying factors (Ben-Peretz et al., 2003).

More than one definition of the concept of metaphor is present in the literature. As an example, while the concept of metaphor is referred to as "simile" according to the Turkish Language Association (TLA, 2022), Saban (2004) defines metaphors as a powerful mental tool that shapes an individual's opinions in the face of a plot. In addition, there are many other definitions such as a way of thinking that expands individuals' horizons by making them look at life from different perspectives (Morgan, 1998), as well as a way of making sense of a phenomenon depending on another phenomenon (Lakoff & Johnson, 2005), enabling a transfer from the known to the unknown (Soysal & Afacan, 2012), and helping individuals understand the world (Güler et al., 2011). As stated by Cassel and Vincent (2011), metaphors are an important tool for constructing meaning rather than searching for it. From this standpoint, it is believed that the use of metaphors is necessary to determine how the students of the Pre-service Mathematics Teachers, who are trained to become mathematics teachers, and the students of the Undergraduate Mathematics, who are trained to become mathematicians, construct meanings for the phenomenon of mathematics and on which basis they make sense of it.

Literature Review

Research has shown that studies conducted on metaphors developed for the concept of mathematics have two aspects: (1) determine how participants use metaphors in the construction

of mathematical phenomena (Lakoff & Nuñez, 2000; Danesi, 2007; Sinclair & Tabaghi, 2010; Font et al., 2010; Zandieh et al., 2017), and (2) focus on metaphors used as a tool to determine how participants construe mathematics as an entity (Cassel & Vincent, 2011; Latterell & Wilson, 2016; Soto-Johnson et al., 2016; Olsen et al., 2020; Smith et al., 2023). As an example, Sinclair and Tabaghi (2010) aimed to determine how mathematical abstractions made by mathematicians on the concept of eigenvector are construed by using metaphors in mathematical language. One of the participants, used the metaphor of elastic band to represent the stretching of eigenvectors. In another study, researchers (Font et al., 2010) investigated how teachers used metaphors in the process of reading the Cartesian graphs in relation to functions. As a result of that study, teachers turned out to have chosen to use conceptual metaphors, in general, in teaching the subject of function; and an example of conceptual metaphors used in the study was that the graph was associated with the road metaphor.

The relevant literature review pointed to some other studies conducted mostly with students (Schinck et al., 2008; Sezgin Memnun, 2015; Markovits & Forgasz, 2017; Yetim Karaca & Ada, 2018; Koçak & Bilecik, 2019) and prospective teachers (Reeder et al., 2009; Cassel & Vincent, 2011; Tarım et al., 2017; Kuzu et al., 2018). Kuzu et al. (2018), for example, aimed to determine the perceptions of prospective teachers in different branches of teaching as regards mathematics and through which metaphors they conveyed such perceptions. As a result of the study, the students' perceptions towards mathematics were found to differ depending on their department of study, and in fact, the attitudes of the prospective mathematics teachers were found to be more positive than the attitudes of those in other departments, whereas the attitudes of the prospective Turkish teachers were found weaker than those of the students in other departments. In another study, researchers (Markovits & Forgasz, 2017) asked primary school students to create metaphors for the concept of mathematics and used such metaphors to understand students' attitudes towards mathematics. For example, one of the participants using the metaphor of a lion emphasized that mathematics can be achieved by smart people. Another participant used the metaphor of a bird while suggesting that mathematics cannot be learned without effort and struggle. Furthermore, Markovits and Forgasz (2017) associated lion and similar metaphors with wisdom, but bird and similar metaphors with the teaching process of mathematics.

From a perspective which has never been emphasized in the relevant literature, this study has made use of metaphors as a tool to compare the mathematics-related perceptions of the students, with a similar mathematical background, the Pre-service Mathematics Teachers (PMT) and taking a course on how mathematics should be taught, as well as those students of the Undergraduate Mathematics (UM), who were studying advanced mathematics. In view of this, the present study has two main purposes. The first goal is to determine the discourses of PMT and UM about the phenomenon of mathematics and carry out an examination with respect to the development process of courses so as to contribute to the literature. Another goal of ours is to examine how the experiences in mathematics lessons, which play a significant role in shaping students' perceptions of mathematics will create differences for students from different departments with similar mathematical backgrounds. To this end, answers were sought to the following research problems:

- What is the metaphorical perception of the concept of mathematics of pre-service (prospective) mathematics teachers and undergraduate mathematics students?
- Do students' metaphorical perceptions of the concept of mathematics vary according to their level of class and the department in which they study?

Method

With the aim of exploring and comparing the metaphors developed by the students of the Pre-service Mathematics Teachers and those of the Undergraduate Mathematics regarding the concept of mathematics, this study an in-depth analysis (Patton, 2002, p. 28) and employed a qualitative research method to obtain rich data (Strauss & Corbin, 1998, p. 40).

Research Design

Hermeneutic (interpretive) phenomenology was used in this study as a type of phenomenology design, with the aim of defining the essence of the mathematics subject in terms of the experiencer of the phenomenon (Teherani et al., 2015). This type of phenomenology is concerned with how individuals' experiences through life and the meanings they attribute to such experiences affect their preferences (Laverty, 2003). In this connection, this study examined the relationship between the metaphors that the students developed for mathematics and their explanations for such metaphors depending on their department of study, and likewise, the metaphors were then interpreted in the same context (Heidegger, 1867; as cited in Neubauer et al., 2019).

Participants

Considering the research design, it is clear that the participants should have a homogeneous structure (Creswell, 1998). For this reason, utmost attention was paid to the formation of the study sample so that it would consist of people who had similar and meaningful experiences with mathematics, and the purposive sampling method was used. Table 1 presents the descriptive statistics of the participants.

Table 1
Data about the participants

	PMT		UM		Total
Class	Female	Male	Female	Male	F+M
Class 1	31	13	26	12	82
Class 2	19	5	14	5	43
Total	50	18	40	17	125

Data Collection

Data was collected through an interview form consisting of open-ended questions prepared after the opinions of three faculty members in the field of Mathematics Education were taken, and by using a number of metaphors collected in different studies in the literature (i.e., Mahlios & Maxson, 1998; Carlson, 2001; Saban, 2003; Güveli et al., 2011). In the interview form, the participants were asked to fill in the blanks given as "Mathematics is like the colour… / similar to the colour… (or food, vehicle, season)" and to explain the reasons for their answers. Before the interview forms were presented, volunteer students were given the "Informed Consent Form for the Respondents" and were asked to abide by the instructions.

The Kilis 7 Aralık University Ethics Committee was applied on 25.04.2022 for research compliance, which was then accepted with the decision number 2022/10, dated 10.05.2022.

Data Analysis

A total of four stages were used for the analysis of the metaphors developed by the participants in the study sample for the concept of mathematics.

Data Coding and Extraction Phase

In the first stage, the researcher entered the answers given by the respondents into an Excel file in a temporary order, after which, the answers were analysed. At this stage, some of the forms were excluded from the analysis process since they contained answers indicating no logical relationship between the metaphor itself and the subject of the metaphor, such as "*Mathematics is like the colour brown as it reminds me of brown*", or "*Mathematics is like Adana kebab because I am from Adana*", and those forms of the participants who apparently misread the metaphor of "vehicle" (i.e., taşıt in Turkish) as "stone" (i.e., taş in Turkish) and presented the metaphors of "diamond, touchstone, and gravel" as answers, as well as those forms with the questions left unanswered (20). In the coding process, a process was followed in which the departments, level of class, genders and student numbers of the participants in the classroom list were taken into account. As an example, the 8th female student studying in the 2nd class of the Pre-service Mathematics Teachers was given the code "PMT2F8", and the 4th male student studying in the 1st class of the Undergraduate Mathematics was coded as "UM1M4". Table 2 presents the distribution of the participants according to their department of study at the end of the coding and sorting phase.

Table 2
The participants at the end of the selection process

	PMT		UM		Total
Class	Female	Male	Female	Male	F+M
Class 1	27	10	22	11	70
Class 2	17	3	11	4	35
Total	44	13	33	15	105

A Sample Metaphor Compilation Stage

The participants' responses, which after the sorting and coding phase, were divided into four parts as PMT1, UM1, PMT2 and UM2, respectively. At this stage, the answers given by the participants within the context of the metaphors of colours, foods, vehicles, and seasons were evaluated as the source of the metaphor and also listed alphabetically within their own sections. Then, the frequency distributions were obtained for each metaphor among the listed metaphor sources, which were then demonstrated in tables separately for the four sections together with their explanations. These tables can be taken as a reference in the process of determining the themes under which the metaphors were gathered.

Category Development Stage

At this stage, content analysis was used and the source of the metaphor (itself) was examined in the way suggested by the participants in terms of the subject of the metaphor (explanations) through the tables formed during the sample metaphor compilation stage. Next, the subjects of metaphors with a certain common feature were gathered under 18 similar draft themes. However, the fact that having a small number of themes allows for deeper abstraction (Merriam, 2009/2018, p. 179), the draft themes were revised and rearranged to come up with main themes and sub-themes. An example of this process is given in Table 3.

Table 3
Themes derived from the source-subject relationship of metaphors

Theme	Sub-themes	Description	Colour	Food	Vehicle
Embedded in life	Basis of life	Mathematics is the building block of life and science	*It is the same colour as the sun. Science needs mathematics just as the Earth needs the Sun* (PMT1F9).	*It is like protein, there is no life without mathematics* (UM1M11).	*...like a public transport vehicle, which everyone tries to get on and what everyone really needs* (PMT1M9).
	Everywhere in life	Mathematics is comprehensive and involved in every field	*It contains all colours. Mathematics is everywhere in daily life* (PMT1M3).	*Bread is always eaten with every meal. Mathematics is also used in most parts of our lives* (UM2M1).	*It exists throughout our lives and affects everyone* (PMT1M2).

The Stage of Ensuring Validity and Reliability

The triangulation analysis strategy (Patton, 2000, p. 560) was used to ensure the internal validity of the research. In this context, the researcher and a lecturer actively working in the field of Mathematics Education conducted the data analysis process independently of each other and compared the results of the analysis. In addition, another strategy called participant validation (Merriam, 2009/2018, p. 207) was used to ensure internal validity. In line with this strategy, five participants were accessed to share the findings with and to ask for their feedback. In order to ensure the external validity of the study, the participants were given names and the entire data analysis process was explained in detail, and then the results were reported in depth and compared with the studies in the literature.

For the reliability of a phenomenological study, the most frequently used strategies are determining the researcher bias, confirming the findings by the participants, and calculating the inter-coder reliability (Creswell, 2013, p. 250-253). In addition to this, it is necessary to determine the role of the researcher in the study in order to eliminate researcher bias (Creswell, 2013, p. 251). In this study, the researcher is responsible for applying the data collection tool, conducting data analysis, interpreting the findings in depth, and discussing the results obtained with reference to the literature. The process of verifying the findings by the participants was presented in the section about the internal validity, and hence, in this stage, expert opinion was obtained and the inter-coder reliability was calculated. An active faculty member in the field of Mathematics Education opinion was sought in order to confirm the themes prepared based on the relationship between the source of the metaphors and the subject of the metaphors. At the end of this process, the feedback from the expert and the themes created by the researcher were compared and the calculation was made with the following formula (1), developed by Miles and Huberman (1994, p. 64):

$$\text{Reliability} = \frac{\text{Number of Agreement}}{\text{Number of agreements + Number of disagreements}} \quad (1)$$

According to Miles and Huberman (1994, p. 64), a result of 90% or more is considered sufficient in this formula. As a result of the comparison, the reliability was found to be 0.95 (95%) (Reliability = 399 / (399+21) = 0.95 (95%)).

Results

Students' Perceptions of the Concept of Mathematics by Four Metaphors

Figure 1, Figure 2, Figure 3, and Figure 4 present the findings in relation to the metaphors of colours, foods, vehicles, and seasons that best represent (most preferred) the perceptions of the UM students and PMT students about the concept of mathematics.

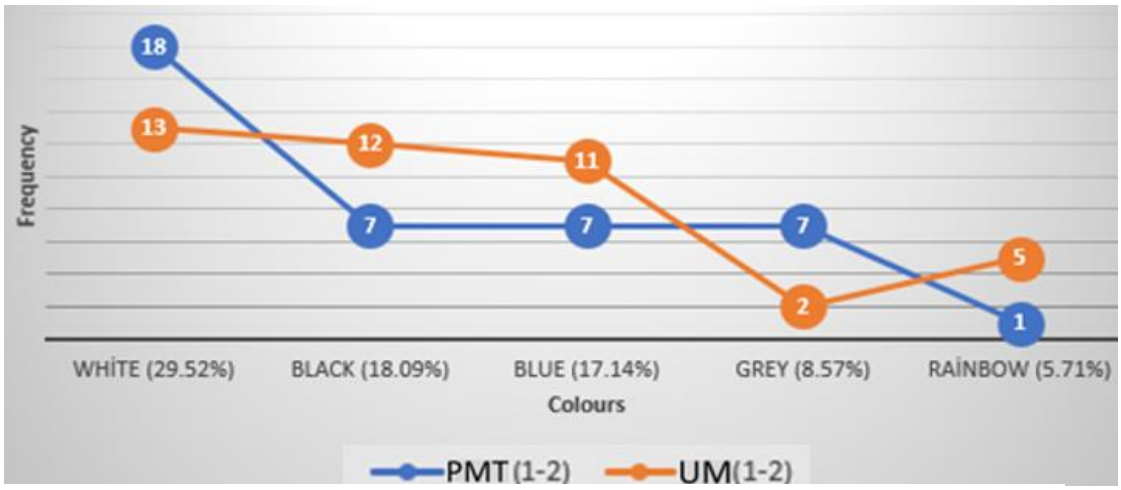

Fig. 1 Perceptions of PMT and UM students about Mathematics by the colour they choose

In a general sense, the students seemed to have referred to the colour white to state that mathematics is an interdisciplinary course that plays a critical role in all areas of life and contains no doubt. They also seemed to have associated their negative feelings towards mathematics with the colour black. As an example, they used the metaphor of the colour black to indicate that mathematics is a difficult subject. With the colour blue, on the other hand, they appeared to have addressed mathematics as an indefinite and endless set of knowledge. In addition, one of the students referred to mathematics as the colour of life by saying "*…because it is a lesson that connects you to life as you keep studying* (PMT2K10)", adding that mathematics can be considered a factor for connecting to life, while another student likened mathematics to the colour of a chessboard and said: "*…it is sometimes dark and sometimes bright* (PMT2K5)", emphasizing the fact that mathematics consists of contrasts.

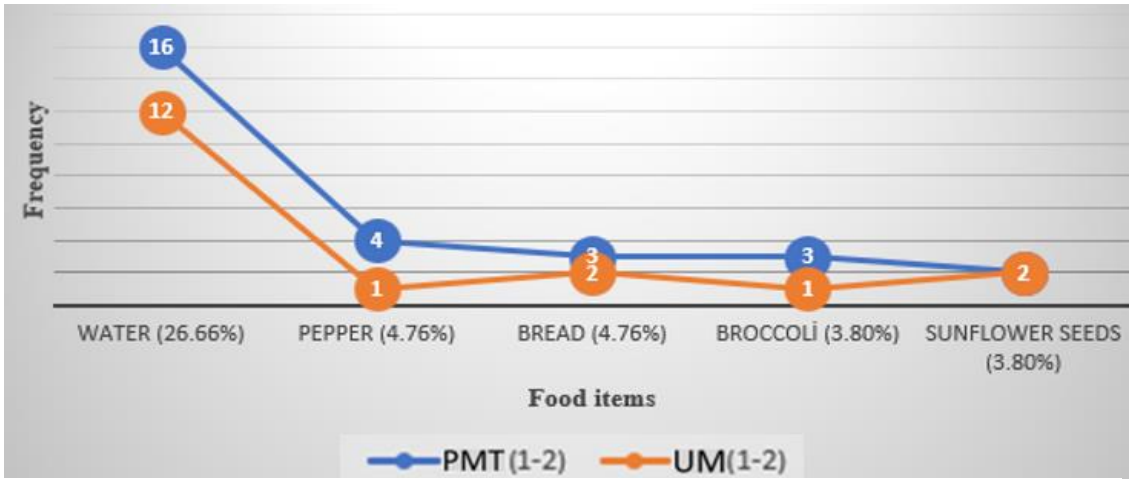

Fig. 2 Perceptions of PMT and UM students about mathematics in terms of food items selected as metaphors

It can be clearly seen that the students generally considered water and mathematics as the source of life and science. Moreover, they used the metaphor of bread to state that mathematics is the complement of other courses and the metaphor of sunflower seeds to stress the addictive feature of mathematics. While asserting that mathematics tends to hold opposites together, the students used the metaphors of pepper and broccoli. In addition, some students likened mathematics to carbohydrates by saying, "*...it is everywhere* (UM1E5)", while some similized it to protein and said, "*... because protein acts like the building block of the body, and so does mathematics to science* (UM2K4)". While comparing mathematics to fatty food, it can be concluded that the students emphasized that mathematics exists in all areas of life and that it is useful, by stating that "*...the body stores the fatty food to use it later, and likewise, we store and use information in mathematics* (UM2K10)".

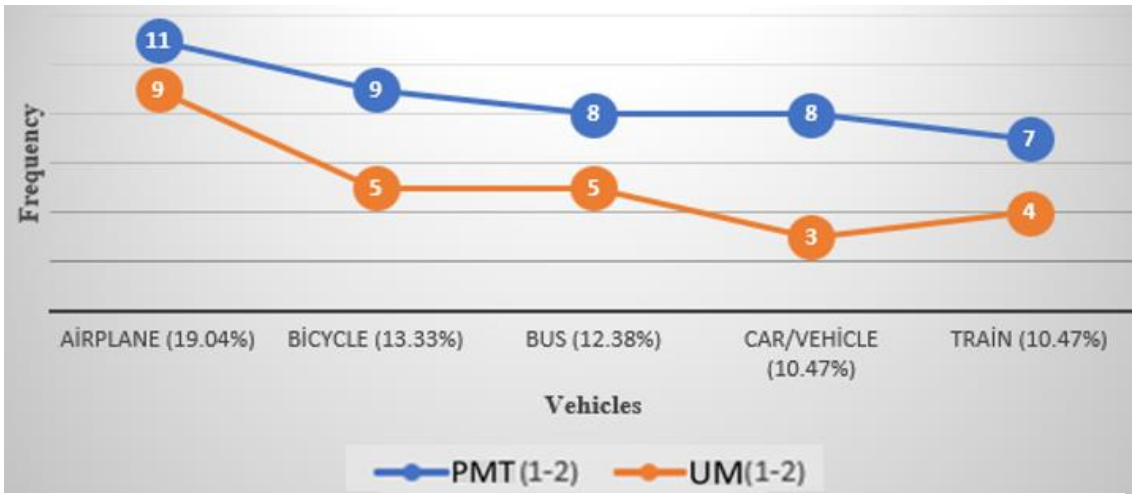

Fig. 3 Perceptions of PMT and UM students about mathematics in terms of vehicles selected as metaphors

It has also been observed in this study that the students generally emphasized the developmental aspect of mathematics with the airplane analogy, stating that mathematics brings you success, and with the bicycle analogy, they stressed that mathematics is a demanding course. The students also seemed to have associated the metaphor of the bus with the fact that mathematics is a time-consuming lesson despite the systematic continuation of it. They further emphasized the usefulness of mathematics with the analogy of a car, considering it as a lesson that not everyone could be interested in. In addition, while the students stated that mathematics consists of many subjects, they turned out to prefer using the analogy of a train. In addition, some students similized mathematics to a horse carriage, saying that "*...we can go through the topics and questions slowly and step by step* (PMT1K16)", "*...if you do not lead the horse, the carriage will not move. So, the horse must be taught how to ride on the road. No progress can be made without learning* (UM1K1)", "*... a horse will not go without us telling them 'Giddy up'* (UM1K9)". Thus, it can be considered that the students emphasized that mathematics is a course that can be achieved over time and is necessary to learn.

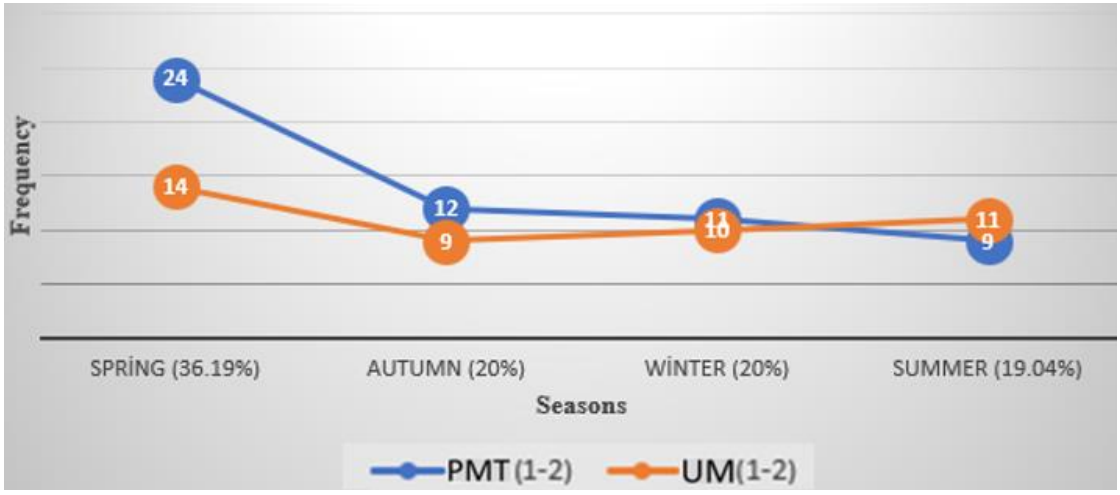

Fig. 4 Perceptions of PMT and UM students about mathematics in terms of seasons selected as metaphors

It is also clear that the students who referred to the allegory of the spring were generally of the opinion that mathematics requires effort, but that this effort is surely rewarded when they work. Also, the students seemed to associate their negative feelings towards mathematics with autumn and winter seasons. As an example, the fact that mathematics is a difficult lesson to understand was expressed with the metaphor of the autumn, and that it is a lesson that not everyone likes due to its difficulties was expressed with the metaphor of the winter. On the other hand, the students suggested that mathematics contains positive emotions against the occurrence of some challenges in mathematics by using the allegory of summer. In addition, some students likened mathematics to the four seasons, saying that "*...mathematics covers everything, with its pluses and minuses, like the four seasons* (PMT1K5)", "*...it is like hearing a ringing sound in your brain and experiencing enlightenment at a point where you think you do not understand, or realizing that you have no idea about anything just when you are thinking that you have understood something* (UM2K2)", "*...mathematics needs something on every subject. Even if you get into trouble, it still goes around and never gives up on loving you and never lets you give up* (UM2K5)". By making these explanations, it can be asserted that they emphasized the comprehensive, incomprehensible and indispensable nature of mathematics.

Differences Between the Themes by Level of Class and the Department

Based on the purpose of determining the participants' perceptions of the concept of mathematics, Table 4 and Table 5 present the comparisons in terms of level of class and the department for the themes created through the four metaphors.

Table 4
Frequency of themes by the level of class

Themes	Sub-themes	Description	F				Total (f)	Perc. (%)
			PMT1	PMT2	UM1	UM2		
Embedded in life	Basis of life	Mathematics as the building block of life and science	14	11	9	9	73	17.38
	Everywhere in life	Mathematics as comprehensive and being involved in every field	11	3	10	6		
Valuable	Affective	A useful and favourite subject	28	17	25	12	97	23.09
	Person-dependent	Approaching from different angles	2	0	0	1		
	Addictive	Triggers the desire to constantly learn	4	3	4	1		
Relatable	Contains many topics	Composed of many topics	5	4	9	0	31	7.38
	Interdisciplinary	Being associated with other sciences	5	5	1	2		
Holds the opposites together	Variable	Linking positives and negatives	35	16	27	5	83	19.76
Immutable and systematic	Clear	Clear and provable	3	2	4	6	30	7.14
	Has an algorithm	Systematic	7	1	3	4		
Infinite	Endless knowledge	No limits to mathematical knowledge	2	3	8	6	19	4.52
Developmental	Self-renewing	Open to development and generating new ideas	0	1	2	3	6	1.42
Hard to comprehend	Deep	Going into detail for understanding	5	3	4	1	13	3.09
Effortful	Labour and patience	Effortful and patience to achieve success	7	2	6	0	15	3.57
Distressing	Achievable only by those who are capable	Not achievable by everyone	7	0	10	0	53	12.61
	Challenging and boring	Unpopular and boring	13	9	10	4		

As can be seen in Table 4, when compared to the 2nd class PMT students, the 1st class PMT students seem to have associated mathematics more with the following themes: “holding the opposites together (23.64%-20%)”, “immutable and systematic (6.75%-3.75%)”, “effortful (4.72%-2.5%)”, and “distressing (13.51%-11.25%)”, while they appeared to have addressed the following themes less frequently: being “embedded in life (16.89%-17.5%)”, “valuable (22.97%-25%)”, “relatable (6.75%-11.25%)”, “infinite (1.35-3.75%)”, “developmental (0%-1.25%)”, and “hard to comprehend (3.37%-3.75%)”. And likewise, when compared to the 2nd class UM students, the 1st class UM students seem to have associated mathematics more with the following themes: being “relatable” (7.57%-3.33%), “holding the opposites together (20.45%-8.33%)”, “hard to comprehend” (3.03% - 1.66%), “effortful (4.54%-0%)”, and “distressing (15.15%-6.66%)”, while they appeared to have addressed the following themes less frequently: being “embedded in life (14.39%-25%)”, “valuable (21.96%-23.33%)”, “immutable and systematic (5.30%-16.66%)”, “infinite (6.06%-10%)”, and “developmental (1.51%-5%)”.

Furthermore, when compared to the 1st class UM students, the 1st class PMT students seemed to have associated mathematics more with the following themes: being “embedded in life (16.89%-14.39%)”, “valuable (22.97%-21.96%)”, holding the opposites together (23.64%-20.45)%)”, “immutable and systematic (6.75%-5.30%)”, and “effortful (4.72%-4.54%)”, while they appeared to have addressed the following themes less frequently: being “relatable (6.75%-7.57%)”, “infinite (1.35-6.06%)”, “developmental (0%-1.51%)”, and “distressing (13.51%-15.15%)”. And similarly, when compared to the 2nd class UM students, the 2nd class PMT students were found to have associated mathematics more with the following themes: being “valuable (25%-23.33%)”, “relatable (11.25%-3.33%)”, “holding the opposites together (20%-8.33%)”, “hard to comprehend (3.75%-1.66%)”, “effortful (2.5%-0%)”, and “distressing (11.25%-6.66%)”, whereas they appeared to have referred to the following themes less frequently: being “embedded in life (17.5%-25%)”, “immutable and systematic (3.75%-16.66%)”, “infinite (3.75%-10%)”, and “developmental (1.25%-5%)”.

When the themes were examined in terms of the students’ level of class, when compared to the 2nd class PMT and UM students, the 1st class PMT and UM students seemed to have associated mathematics more with the themes presented as follows: “holding the opposites (44.10%-28.33%)”, “hard to comprehend (6.40%-5.41%)”, “effortful (9.27%-2.5%)”, and “distressing (28.66%-17.91%)”, whereas they appeared to have referred to the following themes less frequently: being “embedded in life (31.28%-42.5%)”, “valuable (44.94%-48.33%)”, “relatable (14.33%-14.58%)”, “immutable and systematic (12.05%-20.41%)”, “infinite (7.41%-13.75%)”, and “developmental (1.51%-6.25%)”.

In addition, the ordering of the metaphors created by the students regarding the concept of mathematics from the most common to the least heaped up theme is as follows: “being valuable (23.09%), holding the opposites together (19.76%), being embedded in life (17.38%), distressing (12.61%), being relatable (7.38%), immutable and systematic (7.14%), infinite (4.52%), effortful (3.57%), hard to comprehend (3.09%), and developmental (1.42%)”.

Table 5
Frequency of themes by the department

Themes	Colours		Foods		Vehicles		Seasons		Total		Percentage (%)	
	PMT	UM	PMT	UM	PMT	UM	PMT	UM	PMT	UM	PMT	UM
Embedded in life	14	9	20	22	4	2	1	1	39	34	53.42	46.57
Valuable	12	11	11	9	17	9	14	14	54	43	55.67	44.32
Relatable	2	3	6	4	8	5	3	0	19	12	61.29	38.70
Holding the opposites together	8	2	13	8	4	5	25	17	50	32	60.97	39.02
Immutable and systematic	5	3	0	3	7	7	1	4	13	17	43.33	56.66
Infinite	4	9	1	0	1	4	0	1	6	14	30	70
Develop-mental	0	2	0	1	0	2	1	0	1	5	16.66	83.33
Hard to compre-hend	3	3	1	0	3	1	1	1	8	5	61.53	38.46
Effortful	1	0	0	0	6	4	2	2	9	6	60	40
Distressing	8	6	5	1	7	9	9	8	29	24	54.71	45.28

As shown in Table 5, it is clear that the answers of the PMT students (53.42%) fit under the theme of being "embedded in life" more than those of the UM students (46.57%), and the metaphor of food (57.53%) was used more than other metaphors. The general features of the metaphors that make up this theme are as follows:

(1) Mathematics is the building block of life and science (white, yellow, black, rainbow, water, meat, latte, tomatoes, protein, salt, food, bread, public transport, vehicles, buses)
(2) Mathematics is a comprehensive course which exists in every field (white, black, rainbow, blue, colour of life, carbohydrates, fatty foods, Noah's pudding, wheat, bread, protein, buses, cars, and four seasons).

> "*Mathematics is like a tomato because there are no meals without tomatoes, and no life without mathematics* (PMT1K26)."
> "*Mathematics is like Noah's pudding because it is comprehensive, and it includes and deals with everything* (UM1E7)."

The answers of the PMT students (55.67%) fit under the theme of being "valuable" more than those of the UM students (44.32%), and the metaphor of season (28.86%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is a useful and favourite subject (white, sea, blue, orange, rainbow, pink, black, purple, yellow, green, lilac, sweet, fast food, doner kebab, cauliflower, walnut, vegetables, fruit and vegetables, milk, chocolate, spinach, leaf vegetables, meat dishes, car, plane, ambulance, the Taurus Mountains, public transport, motorcycle, bumper car, cable car, bus, spring, autumn, summer, spring and autumn, winter)
(2) Mathematics is the act of approaching from different angles (rainbow and cars).
(3) Mathematics is an addictive subject (blue, sunflower seeds, tea, kebab, spinach, meat, cars, winter, and four seasons).

"*Mathematics is like spring because, like spring, every new piece of knowledge in mathematics makes people bloom* (UM2E2)."
"*Mathematics is like a car. Everyone has their own unique style of solving a math problem, just like everyone having a different car* (PMT1K6)."
"*Mathematics is like the winter. Just like we put on some other clothes to warm us up when we get cold in the winter, as we learn in mathematics, we want to learn more* (UM1E10)."

The answers of the PMT students (61.29%) fit under the theme of being "relatable" more than those of the UM students (38.70%), and the metaphor of vehicles (41.93%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is composed of many topics (white, Turkish bulgur salad, salad, pomegranates, potatoes, grapes, soup, train, watercraft, subway, bus)
(2) Mathematics is a subject related to other sciences (white, tahini, tomato, milk, bread, bus, minibus, and spring).

"*Mathematics is like a train. Every topic you learn and can learn is chained like wagons* (PMT1K4)."
"*Mathematics is like a bus. There are different people on the bus and likewise, there are different topics in math* (PMT2E1)."
"*Mathematics is like a minibus. Mathematics also includes every school subject, just like a minibus, which accommodates people from all walks of life* (UM2K3)."

The answers of the PMT students (60.97%) fit under the theme of "holding the opposites together" more than those of the UM students (39.02%), and the metaphor of seasons (51.21%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is a lesson that connects positive and negative emotions (grey, a chessboard, the colour of chilli isot pepper flakes, water, oranges, peppers, okras, chocolate, pickles, green peppers, plums, honey, cola, broccoli, peaches, eggplant, cactus fruit, Doritos, bread, sea water, truck, train, bicycle, motor, motorcycle, jet, semi-trailer truck, autumn, spring, summer, winter, and four seasons)

"*Mathematics is like the spring. Although there are sunny days in the spring, it can rain at any time. In mathematics, likewise, you may encounter difficulties when you least expect them* (UM1K4)."
"*Mathematics is like sea water. Sea water is neither drinkable nor can be abandoned, just like mathematics* (UM2E2)."

The answers of the UM students (56.66%) fit under the theme of "immutable and systematic" more than those of the PMT students (43.33%), and the metaphor of a vehicle (46.66%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics consists of certainty and proof (blue, the colour of water, white, transparent, water, airplane, Volvo).
(2) Mathematics is a course with an algorithm (bicycles, cars, horse-drawn carriages, trains, motorcycles, and all vehicles).

"*Mathematics is like a Volvo. It is solid and proven. No one can beat mathematics with their theories* (UM2K7)."
"*Mathematics is like a horse-drawn carriage. If you don't lead the horse, the carriage won't go. Therefore, the horse must be taught how to ride on the road. No progress can be made without learning, just like mathematics* (UM1K1)."

The answers of the UM students (70%) fit under the theme of being "infinite" more than those of the PMT students (30%), and the metaphor of colours (65%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is an unlimited collection of knowledge (white, black, blue, yellow, sea, broccoli, spacecraft, spaceship, ship, and winter).

"*Mathematics is like the colour black because it is always interesting, like the endless space* (UM2E4)."
"*Mathematics is like a spaceship because like information in mathematics, the spaceship is located in a vast space* (UM1K15)."

The answers of the UM students (83.33%) fit under the theme of being "developmental" more than those of the PMT students (16.66%), and the metaphor of colours and vehicles (33.33%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is open to development and new ideas (white, airplane, bus, and spring)

"*Mathematics is like a bus. There are those who get on and off the bus, and likewise, in mathematics, each newcomer continues the task where the previous one has left off* (UM2E3)."
"*Mathematics is like the spring. Nature is renewed in spring. I likened it to this because mathematics is also renewed* (PMT2E1)."

The answers of the PMT students (61.53%) fit under the theme of being "hard to comprehend" more than those of the UM students (38.46%), and the metaphor of colours (46.15%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is a deeply structured course (black, blue, sky, pomegranate, submarine, airplane, spaceship, train, winter, and summer).

"*Mathematics is like the colour black, which everyone uses a lot but does not know where it actually comes from* (UM1K19)."
"*Mathematics is like an airplane. No one knows what it is, but everyone is trying to do it* (UM1K17)."

The answers of the PMT students (60%) fit under the theme of being "effortful" more than those of the UM students (40%), and the metaphor of vehicles (66.66%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1) Mathematics is a subject that requires effort and patience (grey, bicycle, bus, car, horse-drawn carriage, winter, spring, and autumn).

"*We try hard to learn mathematics, just like we do with a bicycle. It is learned both with difficulty and gradually* (PMT1K19)."
"*Mathematics is like the colour grey because it is neither white nor black, and it takes effort to understand it* (PMT1K3)."

The answers of the PMT students (54.71%) fit under the theme of being "distressing" more than those of the UM students (45.28%), and the metaphor of seasons (32.07%) was used more than other metaphors. The general characteristics of the metaphors that make up this theme are as follows:

(1)Mathematics cannot be achieved by everyone (red, purple, black, cashews, broccoli, spinach, wheelbarrow, car, Ferrari, BMW, Tesla, ship, winter, spring, and summer).
(2)Mathematics is a difficult, disliked and boring subject (purple, white, yellow, black, meat, stuffed peppers, strawberries, airplane, bike, bus, semi-trailer truck, motorcycle, train, pickup truck, winter, autumn, summer, and spring).

"*Mathematics is like the winter. Snow scenery is beautiful in winter, but most people don't like it* (PMT1K22)."
"*Mathematics is like cashews. Not everyone can eat cashews, and not everyone can do math* (PMT1E8)."
"*Mathematics is like the autumn because I have trouble understanding and I feel like trees dropping leaves in autumn* (UM2E1)."

Discussion, Conclusion and Recommendations

Based on the aim of comparing the perceptions of the PMT students and UM students with similar mathematical backgrounds, towards the concept of mathematics, this study revealed some notable results. First, many metaphors are required for a correct and holistic understanding of the concept of mathematics. As an example, although mathematics was limited to the metaphors of "colours", "foods", "vehicles", and "seasons" in this study, it was represented by a total of 103 sub-metaphors (white, water, airplane, spring, etc…). Similarly, for the concept of mathematics, the relevant literature shows that there are 115 metaphors by Güler et al. (2011), 80 metaphors by Çalışıcı and Sümen (2019), and 244 by Yaman and Yaman (2020). As Yob (2003) stated, it is necessary to use more than one metaphor to represent a phenomenon. In this respect, it can be argued that using many metaphors is necessary in order to explain the concept of mathematics in a holistic way.

Secondly, four specific themes (being "valuable", "embedded in life", "distressing, and "holding the opposites together") appeared to be the most common metaphors created by students regarding the concept of mathematics. In addition to this, there are six more themes ("relatable", "immutable and systematic", "infinite", "effortful", "hard to comprehend", and "developmental") which were much less addressed, considering the number of students. However, these six themes are also important, as are the four themes which were largely addressed. For example, the themes "relatable", "effortful", and "developmental" represent that mathematics is associated with "interdisciplinary education" and "self-efficacy", and that "mathematics is not an isolated science". In addition, it can be argued that the themes of "holding the opposites together" and being "embedded in life" represent "daily life", and the theme of being "distressing" represents negative attitude towards mathematics. The relevant literature review has revealed some studies similar to the themes created in this study. As an exemplification, for the theme of being "embedded in life", some other themes found in the literature can be considered relevant and listed as follows: "mathematics in life" (Güveli et al., 2011), "real/common situations" (Uygun et al., 2016), "an activity intertwined with life"

(Turhan Türkkan & Yeşilpınar Uyar, 2016), "necessity" (Tarım et al., 2017), "an area needed in daily life" (Çalışıcı & Sümen, 2019), "mathematics as a necessary tool for life" (Yaman & Yaman, 2020), and "mathematics in everything/everywhere" (Katrancı & Kıral, 2021). For the themes of "holding the opposites together", the following themes can be assumed to be relevant: "opposite concepts/positive-negative concepts" (Uygun et al., 2016), being "an activity that changes depending on the situation" (Turhan Türkkan & Yeşilpınar Uyar, 2016), "mathematics as a difficult but learnable lesson" (Yaman & Yaman, 2020), and something that "depends on the situation" (Katrancı & Kıral, 2021). Similarly, the theme of being "relatable", where there is not much clustering seemed to be associated with the following themes such as: "mathematics consisting of many subjects/mathematics as an assistant of other sciences" (Güveli et al., 2011), "basis of other sciences" (Çalışıcı & Sümen, 2019), and "mathematics as a subject that includes many subjects / mathematics as a subject related to many subjects" (Yaman & Yaman, 2020). Moreover, the theme of being "infinite was found to be directly associated with the themes of being "infinite" (Uygun et al., 2016; Katrancı & Kıral, 2021), as well as being "an area that contains many unknowns" (Çalışıcı & Sümen, 2019). Nevertheless, the theme of "effortful", in which there was not much clustering in this study, was addressed in many studies in the form of metaphors such as mathematics which "requires work" (Schinck et al., 2008), "mathematics as a subject requiring hard work" (Güveli et al., 2011), mathematics which "requires effort/skills" (Sezgin Memnun, 2015; Uygun et al., 2016), "a cognitive and affective effortful activity" (Turhan Türkkan & Yeşilpınar Uyar, 2016), "effort" (Tarım et al., 2017), "a field that requires effort" (Çalışıcı & Sümen, 2019), and an "effortful course" (Yaman & Yaman, 2020).

Third, it was clear that the themes differed in terms of the students' level of class as well as their department of study. For example, the analysis of the themes according to the students' level of class indicated that the 1st class students studying in either departments turned out to define mathematics as "holding the opposites together", "effortful", and "distressing" outnumbered the 2nd class students, while they were less likely to define it something which is "embedded in life", "valuable", "infinite", and "developmental". Based on these results, it can be suggested that the hardships (subjects and questions beyond a student's capacity to comprehend, adaptation to university, or attitude of academics, etc.) experienced by the students as they moved from secondary education to higher education may be the reason why 1st class students believed that mathematics is an effortful course, when compared to what 2nd class students believed (Wintre & Yaffe, 2000). Due to these difficulties, it can also be suggested that students describe mathematics as a lesson that cannot be achieved by everyone and is disliked. In a similar manner, Akhan and Karamik (2019) tried to determine the changes in the perceptions of the first year students of the faculty of education regarding their adaptation to the university. As a result of that study, the students' tendency for the themes that contain negative attitude, anxiety and prejudice towards the concept of university supports the result of this study. However, there are also studies that reported some negative perceptions towards mathematics as a result of the increase in education level (Uygun et al., 2016; Koçak & Bilecik, 2019). In addition, when compared to the 1st class students, the reason why the 2nd class students considered mathematics as valuable and associated it with daily life with the idea that mathematics continues to develop in the unknown, could be that students learn by doing and experiencing as they adapt to the learning process (Yurtbakan et al., 2016), as well as by listening to the lessons well (Dede & Dursun, 2004), thereby developing their thinking skills (Dane et al., 2009).

As a result of examining the themes according to the students' department of study, the PMT students who were taking courses on how mathematics should be taught turned out to be more likely to regard mathematics as something which is "embedded in life", "valuable", "relatable", "holding the opposites together", and "hard to comprehend", "effortful", and "distressing", when compared to the UM students who study advanced mathematics. Similarly, it was also observed that the UM students were more likely to perceive mathematics as

"immutable and systematic", "infinite", and "developmental", when compared to the PMT students. The reason for such a result could be the fact that the PMT students' curricula contain less abstract expressions than that of the UM students, give students active roles, provide students with an environment for learning-by-doing, and attach less importance to theoretical courses, and also that the purpose of this department is to train mathematics teachers rather than mathematicians. In this connection, Özdemir (2018) compared the curricula of the Pre-service Mathematics Teachers and the Undergraduate Mathematics within the scope of some variables, and reported results in conformity with those of this study.

To conclude, metaphors can be used as a factor that can contribute positively to questioning, revealing, understanding and improving the perceptions of individuals regarding the concept of mathematics. In this sense, future studies may identify some other different factors underlying individuals' perceptions of mathematics by using different metaphors (e.g., curriculum, academicians, etc.). It is also known that another variable affecting the perceptions of individuals towards mathematics is family attitudes (Lin et al., 2019; Thippana et al., 2020). In this respect, the relationship between individuals' perceptions of mathematics and their families' attitudes towards mathematics could be explored so that the influence of such a relationship could be investigated. The participants of this study were 1st and 2nd class students in two different departments with common mathematical roots. It can be suggested that future researchers conduct similar studies by including students from different departments (Science Education, Engineering Department…) and the results should be compared depending on the level of class and department of study. Also, in order to ensure the validity of this and many other similar studies, longitudinal studies may be conducted by considering the level of class. Thus, it is believed that the changes in the perceptions of individuals towards mathematics can be evaluated in a sound manner.

References

Akhan, N. E., & Karamik, G. A. (2019). Ensuring Adaptation of First-Year Students at the Faculty of Education to University through Creative Drama. *Journal of Education Theory and Practical Research, 5*(2), 141-152. https://dergipark.org.tr/en/pub/ekuad/issue/47044/591323

Altun, M. (2001). *Mathematics teaching for faculty of education and primary school teachers*. Bursa: Erkam Printing press.

Altun, M. (2008). *Teaching Mathematics in High Schools*, First Edition, Bursa: Aktüel Publications.

Başıbüyük, K. (2018). *The effect of using the history of mathematics in teaching algebra and numbers on success and attitude and in-class reflections* (Doctoral, Atatürk University, Institute of Education Sciences). Accessed from the thesis center database of the Council of Higher Education (503487).

Baykul, Y. (1999). *Effective Teaching and Learning in Primary Education Teacher's Handbook Module 6 Teaching Mathematics in Primary Education*. Ankara: National Education Printing House.

Ben-Peretz, M., Mendelson, N., & Kron, F. W. (2003). How teachers in different educational context view their roles. *Teaching and Teacher Education, 19*, 277-290. https://doi.org/10.1016/S0742-051X(02)00100-2.

Çalışıcı, H., & Sümen, Ö. Ö. (2019). Pre-service Mathematics Teachers' Perceptions about Mathematics Concept: A Metaphor Study. *International Journal of Educational Studies in Mathematics, 6*(3), 108-123. https://dergipark.org.tr/en/pub/ijesim/issue/49111/620251

Carlson, T. B. (2001). Using Metaphors to Enhance Reflectiveness Among Preservice Teachers. *Journal of Physical Education, Recreation & Dance. 72, 1; ProQuest Education Journals*,49-53. https://doi.org/10.1080/07303084.2001.10605820

Cassel, D., & Vincent, D. (2011). Metaphors reveal preservice elementary teachers' views of mathematics and science teaching. *School Science and Mathematics, 111*(7), 319-324. https://doi.org/10.1111/j.1949-8594.2011.00094.x

Creswell, J.W. (1998) *Qualitative Inquiry and Research Design: Choosing among Five Traditions*. Thousand Oaks, CA: Sage.

Creswell, J.W. (2013). *Qualitative Inquiry & Research Design: Choosing among Five Approaches*. Los Angeles, CA: Sage.

Dane, A., Kudu, M., & Balkı, N. (2009). The Factors Negatıvely Effectıng Hıgh School Students' Mathematıcal Success Accordıng to Theır Perceptıons. *Erzincan University Journal of Science and Technology, 2*(1), 17-35. https://dergipark.org.tr/en/pub/erzifbed/issue/6018/8062

Danesi, M. A. (2007). Conceptual Metaphor Framework for The Teaching Of Mathematics. *Studies in Philosophy and Education 26*, 225-236. https://doi.org/10.1007/s11217-007-9035-5

Dede, Y., & Argün, Z. (2004). Identification of Students' Intrinsic and Extrinsic Motivation Towards Mathematics. Educatıon and Scıence, *29*(134), 49-54.

Dede, Y., & Dursun, Ş. (2004). The Factors Affecting Students Success in Mathematics Mathematics Teachers Perspectives. *Journal of Gazi Education Faculty, 24*(2), 217-233. https://dergipark.org.tr/en/pub/gefad/issue/6759/90924

Font, V., Bolite, J., & Acevedo, J. (2010). Metaphors in mathematics classrooms: Analyzing the dynamic process of teaching and learning of graph functions. *Educational Studies in Mathematics, 75*(2), 131-152. https://doi.org/10.1007/s10649-010-9247-4

Göker, L. (1997). *History of Mathematics and the Place of Turkish-Islamic Mathematicians*. Ministry of Education.

Güler, G., Akgün, L., & Öçal, M. F. (2011). Pre-service mathematics teachers' metaphors about mathematics teacher concept. *Procedia - Social and Behavioral Sciences, 15*, 327-330. https://doi.org/10.1016/j.sbspro.2011.03.095

Güveli, E., İpek, A. S., Atasoy, E., & Güveli, H. (2011). Candidate Class Teachers' Metaphorical Perceptions Towards Mathematics. *Turkish Journal of Computer and Mathematics Education, 2*(2), 140-159.

Heidegger M. (1867). *Being and time*. Blackwell: Oxford UK and Cambridge USA.

Katrancı, Y., & Kıral, B. (2021). The Perceptions of Pre-Service Middle School Mathematics Teachers Regarding Mathematics and Mathematics Teacher: A Metaphorical Approach. *Asya Studies, 5*(18), 21-41. https://doi.org/10.31455/asya.940207

Koçak, D., & Bilecik, T. (2019). Comparison and Determination of Metaphors of Mathematics Education at Different Level of Education. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 13*(2), 909-940. https://doi.org/10.17522/balikesirnef.544055

Kuzu, O., Kuzu, Y., & Sıvacı, S. Y. (2018). Preservice Teachers' Attitudes and Metaphor Perceptions towards Mathematics. *Cukurova University Faculty of Education Journal, 47*(2), 897-931. https://doi.org/10.14812/cuefd.383527

Lakoff, G., & Johnson, M. (2005). *Metaphors: Life Meaning and Language* (Translator G.Y. Demir). İstanbul: Paradigma

Lakoff, G., & Nuñez, R. (2000). *Where mathematics comes from: How the embodied mind creates mathematics*. Basic Books

Latterell, C. M., & Wilson, J. L. (2016). Math is like a lion hunting a sleeping gzelle: Preservice elementary teachers' metaphors of mathematics. E*uropean Journal of Science and Mathematics Education, 4*(3), 283-292. https://doi.org/10.30935/scimath/9470

Laverty, S. M. (2003). Hermeneutic phenomenology and phenomenology: A comparison of historical and methodological considerations. *International journal of qualitative methods, 2*(3), 21-35. https://doi.org/10.1177/160940690300200303

Lin, Y. C., Washington-Nortey, P. M., Hill, O. W., & Serpell, Z. N. (2019). Family functioning and not family structure predicts adolescents' reasoning and math skills. *Journal of Child and Family Studies, 28*(10), 2700-2707. https://doi.org/10.1007/s10826-019-01450-4

Mahlios, M., & Maxson, M. (1998). Metaphors as Structures for Elemantary and Secondary Preservice Teachers‟ Thinking. *International Journal of Educational Research*, 29, 227- 240. https://doi.org/10.1016/S0883-0355(98)00027-5

Markovits, Z., & Forgasz, H. (2017). "Mathematics is like a lion": Elementary students' beliefs about mathematics. *Educational studies in mathematics*, *96*(1), 49-64. https://doi.org/10.1007/s10649-017-9759-2

Merriam, S. B. (2018). *Qualitative Research: A Guide to Design and Implementation* (Translator S. Turan). Ankara: Nobel Publishing (Original release date, 2009).

Miles, M.B., & Huberman, A.M. (1994). *Qualitative data analysis*. Thousand Oaks, CA: Sage.

Morgan G. (1998). *Metaphor in management and organizations* (Translator, G. Bulut). İstanbul: BZD Publishing.

Nasibov, F., & Kaçar, A. (2005). On the mathematics and mathematics education. *Gazi University Kastamonu Journal of Education*, *13*(2), 339-346.

Neubauer, B. E., Witkop, C. T., & Varpio, L. (2019). How phenomenology can help us learn from the experiences of others. *Perspectives on medical education, 8*(2), 90-97. https://doi.org/10.1007/s40037-019-0509-2

Noyes, A. (2004). (Re) Producing Mathematics Teachers: A sociological perspective. *Teaching Education, 15*(3), 243-256. https://doi.org/10.1080/1047621042000257180

Olsen, J., Lew, K., & Weber, K. (2020). Metaphors for learning and doing mathematics in advanced mathematics lectures. *Educational Studies in Mathematics*, *105*(1), 1-17. https://doi.org/10.1007/s10649-020-09968-x

Özdemir, B. (2018). *Comparıson of Undergraduate Programs of Mathematıcs Educatıon and Mathematıcs Departments and Students' Vıew in The Framework of Competencıes* (Master Thesis, Hacettepe University, Institute of Education Sciences). http://www.openaccess.hacettepe.edu.tr:8080/xmlui/handle/11655/5381

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Reeder, S., Utley, J., & Cassel, D. (2009). Using metaphors as a tool for examining preservice elementary teachers' beliefs about mathematics teaching and learning. *School science and mathematics, 109*(5), 290-297. https://doi.org/10.1111/j.1949-8594.2009.tb18093.x

Saban, A. (2003). A Turkish Profile of Prospective elementary School Teachers and Their Views of Teaching. *Teaching and Teacher Education*, 19, 829-846. https://doi.org/10.1016/j.tate.2003.03.004

Saban, A. (2004). Entry Level Prospectıve Classroom Teachers' Metaphors about The Concept of "Teacher". *The Journal of Turkish Educational Sciences*, *2*(2), 131-155. https://dergipark.org.tr/en/pub/tebd/issue/26128/275216

Schinck, A. G., Neale Jr, H. W., Pugalee, D. K., & Cifarelli, V. V. (2008). Using metaphors to unpack student beliefs about mathematics. *School science and mathematics*, *108*(7), 326-333. https://doi.org/10.1111/j.1949-8594.2008.tb17845.x

Sezgin Memnun, D. (2015). Secondary School Students' Metaphors about Mathematical Problem and Change of Metaphors according to Grade Levels. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 9*(1), 351-374. https://doi.org/10.17522/nefefmed.30643

Sinclair, N., & Tabaghi, S. G. (2010). Drawing space: Mathematicians' kinetic conceptions of eigenvectors. *Educational Studies in Mathematics, 74*(3), 223-240. https://doi.org/10.1007/s10649-010-9235-8

Smith, J.L., Karcher, S. & Whitacre, I. (2023). Is i a Number? An Examination of Advanced Undergraduate Students' Definitions of Number. *International Journal of Research in Undergraduate Mathematics Education*. https://doi.org/10.1007/s40753-022-00210-y

Soto-Johnson, H., Hancock, B., & Oehrtman, M. (2016). The interplay between mathematicians' conceptual and ideational mathematics about continuity of complex-valued functions. *International Journal of Research in Undergraduate Mathematics Education, 2*(3), 362-389. https://doi.org/10.1007/s40753-016-0035-0

Soysal, D., & Afacan, Ö. (2012). Metaphors used by primary school students to describe science and technology lesson and science and technology teacher. *Journal of Mustafa Kemal University Institute of Social Sciences, 9*(19), 287-306.

Strauss, A. L., & Corbin, J. (1998). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage.

Tarım, K., Özsezer, M. S. B., & Canbazoğlu, H. B. (2017). Pre-Service Classroom Teachers; Perceptions of Related with Mathematics and Teaching Mathematics. *Journal of Ahi Evran University Kırşehir Education Faculty, 18*(3), 1032-1052.

Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A., & Varpio, L. (2015). Choosing a qualitative research approach. *J Grad Med Educ, 7*, 669-70. http://dx.doi.org/10.4300/JGME-D-15-00414.1

Thippana, J., Elliott, L., Gehman, S., Libertus, K., & Libertus, M. E. (2020). Parents' use of number talk with young children: Comparing methods, family factors, activity contexts, and relations to math skills. *Early Childhood Research Quarterly, 53*, 249-259. https://doi.org/10.1016/j.ecresq.2020.05.002

Toluk, Z. (2003). Third international math and science survey (TIMSS): What is Mathematics. *Elementary Education Online, 2*(1), 36-41.

Turhan Türkkan, B., & Yeşilpınar Uyar, M. (2016). The Metaphors of Secondary School Students Towards the Concept of "Mathematical Problem". *Cukurova University Faculty of Education Journal, 45*(1), 99-130.

Turkish Language Association (TLA). (2022). *Large Turkish Dictionary*. Turkish Language Association.

Uçar, T. Z., Pişkin, M., Akkaş, N. E., & Taşçı, D. (2010). Elementary Students' Beliefs about Mathematics, Mathematics' Teachers and Mathematicians. *Education and Science, 35*(135), 131-144.

Uygun, T., Gökkurt, B., & Usta, N. (2016). Analysis of the Perceptions of the University Students about Mathematics Problem through Metaphor. *Bartın University Journal of Faculty of Education, 5*(2), 536-556. https://doi.org/10.14686/buefad.v5i2.5000187677

Wintre, M.G., & Yaffe, M. (2000). First-year students' adjustment to university life as a function of relationships with parents. *Journal of Adolescent Research, 15*(9), 9-37. https://doi.org/10.1177/0743558400151002

Yaman, F., & Yaman, B. (2020). Metaphorıc Perceptıons of Secondary School Students on Mathematıc Concept. *Eurasian Journal of Researches in Social and Economics, 7*(6), 250-265. https://dergipark.org.tr/en/pub/asead/issue/55211/737640

Yetim Karaca, S., & Ada, S. (2018). Determining Students' Perceptions Regarding The Mathematics Course and Mathematics Teachers Through Metaphors. *Kastamonu Education Journal, 26*(3), 789-800. https://doi.org/10.24106/kefdergi.413327

Yob, I. M. (2003). Thinking Constructively with Metaphors. *Studies in Philosophy and Education*, 22, 127-138. https://doi.org/10.1023/A:1022289113443

Yurtbakan, E., Iskenderoglu, T. A., & Sesli, E. (2016). The views of the classroom teachers on enchancing the students' success of mathematics. *Ondokuz Mayis University Journal of Faculty of Education, 35*(2), 101-119. https://doi.org/10.7822/omuefd.35.2.7

Zandieh, M., Ellis, J., & Rasmussen, C. (2017). A characterization of a unified notion of mathematical function: The case of high school function and linear transformation. *Educational Studies in Mathematics, 95*(1), 21- 38. https://doi.org/10.1007/s10649-016-9737-0

Appendix I

Department:
Class:
Gender:

Dear participants,

This study has been prepared to determine your "perspective towards mathematics". Since the answers you give are of a nature that will contribute to mathematics education, it is strongly requested that you do not leave the questions empty. Your answers will only be used for statistical analysis and will not be shared with anyone. You can share your questions and opinions about the research process with the contact address below. This work will take about 15 minutes. Thank you for your participation.

Researcher: …
Institution: …
Contact: …

1. Complete the following sentence.
I came to this department "……..". a) willingly b) unwillingly
2. "Mathematics is like/similar to the color of "……..".” Fill in the dotted place in the sentence.
3. What is your reason for writing this statement in the dotted place?
4. "Mathematics is like/similar to "……..” food." Fill in the dotted place in the sentence.
5. What is your reason for writing this statement in the dotted place?
6. "Mathematics is like/similar to the "……..” vehicle." Fill in the dotted place in the sentence.
7. What is your reason for writing this statement in the dotted place?
8. "Mathematics is like/similar to the "…….” season." Fill in the dotted place in the sentence.
9. What is your reason for writing this statement in the dotted place?

Appendix II

Some of the participant responses regarding colours, foods, vehicles, and seasons are given below.

Colours:

*"Mathematics is like the colour **white**. White consists of many colours, and mathematics is also associated with many fields."* **(PMT1K4)**

*"Mathematics is like the colour **white**. White is clear, with no contradiction. Mathematics is free from flaws and has a logical explanation for everything."* **(UM1E3)**

*"Mathematics is like the colour **black**. You always feel like you are going into the dark and you can run into all sorts of problems."* **(PMT1K27)**

*"Mathematics is like the colour **black**. We do not see any bright days."* **(UM1E7)**

*"Mathematics is like the colour **blue** because blue is the colour of the sky, and mathematics is as deep as the sky."* **(PMT1K22)**

*"Mathematics is like the colour **blue**. It is endless as you go into it, just like the sky."* **(UM2E1)**

Foods:

*"Mathematics is like **water**. Without water, life cannot be sustained, and likewise, without mathematics, most sciences are baseless."* **(PMT1K10)**

*"Mathematics is like **water**. Without water, there would be no life, without mathematics, it would be impossible to get anywhere."* **(UM1K1)**

*"Mathematics is like **pepper**. Pepper is hot, but adds flavour to food, and likewise, mathematics is bitter but adds flavour to life."* **(UM2E4)**

*"Mathematics is like **pepper**- difficult to eat, but healthy."* **(PMT1E5)**

*"Mathematics is like **bread**. It completes the meals. Without mathematics, other subjects would be incomplete."* **(PMT2K8)**

*"Mathematics is like **bread**. ...just as bread does not leave anyone stranded and starving, so is mathematics."* **(PMT2K17)**

*"Math is like **broccoli**. Not everyone likes math."* **(PMT1K1)**

*"Math is like **broccoli**. It is a healthy food but has no taste."* **(UM1E9)**

*"Mathematics is like **sunflower seeds** because it is addictive as we succeed."* **(UM1K20)**

*"Mathematics is like **sunflower seeds**. It is addictive; the more you eat, the more you want to."* **(PMT1E1)**

Vehicles:

*"Mathematics is like an **airplane** because when you succeed, it lifts you to wherever you want."* **(PMT2K6)**

*"Mathematics is like an **airplane**. ... Mathematics is also developing very rapidly."* **(UM1K14)**

*"Mathematics is like a **bicycle**. If you try you will succeed, if you don't you will stay where you are."* **(UM1K21)**

*"Mathematics is like a **bicycle** because it takes effort."* **(PMT1E1)**

*"Mathematics is like a **bus**. Every difficult question needs more time, just like the bus."* **(PMT1K24)**

*"Mathematics is like a **bus**. There are those who get on and off the bus, and likewise, in mathematics, each newcomer continues the task where the previous one has left off."* **(UM2E3)**

*"Mathematics is like a **car/vehicle**. Not everyone can afford a car, not everyone can do math."* **(PMT1K14)**

*"Mathematics is similar to a **car/vehicle**. As cars are the most used vehicles, so is mathematics, which is used a lot in our lives."* **(UM2E1)**

*"Mathematics is like a **train**. Every subject you have learned and can learn is connected in chains like wagons."* **(PMT1K4)**

*"Mathematics is like a **train**. We can see something different in every wagon."* **(UM1K22)**

Seasons:
*"Mathematics is like the **spring**. It has both heat and cold. It intimidates with its difficulty and fascinates with the ease it brings."* **(PMT1K10)**
*"Mathematics is like the **spring**. Spring rewards you for what you sow, so it does mathematics. When you work, it rewards you"* **(UM1K1)**
*"Mathematics is like the **autumn**. It is a mixed season. Suddenly, it starts to rain, and then the sun comes out. Mathematics is like the sun when we can do it, and like the rain when we can't."* **(PMT1K8)**
*"Mathematics is like the **autumn**. You get over a bad day, and you say 'Okay, it's gone', but the next day could be even worse. The more you learn, the harder it gets."* **(UM1E9)**
*"Mathematics is like the **winter**. Snow scenery is beautiful in winter, but most people don't like it."* **(PMT1K22)**
*"Mathematics is like the **winter**. It is very rough and difficult."* **(UM1E6)**
*"Mathematics is like the **summer**. When you look at mathematics from the outside, it looks very cold. But if you like math, it will feel warm. It's just like the summer."* **(UM2K6)**
*"Mathematics is like the **summer**. It burns our brains, like the summer sun."* **(PMT2K13)**

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Prospective Teachers' Views on Gamified Online Assessment Tools

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***Abstract*:** Gamification, which refers to the integration of game mechanics, dynamics and components into non-game contexts, has attracted significant attention in education in recent years. When the literature is examined, it is possible to find many applications that can gamify content. This study aims to explore students' perspectives on gamification in education with a special focus on the widely known Kahoot application. Within the scope of this research, it aims to explore students' views on the application of Kahoot-based gamification techniques in formal and distance education courses. The study was conducted with a mixed research method in which both quantitative and qualitative methods were used together. Quantitative data were analyzed using statistical measures such as arithmetic mean, standard deviation and independent sample t-test. Qualitative data were collected and analyzed through interviews. In the fall semester of 2021-2022, 278 pre-service teachers enrolled in the education programs of a state university in Turkey participated in the study. While 162 students participated in the study with distance education method, 116 students participated with formal education method. A 19-item opinion questionnaire on gamification using Kahoot and a form consisting of open-ended questions were used to collect data. The participants regularly participated in Kahoot gamification activities at the end of classes for 8 weeks. According to the results, the participants were generally satisfied with the gamification applications with Kahoot. They found these applications both fun and instructive. Students generally agreed that Kahoot is a useful application. However, it was concluded that some participants experienced internet connection problems, internet quota problems, insufficient response time and fear of being left behind in the ranking. According to these results, it is recommended to use Kahoot application and gamification activities in classrooms. In order to reduce the problem of lack of interaction in distance education environments, it is recommended to include Kahoot-like applications in distance education.
Keywords: Gamification, Kahoot, Distance education, Formal education.

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Introduction

Gamification's appearance in the literature coincides with 2008 and its popularization with the influence of conferences and meetings in the second half of 2010 (Deterding et al., 2011). This concept started to become evident with the statement that the features of digital games that connect individuals to them actually exist in real life (Schell, 2010). McGonigal (2011) emphasized the engagement and motivating aspect of games by stating that the feelings of fun, enjoyment and satisfaction found in digital games are actually applicable in the real world and that games can provide this.

Kapp (2012) states that the use of gamification in education using various game mechanisms can promote learning achievement and positive attitudes towards learning. Gamification can engage learners in a meaningful learning process with the help of reward and reputation systems and extrinsic motivations such as earning points, increasing levels, avatars, leaderboards (Kapp, 2012).

Gamification involves the integration of game elements into non-game settings. Its aim is to facilitate the teaching of educational content by using students' interests in games as a motivating factor (Arkün Kocadere & Samur, 2016). Gamification has gained significant attention as a topic of discussion in education, with its implementation evident in various sectors. Recently, gamification has become an increasingly popular area of interest within the field of education. Arkün Kocadere and Samur (2016) outline simple examples of gamification in education, such as displaying the best work on a board, awarding certificates of appreciation, and giving a ribbon to a student who has learned to read. Technical term abbreviations will be explained upon first use.

Pyramidal Design Model, developed by Werbach & Hunter (2012), shows that gamification is categorised into three components: dynamics, mechanics, and components. According to this model, game design is a procedural matter that commences with choosing dynamics and proceeds with ascertaining mechanisms and components (Bozkurt & Genç Kumtepe, 2014). The structure of the pyramid design model is shown in the figure below.

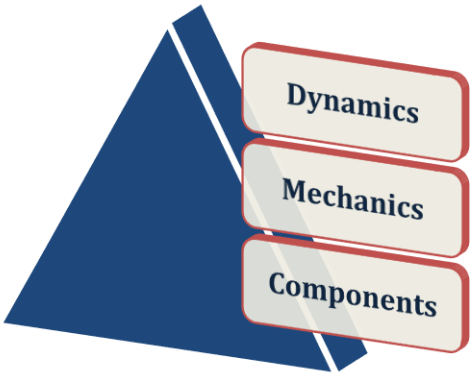

Figure 1. Pyramid Design Model

Dynamics are at the top level of the pyramid and form the basis of gamification. Dynamics may include elements such as constraints, emotions, and progression that support gamification (Werbach & Hunter, 2012).

Mechanics are the elements that make players more motivated and committed. Mechanics are the basic processes that engage players and advance movement, and include elements such as

challenge, chance, competition, cooperation, feedback, reward and interactions. (Werbach & Hunter, 2012).

Components are the elements that users interact with design objects in the front section. Apart from gamification components such as points, badges and leaderboards, other gamification components used are levels, tasks, achievements, avatars, content unlocks, social schedules, teams, virtual items (Werbach & Hunter, 2012).

Motivation can be defined as a state of mind that leads people to behave in a certain way and makes them willing to do a job (Başaran, 1991). Motivation can be integrated into lessons by using it appropriately in different learning approaches. Learning environments that are interesting and provide active participation of students can positively affect student motivation (Ünsal, 2007).

There are many gamification applications used in learning environments. Busuu, Classcraft, Doulingo, Quizlet, Socrative, Kahoot, Quizizz, Plickers, ClassDojo and Flipquiz are examples of online gamification applications that can be used in educational environments (Marangoz & Marangoz, 2021). It is possible to create online quizzes and surveys with different question types by using Kahoot. With Kahoot, questions prepared by the teacher are displayed one by one on the screen, students mark the answers via the internet with their mobile devices and collect points. When the questions are finished, the names of the ranking students are displayed on the screen. Within the scope of this research, Kahoot application was preferred for the study. The teacher can reveal students' deficiencies by examining the result reports (Byrne, 2013; Dellos, 2015). The reviewed studies emphasize that it is possible to increase students' motivation towards the lesson by using Kahoot application.

In the light of this information, the aim of our research is to examine the views of pre-service teachers towards Kahoot-based gamification approach in digital literacy teaching. For this purpose, the following questions were tried to be answered:

1. What do students believe about the impact of the Kahoot application on motivation?
2. What do students think about the impact of Kahoot on learning?
3. How does Kahoot impact student interaction?
4. What is the level of satisfaction among students regarding Kahoot?
5. What are the students concerning the positive and negative aspects of the Kahoot application?

Methodology

Research Model

This study was designed according to a mixed research design in which both quantitative and qualitative research methods and techniques were used. There are different reasons why mixed methods are preferred in scientific research. According to Creswell (2017b), combining statistical trends with personal experiences to better understand the research problem is more advantageous for the researcher than using any of these methods alone.

In this study, the survey model was preferred. The survey model is defined as one of the descriptive research methods. The survey model is one of the research methods that aims to describe a past or present situation as it is (Büyüköztürk et al., 2016).

In the study, quantitative data were collected and analyzed first and then qualitative data were collected to support the quantitative data. Therefore, in this study where quantitative research method was more dominant than qualitative research method, sequential explanatory

mixed design of mixed method was used. While quantitative data were collected through a questionnaire, qualitative data were collected through open-ended questions. In this study, it was tried to determine the effectiveness of the application within the framework of student views on gamification with Kahoot.

Working Group

The study was conducted with 278 pre-service teachers studying at Kilis Aralık University Kilisli Muallim Rıfat Faculty of Education in the fall semester of 2021-2022 academic year and selected by convenience sampling method. Convenience sampling method is defined as the researcher turning to the easiest elements that the researcher can reach while forming the sample (Patton, 2005).

Although the convenience sampling method is weaker in terms of representing the universe compared to other sampling methods, it provides benefits in terms of time and cost in terms of reaching the participants. The frequency distribution of the students participating in the study is presented in Table 1.

Table 1
Frequency distribution of pre-service teachers

Departments		**f**	***(%)***
Guidance and Psychological Counseling		58	20.9
Elementary Mathematics Teaching	Distance Education	52	18.7
Turkish Teaching		52	18.7
Social Studies Teaching		33	11.9
Classroom Teaching	Formal Education	43	15.5
Preschool Teaching		40	14.4
Total		**278**	**100.0**

Considering the data in Table 1, it is seen that the participants of the study consisted of 278 pre-service teachers in total, including 58 guidance and psychological counseling candidates, 52 pre-service elementary mathematics teachers, 52 pre-service Turkish teachers, 33 pre-service social studies teachers, 43 pre-service classroom teachers, and 40 pre-service preschool teachers. While 162 teacher candidates participated in the practice with the distance education model, 116 teacher candidates participated in the training in a formal education environment.

Data Collection Tools

Student opinion survey and interview questions were used as data collection tools. The survey was developed by Korkmaz and Tetik (2018) and is a 5-point Likert type consisting of a total of 19 questions. Open-ended interview questions were prepared to support the questions in the survey. Structured interview technique was used when asking questions to the students. Interview questions were added to the bottom of the survey form and students were asked to fill in the blank sections.

The questionnaire consists of three sub-factors: motivation, learning and interaction. An exploratory factor analysis was conducted and KMO=0.944 and Bartlett=2430.487, df=171, $p<0.001$. Cronbach's alpha reliabilities for motivation, learning and interaction sub-factors were

α=0.973, α=0.975 and α=0.944 respectively. The item numbers for the sub-items of the questionnaire are given in Table 2.

Table 2
Sub-dimensions of questionnaire

Sub-Dimensions	Item Numbers
Motivation	1,2,3,4,5,6
Learning	7,8,9,10,11,12,13,14
Interaction	15,16,17,18,19

Results of Cronbach's alpha reliability analysis of the sub-dimensions of the questionnaire is presented in Table 3.

Tablo 3
Cronbach's alpha analysis results of questionnaire

Sub-Dimensions	Cronbach's Alfa(α)
Motivation	0.792
Learning	0.844
Interaction	0.746
Total	**0.931**

Cronbach's alpha internal consistency coefficient for the questionnaire items of our study was calculated as α=0.931. The first sub-factor had a Cronbach's alpha coefficient of internal consistency of α=0.792, while the second sub-factor had a coefficient of α=0.844, and finally the third sub-factor had a coefficient of α=0.746. Kaiser Mayer Olkin (KMO)=0.937 and Bartlett=2083.551, df=171, $p<0.001$. As a result of the reliability analysis conducted according to these values, the scale and sub-scale dimensions and the entire scale were found to be reliable.

Teaching Material

Kahoot is a Web 2.0 tool for designing quizzes, creating online quizzes, surveys or discussions. It requires membership and has paid and free packages. Using this tool, gamification activities can be designed both in the classroom environment and in live lessons on distance education systems. Within the framework of this research, it was aimed to design a fun competition environment using Kahoot as an activity for measurement and evaluation, receiving feedback on learning levels, and providing motivation in the digital literacy course.

The application was conducted over 8 weeks, with 8 online exams administered to students at the end of each lesson. The teacher controlled the initiation of the game, progression to the next question and the conclusion of the competition. In this context, the teacher adapted a technology-based quiz application to in-class activities (Dellos, 2015).

Students can access the quiz by entering www.kahoot.it from their phones and typing their names with the given pin code. The names of the students participating in the application are displayed on the main screen as shown in Figure 2. After all students participate, the application is launched.

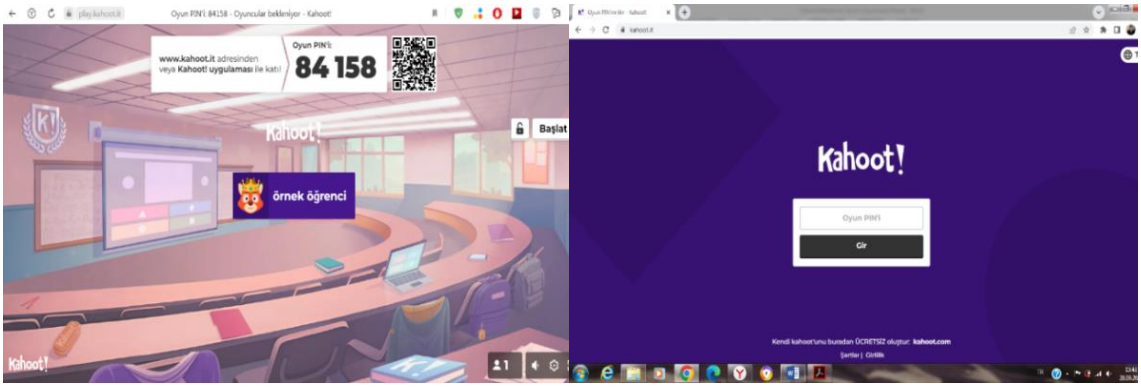

Figure 2. Competition Pin Code and Student Login Screen

Students answer the questions and answers projected on a smart board or screen on their phones within a certain period of time (Özdemir, 2017).

Figure 3. Kahoot Question Screen

On students' phones or tablets, the answer choices of the projected question appear in different colors. Students mark the color that represents the correct answer according to them from the answer choices of the question they see on their own screens.

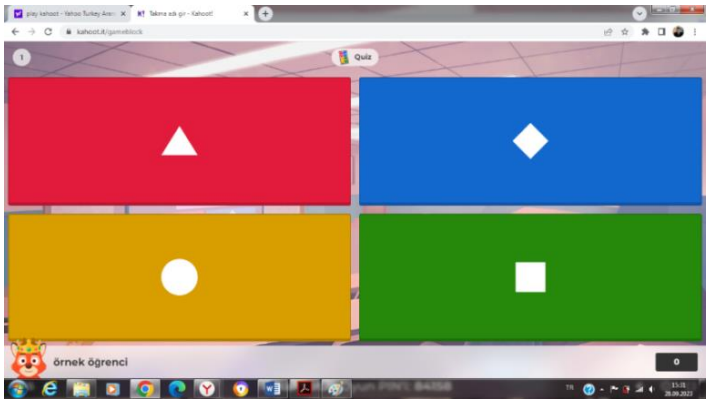

Figure 4. Answer Options on the Student Screen

At the end of the answering time for each question, the correct answer and how many students answered correctly are displayed on the screen. The students who give the correct answer in the shortest time score higher points than the other students who give the correct answer.

In the application carried out within the scope of this research, 8 quizzes were held at the end of classes every week for 8 weeks, both as an in-class activity in formal education and as a live lesson activity in distance education programs. In each application, students earned points as they solved the questions correctly and quickly. After all the questions are answered, the competition is terminated and the ranking students are displayed on the podium (Figure-5).

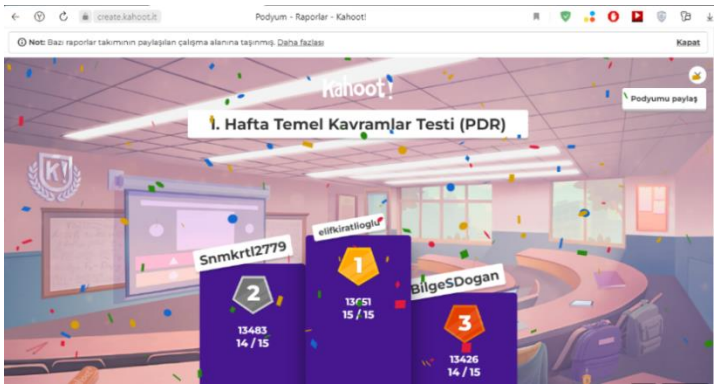

Figure 5. Podium Screen Showing Ranking Students

At the end of each activity, the leadership sign was projected on the screen so that students could see their rankings. In addition, the score sheet showing the scores of all students participating in the competition can also be downloaded from the system in excel format. The teacher can review the outcome reports and disclose any shortcomings (Byrne, 2013).

Data Analysis

SPSS 25 package program was utilized to analyse the quantitative data in this research. The analysis of the quantitative data employed frequency, percentage, arithmetic mean and independent sample t-test. The qualitative data was examined using content analysis.

Findings

Table 4
Normality test values for survey sub-dimensions

Sub-dimensions	Formal Education		Distance Education	
	Skewness	Kurtosis	Skewness	Kurtosis
Motivation	-.754	1.288	-.824	1.084
Learning	-.582	1.464	-.218	-.026
Interaction	-.439	.811	-.323	.238
Total	-.637	1.672	-.365	.471

When Table 4 is examined, it is seen that the kurtosis and skewness values of the survey in general and in its sub-dimensions are between -2 and +2. These values show that the survey is suitable for normal distribution and therefore can be used in parametric tests (George and Mallery, 2003).

The viewpoints of students regarding the impact of the Kahoot application on students are shown in Table 5.

Table 5
Students' views on the effect of kahoot practice

Students	n	$\bar{X}$	s	t	SD	p
Formal Education	116	3.73	0.494	3.839	276	0.000
Distance Education	162	3.96	0.456			

When the values regarding the impact of Kahoot applications on students are examined in Table 5, the total score average of formal education students was calculated as ($\bar{X}$= 3.73) while the total score average of distance education students was calculated as ($\bar{X}$= 3.96). When the t-test results regarding whether these differences are significant or not are examined, it is seen that the general average of distance education students is significantly higher than formal education students. Accordingly, it can be said that distance education students think that Kahoot activities contribute to them significantly more than formal education students. Therefore, it can be concluded that the observed difference is significant ($p<0.05$).

The viewpoints of students regarding the impact of the Kahoot application by sub-dimensions are outlined in Table 6.

Table 6. Students' Views on the Effect of Kahoot Practice by Sub-dimensions

Sub-dimensions		n	$\bar{X}$	s	t	SD	p
Motivation	Formal Education	116	3.77	0.515	2.912		0.004
	Distance Education	162	3.97	0.600			
Learning	Formal Education	116	3.72	0.514	3.478	276	0.001
	Distance Education	162	3.94	0.525			
Interaction	Formal Education	116	3.71	0.456	3.784		0.000
	Distance Education	162	3.96	0.495			

When the values regarding the effect of Kahoot applications on student motivation are examined in Table 6, the total score average of formal education students was calculated as ($\bar{X}$= 3.77) and the total score average of distance education students was calculated as ($\bar{X}$= 3.97). When the t-test results regarding whether these differences are significant or not are examined, it is seen that the general average of distance education students is significantly higher than that of formal education students. Accordingly, it can be said that students think that Kahoot activities contribute positively to their motivation for the course or environment. Therefore, it can be said that the observed difference is significant ($p<0.05$).

When the values regarding the effect of Kahoot applications on learning are examined, the total score average of formal education students is calculated as ($\bar{X}$= 3.72) and the total score average of distance education students is ($\bar{X}$= 3.94). When the t-test results regarding whether these differences are significant or not are examined, it is seen that the general average of distance education students is significantly higher than that of formal education students. Accordingly, it can be said that students think that Kahoot activities contribute positively to their learning. Therefore, it can be said that the observed difference is significant ($p<0.05$).

When the values related to student interaction in Kahoot applications were examined, the total score average of formal education students was calculated as ($\bar{X}$= 3.71) and the total score average of distance education students was calculated as ($\bar{X}$= 3.96). When the t-test results regarding whether these differences are significant or not are examined, it is seen that the general average of distance education students is significantly higher than that of formal education

students. Accordingly, it can be said that students think that Kahoot activities contribute positively to student interaction. Therefore, it can be said that the observed difference is significant ($p<0.05$).

Students' satisfaction levels regarding the Kahoot application: "If you were to evaluate the Kahoot application in classes out of 5 points, how many points would you give? Why?" was tried to be determined by asking the open-ended question. Student opinions reflected in this framework are summarized in Table 7.

Table 7
Students' satisfaction level opinions on Kahoot application

Sub-Themes	f
I give 5 points	142
I give 4 points	113
I give 3 points	23
Increases motivation	48
Makes the lesson enjoyable	41
Increases interest in the lesson	35
Increases interaction in the classroom	33
Enables competition in the classroom	25
Easy to use	16
Ensures permanent learning of information	12
Provides preparation for exams	8

When Table 7 is examined, it can be seen that a significant part of the students (f = 142) were very satisfied with the Kahoot activities and showed this by giving full points to the application. When the answers given according to the reason for the score they gave were examined, 48 students stated that it increased motivation, 41 students stated that it made the lesson fun, and 35 students stated that it increased interaction in the lesson. Accordingly, it can be said that students are largely satisfied with the Kahoot application.

Students' views on the positive and negative aspects of Kahoot application: "What are your opinions about the positive and negative aspects of the Kahoot application?" was tried to be determined by asking the open-ended question. Student opinions reflected in this framework are summarized in Table 8 and Table 9.

Table 8
Students' views on the positive aspects of Kahoot practice

Positive Sub-Themes	f
Maximizing motivation	54
Creating a fun environment	49
Increasing participation and interest in the course	43
Creating competition in the lesson	25
Providing permanent learning	12

When students' opinions on the positive aspects of the Kahoot application are examined in Table 8, it is seen that 54 students stated that it increased motivation, 49 students stated that it

provided an entertaining learning environment, and 43 students stated that it increased participation and interest in the lesson.

Table 9.
Students' views on the negative aspects of Kahoot practice

Negative Sub-Themes	f
No negative aspects	62
Slow internet connection speed	43
Fear of falling behind in the scoreboard	38
Technical problems encountered when projecting questions	25
Internet quota expiration	16
Limited response time	13

When students' opinions on the negative aspects of the Kahoot application are examined in Table 9, it is seen that 62 students did not report any negative aspects. 43 students reported answering questions late or being unable to answer due to disconnections and slowdowns in their Internet connections. Additionally, 38 students expressed fear of appearing at the bottom of the scoreboard.

When we look at the findings obtained in general, most of the students stated that they were satisfied with the Kahoot application and that there were no negative aspects of the application, while some of them stated that they had problems with internet connection and that they were uncomfortable with appearing in the last places on the scoreboard.

Conclusion and Discussion

When the students' answers to the survey questions are analyzed, they generally think that Kahoot activities contribute positively to their motivation towards the course, learning processes and classroom interaction. When distance education students are compared with formal education students, especially distance education students think that Kahoot activities contribute significantly more to their motivation, learning processes and classroom interaction than formal education students.

When the students' responses to the open-ended questions were analyzed, it was concluded that the students were largely satisfied with the Kahoot application. When the students' views on the positive aspects of Kahoot application were examined, they stated that it increased student motivation, made the lesson fun, contributed positively to interaction, reinforced learning, gave clues about the types of questions that may appear in the exam, and increased interest and participation in the lesson. When the students' opinions on the negative aspects of the Kahoot application were analyzed, most of the participants stated that there were no negative aspects of Kahoot, while a small number of participants stated that they had problems due to the slowness of the internet, they were afraid of falling behind in the scoreboard, they consumed their internet quota quickly and the answer time was insufficient. In this context, it was concluded that students were generally satisfied with the Kahoot application and thought that there was no negative aspect, but some students encountered technical problems and were afraid of falling behind in the ranking.

The student opinions analyzed above are also consistent with the literature. In studies on the effect of Kahoot on students' motivation, it was observed that students' work with Kahoot

made a significant positive difference on their motivation. In the studies conducted by Saraçoğlu (2019), Yapıcı and Karakoyun (2017), results were found to support Kahoot-like applications. Chaiyo and Nokham (2017) emphasize that Kahoot has positive effects on focus, connection, fun, motivation and satisfaction. According to this result, it can be stated that students are open to using web 2.0 tools such as Kahoot and will not have negative emotions, on the contrary, they will be motivated.

Based on the findings of Kahoot for learning, it can be concluded that this tool can be used as an effective method to increase academic achievement in the educational process. In a study conducted by Allran et al. (2021), it was concluded that Kahoot application was interesting for students and increased interaction and competition. According to the research results, Kahoot activities, which contribute positively to students' motivation, make it possible to learn while having fun.

Wang and Tahir (2020) evaluated the Kahoot application from the teacher and student perspective and emphasized that the application does not provide reliable results due to problems such as internet connection. In another study conducted by Chiang (2020), the use of Kahoot in high school was examined and it was observed that some problems related to the application were encountered. Students stated that they were not given enough time to answer the questions, so they could not answer the questions. In the light of these results, it is suggested that Kahoot applications should be included in the courses to solve the interaction problem in distance education environments.

References

Arkün Kocadere, S. & Samur, Y. (2016). *Oyundan oyunlaştırmaya* in A. İşman, H. F. Odabaşı & B. Akkoyunlu (Eds.), *Eğitim teknolojileri okumaları* 2016, 397-414. Ankara: Salmat Basım Yayın.

Allran, J. S., Russell, M. G., Tantong, K. & Becker, J. (2021). The effectiveness of kahoot, quizlet , and flipgrid in online esl teaching. *The 16th International Conference on Humanities and Social Sciences Education transformation: Humanities and Social Sciences*. 2021(November), 86– 93.

Başaran, İ. E. (1991). *Eğitim yönetimi*. Ankara: Gül Yayınevi.

Bozkurt, A. & Genç Kumtepe, E. (2014). Oyunlaştırma, Oyun Felsefesi ve Eğitim: Gamification. *16.Akademik Bilişim Konferansı*, Mersin Üniversitesi, Mersin.

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö.E., Karadeniz, Ş. & Demirel, F. (2016). *Bilimsel araştırma yöntemleri*. Ankara: Pegem Yayınları.

Byrne, R. (2013). Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Chaiyo, Y. & Nokham, R. (2017). The effect of Kahoot, Quizizz and Google Forms on the student's perception in the classrooms response system. *In IEEE International Conference on Digital Arts, Media and Technology (ICDAMT), 178-182. Thailand: Chiang Mai University*.

Chiang, H.-H. (2020). Kahoot! in an EFL Reading Class. *Journal of Language Teaching and Research*, 11(1), 33–44. https://doi.org/10.17507/jltr.1101.05.

Creswell, J. W. (2017b). *Araştırma deseni nitel, nicel ve karma yöntem yaklaşımları*. (S. B. Demir, Trans. Ed.). Eğiten Kitap.

Dellos, R. (2015). Kahoot! A digital game resource for learning. *International Journal of Instructional Technology and Distance Learning*, *12*(4), 49-52.

Deterding, S., Khaled, R., Nacke, L. E. & Dixon, D. (2011). Gamification: Toward a definition. *CHI 2011 Gamification Workshop Proceedings*, 12-15.

George, D. & Mallery, P. (2003). *SPSS for windows step by step*: A simple guide and reference. Boston: Allyn & Bacon.

Kapp, K. M. (2012). *The gamification of learning and instruction*. San Francisco: Wiley.

Korkmaz, Ö. & Tetik, A. (2018). Örgün ve uzaktan eğitim öğrencilerinin derslerde kahoot ile oyunlaştırmaya dönük görüşleri. *Journal of Instructional Technologies & Teacher Education, 7(2), 46-55.*

Marangoz, M. & Marangoz, G. (2021). E-öğrenme ortamında kullanılan oyunlaştırma uygulamaları. *Journal of Social and Humanities Sciences Research, 8*(67), 606-610.

McGonigal, J. (2011). R*eality is broken: Why games make us better and how they can change the world.* London: Penguin.

Özdemir, O. (2017). Türkçe öğretiminde dijital teknolojilerin kullanımı ve bir web uygulaması örneği. *Turkish Studies, 12*(4), 427-444.

Patton, M. Q. (2005). *Qualitative research: Qualitative research*. Sage, Thousand Oaks, CA.

Saraçoğlu, G. (2019). Lise öğrenci ve öğretmenlerinin kahoot kullanımına ilişkin görüşleri. *Akdeniz Eğitim Araştırmaları Dergisi, 13*(29).

Schell, J. (2010). *Design Outside the Box*. *DICE Summit*. https://www.realtimetranscription.com/showcase/DICE2010/JesseSchell/index.php

Ünsal, H. (2007). Harmanlanmış öğrenme etkinliğinin çoklu düzeyde değerlendirilmesi (Dissertation). Gazi University, Institute of Educational Sciences, Ankara.

Wang, A. I. & Tahir, R. (2020). The effect of using Kahoot! for learning–A literature review. *Computers and Education, 149*, 103818.

Werbach, K. & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Philadelphia, PA: Wharton Digital Press.

Werbach, K. & Hunter, D. (2015). *The gamification toolkit: Dynamics, mechanics, and components for the win*. Philadelphia: Wharton Digital Press.

Yapıcı, İ. & Karakoyun, F. (2017). Gamification in biology teaching: A sample of Kahoot application. *Turkish Online Journal of Qualitative Inquiry, 8*(4), 396-414.

Yılmaz, R. & Karaoğlan Yılmaz, F. G. (2019). Bir oyunlaştırma ve biçimlendirici değerlendirme aracı olarak kahoot kullanımına yönelik öğretmen adaylarının görüşlerinin incelenmesi. *II. Uluslararası Eğitimde ve Kültürde Akademik Çalışmalar Sempozyumu Bildiriler Kitabı*, Denizli, 331-337.