JEGYS

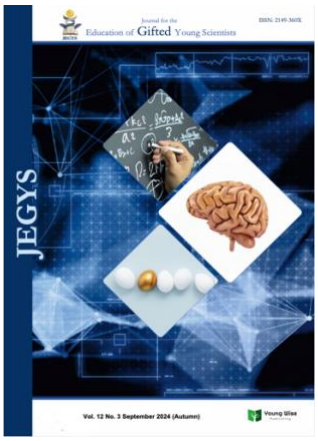
Journal for the
Education of Gifted Young Scientists

ISSN: 2149-360X

JEGYS

Vol. 12 No. 3 September 2024 (Autumn)

Young Wise Publishing



Journal for the Education of Gifted Young Scientists
e-ISSN: 2149- 360X

Vol. 12 No. 3 September 2024 (Autumn)

Young Wise Publishing

Editorial Board of JEGYS

Journal for the Education of Gifted Young Scientists
e-ISSN: 2149- 360X

September 2024 (Autumn), Vol. 12 No. 3
https://dergipark.org.tr/en/pub/jegys

Contents

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Journal for the Education of Gifted Young Scientists, 12(3), 0-0, Sept 2024
e-ISSN: 2149- 360X
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From the Editorial

Change in education: the role of JEGYS and the quality gap in academic publishing

Hasan Said Tortop[1]

Antalya, Turkiye.

Abstract

The change in education and the era of artificial intelligence coincide with the concept of 'Gifted Young Scientists' introduced by JEGYS. It will no longer be rare to encounter many young scientists and entrepreneurs. Aware of its role in this regard, JEGYS will continue its publications. JEGYS will update and adhere to its publication policies and ethical principles for the year 2025. New appointments have been made to the editorial board of JEGYS. The academic quality gap between articles in journals from developing countries and those from developed countries has been discussed, along with the reasons and suggestions for improvement.

Keywords:

Academic quality gap in articles, changing of education, AI era, journals in developing countries

To cite this article:

Tortop, H.S. (2024). Editorial and entrepreneurial talents of gifted young scientists who are academic journal owners: problems and suggestions. *Journal for the Education of Gifted Young Scientists*, *12*(3), 0-0.

Today, a clear change in education is evident. Among the working population, especially young people, there is an increasing desire not to be physically present in a fixed location. With the role of artificial intelligence in reducing labor and time in a job, generating strategies or using thinking skills has become more important. The era of 'Gifted Young Scientists' introduced by JEGYS has begun. But are we ready for this? In this period, where we will meet talented individuals at a very young age, our educational practices need to be aimed at them. JEGYS has updated the previous article section title 'Advanced Technologies in Education' to 'AI, Metaverse, and Advanced Technologies in Education.' It has invited individuals like Dr. Hasan Tinmaz, who work in the field of artificial intelligence, to become field editors. In the 2025 publication period of JEGYS, adherence to publication policies and ethical principles, such as publishing no more than 10 articles per issue and ensuring that articles from one country do not exceed 20% of the total, will be maintained. Additionally, we thank Prof. Dr. Michael Saughnessy for accepting the role of chief editor. We already appreciate his contribution to determining the field editors and editorial board members. With our field editors and editors, we have high hopes that 2025 will be a very successful year. We know that the Dergipark journal system has many procedures for submitting articles. The Dergipark team is improving themselves and their software every day, especially working to create software that is sensitive to ethical issues in academic publishing. You can always contact me during the process of submitting your articles.

Currently, many countries around the world operate an index-based promotion procedure for academic staff. This situation leads academics to focus on journals indexed in specific databases. This, in turn, creates an academic quality gap in articles, similar to the gap between university education in developed and developing countries. As a solution to this, it is observed that major publishers are creating multidisciplinary journals to meet the need for indexed journal articles for academics in developing countries. In addition, the increase in the number of indexed journals in developing countries can be considered another positive development. However, as Snow (2001) described with his

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depiction of two cultures, a gap has emerged between them, with one having a detrimental effect on scientific development. Researchers who excel in an academic field are often reluctant to choose journals from developing countries. Authors in these journals tend to contribute to their fields through articles that may contain certain scientific issues, mainly in journals from developing countries. The higher education boards in developing countries, which only demand promotions based on indexed journal articles, lead academics in these countries to focus more on journals with fast publication processes. The high article processing charges of these journals also cause a significant portion of the capital to shift from research to publication fees. I observe that this academic quality gap is deepening. In addition, the effectiveness of initiatives encouraging open access to journals and reducing the costs of accessing scientific knowledge is questionable. I believe that advancing technology will greatly help reduce this academic quality gap. The most crucial factor in academic publishing is the development of reviewers. At this point, the concept of 'developmental reviewing' can be introduced to support the development of authors' research and improve the quality of their articles.

In this issue, we present you with five articles. We would like to thank our authors, as well as our reviewers and editors. We invite you to submit your articles to JEGYS.Enjoy the pleasure of reading the articles

Dr. Hasan Said Tortop
Managing Editor of the JEGYS

Rererences

Snow, C.P. (2001). İki kültür (Two cultures) (Trans: Tuncay Birkan). TUBİTAK publishing.

Journal for the Education of Gifted Young Scientists, 12(3), 95-100, Sept 2024
e-ISSN: 2149- 360X
jegys.org
dergipark.org.tr/jegys

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Teaching Techniques and Activities for Gifted

Is there a missed relationship between entropy and kinetic theory of gases? a new perspective for the instruction

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Article Info

Received: 22 March 2024
Accepted: 8 Sept 2024
Available online: 30 Sept 2024

Keywords
Entropy
Kinetic theory of gases
Modeling
Molecular velocity
Thermodynamic

Abstract

This paper is concerned with the investigation for finding missed models that combining between thermodynamic and kinetic theory of gases. The research was initiated by supposing a fixed number of molecules at gas state in a closed box of two equivalents parts. When the barrier between those two parts is removed, the volume of the box will be double of the first stage. It was concluded that the present study gives confirmation for the already existing models with no new developed model unless the employment of Charles's law in derivation process, in spite of the last law is proper for ideal gas rather than the proposed real gas. The derived model of entropy (ΔS) using the last law gives the same value of ΔS that calculated from the standard model. The presented article can be considered as a good exercise for students in order to get an idea of how one could think for connect two different subjects for developing new models which could help in understanding the scientific theories and also in opening new doors of science.

To cite this article:

Khalil, R.A., & Ali, A.A. (2024). Is there a missed relationship between entropy and kinetic theory of gases? a new perspective for the instruction. *Journal for the Education of Gifted Young Scientists*, *12*(2), 95-100.

Introduction

There is no doubt about the significantly importance of thermodynamics and kinetic theory of gases particularly in understanding and predicting the physical and chemical phenomena of systems. Indeed, the thermodynamic parameters including enthalpy, free energy and entropy play an excellent role in most fields of science. On the other side, it is well known that the interesting thermodynamic property of entropy (S) has wide applications in the field of second law of thermodynamics. It is combined with all of the thermodynamical functions such as enthalpy, Gibbs energy, differential equations of Maxwell and Van't Hoff equation (Wu & Guo, 2014; Treumann & Baumjohann, 2019; de Abreu & Vasco Guerra, 2012; Devriendt, 2021; Atkins, 2006). In addition, the second law of thermodynamic was developed by Boltzmann in order to calculate the entropy by statistical approach of probability through the following known equation (Treumann & Baumjohann, 2019; de Abreu & Vasco Guerra, 2012):

$$S = k \ln W$$

where k is the Boltzmann constant and W is the number of energy microstates. In general, the scientists who concerning in this field may realizing the presence of somewhat lack in relationships between thermodynamic and kinetic theory of gases. The aim of the present paper is an attempt deriving new models that combining the entropy and its other related quantities within the framework of classical thermodynamic with the molecular kinetic energy. According to the literature, there is no obvious and direct model expressing the relationship between thermodynamic

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functions with kinetic theory of gases. The present work hopes to provide an idea about the microscopic physical meaning of entropy which could help in understanding the thermodynamic properties.

It should be noted that the kinetic theory of gases was described from thermodynamic point of view by simple classical model. According to this theory, the gas is treated as a composition of numerous submicroscopic particles moving in random motion. It was supposed that the collision of gas particles whether with each other or container is perfectly elastic (ideal gas). Indeed, the last assumption can be considered as a fictional due to presence of molecular interactions or attraction forces between the particles of gas. In other words, the ideal gas does not exist in nature, even the inert gases such as helium atom possesses attraction force of dispersion type with each other (Laidler et al., 2003). Therefore, the suggested relationships by kinetic theory between volume, pressure and temperature are only limited to ideal gas. However, the modification of ideal gas law by van der Walls concerning the molecular interactions between gas particles in addition to their molecular size was done with a remarkable complexity.

Aim of Instructional Activity

In order to find a new relationship that could combine the topic of thermodynamic with that of kinetic theory of gases. The yield of this investigation is very interesting for understanding these scientific disciplines as well as can be considered as optimum exercise for young scientists.

Instruction of the Entropy and Gas Theory

Well, considerable efforts must be paid for deriving or building up any scientific model. Since the equation is a mathematical relationship, the process of obtaining it is not easy or direct and falls within trial and error. Therefore, the derivation process requires a high degree of patience. For example, Schrödinger took a period of two years to derive his famous equation in quantum mechanics (Khalil, 2020). Thus, according to second law of thermodynamic, the entropy can be defined as a measure of the distribution of energy in the system (Atkins, 2006; Yee & Sjögreen, 2020; Laidler et al., 2003; Callen, 1985; Daniels & Alberty, 1979). Such a distribution of the system increases with increasing the temperature and vice versa unless reaching the temperature of absolute zero (Atkins, 2006). On the other side, one could understand from the laws of gases that the kinetic energy of gases has a direct proportional with the temperature, due to the increasing in the kinetic energy of molecules. According to the law of the kinetic theory of gases, one could find the following relationship (Atkins, 2006):

$$\boldsymbol{PV = \frac{1}{3}Nmv^2} \qquad (1)$$

where P is the pressure, V is the volume, N is the number of molecules, m is the molecular mass of the gas and v it is the velocity. Multiply equation 1 by 3/2 one could get:

$$\boldsymbol{\frac{3}{2}PV = \frac{1}{2}Nmv^2} \qquad (2)$$

The kinetic energy (K_E) is equal to $1/2mv^2$ which can be substituted in equation 2 in order to give:

$$\boldsymbol{\frac{3}{2}PV = NK_E} \qquad (3)$$

In the case of real gases, the general law according to Virial equation of gases which is derived from perturbative treatment of statistical mechanics could be represented by the following equation (Devriendt, 2021; Atkins, 2006; Callen, 1985):

$$\boldsymbol{PV_m = RT\left[1 + \frac{A(T)}{V_m} + \frac{B(T)}{V_m^2}V + \frac{C(T)}{V_m^3} + \cdots\right]} \qquad (4)$$

where V_m is the molar volume, R is the ideal gas constant, T is the absolute or Kelvin temperature, A, B, and C are temperature dependent constants. The term between the brackets of the above equation (4) can be abbreviated by ω symbol as following:

$$\boldsymbol{PV_m = RT\omega} \qquad (5)$$

By combination equation 5 with that of 3 for one mole of gas one could obtain the following relationship:

$$\boldsymbol{K_E = \frac{3}{2}RT\omega} \qquad (6)$$

Now, if one suppose there is an isothermal system of a fixed dimensional box containing M number of real gas molecules. This box is divided into two equivalents parts by a suitable barrier as illustrated in Figure 1. Therefore, the kinetic energy of these molecules (K_{E1}) can be expressed by equation 7 as the sum of the kinetic energies of molecules. When the barrier is removed the molecules will diffuse to the other part of the system as the new volume (V_2) is the double of V_1 ($V_2 = 2V_1$), and the kinetic energy of this new system (Figure 2) will be termed as K_{E2}.

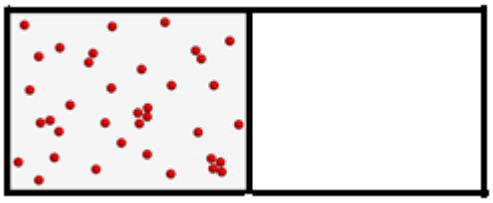

Figure 1. Virtual box of fixed dimensions including a barrier

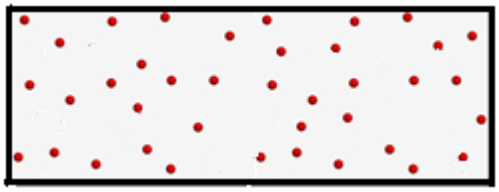

Figure 2. Virtual box of fixed dimensions without the barrier

The total kinetic energy of M molecules can be expressed as the sum of the kinetic energies of all molecules ($K_E = \sum_{i=1}^{M} \frac{1}{2} mv^2$). Since the proposed system contains identical molecules, the averaged kinetic energy of these molecules are also identical. Thus, the total energy of the system may be expressed by the following equation:

$$\boldsymbol{K_E = \left(\frac{1}{2} mv^2\right) M} \qquad (7)$$

where $\boldsymbol{\frac{1}{2} mv^2}$ is the averaged kinetic energy, M is the number of molecules at the system. The total kinetic energy of V_1 (Figure 1) and V_2 (Figure 2)) can be expressed as K_{E1} and K_{E2} respectively (equations 8 and 9).

$$\boldsymbol{K_{E1} = \left(\frac{1}{2} mv_1^2\right) M} \qquad (8)$$

$$\boldsymbol{K_{E2} = \left(\frac{1}{2} mv_2^2\right) M} \qquad (9)$$

where v_1 and v_2 are the averaged molecular velocities of the gas molecules at V_1 and V_2, respectively. The molecular linear momentum (p) is equal to mv which can be substituted in equations 8 and 9 (multiplying the right side by m/m) to give equations 10 and 11, respectively.

$$\boldsymbol{K_{E1} = \left(\frac{p_1^2}{2m}\right) M} \qquad (10)$$

$$\boldsymbol{K_{E2} = \left(\frac{p_2^2}{2m}\right) M} \qquad (11)$$

Dividing eq. 10 by that of 11 one could get:

$$\boldsymbol{\frac{K_{E1}}{K_{E2}} = \frac{\left(\frac{p_1^2}{2m}\right) M}{\left(\frac{p_2^2}{2m}\right) M}} \qquad (12)$$

which then gives

$$\boldsymbol{\frac{K_{E1}}{K_{E2}} = \frac{p_1^2}{p_2^2}} \qquad (13)$$

It is clear that the volume at the second state becomes the double of the first state which can be expressed as following:

$$\boldsymbol{V_2 = 2V_1} \qquad (14)$$

or

$$\frac{V_1}{V_2} = \frac{1}{2} \qquad (15)$$

At this case, if one suppose that the Charles's law of isobaric system can be applied to the suggested isothermal system (the temperature has direct proportionality with the volume) using the following relation (Daniels & Alberty, 1979). This may be somewhat attributed to that of Charles's law is suitable to ideal gas rather than the postulated real gas as the energies of attraction and repulsion between molecules are affected directly by the expansion process in comparison to that of ideal gas.

$$\boldsymbol{T \propto V}$$

then

$$\boldsymbol{T = \varphi V} \qquad (16)$$

where φ is the constant term.

By substitution eq. 16 into that of 6 for one mole of V_1 and V_2 one could get the following:

$$\boldsymbol{K_{E1} = \frac{3}{2} R \varphi V_1 \omega} \qquad (17)$$

$$\boldsymbol{K_{E2} = \frac{3}{2} R \varphi V_2 \omega} \qquad (18)$$

Substitution eqs. 17 and 18 into that of eq. 13 one could get the following:

$$\frac{\frac{3}{2} R \varphi V_1 \omega}{\frac{3}{2} R \varphi V_2 \omega} = \frac{p_1^2}{p_2^2} \qquad (19)$$

$$\frac{V_1}{V_2} = \frac{p_1^2}{p_2^2} \qquad (20)$$

$$\frac{p_1^2}{p_2^2} = \frac{1}{2} \qquad (21)$$

Thus $\boldsymbol{p_2^2 = 2p_1^2}$

Then, substituting eq. 13 into that of eq. 21 one could obtain:

$$\frac{K_{E1}}{K_{E2}} = \frac{1}{2} \qquad (22)$$

Hence, one could realize clearly that the kinetic energy of Figure 2 (K_{E2}) is twice that of Figure 1 (K_{E1}). Since equations 15 and 22 are both equal to same quantity of ½. Therefore,

$$\frac{K_{E1}}{K_{E2}} = \frac{V_1}{V_2} \qquad (23)$$

Interestingly, this means that the kinetic energy has a direct proportional with the volume, and it is clear that the ratio between the first volume and second volume is equal to 1/2, as following:

$$\boldsymbol{K_{E2} = 2K_{E1}} \qquad (24)$$

Equations 23 and 24 can be represented in terms of velocity ($\boldsymbol{K_E = \frac{1}{2} m v^2}$) in order to give equations 25 and 26 respectively as following:

$$\frac{v_1}{v_2} = \frac{V_1}{V_2} \qquad (25)$$

$$\boldsymbol{v_2 = 2v_1} \qquad (26)$$

The above equations (23-26) indicate that the potential energy of gas molecules are changed to that of kinetic energy when the volume of expanded and vice versa. In other words, these relationships are contradict with that of non-

changing in kinetic energy due to isothermal expansion for ideal gasses. However, it is may be true for the real gas as proposed hypothetically at this work. Indeed, the most useful form of the second law for physicochemical applications is expressed in terms of an additional thermodynamic function of entropy (S). It is a function of the state of system and has the following properties. For an infinitesimal reversible process: $= \frac{\partial q}{T}$, and for an infinitesimal spontaneous process: $dS > \frac{\partial q}{T}$, where q is the heat and T is the absolute temperature. On the other hand, for isothermal process the entropy can be given by the following equation (Atkins, 2006; Daniels & Alberty, 1979):

$$\Delta S = Rln\frac{V_2}{V_1} \quad (27)$$

Dividing both sides of equation 27 by R gives:

$$\frac{\Delta S}{R} = ln\frac{V_2}{V_1} \quad (28)$$

The reciprocal of equation 23 is:

$$\frac{K_{E2}}{K_{E1}} = \frac{V_2}{V_1} \quad (29)$$

By taking the natural logarithm (ln) of both sides of equation 29 one could get:

$$ln\frac{K_{E2}}{K_{E1}} = ln\frac{V_2}{V_1} \quad (30)$$

Hence, the right sides of both equations 28 and 30 are equal, therefore, their left sides are equal too which can be expressed by the following relation:

$$\frac{\Delta S}{R} = ln\frac{K_{E2}}{K_{E1}} \quad (31)$$

Multiplying both sides of equation 31 by R one could get the following important relationship:

$$\Delta S = Rln\frac{K_{E2}}{K_{E1}} \quad (32)$$

The last model might also be expressed by the term of the velocity terms in a similar manner to that of equation 25 as following:

$$\Delta S = Rln\frac{v_2}{v_1} \quad (33)$$

Thus, the last two equations are representing the endeavor of the present assumption as they combining they between thermodynamic and the kinetic theory of gases. However, it is not true to use Charles's law in this study which could only applied for isobaric systems (Daniels & Alberty, 1979). But, at the same time, as mentioned above, the last law is for ideal gases, not for real gases. On the other side, the Boyle's law ($P \propto \frac{1}{V}$) is more suitable for the present study which therefore no new model could be derived from the present work. In other words, equation 20 can be represented by the following form:

$$\frac{P_1V_1}{P_2V_2} = \frac{p_1^2}{p_2^2} \quad (34)$$

According to Boyle's law:

$$P_1V_1 = P_2V_2$$

Then equation 34 can be represented as following:

$$\frac{p_1^2}{p_2^2} = 1$$

which means no change in the average of kinetic energy due to change from V_1 to V_2 ($K_{E1} = K_{E2}$) and the value ΔS can be determined using equation 27 will give the same value of equations 32 and 33.

Conclusions

On the bases of the achieved results, one could conclude that there is no acceptable success in reaching the endeavor of the present work by suggesting developed relationships between the thermodynamic and the kinetic theory of gases. In other words, no new scientifically acceptable models are achieved for combining between the thermodynamic and the kinetic theory of gases except if one employ Charles's law in the derivation process. However, the last law should not be applied to the proposed system as an isothermal, but at the same time, the proposed gas is a real which not obey completely on Charles's law in contrast the perfect gas. This because the real gases are suffering from electrostatic interactions which may affected by expansions and contractions even at isothermal process. The new developed model using Charles's law of entropy (equations 32 and 33) yield the same value of that of standard model (equation 27). Thus, the presented article could give an example for students about how one supposes something hypothetically in order to find new relationship. Of course, such new derived relationship if can be verified would be quite helpful for understanding the physical meanings of any selected topic.

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Journal for the Education of Gifted Young Scientists, 12(3), 101-118, Sept 2024
e-ISSN: 2149- 360X
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Research Article

Investigation of the relationship between secondary school students' geometry achievements, anxiety and attitudes towards geometry[1]

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Article Info

Received: 5 May 2024
Accepted: 2 Sept 2024
Available online: 30 Sept 2024

Keywords
Attitudes towards geometry
Correlation
Geometry anxiety
Secondary school students

Abstract

In international evaluations of mathematics achievement, it is noted that geometry in terms of achievement has mostly changed over the years. Still, it is a sub-learning field with the lowest scores. The underlying reason for this failure may be the affective characteristics of students such as anxiety and attitude. This research was conducted to examine the geometry achievements, geometry anxieties, and attitudes of secondary school students. The design of the research is quantitative and the model used is the relational screening model. The sample of the research consists of three hundred and forty students who are studying in seventh and eighth grade in private and public schools in Kars in the 2022-2023 academic year. Students were selected using the appropriate sampling method because it is economical in terms of time and accessibility. As data collection tools, the Attitude Scale Towards Geometry at the Secondary School Level, the Geometry Anxiety Scale for Secondary School Students, and the Demographic Information Form containing the personal information of the participants were used. The data collection tools were applied to the students by the researcher after the necessary permissions were obtained. It is indicated that in the research, geometry achievement, anxiety, and attitude do not differ according to gender and class level, but geometry achievement differs according to the state of education of parents. Also, geometry achievement, anxiety, and attitude differ according to the school being taught. When examining the correlations between the variables, it was concluded that there is a negative and significant relationship between geometry attitude and anxiety, as well as between geometry achievement and anxiety, while there is a positive and significant relationship between geometry attitude and success.

To cite this article:

Ilgun, S., Altintas, E., & Yaylali, H. (2024). Is Investigation of the relationship between secondary school students' geometry achievements, anxiety and attitudes towards geometry. *Journal for the Education of Gifted Young Scientists*, *12*(3),101-118. DOI: http://dx.doi.org/10.17478/jegys.1478999

Introduction

The Monitoring and Evaluation of Academic Skills in Turkey (ABİDE) and the Trends in International Mathematics and Science Study (TIMSS) demonstrate that mathematics holds critical importance in assessing students' achievements (Ministry of National Education [MoNE], 2020). Mathematics, as the science of abstract objects/structures, is often perceived by students as complex and difficult to understand. (Işık and Konyalıoğlu, 2005). According to data from the Programme for International Student Assessment (PISA) covering the period from 2003 to 2022, while Turkey's

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mathematics achievement has increased, it has remained below the OECD (Organisation for Economic Co-operation and Development) average. However, in 2022, Turkey's mathematics achievement surpassed the overall average. According to TIMSS data, Turkey has improved its mathematics achievement over time and has come close to the scale average in 8th grade with 496 points (MoNET, 2020). According to ABIDE, the rate of demonstrating below basic and basic proficiency in mathematics among students in Turkey is quite high (ERG, 2020). TIMSS data indicates that geometry has shown slight changes over the years but generally remains an area of weakness (MEB, 2020). Geometry, as a branch that examines shapes and their properties (Kavaklı et al., 2023), includes topics such as lines and angles, polygons, transformation geometry, and circles. Some students express that they enjoy numbers and operations but struggle with geometry. Overall, students understand geometry topics less than other sub-disciplines of mathematics (Yenilmez and Yaşa, 2008). The reason for students' struggles in geometry may be related to their perceptual characteristics, as indicated in TIMSS mathematics achievement (Sarıer, 2020), and may be associated with perceptual characteristics such as attitudes and anxiety towards geometry. Studies have demonstrated a positive relationship between attitude towards geometry and geometry achievement (Özkeleş & Çağlayan, 2010; Ünlü, 2014; Poçan et al., 2020), as well as a negative relationship between geometry anxiety and achievement (Akarca, 2019).

Students often associate mathematics with difficulties they hear from their parents and may develop biases against mathematics before starting school. This situation can lead to the emergence of mathematics anxiety. Cüceloğlu (2003) defines anxiety as a state of mind where negative feelings or fears dominate, the predominant feeling being the belief that something bad will happen. Mathematics anxiety often begins in elementary school and continues for years, causing students to step back from mathematics topics (Şentürk, 2010). Students' mathematics anxieties affect their attitudes towards this course (Şimşek et al., 2017). Attitude is defined as the unique tendency to regulate one's thoughts, feelings, and behaviors towards an object (Özabacı and Yenilmez, 2003). According to another definition, attitude is developing a positive or negative attitude towards an object or situation (Turanlı et al., 2008). Based on these definitions, the reaction developed towards a specific situation can be defined as an attitude, whether positive or negative. Neale (1969) defines mathematics attitude as the desire to solve or avoid a mathematical problem when encountered, whether one likes mathematics or not, and whether one believes mathematics will contribute to us. "Different attitudes can be exhibited towards geometry from mathematical attitude." (Bulut et al., 2002). Bindak (2004) defines geometry attitude as a person's cognitive, behavioral, and emotional approach to issues related to geometry, the geometry teacher, and himself/herself. It is stated that affective characteristics such as mathematics anxiety and attitude are associated with mathematics achievement (Şentürk, 2010). According to the TIMSS 2019 report, students' achievement in geometry, one of the subfields of mathematics, is quite low (MEB, 2020). This failure lies behind students' cognitive and affective characteristics (Ünlü, 2014). Anxiety and attitude toward geometry affect geometry achievement (Özkan, 2010).

Mathematics anxiety can prevent students from fully demonstrating their potential and lead to failure in mathematics. Research shows that mathematics anxiety negatively affects students' mathematics performance (Bekdemir, 2009; Bozkurt, 2012; Sapma, 2013; Al Mutawah, 2015; Barroso et al., 2021). A similar study shows that as mathematics achievement of secondary school students increases, mathematics anxiety decreases (Özabacı and Yenilmez, 2003). Studies investigating the relationship between mathematics anxiety and achievement also bring to mind the relationship between geometry anxiety and geometry achievement. Akarca (2019) developed a scale to measure geometry anxiety for secondary school students. In this study, a negative relationship was found between students' attachment to school and grade point average and geometry anxiety, geometry anxiety did not differ according to parental education level, those who liked mathematics had lower geometry anxiety, girls had higher geometry anxiety than boys, and preschool education was not associated with geometry anxiety. Studies on secondary school students' geometry anxiety are limited to scale development studies (Sağlam et al., 2011; Akarca, 2019). Another affective variable that affects students' educational achievements is attitude. Students who develop a positive attitude towards mathematics are highly likely to be successful in this course (Taşdemir, 2008). In a study conducted by Koca (2011) with 8th-grade students, it was found that mathematics attitude did not differ according to gender, but similar to the conclusion in Şentürk's (2010) study, those satisfied with the mathematics teacher had a more positive attitude towards mathematics, and learning styles

also affected mathematics attitude. Research has shown that as mathematics attitude increases, mathematics achievement also increases (Savaş et al., 2010; Çavdar and Şahan, 2019; Tabuk, 2019). Students often feel fear and dissatisfaction towards geometry (Bulut et al., 2002). This situation has brought research on attitudes toward geometry to the agenda. Significant differences may exist in students' attitudes towards mathematics and geometry (Bulut et al., 2002). Some studies have been conducted to determine attitudes towards geometry (Özdişci and Katrancı, 2019; Bulut et al., 2002). In light of studies indicating the relationship between anxiety and attitude with mathematics achievement, it is evident that geometry achievement is affected by attitude and anxiety variables. However, it is envisaged that it is important to conduct a study in which all variables are considered together to see this situation. Knowing the relationships between these variables will be extremely important to determine the direction and extent to increase students' geometry achievement. It is thought that the relevant study will contribute to the increase in studies on geometry in the literature and encourage researchers in this regard. In this context, the aim of the study is determined as examining the relationships between secondary school students' geometry achievement, anxiety, and attitude towards geometry. In line with this aim, answers were sought to the following problems and sub-problems.

"What is the relationship between secondary school students' geometry achievement, geometry anxiety, and attitude towards geometry?"

Sub-Problems

Is there any relationship between secondary school students' geometry achievement, anxiety, and attitude;

- According to gender
- According to the mother's educational level
- According to the father's educational level
- According to grade level
- According to the school type, is there a significant difference?
- Is there a significant relationship between them?

Method

Research Model

The study aims to investigate the relationships between different variables. Therefore, the research is in quantitative research design, and the relational survey model, one of the survey models, has been chosen to be used in the research. The survey model takes a situation that has been or is currently happening as it is (Bahtiyar and Can, 2017). The relational survey model is a research model that examines how variables can affect a given situation and the degree of relationship between them (Kaya et al., 2012). The relational survey model is used since the level and direction of the relationship between students' existing geometry achievement, anxiety and attitude will be examined in the current study.

Population and Sample

The population of this study consists of all 7th and 8th grade students in the province of Kars. The sample of this study consists of 340 students studying in the 7th and 8th grades from 8 secondary schools in the center of Kars province. The studied sample was selected using the convenience sampling method for its time efficiency and easy accessibility (Büyüköztürk et al., 2012). According to Piaget, children enter the stage of abstract thinking from the age of 11, and they grasp abstract concepts better during this period (Karaşan, 2019). 7th and 8th grade students, who have already encountered geometry were considered suitable for the research since it is thought that students in the abstract thinking phase will be more aware of abstract concepts like anxiety and attitude, and how these concepts reflect in geometry.

Table 1. Frequency values of variables

Variables	Categories	f	%
Gender	Girl	176	51,8
	Boy	164	48,2
Grade	7	174	51,2
	8	166	48,8
School Type	Private	64	18,8
	Public	276	81,2
Mother's Educational level	Illiterate	8	2,4
	Primary School	72	21,2
	Secondary School	80	23,5
	High School	98	28,8
	University	59	17,4
	Postgraduate	23	6,8
Father's Educational Level	Illiterate	6	1,8
	Primary School	47	13,8
	Secondary School	56	16,5
	High School	95	27,9
	University	98	28,8
	Postgraduate	38	11,2
Total		340	100

When examining Table 1, it is observed that 51.8% of the sample consists of girls and 48.2% consists of boys. The majority of the sample is made up of female students. When looking at the sample distribution by grade level, 51.2% of the sample consists of 7th graders, while 48.8% consists of 8th graders. The number of 7th grade students is higher. When classified by school type, 18.8% of the sample attends private schools, while 81.2% attends public schools. The largest portion of the sample consists of students from public schools. Regarding the mothers of the students, 2.4% are illiterate, 21.2% are elementary school graduates, 23.5% are secondary school graduates, 28.8% are high school graduates, 17.4% are university graduates, and 6.8% are postgraduate graduates. When looking at the mothers' educational level in the sample, it is seen that the majority are high school graduates. As for the fathers of the students, 1.8% are illiterate, 13.8% are elementary school graduates, 16.5% are secondary school graduates, 27.9% are high school graduates, 28.8% are university graduates, and 11.2% are postgraduate graduates. When looking at the fathers' educational level in the sample, it is seen that the majority are university graduates.

Data Collection Tools

In this study, the Geometry Anxiety Scale (GAS) developed by Akarca (2019) for secondary school students was used. GAS consists of 12 items, is single-factorial, and doesn't contain reverse items. The rating of the scale is "Not suitable at all", "Not suitable for me", "Suitable for me", and "Completely suitable for me". In Akarca's (2019) study, Cronbach's alpha internal consistency reliability coefficient of the scale was found to be 0.894. In this study, Cronbach's alpha internal consistency reliability coefficient was calculated as 0.911. The scale developed by Katrancı and Özdişci (2019) to measure secondary school students' attitudes toward geometry was used in the research. The scale consists of 24 items, is in a 5-point Likert format, and the options are ranked as "Strongly disagree", "Disagree", "Partially agree", "Agree", and "Completely agree". The scale has 3 subscales: positive attitudes (9), negative attitudes (5), and technology (10). Items 5, 9, 12, 22, and 24 of the scale are reversed. In the scale development study of Katrancı and Özdişci (2019), Cronbach's alpha internal consistency reliability coefficient was found to be 0.886. In this study, Cronbach's alpha internal consistency reliability coefficient was calculated as 0.896 using a statistical package program. A personal information form was used to learn some characteristics of the students. These characteristics are gender, school attended, grade level, mother's educational level, father's educational level, and the previous year's 2nd semester 2nd mathematics exam grade. Geometry achievement was determined by the score obtained from a written exam consisting entirely of outcomes related to the sub-learning area of geometry, which was prepared based on the opinions of two experts. This written exam was the second mathematics exam those students took in the second semester of the previous year.

Data Analysis

The data obtained through a statistical package program were analyzed. The responses that students were given to the scale items were coded using this statistical program. The Geometry Attitude Scale, which contains reverse items, was reverse-scored. The personal characteristics of the students constituting the sample were indicated with frequency (n) and percentage (%) values. Firstly, it was decided to use parametric analysis for geometry attitude with the Skewness-Kurtosis test, and non-parametric analysis for geometry anxiety, achievement, and belief. Kolmogorov-Smirnov test was applied to check whether the data were normally distributed, as the sample size was greater than 50 (Büyüköztürk, 2021). In the geometry attitude, which showed a normal distribution, the Independent Group t-test was used for comparisons with dichotomous variables, and One-Way Analysis of Variance (ANOVA) was used for comparisons with variables having three or more categories. For geometry anxiety and achievement, which did not show a normal distribution, the Mann-Whitney U test and the Kruskal-Wallis Test were applied. The relationships between geometry anxiety, attitude, and achievement were determined using Spearman-Brown Rank Order Correlation Analysis.

Findings

In the research investigating the relationships between secondary school students' geometry achievement, anxiety, and attitude, the following findings were obtained based on the responses taken from the scales: The results of the Mann-Whitney U test conducted to determine whether there is a significant difference in secondary school students' geometry achievement based on gender for the first sub-problem of the research are presented in Table 2.

Table 2. Results of the Mann Whitney U Test for geometry achievement scores

Group	N	Mean Rank	Rank sum	U	Z	p
Girl	176	172,46	30353,00	14087,00	-,382	,703
Boy	164	168,40	27617,00			

According to Table 2, geometry achievement scores of the students do not create a significant difference based on gender ($U_{(Total)}$=14087, z=-0.382; p> 0.05). The Mann-Whitney U test results to determine whether there is a significant difference in secondary school students' geometry anxieties based on gender are provided in Table 3.

Table 3. Results of the Mann-Whitney U Test for geometry anxiety scores

Group	N	Mean Rank	Rank sum	U	Z	p
Girl	176	166,92	29377,50	13801,500	-,697	,486
Boy	164	174,34	28592,50			

According to Table 3, geometry anxiety scores of the students do not create a significant difference based on gender ($U_{(Total)}$=13801, z=-0.697; p> 0.05). The results of the independent samples t-test to determine whether there is a significant difference in secondary school students' attitudes toward geometry based on gender are provided in Table 4.

Table 4. Independent Group t-Test results applied to determine whether attitude scores towards geometry differ by gender

Group	N	$\bar{x}$	Sd	dF	T	p
Girl	176	78,44	19,48	336,573	0,953	0,341
Boy	164	76,56	17,00			

According to Table 4, the students' geometry attitude scores do not show a significant difference based on gender [$t_{(336.573)}$= 0.953; p > 0.05]. Despite the lack of a significant difference, the mean geometry attitude score of girls is higher than the mean geometry attitude score of boys. The results of the Kruskal-Wallis test to determine whether there is a significant difference in secondary school students' geometry achievements based on mother's education level are provided in Table 5.

Table 5. Kruskal Wallis results to determine whether geometry achievement scores differ by mother-educational status

Mother's Educational Level	N	Mean Rank	SD.	X^2	P	Difference
Illiterate (0)	8	124,69	5	70,046	,000	0-4, 0-5, 1-3,
Primary school (1)	72	132,58				1-4, 1-5, 2-3,
Secondary school (2)	80	134,81				2-4, 2-5, 3-4,
High school (3)	98	169,33				3-5
University (4)	59	241,10				
Postgraduate (5)	23	253,20				

According to Table 5, students' geometry achievements vary significantly based on mother's education level (X^2= 70; df = 5; p < 0.05). The significant differences in students' geometry achievement scores based on mother's education level are observed between illiterate and university graduate, postgraduate; primary school graduate and high school graduate, university graduate, postgraduate; secondary school graduate and high school graduate, university graduate, postgraduate; secondary school graduate and high school graduate, university graduate, postgraduate; high school graduate and university graduate, postgraduate. As a result, the geometry achievement of students whose mothers are illiterate is lower compared to those whose mothers are university and postgraduate graduates; the geometry achievement of students whose mothers are primary school graduates is lower compared to those whose mothers are high school, university, and postgraduate graduates; the geometry achievement of students whose mothers are secondary school graduates is lower compared to those whose mothers are high school, university, and postgraduate graduates; the geometry achievement of students whose mothers are high school graduates is lower compared to those whose mothers are university and postgraduate graduates. In conclusion, students whose mothers are university and postgraduate graduates are more successful in geometry. The results of the Kruskal-Wallis test to determine whether there is a significant difference in secondary school students' geometry anxieties based on mother's education level are provided in Table 6.

Table 6. Kruskal Wallis results to determine whether geometry anxiety scores differ by mother-educational status

Mother's Educational Level	N	Mean Rank	SD.	X^2	p
Illiterate (0)	8	210,31	5	3,822	,575
Primary school (1)	72	174,83			
Secondary school (2)	80	179,56			
High school (3)	98	166,48			
University (4)	59	162,80			
Postgraduate (5)	23	148,43			

According to Table 6, students' geometry anxieties do not vary based on mother's education level (X^2= 3.82; df = 5; p > 0.05). The results of the One-Way Analysis of Variance (ANOVA) test conducted to determine whether there is a significant difference in secondary school students' geometry attitudes based on mother's education level are provided in Table 7.

Table 7. Results of One-Way Analysis of Variance (ANOVA) conducted to determine whether geometry attitude scores differ by mother-educational status

N, $\overline{x}$, ss Values					**ANOVA Results**					
Point	**Group**	*N*	$\overline{x}$	*ss*	**Var.K.**	*KT*	*Sd*	*KO*	*F*	*p*
ATG	Illiterate	8	72,50	14,42	**G.B**	1990,954	5	398,191	1,189	,314
	Primary school	72	74,18	18,48	**G.I**	111891,549	334	335,005		
	Secondary school	80	77,22	18,30	**Total**	113882,503	339			
	High school	98	79,58	16,35						
	University	59	80,25	20,10						
	Postgraduate	23	75,21	21,63						

ATG: Attitudes Toward Geometry

When examining Table 7, it has been determined that there is no significant difference in students' attitudes towards geometry based on mother's education level ($F = 1.18$; $p > 0.05$). The results of the Kruskal-Wallis test conducted to determine whether there is a significant difference in secondary school students' geometry achievements based on father's education level are provided in Table 8.

Table 8. Kruskal Wallis Results to determine whether geometry achievement scores differ by father's educational status

Father's Educational Level	**N**	**Mean Rank**	**SD.**	X^2	**p**	**Difference**
Illiterate	6	72,58	5	52,177	,000	0-3, 0-4,
Primary school	47	123,50				0-5, 1-4,
Secondary school	56	138,98				1-5, 2-4,
High school	95	156,00				2-5, 3-4,
University	98	210,18				3-5
Postgraduate	38	224,46				

According to Table 8, students' geometry achievements vary based on father's education level (X^2=52.17; sd = 5; $p < 0.05$). The significant differences in students' geometry achievement scores based on father's education level are observed between illiterate and high school graduates, university graduates, and postgraduates; between primary school graduates and university graduates, postgraduates; between secondary school graduates and university graduates, postgraduates; and between secondary school graduates and university graduates, postgraduates. Consequently, it has been determined that the geometry achievements of students whose fathers are illiterate are lower compared to those whose fathers are high school, university, or postgraduate graduates; the geometry achievements of students whose fathers are primary school graduates are lower compared to those whose fathers are university or postgraduate graduates; the geometry achievements of students whose fathers are secondary school graduates are lower compared to those whose fathers are university or postgraduate graduates; and the geometry achievements of students whose fathers are high school graduates are lower compared to those whose fathers are university or postgraduate graduates. Therefore, it can be concluded that students whose fathers are university or postgraduate graduates have higher geometry achievements. The results of the Kruskal-Wallis test conducted to determine whether there is a significant difference in secondary school students' geometry anxieties based on father's education level are presented in Table 9.

Table 9. Kruskal Wallis results to determine whether geometry anxiety scores differ by father's educational status

Father's Educational Level	**N**	**Mean Rank**	**SD.**	X^2	**p**
Illiterate	6	164,83	5	1,933	,858
Primary school	47	186,20			
Secondary school	56	170,30			
High school	95	170,34			
University	98	168,67			
Postgraduate	38	157,38			

According to Table 9, students' geometry anxieties do not vary based on father's education level (X^2=1.93; sd = 5; $p>0.05$). The results of the One-Way Analysis of Variance (ANOVA) conducted to determine whether there is a significant difference in secondary school students' geometry attitudes based on father's education level are presented in Table 10.

Table 10. Results of One-Way Analysis of Variance (ANOVA) conducted to determine whether geometry attitude scores differ by father-education status

N, $\overline{x}$, ss Values					**ANOVA Results**					
Point	**Group**	*N*	$\overline{x}$	*Ss*	**Var.K.**	*KT*	*Sd*	*KO*	*F*	*p*
ATG	Illiterate	6	83,1667	17,82	**G.B.**	794,198	5	158,840	,469	,799
	Primary school	47	75,0213	16,97	**G.I**	113088,305	334	338,588		
	Secondary school	56	76,3214	17,13	**Total**	113882,503	339			
	High school	95	78,9789	18,75						
	University	98	77,9184	17,94						
	Postgraduate	38	76,9737	21,92						

ATG: Attitudes Toward Geometry

Upon examining Table 10, it has been determined that students' attitudes towards geometry do not show a significant difference based on father's education level (F=0.469; p > 0.05).

Table 11. Results of the Mann-Whitney U Test for geometry achievement scores

Group	**N**	**Mean Rank**	**Rank Sum**	**U**	**Z**	**p**
7th grade	174	162,92	28348,50	13123,500	-1,459	,145
8th grade	166	178,44	29621,50			

When examining Table 11, students' geometry achievement scores do not create a significant difference based on grade level ($U_{(Total)}$=13123, z=-1.459; p>0.05).

Table 12. Results of the Mann-Whitney U Test for Geometry Anxiety Scores

Group	**N**	**Mean Rank**	**Rank Sum**	**U**	**Z**	**p**
7th grade	174	167,72	29182,50	13957,50	-,535	,593
8th grade	166	173,42	28787,50			

According to Table 12, students' geometry anxiety scores do not create a significant difference based on grade level ($U_{(Total)}$=13957, z=-0.535; p>0.05).

Table 13. Independent Group t-Test results applied to determine whether attitude scores towards geometry differ by grade level

Group	**N**	$\overline{x}$	**Sd**	**dF**	**T**	**p**
7th grade	174	79,52	16,34	318,494	2,044	0,42
8th grade	166	75,45	20,04			

According to Table 13, there is no significant difference in geometry attitudes between 7th grade and 8th grade students ($t_{(318.494)}$ = 2.044; p > 0.05).

Table 14. Mann-Whitney U Test results conducted to determine whether geometry achievement scores differ by school type

Group	N	Mean Rank	Rank Sum	U	Z	P
Privacy School	64	276,80	17715,50	2028,50	-9,624	,000
Public School	276	145,85	40254,50			

According to Table 14, students' geometry achievements vary significantly in favor of private schools based on school type ($U_{(Total)}$=2028, z=-9.624; p<0.05).

Table 15. Mann-Whitney U Test results conducted to determine whether geometry anxiety scores differ by school type

Group	N	Mean Rank	Rank Sum	U	Z	P
Privacy School	64	149,41	9562,50	7482,500	-1,906	,057
Public School	276	175,39	48407,50			

According to Table 15, students' geometry anxieties do not vary based on school type ($U_{(Total)}$=7482, z=-1.906; p > 0.05).

Table 16. Results of One-Way Analysis of Variance (ANOVA) conducted to determine whether geometry attitude scores differ by the school attended

Group	N	$\overline{x}$	Sd	dF	T	P
Privacy School	64	79,26	19,17	338	,836	,809
Public School	276	77,13	18,13			

Upon examining Table 16, it was determined that students' attitudes towards geometry did not show a significant difference based on school type ($t_{(338)} = 0.836$; $p > 0.05$). Since the variables did not follow a normal distribution, Spearman's Correlation Analysis was conducted to determine the level of relationship between secondary school students' geometry anxieties and their achievements (Büyüköztürk, 2021, p. 31).

Table 17. Results of Spearman Correlation Analysis Performed to Determine the Relationships Between Geometry Anxiety and Geometry Achievement

Variables	**N**	**r**	**p**
GAn-GAc	340	-,299	,000

GAn: Geometry Anxiety **GAc**: Geometry Achievement

As seen in Table 17, the results of the Spearman Correlation Analysis conducted to determine the relationship between secondary school students' geometry anxiety scores and geometry achievement scores revealed a significant, negative, and low-level relationship between the variables ($r = -0.299$; $p < 0.05$). In other words, it can be said that as geometry achievement increases, geometry anxiety decreases, and as geometry anxiety increases, geometry achievement decreases.

Table 18. Results of Spearman correlation analysis conducted to determine the relationships between attitude towards geometry and geometry achievement

Variables	**N**	**r**	**p**
ATG-GAc	340	,108	,046

ATG: Attitudes Toward Geometry **GAc**:Geometry Achievement

As observed in Table 18, the results of the Spearman Correlation Analysis conducted to determine the relationship between secondary school students' geometry attitude scores and geometry achievement scores revealed a significant, positive, and low-level relationship between the variables ($r = 0.108$; $p > 0.05$). Thus, it can be said that as geometry achievement increases, the attitude towards geometry also increases. The results of the Spearman Correlation Analysis conducted to determine the level of relationship between secondary school students' geometry attitudes and their anxieties are provided in Table 19.

Table 19. Results of Spearman correlation analysis conducted to determine the relationships between attitude towards geometry and geometry anxiety

Variables	**N**	**r**	**p**
ATG-GA	340	-,519	,000

ATG: Attitudes Toward Geometry **GA**:Geometry Attitude

As shown in Table 19, the results of the Spearman Correlation Analysis conducted to determine the relationship between secondary school students' geometry attitude scores and geometry anxiety scores revealed a significant, negative, and moderate-level relationship between the variables ($r = -0.519$; $p < 0.05$). Thus, it can be concluded that as geometry anxiety increases, the attitude towards geometry decreases.

Conclusion and Discussion

Examination of Geometry Achievement, Anxiety, and Attitude According to Gender Variable: Results and Discussion

When examining students' geometry achievements, it was concluded that there was no significant difference between geometry achievements and gender. This situation may stem from the similarity of the social environments of the children studied, the parallelism of the education they received, and the similarity of the support received for education. TIMSS 2011, 2015, and 2019 data also show that the gender factor does not significantly differentiate mathematics achievement at the 8th grade level, and the mathematics averages of female and male students are close (MEB, 2020).

Parallel to the study, there are studies indicating that there is no connection between students' geometry achievement and gender (Özkan and Yıldırım, 2013; Erkek and Işıksal-Bostan, 2015; Özkan and Yıldırım, 2013; Şahin and Keşan, 2022). Similar results were also found in studies by Dursun and Dede (2004) and Taşdemir (2015) that mathematical achievement did not change depending on gender.

It was concluded that there was no significant difference between students' geometry anxiety and the gender variable. Factors causing geometry anxiety in students, regardless of gender, may include reflections of parents' math anxiety on the student, and teacher attitudes and behaviors. The behaviors of mathematics teachers that cause anxiety in students, such as ignoring the questions asked by students, being indifferent, appearing angry and frowning, and making disdainful comments, prevent students from focusing on the lesson (Bekdemir et al., 2004). Although mathematics anxiety and geometry anxiety are considered different concepts in the literature, studies examining whether there is a significant difference between mathematics anxiety and the gender variable have been reviewed since geometry is a branch of mathematics. In this regard, the studies by Cooper and Robinson (1991), Bindak and Dursun (2011), and Sapma (2013) have concluded that there is no significant difference between mathematics anxiety and gender, which is consistent with the result of the current study. In addition, Erktin et al. (2006) found in their study that girls' math anxiety was higher than that of male students. Akarca (2019) found a significant relationship between gender and geometry anxiety in the scale development study and determined that girls' geometry anxiety was higher compared to boys. There are studies in the literature that are consistent with this result (Doruk and Kaplan, 2016; Kartal et al., 2022). The higher level of anxiety in girls may have different reasons. According to Akarca (2019), the social environment, experiences, and the different roles and responsibilities assigned to women and men in society have led to girls being anxious. From this perspective, it can be said that parents and society's biases on this issue may cause anxiety in female students.

It was concluded that there was no significant positive or negative difference between students' attitudes towards geometry and gender. Students' attitudes towards geometry may vary depending on whether the student likes the teacher and the course, whether the teacher teaches the lesson at the student's level and actively involves the student and the methods and techniques used by the teacher. In terms of teaching methods and techniques, it has been determined that dynamic geometry software used in the lesson (Akyüz and Türk, 2016), drama-based teaching (Duatepe-Paksu and Ubuz, 2009), lessons where metacognitive strategies are used (Şahin and Kendir, 2013), and project-based teaching where students create their models and encounter daily life problems (Özdemir, 2006) increase students' attitude towards geometry. Similar results are also seen in studies in the literature that have similar results in the relationship between attitude toward geometry and gender (Anıkaydın, 2017; Sevgi and Gürtaş, 2020; Avcı et al., 2014; Poçan et al., 2020). On the other hand, Kaba et al. (2016) found in their study that there was a significant difference between secondary school students' attitudes toward geometry and gender. It can be said that the higher attitudes of female students towards geometry than male students are due to the positive relationship between success and attitude (Kaba et al., 2016). Moreover, considering that students' attitudes will be positive when they are willing to learn geometry (Günhan and Başer, 2007), it can be said that the girls in the sample of the mentioned study are more interested and willing to learn geometry.

Examination of Geometry Achievement, Anxiety, and Attitude According to Mother's Education Level: Results and Discussion

When examining students' geometry achievements, it was found that there is a significant difference between geometry achievements and the mother's education level. According to pairwise comparisons, students whose mothers are university and postgraduate graduates have significantly higher geometry achievement compared to those with lower levels of education. The main reason for this could be that mothers with higher education levels are more advantageous in providing both economic and academic support to their children's education. As the mother's education level increases, her positive contribution to her child's mental and physical support will also increase (Aslanargun et al., 2016). This situation may be because in Turkish society, mothers have a lot of responsibilities in all stages of development from the birth of the baby, and the awareness of an educated mother leads to a greater focus on the child's success (Gelbal,

2008). Considering that mothers guide their children in their lessons and homework like a teacher (Hortaçsu, 1995), having a particularly high level of education, especially at the university and higher level, means that the mother will be more conscious about researching how the child learns better and following the student's development, thus increasing the student's math achievement. Parallel to the increase in the student's mother's education level, the student's opportunities may increase as a result of the mother having a higher-paying profession. Çınar and Ural (2016) also found that as the mother's education level increases, providing a more prosperous environment for the child will increase success. The result of the current study that "Geometry achievement increases as students' mother's education level increases" is parallel to the study by Geçici and Aydın (2019), which found that students with higher levels of mother's education were more successful in geometry activities, and the study by Çanakçı and Özdemir (2015), which found that those whose mothers are university graduates are more successful in mathematics compared to those with primary education. On the other hand, Çınar and Ural (2016) concluded that mathematics achievement did not significantly differ according to the mother's education level.

When examining students' geometry anxiety, it was found that there is no significant difference between geometry anxiety and the mother's education level. The influence of the school and the teacher who conducts the teaching may have a greater effect on the formation of anxiety. Kutluca et al. (2015) stated in their study, "Math anxiety is not a congenital condition but a trait acquired after starting school and can increase," which can be associated with the fact that the student is mostly exposed to geometry at school and by the mathematics teacher. Ashcraft et al. (2005) suggested that the student's anxiety about mathematics is entirely acquired at school. In addition, individuals experiencing math anxiety attribute this to the mathematics teacher who taught them when they were children (Perry, 2004). The idea that anxiety arises in students due to teachers' demeaning or prejudiced behaviors supports this notion (Furner and Duffy, 2002). Similar results were obtained regarding math anxiety (Kutluca et al., 2015; Tuncer and Yılmaz, 2016). Studies such as Akarca (2019) found that geometry anxiety decreases as the mother's education level increases, and studies such as Özbey and Yenilmez (2006), Sapma (2013), and Bozkurt (2012) found that math anxiety decreases as the mother's education level increases, reached a different conclusion from the current study.

When examining students' attitudes towards geometry, it was found that there is no significant difference between attitude towards geometry and the mother's education level. Students' attitudes towards geometry may vary depending on teaching methods and materials or the student's ability to think geometrically. The methods and strategies that make geometry attitude positive are dynamic geometry software, drama-based teaching, metacognitive strategies, and project-based teaching and concrete models, while traditional methods lead to a negative attitude in students (Bayram, 2004; Özdemir, 2006; Duatepe-Paksu and Ubuz, 2009; Şahin and Kendir, 2013; Akyüz and Türk, 2016). Another study also shows that there is a positive and low correlation between Van Hiele's geometric thinking levels and geometry attitude (Uzun, 2019). As secondary school students' attitude toward geometry increases, there is also a moderate positive relationship in their geometric thinking levels (Günhan et al., 2022). In the literature, it is shown that the attitude towards mathematics does not differ according to the mother's education level, which is parallel to the results of studies by Özabacı and Yenilmez (2003), Kaba and Özdişci (2018), Kara (2021), Kaba et al. (2016), Tuncer and Yılmaz (2016), and Tan (2015). On the other hand, in the study by İlhan et al. (2021), it was found that the attitude towards mathematics increases as the mother's education level increases, forming a more positive attitude.

Examination of Geometry Achievement, Anxiety, and Attitude According to Father's Education Level: Results and Discussion

When examining students' geometry achievements, it was found that there is a significant difference between geometry achievements and the father's education level. According to pairwise comparisons, students whose fathers are university and postgraduate graduates have significantly higher geometry achievement compared to others. As the father's education level increases, except for exceptional cases, the financial support for education is likely to increase due to the higher income level of the family. Therefore, the father's education level may create a difference in the student's geometry achievement. Özkan and Yıldırım (2013) suggested in their study that as the father's education level increases, the contribution of an educated father to the student's academic life and self-confidence is greater. Moreover, in affluent

families, parents have the opportunity to be more involved in their children's education and development, which can lead to more success for children both in school and in life (Aslanargun et al., 2016).

When examining students' geometry anxiety, it was found that there is no significant difference between geometry anxiety and the father's education level. This result may be because fathers generally have less influence on students' emotional characteristics such as anxiety in Turkish society, and mothers are usually observed to be more emotional towards their children. In parallel, Özabacı and Yenilmez (2003) encountered a result that the mother's education level significantly differentiated students' math anxiety, while the father's education level did not bring about any change. However, studies with opposite results can be found in the literature. Akarca (2019) found in their study that there is a negative and significant relationship between the father's education level and geometry anxiety. There are also studies showing that math anxiety in students differs significantly according to the father's education level (Özbey and Yenilmez, 2006; Bozkurt, 2012; Sapma, 2013; Tuncer and Yılmaz, 2016).

When examining students' attitudes towards geometry, it was found that there is no significant difference between attitude towards geometry and the father's education level. Attitude towards geometry is related to the student's liking for the lesson, how time passes in the lesson according to him, and what technology-supported or different method-based geometry lesson means to him. In this regard, the items of the geometry attitude scale developed by Katrancı and Şengül (2019) support this. Similar results have been encountered in the literature regarding math attitude (Özabacı and Yenilmez (2003); Tuncer and Yılmaz, 2016). The result of the current study contradicts the result of the study by Kaba et al. (2016) and Kaba and Özdişci (2018). In the study by Kaba et al. (2016), it was found that especially fathers with a master's degree have much more positive attitudes towards geometry compared to those with lower graduation degrees. In this context, it can be said that fathers also closely involve themselves in their children's lessons and homework, and as their education levels increase, they can provide more appropriate guidance to them.

Examination of Geometry Achievement, Anxiety, and Attitude Variables in terms of Grade Level: Results and Discussion

When examining students' geometry achievement, it was found that there is no significant difference between geometry achievements and grade levels. In secondary school, the foundations of geometry are laid in the 5th and 6th grade grades, and with the development of abstract thinking in the 7th and 8th grades, new information is added on top of the previously established foundation, which may explain why there is no difference in geometry achievement across grade levels. The abstract concept of equations, as mentioned by Altıntaş et al. (2021), is challenging for students to learn. Formulating equations in the problems they encounter helps students solve those problems more systematically and coherently (Köroğlu et al., 2004). Equations come before geometry topics in the mathematics curriculum. Thus, being able to formulate equations in subsequent geometry topics can facilitate problem-solving. A student who has grasped equations will be successful in geometry regardless of their class level. In contrast to the current study, Bozkurt (2012) found in their study that the math achievement of 7th grade students is significantly higher than that of 8th grade students, suggesting that the accumulation of learning deficits may be the reason for this difference in a cumulative subject like mathematics.

When examining students' geometry anxiety, it was found that there is no significant difference between geometry anxiety and grade levels. This might be because geometry anxiety is related to the psychological state of the student regarding geometry. In this context, expressions such as "I feel anxious, worried, afraid, nervous, dislike, hate" in the scale developed by Sağlam et al. (2011) and in Akarca's (2019) scale indicate that geometry anxiety is associated with the student's emotional state. In contrast to the findings of this research, Akarca (2019) found that the geometry anxiety of 7th and 8th grade students is significantly higher than that of 6th grade students, while Bindak and Dursun (2011) found that the math anxiety of 8th graders is significantly higher than that of 6th and 7th graders. The presence of an exam (LGS) at the end of the year that determines the high school they will attend could be a reason why math and geometry anxiety in 8th grades are significantly higher than in other grades. The results of studies on the relationship between math anxiety and class level in the literature do not align with the results of this study (Özbey and Yenilmez, 2006; Sapma, 2013; Bozkurt, 2012).

When examining students' attitudes towards geometry, it was found that there is no significant difference between attitudes towards geometry and grade levels. This may be because attitudes take a long time to form, and students' attitudes towards geometry may not change after a year. Attitudes are the result of decisions reached through life experience and are not easily changed (Uysal, 2022). As indicated by expressions such as "Time never passes in geometry classes, it's like solving a puzzle and fun, the use of technology in geometry classes provides an advantage" in the scale developed by Katrancı and Özdişci (2019), making these decisions requires a process. In the literature, while there is no difference found in the studies of Cansız-Aktaş and Aktaş (2012) and Avcı et al. (2014); Dede (2012) covering secondary and high school students, Kaba et al. (2016), Kaba and Özdişci (2018) focusing solely on secondary school students; and Sevgi and Yakışıklı (2020) showed opposite results. Katrancı and Şengül (2019) found that as the class level increases, math attitude also increases. There are both overlapping and non-overlapping results in the literature.

Examination of Geometry Achievement, Anxiety, and Attitude Variables in terms of School Type: Results and Discussion

When examining students' geometry achievement based on school type, it was found that there is a significant difference favoring private schools. This result can be interpreted as "Geometry achievement in private schools is higher than that in public schools." This finding aligns with the conclusion of Savaş et al. (2010) that "Students attending private schools perform better in mathematics than those in public schools." The reasons for this may include the better physical and social environment provided by private schools, as well as more advanced student assessment systems and guidance services. The smaller class sizes in private schools allow teachers to devote more attention to individual students, and students can benefit from technology and counseling services, leading to a higher quality education. Additionally, grades given to students in private schools tend to be more lenient (Gürler, 2020), which may contribute to the higher geometry achievement observed in private schools in this study. Considering the financial adequacy of students attending private schools, there are studies indicating a positive relationship between family income and math achievement (Ainley et al., 1995; Zabulionis, 1997).

When examining students' geometry anxiety based on school type, it was found that there is no significant difference. This finding may be attributed to the idea that geometry anxiety, like math anxiety, is a learned type of anxiety over time, as suggested by Kutluca et al. (2015). Parents may contribute negatively to students' geometry anxiety, as parents' math anxiety can be passed on to students and lower their achievement (Soni & Kumari, 2017). The pressure parents put on students regarding math achievement increases their stress and anxiety (Cangüven et al., 2022). The result that math anxiety does not differ based on school type aligns with the conclusion of the study by Özbey and Yenilmez (2006).

When examining students' attitudes towards geometry based on school type, it was found that there is no significant difference. Regardless of whether it is a private or public school, if the learning environment is suitable for students, they feel comfortable and are not hesitant to ask questions, and their attitude toward geometry can be positive. The social-psychological climate of the classroom affects the attitude toward mathematics (Haladyna et al., 1983). Therefore, students' attitude toward geometry is influenced by the classroom atmosphere.

Geometry Achievement, Anxiety, and Attitude: Results and Discussion of Their Relationships

An examination of the relationship between attitude towards geometry and geometry anxiety revealed a significant, moderate negative correlation. As attitude towards geometry increases, geometry anxiety decreases. According to Neale (1969), a student's attitude towards a subject is related to whether they like the subject or not. In line with this, Peker and Şentürk (2012) found that students who enjoy mathematics have lower math anxiety, while Akarca (2019) found that those who love mathematics have lower geometry anxiety. The presence of anxiety as one of the sub-dimensions in Bulut et al.'s (2002) geometry attitude scale also supports the relationship found between these two variables. Studies in the literature have also shown a negative correlation between math attitude and math anxiety (Özabacı and Yenilmez, 2003; Şentürk, 2010; Karadağ and Karadeniz, 2014; Tuncer and Yılmaz, 2016; Adal and Yavuz, 2017; Doruk et al., 2016; Ergin, 2022).

A significant, low positive correlation was found between attitude towards geometry and geometry achievement. Similar results have been in the studies of Ünlü (2014), Özkeleş-Çağlayan (2010), and Poçan et al. (2020), where a high,

positive correlation between geometry attitude and math achievement was identified. Studies also show that as math attitude increases, math achievement increases (Burrus and Moore, 2016; Ekici and Sarı, 2018; Kara, 2021; İlhan et al., 2021).

Lastly, a significant, low negative correlation was found between geometry anxiety and geometry achievement. This result is supported by Akarca (2019). Similar findings exist in the literature, including studies showing a significant relationship between math anxiety and math achievement (Ma and Xu, 2004; Özbey and Yenilmez, 2006; Sapma, 2013) as well as studies showing a negative, moderate correlation between math anxiety and math achievement (Bindak and Dursun, 2011).

Recommendations

In this study, where geometry achievement, anxiety, and attitude are examined, it has been concluded that geometry achievement varies according to father's education level, and geometry attitude, anxiety, and achievement differ according to the type of school attended. It has also been found that there is a negative relationship between geometry anxiety and attitude and achievement, while there is a positive and significant relationship between geometry attitude and achievement. In light of these results, some opinions and recommendations are provided below:

- This research was conducted with 7th and 8th grade students in Kars. A more comprehensive study including students from different cities and grades, such as 5th and 6th grades, can be conducted.
- It has been observed that students attending private schools are more successful in geometry. Therefore, the physical conditions, class sizes, student monitoring, and teaching materials of public schools can be improved and enhanced.
- Since the methods and techniques used in mathematics lessons increase mathematics attitudes, teachers can use different methods and approaches in geometry teaching to increase students' positive attitudes.
- Since the scope of the current study does not cover the reasons behind geometry anxiety, attitude, and achievement, a qualitative study can be conducted to investigate these variables.
- It has been found that there is a significant but low negative relationship between geometry anxiety and success. This result may serve as a basis for further research on the level of anxiety.
- By asking students about the departments their parents studied in university, meaningful differences in terms of geometry anxiety, achievement, and attitude between departments containing geometry and those that do not can be explored.

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Journal for the Education of Gifted Young Scientists, 12(3), 119-135, Sept 2024
e-ISSN: 2149- 360X
jegys.org
dergipark.org.tr/jegys

Genc Bilge (Young Wise) Publishing
gencbilgeyayincilik.com

Research Article

Service quality in higher education: A literature review

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Article Info

Received: 19 July 2024
Accepted: 29 August 2024
Available online: 30 Sept 2024

Keywords
HEdPERF
higher education
service quality
SERVPERF
SERVQUAL

Abstract

In a time where the student experience increasingly mirrors a customer-centric approach, universities are tasked with fulfilling the role of comprehensive educational service providers. This paper presents a comprehensive literature review on service quality in higher education, focusing on various generic and industry-specific scales. The primary objective of this article is to analyse and compare prominent measurement scales such as SERVQUAL, SERVPERF, HEdPERF, UnivQual, and HiEduQual. Each scale is defined according to its original literature and provides a foundational understanding of their respective constructs and factors. To achieve a nuanced comparison, the paper examines these scales based on the number of factors extracted from studies and their characteristics. The analysis reveals a great diversity and specificity of factors in measuring service quality across different higher education contexts. Beyond that, the paper analyses a database of 49 selected peer-reviewed articles to understand the practical application of service quality scales in empirical research. This examination considers multiple dimensions such as the country of focus, the statistical procedures employed, and the research methods. These dimensions offer a rich comparative insight into the trends in service quality research within higher education. Additionally, the study delves into the number and names of factors identified in each article, mapping them against the established scales to uncover patterns and deviations in empirical findings. A notable aspect of the review is the exploration of gender differences in service quality perceptions, a critical yet often underexplored area. This gender-based analysis provides valuable insights into how male and female students may perceive service quality differently, thereby informing more nuanced and inclusive service quality enhancement strategies. The findings of this paper underscore the multifaceted nature of service quality in higher education and the importance of context-specific scales. By comparing different measurement approaches and analysing a broad spectrum of empirical studies, this review contributes to a deeper understanding of how service quality is conceptualised and measured in higher education. It also offers practical implications for researchers and practitioners aiming to enhance service quality and align it more closely with student expectations and experiences.

To cite this article:

Bartolo, R.P., & Tinmaz, H. (2024). Service quality in higher education: A literature review. *Journal for the Education of Gifted Young Scientists*, *12*(3), 119-135. DOI: http://dx.doi.org/10.17478/jegys.1518891

Introduction

Academic interest towards service quality has grown in the 1980s with the increased importance of marketing practices and quality measurement. Defining, assessing and measuring quality became central to businesses. Academics addressed the issue of service quality with the objective to fill a gap in the literature. Service quality has been the subject of growing attention in a large array of fields and industries. To this day, service quality is yet to be commonly defined and accepted.

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The higher education sector is no stranger to the growing importance of service quality as a core component of the student experience. With the commodification of higher education and the implementation of tuition fees, students can be increasingly viewed as customers (Watjatrakul, 2014). In this regard, students pay for a service and expect higher education institutions to deliver a service that matches their needs. Measuring service quality in the higher education context has become an essential part of university management practices.

The objective of this article is to offer a comprehensive literature review on service quality in higher education. This paper will examine the different types of service quality theories and measurement scales that have been developed. A list of 49 articles focusing on service quality applied to the field of higher education was selected (n = 49). This research discusses and compares higher education service quality over distinctive characteristics, such as the measurement scale, the type of research methods, the service quality factors, as well as the country of focus, sample size, and number of involved institutions in research.

The genesis of service quality

In the services marketing literature, quality is an important component of customer satisfaction. Discussion on quality took place from the 1970s onwards. It was first defined as conformance to requirements (Crosby, 1979) and was attained depending on the count of internal and external failures (Garvin, 1983). In this thinking, quality was reached when the characteristics satisfied the customer.

Service quality goes beyond the concept of quality. Judging the quality of a service is by definition intangible and academics looked for scientific ways to measure and assess the performance of a given service or product. Parasuraman et al. (1985) acknowledged the importance to find ways to measure such performance and identified this gap in the existing literature. Until their article was published in 1985, few studies had addressed the question of service quality (Grönroos, 1982). These prior studies had established that measuring service quality was harder than measuring quality alone, and that judgement was based on a comparison between performance and expectations (Parasuraman et al., 1985).

To this day, a unique and common definition of service quality is lacking. However, in a competitive marketplace such as higher education with increasing commercial stakes, service quality gathers common characteristics such as the need to satisfy customers and produce performance according to the organisational point of view. Service quality has been frequently addressed as an academic concept to better understand the depending factors in service-related industries. Over the last decades, academics have attempted to define service quality. Grönroos's definition established the concept of service quality with the combination of corporate image, functional quality and technical quality (Grönroos, 1982). These works contributed to the making of the SERVQUAL measurement model developed by Parasuraman and his colleagues.

Service quality measurement scales

The scientific and quantifiable approach towards service quality has generated the conception of measurement scales to evaluate perceptions according to the customer point of view. In the field of higher education, studies have been conducted using generic or specific scales. This section discusses the various service quality scales.

General measurement scales

SERVQUAL

SERVQUAL was the first service quality measurement model developed in the mid-1980s. Service quality is a core element in the service industry measuring the degree of excellence of a service or product perceived by customers. According to this model, service quality is met when the service provided meets or exceeds the customer's expectations. In the case if performance is unable to meet expectations, service quality is not attained, and this situation has the potential to lead towards customer dissatisfaction. Parasuraman et al., (1985) acknowledged the importance to find ways to measure performance and filled a gap by developing the SERVQUAL scale.

In their exploratory research, the initial objective was to assess consumer perceptions about a service or product in the retail industry in the United States. The measurement scale was elaborated following focus group interviews with customers and interviews with executives in four different industries in the United States. Defined on Table 1, the five

factors are reliability, assurance, responsiveness, empathy and tangibles. Reliability focuses on the consistent and timely delivery of a service, with the objective to meet customer expectations. Assurance lies with the importance for staff to be able to answer questions and provide customers with accurate information. The responsiveness factor items measure the ability to address quickly customer inquiries and solve issues efficiently. Empathy relates to the importance for staff to understand customer needs, take time in offering a personalised service and show an interest in ensuring customer satisfaction. Lastly, the visual appearance of facilities and staff make up the tangibles factor.

Table 1. Definition of SERVQUAL dimensions (Parasuraman et al., 1988)

Factor	Definition	Number of items
Reliability	The ability to perform the promised service dependably and accurately	4
Assurance	The knowledge and courtesy of employees and their ability to convey trust and confidence	5
Tangibles	The appearance of physical facilities, equipment, personnel and communication materials	4
Empathy	The provision of caring, individualised attention to customers	5
Responsiveness	The willingness to help customers and to provide prompt service	4

The SERVQUAL measurement model was initially made up of ten factors and 97 items. Each item would require a dual measurement on expectations and performance, and the scale resulted in the collection of 194 items. Through stages of exploratory and confirmatory factor analysis, the model resulted in the generation of 22 items making up five factors, with a 7-point Likert scale (Parasuraman, Zeithaml & Berry, 1988). Service quality is a multifactorial phenomenon and the five SERVQUAL factors are reliability, assurance, tangibles, empathy and responsiveness.

This model is grounded in the expectancy – disconfirmation theory according to which quality is measured by the difference between the expected performance and perceived performance (Figure 1). The gap reflects the perceived service from the customer's point of view and results in the positive, neutral or negative evaluation of quality. The disconfirmation model was confirmed in other studies (Abrate, Quinton & Pera, 2021; Rust & Oliver, 1994; Xu & Li, 2016).

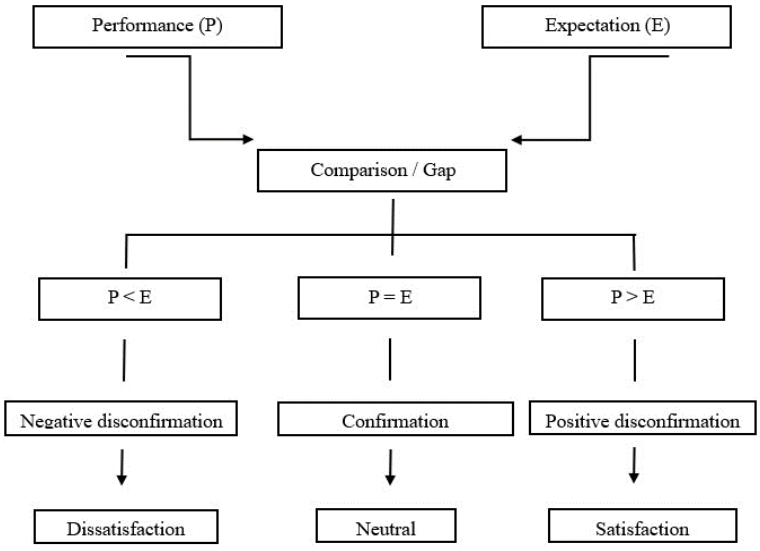

Figure 1. The disconfirmation model applied to SERVQUAL

Service quality (SQ) is the result of the gap between perception score (P) and expectation score (E). The scale measures both expectations and perceived performance with the same dimensions. Results of these measurements lead to the creation of a gap that reflects the perceived service on the customer's point of view. To sum up, service quality is defined as follows:

SQ (service quality) = P (perception) – E (expectation)

Service quality in Figure 1 is understood as a comparison between the pre-purchase expectation and post-purchase performance or perception about a service or product (Oliver, 1980). The SERVQUAL scale has been used widely across the literature in diverse fields such as the medical and health care sector (Akob et al., 2021; Meesala & Paul, 2018), e-commerce (van Iwaarden et al., 2003), sales , hospitality and tourism (Shafiq et al., 2019), sales (Shokouhyar et al., 2020), airlines (Rezaei, et al., 2018), Internet banking (D. T. Nguyen et al., 2020; Raza et al., 2020), banking (Pakurár et al., 2019), or higher education (Athiyaman, 1997; Ongo, 2019; Phonthanukitithaworn et al., 2022; Quintal et al., 2012; Tsiligiris, Keri & Cheah, 2022).

In the case of assessing service quality of a university, such a model refers to comparing the prospective student's expectations before enrolment with their actual university experience. Studies on service quality applied to higher education borrowed from the expectancy – disconfirmation model to measure the level of satisfaction of Asian students in Australia (Arambewela & Hall, 2009).

Debate on the SERVQUAL scale

There has been extensive literature and debate on the practicality and usefulness of the SERVQUAL measurement model over the years. In a comparative study about twenty years of SERVQUAL research, Ladhari (2009) identified eleven ongoing debates related to SERVQUAL, ranging from statistical measurements to the possible inadaptability to all sectors and cultural contexts. The SERVQUAL model was also criticised for using negatively worded questions as well as the lengthy duration of time needed to complete a questionnaire. Ladhari stressed the fact that SERVQUAL was developed in an American corporate context and that care should be applied when used in other countries or cultures. Buttle (1996) identified eleven different points of tension in the literature regarding the use of SERVQUAL, including the lack of evidence for the expectation – performance gap model and the boredom generated by the administration of items on expectations and performance. With the large number of SERVQUAL items, boredom is a serious issue to consider as it may reduce respondent engagement and alter the quality of responses in survey research (Bowling et al., 2021). Despite these debates, SERVQUAL remains one of the most successful and widely accepted scales to measure and manage quality. It allows for cross-industry, cross-functional and cross-country comparisons. To this day, SERVQUAL research initiated by Parasuraman et al. have been cited more than 90,000 times in the literature.

SERVPERF

In the early 1990s, Cronin and Taylor (1992; 1994) argued against the use of expectation measurements and claimed that a performance-only scale would be more appropriate to assess service quality. Cronin and Taylor devised the Service Performance measurement model, known as SERVPERF, as an alternative way to measure service quality by removing expectation items. SERVPERF is a variant of SERVQUAL and only focuses on measuring performance items borrowed from the SERVQUAL scale. Here, service quality is seen as an antecedent of customer satisfaction and is best measured with items related to perception and performance. This model halves the number of items from 44 to 22 and focuses on measuring the outcome perception. Here, service quality is understood as follows:

$$\text{SQ (service quality)} = \text{P (performance)}$$

It is argued that SERVPERF is an improvement from SERVQUAL as it enables the reliable measurement of performance with a reduced number of items. Studies confirmed that the SERVPERF scale was a better alternative to SERVQUAL (Brady et al., 2002; Li & Kaye, 1998; Zhou, 2004). Prior SERVPERF studies included assessments of shopping and retail (Gong & Yi, 2018), student satisfaction in Saudi Arabia (Sohail & Hasan, 2021), or Thailand (Fuchs et al., 2022), hospitals (Akdere et al., 2020), and the airline industry (Leong et al., 2015). To this day, SERVPERF remains a primary measurement scale for service quality with over 40,000 citations.

Measurement scales specific to higher education

Unlike SERVQUAL and SERVPERF scales, other service quality scales have been developed with a specific focus on higher education.

HEdPERF

Abdullah (2006a, 2006b) developed the Higher Education Performance measurement model (HEdPERF) as an alternative measurement scale. Contrary to the generic character of SERVQUAL and SERVPERF scales, HEdPERF is specifically designed and applied to the field of higher education from the student's point of view. The HEdPERF scale consists of 41 items focusing on measuring service quality in higher education. 13 items are borrowed and adapted from the SERVPERF scale, while the remaining 28 items are generated through literature review and qualitative research procedures (Abdullah, 2006b). HEdPERF's factor analysis lists six factors including academic and non-academic aspects, reputation, access, programme issues and understanding student needs (Abdullah, 2006b).

To assess the efficiency of HEdPERF, Abdullah compared SERVPERF and HEdPERF scales in a 2004 survey conducted in six Malaysian universities. The objective of this research was to compare SERVPERF and HEdPERF scales alone, and also test the merger of SERVPERF and HEdPERF items. The combined factor analysis of SERVPERF and HEdPERF identified four factors, namely non-academic aspects, academic aspects, reliability and empathy. This combined factor analysis generated two SERVPERF and two HEdPERF factors respectively (Abdullah, 2006a). This finding goes against the five-factor SERVPERF and six-factor HEdPERF scales from the literature. Works on HEdPERF developed by Abdullah have been cited over 3,000 times.

HiEduQual

The Higher Education Service Quality (HiEduQual) measurement scale is another industry-specific alternative (Annamdevula & Bellamkonda, 2012, 2016). HiEduQual is in fact an adapted version of SERVQUAL in the Indian higher education context. HiEduQual measures both expectations and perceptions. Focus group discussion and an extensive literature review generated 54 initial items dedicated to measure service quality. Results from exploratory factor analysis identified 34 items representing six factors, namely teaching, administrative services, academic facilities, campus infrastructure, support services, and internationalisation (Annamdevula & Bellamkonda, 2012). Following the CFA procedure, the final HiEduQual scale was made up of 27 items loading onto five factors. In that case, the internationalisation factor was deleted due to low factor loadings.

Interestingly, in a later study, the same authors conducted another survey to measure perceived service quality in India using the HiEduQual scale that they had developed (Annamdevula & Bellamkonda, 2016). Measurements were done with 42 service quality items. The performing of EFA and CFA retained 31 items and six factors. As seen on Table 2, the two studies identified a different number of service quality factors. The internationalisation factor was dropped in the 2012 study while it remained a part of the structural model in the 2016 study. The number of items also differed, ranging from 27 to 31. The number of items loading onto the support services factor also differed between the two studies. This finding indicates that measuring service quality in the Indian higher education context calls for additional research to be done and opens a door to replication.

Table 2. HiEduQual factors and number of items (Annamdevula & Bellamkonda, 2012, 2016)

Study 1 (2012)		**Study 2 (2016)**	
Factor	**Number of items**	**Factor**	**Number of items**
Teacher quality	8	Teacher quality	8
Administrative services	6	Administrative services	6
Academic facilities	7	Academic facilities	7
Campus infrastructure	4	Campus infrastructure	4
Support services	3	Support services	4
		Internationalisation	2

A second version of the HiEduQual scale was developed in Pakistan. Items were generated following focus group discussions with students, parents, academics and employers (Latif et al., 2019). Through successive stages of focus group interviews and a pilot study, 46 items and seven factors were identified. The exploratory factor analysis of the HiEduQual scale identified a six-factor solution with 37 items, explaining 70.3% of the total variance. As seen on Table 3, factors are teacher quality, administrative services, knowledge services, activities, continuous improvement and leadership quality.

The confirmatory factor analysis technique confirmed that the six-factor structure with 37 items indicated a good model fit.

Table 3. HiEduQual factors and number of items (Latif et al., 2019)

Factor	Number of items
Teacher quality	9
Administrative services	8
Knowledge services	7
Activities	5
Continuous improvement	4
Leadership quality	4

The study by Latif et al. (2019) indicates that teacher quality and administrative services are the two factors matching prior research by Annamdevula and Bellamkonda (2012, 2016). Continuous improvement and leadership quality were two new dimensions that emerged from this research and were not found in prior studies by Annamdevula and Bellamkonda. The three studies have a strong cultural tendency to focus on higher education in the South Asian context. Most studies using the HiEduQual survey instrument have been conducted in India (Singh, 2016; Subbarayudu & Ellaturu, 2021). Beyond South Asia, the HiEduQual model has also been adopted in China (Lekini et al., 2019), or Peru (Barrios-Ipenza et al., 2024).

UnivQual

Marimon et al. (2019) proposed the UnivQual scale to measure the university experience with a sample of 2,557 students in twelve Spanish universities. The objective of this new scale was to assess the perceived quality of students after the completion of their studies. The questionnaire is made up of 20 items with a 5-point Likert scale. Five items from the UnivQual scale are borrowed from SERVQUAL and SERVPERF scales. UnivQual items also address the themes of facilities, library resources and teaching support, student services, website information and complaint management. Contrary to SERVQUAL and SERVPERF scales, half the UnivQual scale items focus on academic issues such as syllabi structure, teaching methodology, learning evaluation systems, internship, thesis and mentoring. Four items question the impact of academic training on the alumni's communication, personal, leadership and future professional skills. Such items are not present in SERVQUAL and SERVPERF scales. Following an exploratory and confirmatory factor analysis, the UnivQual scale was eventually reduced to 17 items and three factors, namely curriculum, skills development, and services and facilities. Curriculum and skills development are two dimensions directed at academic issues. Only the services and facilities dimension relate to general service quality.

Comparison of service quality measurement scales

As generic measurement scales, SERVQUAL and SERVPERF do not focus on identifying factors related to academic quality. Rather, their factors evaluate the overall student experience beyond the classroom and the academic experience. On the contrary, with a specific focus on higher education, HEdPERF, HiEduQual and UnivQual scales include items similar to the SERVQUAL and SERVPERF models, and add factors related to academics and teaching. Such factors are labelled as academic aspects, reputation and programme for HEdPERF, teacher quality and knowledge services for HiEduQual, and curriculum and skill development for UnivQual.

As a result, the number of factors between scales differs. The comparison on Table 4 indicates that the number of identified factors ranges from 3 for UnivQual to 6 for HEdPERF and HiEduQual. A higher number of factors for the HEdPERF and HiEduQual scales can be explained by the inclusion of items related to academics and teaching, unlike SERVQUAL and SERVPERF.

Table 4. Characteristics of service quality measurement scales

	SERVQUAL	SERVPERF	HEdPERF	HiEduQual	UnivQual
NF	5	5	6	6	3
NF	44	22	41	37	20
Factors	Assurance Empathy Reliability Responsiveness Tangibles	Assurance Empathy Reliability Responsiveness Tangibles	Academic aspects Non-academic aspects Reputation Access Programme Understanding student needs	Teacher quality Administrative services Knowledge services Activities Continuous improvement Leadership quality	Curriculum Skill development Services and facilities

NF: Number of Factors

Service quality and higher education

With increasing competition between universities to attract students, providing excellent service quality is essential to enhance the student experience. Different measurement scales have been used to evaluate the factors regarding service quality perceptions and yielded diverse results.

Table 5 gathered 49 studies published between 1994 and 2024 whereby service quality is being measured in the higher education context. The selection of the 49 articles was conducted through a comprehensive search relevant keywords such as 'service quality' and 'higher education' on Google Scholar. The focus was on studies published between 1994 and 2024 with an explicit objective to address service quality in the higher education context, as alternative scales to SERVQUAL had been theorised from 1992 onwards. This approach ensured a representative sample of the literature covering a wide range of geographical contexts, methodologies, statistical procedures and service quality factors. The country of focus, statistical procedure, quantity, and name of factors are discussed. For studies using a single tool for measuring service quality, SERVQUAL, SERVPERF and HEDPERF were used ten times each respectively.

Table 5. Comparative analysis of service quality factors in higher education: Insights from 49 studies (1994 – 2024)

Author and year	Country of focus	Scale	Statistical procedure	No. factors	Service quality factors
Soutar et al., (1994)	Australia	SERVQUAL	CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Athiyaman (1997)	Australia	Other	SEM	3	Services ; core service 1 ; core service 2
Li & Kaye (1998)	United Kingdom	SERVQUAL SERVPERF	Multiple regression	5	Assurance; empathy; reliability; responsiveness; tangibles
Ford et al. (1999)	United States and New Zealand	Importance - performance	EFA	6 & 7	4 common factors: academic reputation, programme issues, physical aspects, cost/time) Factors for United States: choice influences; others Factors for New Zealand: location; career opportunities; others
Tan & Kek (2004)	Singapore	Literature	EFA & CFA/SEM	8	Course organisation; assessment; teaching and advising; learning; university facilities; social activities; library facilities; computing facilities
Abdullah (2006a)	Malaysia	HEdPERF	EFA & CFA/SEM	6	Non-academic aspects; academic aspects; reputation; access; programme issues; understanding student needs
Abdullah (2006b)	Malaysia	Mix of HEdPERF SERVPERF	EFA & CFA/SEM	4	Non-academic aspects; academic aspects; reliability; empathy
Ilias et al. (2008)	Malaysia	SERVQUAL	T-tests and ANOVA	5	Assurance; empathy; reliability; responsiveness; tangibles
Yeo (2008)	Singapore	Qualitative interviews	Content analysis	3	Customer orientation; course design and delivery; support services
Carter (2009)	United States	SERVQUAL	CFA/SEM	5	Class availability; professor knowledge; job advancement; facility; tuition
Gruber et al. (2010)	Germany	Own model	EFA & multiple regression	15	Administrative and student services; atmosphere among students; city attractiveness; computer equipment; courses; library; lecturers; lecture theatres; cafeteria; relevance of teaching to practice; university reputation; school placement; support from lecturers; information presentation; university buildings

Author and year	Country of focus	Scale	Statistical procedure	No. factors	Service quality factors
Sultan & Wong (2010)	Japan	HEdPERF	EFA & CFA/SEM	8	Dependability; effectiveness; capability; efficiency; competencies; assurance; unusual situation management; semester & syllabus
Gallifa & Batallé (2010)	Spain	SERVPERF	EFA	5	Assurance; empathy; reliability; responsiveness; tangibles
Sultan & Wong (2012)	Australia	SERVPERF	EFA & CFA/SEM	3	Academics; administration; facilities
Cardona & Bravo (2012)	Colombia	5Q model	EFA	8	Teaching; learning process; physical resources; environment and campus life; academic programmes; support to student needs; information about activities
Sumaedi et al. (2012)	Indonesia	Literature	Multiple regression	7	Curriculum; facilities; contact personnel; social activities; education counselors; assessment; instruction medium
Sultan & Wong (2013)	Australia	ECSI	EFA & CFA/SEM	3	Academics; administration; facilities
de Jager & Gbadamosi (2013)	South Africa & Swaziland	Own model	Paired samples t-tests	13	Internationalisation; marketing & support; access and approach; international students and staff; academic reputation; student focus; academic quality; variety & reach; location & logistics; accommodation & scholarship; sports reputation & facilities; safety & security; parking
Chavan et al. (2014)	Australia	Qualitative interviews	Interviews	7	Assurance; empathy; reliability; responsiveness; tangibles; social benefits; participation/co-creation in knowledge learning
Casidy (2014)	Australia	SERVQUAL	EFA	3	Process; Empathy; Tangibles
Ansary et al. (2014)	Malaysia	SERVQUAL	Independent samples t tests	5	Assurance; empathy; reliability; responsiveness; tangibles
Min & Khoon (2014)	Singapore	SERVQUAL	CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Randheer (2015)	Saudi Arabia	CUL-HEdPERF	EFA & CFA/SEM	3	Gulf cultural area; professionalism in executing academic and non-academic activities; institutional level
Annamdevula & Bellamkonda (2016)	India	HiEduQual	EFA & CFA/SEM	6	Teaching; administrative services; support services; hostel facilities; library and lab facilities; internationalisation
Karatas et al. (2016)	Turkey	HEdPERF	Independent samples t-tests & ANOVA	6	Non-academic; academic; reputation; access; programmes; facilities
Babic-Hodovic et al., (2018)	Bosnia	SERVPERF	CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Tandilashvili, (2019)	Georgia	HEdPERF	EFA & CFA/SEM	3	Administrative aspects; study programmes; academic staff
Paul & Pradhan (2019)	India	HEdPERF	EFA	6	Functional value; customer intimacy; service quality; value; image; social value
Kim & Park (2019)	South Korea	HEdPERF	EFA	6	Faculty; educational environment; reputation; administrative support; student services; educational programme
Khattab (2019)	Lebanon	Literature	CFA/SEM	7	Quality of education; student services support; campus facilities; university image and reputation; social life on campus; interaction with faculty; interactions with administrative staff
Latif et al. (2019)	Pakistan	HiEduQual	EFA & CFA/SEM	6	Teacher quality; admin services; knowledge services; activities; continuous improvement; leadership quality
Marimon et al. (2019)	Spain	UnivQual	EFA & CFA/SEM	3	Curriculum & educational programme design; skill development; services and facilities
Darawong & Sandmaung (2019)	Thailand	SERVPERF	EFA & CFA/SEM	5	Facility; reliability; professionalism; empathy; responsiveness
Ongo (2019)	United States	SERVPERF	Multiple regression & MANOVA	5	Assurance; empathy; reliability; responsiveness; tangibles
Mulyono et al. (2020)	Indonesia	HEdPERF	CFA/SEM	5	Academic aspects; non-academic aspects; reputation; access; programme issues
Twum & Peprah (2020)	Nigeria	SERVQUAL	Linear regression	5	Assurance; empathy; reliability; responsiveness; tangibles
Abbas (2020)	Turkey	Qualitative	Interviews	6	Teaching quality; facilities; support staff quality; employability links; safety & security; extracurricular activities
Sohail and Hasan (2021)	Saudi Arabia	SERVPERF	CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Doan (2021)	Vietnam	Literature	SEM	1	Service quality seen as one dimension of a larger model
Ramzi et al. (2022)	Saudi Arabia	HEdPERF	CFA/SEM	3	Gulf cultural area; professionalism in executing academic and non-academic activities; institutional level
Moslehpour et al. (2020)	Taiwan	Literature	EFA & CFA/SEM	2	Academic aspects; non-academic aspects
Fuchs et al. (2022)	Thailand	SERVPERF	T-tests and ANOVA	5	Assurance; empathy; reliability; responsiveness; tangibles
Phonthanukitithaworn et al. (2022)	Thailand	Literature	CFA/SEM	1	Perceived education quality seen as one dimension of a larger model

Author and year	Country of focus	Scale	Statistical procedure	No. factors	Service quality factors
Tsiligiris et al. (2022)	United Kingdom	SERVQUAL	CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Ha et al. (2022)	Vietnam	SERVPERF	EFA & CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Sann et al. (2023)	Taiwan	UNIQUAL (derived from SERVQUAL)	EFA & CFA/SEM	4	Empathy; responsiveness; e-learning; accessibility & affordability
Hoque et al. (2023)	Bangladesh	SERVQUAL	CFA/SEM	5	Assurance; empathy; reliability; responsiveness; tangibles
Sari (2023)	Indonesia	SERVQUAL	Multiple linear regression	5	Assurance; empathy; reliability; responsiveness; tangibles
Nguyen et al. (2024)	Vietnam	Literature review	EFA	5	Academic aspects; non-academic aspects; programming issues; facilities; industry interaction

In a study with 128 MBA students from a large Midwestern American university, Carter (2009) found that expectations do not moderate the relationship between service quality and satisfaction in line with the findings of Cronin and Taylor (1992; 1994). A study on a Vietnamese university concluded that the SERVPERF scale was a reliable and valid model and provided a good fit to measure service quality (Ha et al., 2022). In a study on service quality, satisfaction and loyalty, Babic-Hodovic et al. (2018) found that satisfaction mediates service quality dimensions on student loyalty.

Service quality measurement scale

Over time, several generic or specific measurement scales have been used to assess service quality in higher education institutions. Table 6 addresses the count for the type of used measurement scales. Generic SERVQUAL and SERVPERF measurement scales remain the dominant scales used to evaluate service quality in higher education, with ten studies each respectively. An additional study uses both SERVQUAL and SERVPERF scales, while another study used a SERVQUAL version that has been adapted to higher education. With ten occurrences, the HEdPERF scale is the most widely used scale among the specific measurement scales. Variants and adaptations of HEdPERF have also been counted. As a variant to the HEdPERF scale, the CUL-HEdPERF scale was used twice in the specific cultural context of Saudi Arabia (n = 2). The HEdPERF scale has been mixed with other elements from the literature or the SERVPERF scale. Overall, SERVQUAL, SERVPERF and HEdPERF are the three most commonly used scales to measure service quality in higher education in the database. This finding is in line with the use of service quality measurement scales beyond higher education. Silva et al. (2017) counted 495 and 39 studies using SERVQUAL and SERVPERF.

Regarding other measurement scales specific to higher education, two studies used HiEduQual (Annamdevula & Bellamkonda, 2016; Latif et al., 2019), one used UnivQual (Marimon et al., 2019) and another one developed the Uniqual scale with some degree of inspiration from SERVQUAL (Sann et al., 2023). For example, HiEduQual has only been used in the case of universities in countries such as India, Pakistan (Latif et al., 2019), China (Lekini et al., 2019), Indonesia (Pradana et al., 2020) and Peru (Barrios-Ipenza et al., 2024). Beyond the generic and specific measurement scales listed above, some studies evaluated service quality perceptions using other scales such as the importance – performance scale (Ford et al., 1999) and the European Customer Satisfaction Index (Sultan & Wong, 2013). Finally, eleven studies that did not use commonly accepted quantitative measurement scales. As a result, three used qualitative interviews (Abbas, 2020; Chavan et al., 2014; Yeo, 2008). Seven developed their questionnaires based on literature review (Doan, 2021; Gruber et al., 2010; Khattab, 2019; Moslehpour et al., 2020; Sumaedi et al., 2012; Tan & Kek, 2004) and one built its own model (de Jager & Gbadamosi, 2013).

Table 6. Service quality measurement scales used (n = 49)

Measurement scale	n	Share (in %)
SERVPERF	10	20%
HEdPERF	10	20%
SERVQUAL	10	20%
Literature review	7	14%
Qualitative interviews	3	6%
HiEduQual	2	4%
Own model	1	2%
Importance - performance scale	1	2%
ECSI (European Customer Satisfaction Index)	1	2%
UnivQual	1	2%
Uniqual	1	2%
Other	2	4%

Region and country of focus

25 of the selected studies focus on measuring higher education service quality in Asian countries. Tables 7 and 8 highlight the geographic distribution of service quality studies by country and continent of focus. These include studies conducted in Malaysia (n = 4), Singapore (n = 3), Indonesia (n = 3), Vietnam (n = 3), and Thailand (n = 3), as well as India (n = 2), Taiwan (n = 2), Pakistan (n = 1), Japan (n = 1), Bangladesh (n = 1) and South Korea (n = 1). For Europe, the Middle East and Oceania, each region counts six studies. In Europe, studies focus on Spain (n = 2) and the United Kingdom (n = 2), followed by Bosnia (n = 1) and Germany n = 1). In Oceania, Australia makes up the total number of six studies, while Saudi Arabia (n = 3) represents half of the six studies conducted in the Middle East, along with Turkey (n = 2) and Lebanon (n = 1). Africa and North America are less represented in the selected database, with two studies each.

Lastly, 94% of the sampled studies are single country studies. Only 6% focus on measuring service quality in higher education institutions located in two countries or more. Namely, these three studies focus on South Africa and Swaziland, the United Kingdom and the United States, and the United States and New Zealand.

Table 7. Country of focus for service quality studies (n = 49)

Country	n	Share (in %)
Australia	6	12%
Malaysia	4	8%
Saudi Arabia	3	6%
Singapore	3	6%
Indonesia	3	6%
Vietnam	3	6%
Thailand	3	6%
India	2	4%
Spain	2	4%
Turkey	2	4%
United Kingdom	2	4%
United States	2	4%
Taiwan	2	4%
Bosnia	1	2%
Georgia	1	2%
Germany	1	2%
Japan	1	2%
Lebanon	1	2%
Nigeria	1	2%
Pakistan	1	2%
South Korea	1	2%
Bangladesh	1	2%
South Africa & Swaziland	1	2%

Country	n	Share (in %)
United Kingdom and United States	1	2%
United States and New Zealand	1	2%

Table 8. Region of focus for service quality studies (n = 49)

Region(s)	n	Share (in %)
Asia	25	51%
Europe	6	12%
Middle East	6	12%
Oceania	6	12%
Africa	2	4%
North America	2	4%
Europe/North America	1	2%
North America/Oceania	1	2%

Factors

Service quality in higher education remains a multidimensional phenomenon. The number of identified factors remains a core element of the ongoing discussion in the literature on service quality. Results have shown that the number and characteristics of service quality factors differ depending on the type of measurement scale, the country of focus, the type of respondents as well as the research processes adopted by researchers.

The measurement technique influences the number of identified factors. Studies using a CFA technique with SERVQUAL or SERVPERF scales maintained a five-factor structure in numerous instances such as the United Kingdom (Tsiligiris et al., 2022), Saudi Arabia (Sohail & Hasan, 2021), Australia (Sultan & Wong, 2012), the United States (Carter, 2009; Ongo, 2019), Vietnam (Ha et al., 2022) or Singapore (Min & Khoon, 2014). Other SERVQUAL studies did not confirm the five-factor structure. In Indonesia, Sari (2023) found out that only the tangibles, assurance and empathy factors had a significant impact on service quality. It is also interesting to note that studies using the EFA technique with SERVQUAL and SERVPERF has generated different results. In Thailand, the exploratory factor analysis led to the identification of five factors, including two that differ from the traditional SERVQUAL model (Darawong & Sandmaung, 2019). Following the adaptation of SERVQUAL items and focus group interviews, the study identified professionalism and facility as a replacement for SERVQUAL's tangibles and assurance factors. Two other studies conducted in Australia with the EFA technique identified three factors instead of five (Casidy, 2014; Sultan & Wong, 2013). Adapted from the SERVQUAL scale, the study by Casidy (2014) identified process, empathy and tangibles as service quality factors. Derived from a mixed methods literature review that adopted SERVQUAL items, Sann et al. (2023) found that only two of their four identified factors – empathy and responsiveness - had a significant impact on service quality. Based on SERVPERF, Sultan and Wong (2013) identified service quality factors to be divided along academic, administrative, and facilities issues.

Similar differences were found in studies using the HEdPERF scale. Some studies aligned with the HEdPERF's original six-factor structure in South Korea (Kim & Park, 2019), India (Paul & Pradhan, 2019) and Turkey (Karatas et al., 2016). Other studies identified a lesser number of factors. In Indonesia, the understanding student need factor was found to be not significant (Mulyono et al., 2020). The use of an EFA technique with the HEdPERF scale led to the identification of three factors in Saudi Arabia and Georgia. In Saudi Arabia, an adapted version of the HEdPERF scale included a strong cultural dimension specific to the Gulf region along with professionalism and institutional issues (Ramzi et al., 2022; Randheer, 2015). In Georgia, the three factors were labeled administrative aspects, study programme quality, and academic staff (Tandilashvili, 2019). In Malaysia, an interesting finding lies with Abdullah's attempt to find the most appropriate measurement scale for higher education service quality (Abdullah, 2006b). First, survey results were compared with SERVPERF and HEdPERF scales separately. Second, a factor analysis of all 50 HEdPERF and SERVPERF items generated a scale merging both measuring instruments. This merged HEdPERF – SERVPERF scale identified four factors. Non-academic and academic aspects were two factors deriving from HEdPERF while reliability

and empathy originated from the SERVPERF scale. Interestingly, this merged scale borrowed two factors from each scale. The proposed structure differed from the six-factor HEdPERF scale and five-factor SERVQUAL structure.

The grouping of factors according to traditional measurement scales may not always be valid in cross-cultural settings. It is argued that the context could structure factors differently (Ford et al., 1999). In a joint analysis of higher education service quality with business students from the United States and New Zealand, Ford et al. (1999) found out that factors differed. Although four factors such as academic reputation, programme issues, physical aspects, and cost were common to both countries, their research identified unique country-specific factors. Location and career opportunities were factors specific to New Zealand, while choice influences were a significant factor in the United States only.

The dimensionality of service quality was not addressed in some studies in this database (Mai, 2005; Silva et al., 2017). Other studies have included service quality as a variable among a larger conceptual or theoretical framework. In this case, the question of service quality factors was not a main focus. Rather, service quality was part of measurement and structural models that tested its relationships with student satisfaction (Mai, 2005), or loyalty (Phonthanukitithaworn et al., 2022).

Gender

Literature examining the impact of gender on service quality perceptions in higher education presents diverse findings. Some studies found no statistically significant gender differences on service quality perceptions in Malaysia, Turkey and Saudi Arabia (Ansary et al., 2014; Karatas et al., 2016; Ramzi et al., 2022). On the contrary, the study by Min and Khoon (2014) reported gender disparities and reported higher perception levels for men in Singapore. Due to the lack of consensus on the impact of gender on service quality perceptions in higher education, these varied findings highlight the importance of further research for a better understanding.

Sample size and characteristics, including the number of institutions involved

Based on the database, sample size reports an average number of 482 participants and a median number of 345 participants (Table 9). The smallest sample size is 36 for a qualitative research project in Australia (Chavan et al., 2014) and Marimon et al. (2019) report the largest sample size with 2,557 respondents from Spain.

The three articles using qualitative methods report an average of 41 participants. Two focused on a case study method by interviewing participants from a single university in Australia and Singapore (Chavan et al., 2014; Yeo, 2008), while Abbas (2020) selected participants from three Turkish universities. As for quantitative studies, Twum and Peprah (2020) have the smallest sample size with 86 respondents in a Nigerian university.

Table 9. Sample size distribution and research methods in higher education service quality studies

	All	Quantitative methods	Qualitative methods
Number of articles	49	46	3
Average	482	480	41
Median	345	350	43
Minimum	36	86	36
Maximum	2,557	2,557	43

It is acknowledged that most service quality studies do not include respondents from a large number of universities. Convenience sampling is a frequently used method and researchers often carry use students from their own university as survey respondents. It contributes to a higher number of respondents and maximise response rate. In fact, based on the 49 articles in the database on Table 10, participants in service quality studies come from four universities on average. 26 of the 49 articles are based on single case studies. The case study method limits possibilities for generalisibility and is often mentioned in the limitations section of these articles. Seven studies report an average of 10 to 20 participating universities, while two articles are based on respondents from more than 20 universities.

Table 10. Number of institutions involved in service quality studies applied to higher education

	All	Quantitative methods	Qualitative methods
Number of articles	49	46	3
Average	4	5	2
Median	1	1	1
Minimum	1	1	1
Maximum	33	33	3

Conclusion

This paper provides a comprehensive review of service quality measurement in higher education, analyzing and comparing prominent scales such as SERVQUAL, SERVPERF, HEdPERF, UnivQual, and HiEduQual. Each scale offers a unique approach to assessing service quality, with varying numbers and names of factors reflecting the diversity and specificity required in different educational contexts. Our analysis of 49 peer-reviewed articles demonstrates the practical application of these scales, revealing a preference for quantitative research methods and a strong reliance on exploratory and confirmatory factor analysis techniques.

The findings underscore the multifaceted nature of service quality in higher education, highlighting the need for context-specific scales. The diversity of factors identified across different studies suggests that a one-size-fits-all approach is inadequate for capturing the nuances of service quality. Additionally, the exploration of gender differences in service quality perceptions and various findings regarding the influence of gender on these perceptions suggest that further research could be undertaken. This review contributes to the existing literature by offering a detailed comparison of various measurement approaches and mapping empirical findings against established scales.

For higher education institutions, these insights are crucial for designing and implementing strategies that enhance service quality and align more closely with student desires and needs. Understanding the specific needs and perceptions of different student groups can lead to more targeted and effective interventions.

Future research should continue to explore new dimensions of service quality, considering other demographic factors and extending the analysis to a broader range of countries and contexts. More empirical studies are needed to validate and refine the existing scales, ensuring they remain relevant and effective tools for assessing service quality in a rapidly evolving educational landscape.

While this review provides a comprehensive overview, it is not without limitations. The selection of articles and potential biases in the reviewed literature may influence the findings. Nevertheless, the insights gained offer a solid foundation for further research and practical improvements in service quality in higher education.

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Journal for the Education of Gifted Young Scientists, 12(3), 137-150, Sept 2024
e-ISSN: 2149- 360X
jegys.org
dergipark.org.tr/jegys

Genc Bilge (Young Wise) Publishing
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Research Article

Prospective teachers' perception of critical and reflective thinking skills on modern physics: Rasch Analysis

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Article Info

Received: 19 July 2024
Accepted: 5 Sept 2024
Available online: 30 Sept 2024

Keywords
Critical thinking skills
Perception of prospective teacher
Rasch model
Reflective thinking skills

Abstract

Related research on critical and reflective thinking skills has been interesting and conducted by many researchers, but they are still carried out separately. This study aims to determine the perception of prospective teachers towards critical and reflective thinking skills in modern physics lectures. This research includes quantitative research using the cross-sectional survey method. Ninety-seven prospective teachers participated in the study, with details of 15 men and 82 women with an age range of 19-21 years. Questionnaire critical and reflective thinking skills are used as instruments for collecting data. Each of them is a 20-item critical thinking skills questionnaire and 24 items of reflective thinking skills questionnaire. The collected data was analyzed using winsteps software version 4.6.1. which includes descriptive, individual conformity, gender, and bubble chart. The results of detailed data analysis show that for critical thinking skills, 17% of prospective teachers perceive low, 68% of prospective teachers perceive moderate, and 15% of prospective teachers perceive high. As for reflective thinking ability, 11% of prospective teachers perceive low, 78% of prospective teachers perceive moderate, and 11% of prospective teachers perceive high. However, there are many misfit persons, 66% for critical thinking skills and 67% for reflective thinking skills. This means prospective teachers do not have strong perception beliefs in both thinking skills. Therefore, it needs to be strengthened through treatment, training, or workshops to further train both skills.

To cite this article:

Juandi, T., Kaniawati, I., Samsudin, A., & Riza, L.S. (2024). Prospective teachers' perception of critical and reflective thinking skills on modern physics: Rasch Analysis. *Journal for the Education of Gifted Young Scientists*, *12*(3), 137-150. DOI: http://dx.doi.org/10.17478/jegys.1502503

Introduction

Everyone is given the natural gift of the ability to think. The ability to think develops with age. The environment greatly influences the development of thinking ability. The provision of a supportive environment for the development of thinking skills is necessary. Thinking skills honed since childhood will largely determine the mindset of an adult. A person who often hones his thinking skills will have skills in thinking (Gómez and Suárez, 2020; Zhang, 2018). These thinking skills must be possessed in response to the demands of the 21st century.

The 21st century is an era of openness, requiring various skills (Mutohhari et al., 2021; Tijsma et al., 2020). This skill is often called a high-level thinking skill. Among the higher-order thinking skills are critical thinking, communication,

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creative thinking, and collaboration (Ichsan et al., 2019; Ismail et al., 2022). Critical thinking skills as a basis for the development of other thinking skills. Therefore, critical thinking skills must be developed as the main capital to develop the next potential of the individual Critical thinking skills can be seen from a person's ability to reflect in detail in the context of each activity (Teresa Fuertes-Camacho et al., 2021). The keyword critical thinking skills is the ability to reflect. Thus, critical, and reflective thinking skills are part of the higher-order thinking skills that everyone should have.

The Ministry of Education and Culture encourages the provision of critical and reflective thinking skills from an early age. The provision of critical and reflective thinking skills must be carried out on an ongoing basis at every level of education (Barton and Ryan, 2020; Jiménez-Gómez et al., 2019). Debriefing must be done consciously and conditionally to get maximum results. The education unit is expected to be able to manage learning to create an educational environment that supports the development of critical and reflective thinking skills. The content of developing critical and reflective thinking skills can be realized technically in each class through the distribution of subjects (Hidayati et al., 2020; Verawati et al., 2021; Wenno et al., 2022) Thus, the provision of critical and reflective thinking skills can be carried out by each teacher through content development with directed procedures. Before conducting a more in-depth study related to critical and reflective thinking skills. The first step that must be taken is to know the perceptions of prospective teachers regarding these two thinking skills. Perception is very important because it helps a person to interpret and understand the world around them (Han, 2023). Without perception, we cannot recognize, evaluate, or respond to our situations and environment effectively.

Prospective Teachers' Perception

These two types of thinking skills become urgent for everyone as they relate to the basic skills to develop other thinking skills. Educational institutions across the country are launching various learning programs, training, and workshops to develop thinking skills. Therefore, perceptions of various thinking skills, including critical and reflective thinking skills, must be studied more deeply to find real conditions in the field (Syahril et al., 2021). Perception is the internalization of values about an event that the senses acquire through inferring and interpreting messages. In other words, perception is the process of understanding a piece of information against a stimulus. Perception is an aspect that needs to be considered in complementing the ability of prospective teachers to plan, manage, and diversify practical tutoring (Batmang et al., 2021; Oral and Erkilic, 2022). Based on the perceptions of prospective teachers, program mapping can be done to help in achieving one specific goal.

Today, the learning process of modern physics still does not show a clear direction toward critical, creative, and innovative constructions among future teachers. Teaching experience is an important thing that can contribute to the success of the learning process (Ilkorucu et al., 2022). However, it is also necessary to pay attention to the initial conditions of the prospective teacher for the lesson before carrying out the learning process. Knowing the initial conditions of the future teacher is very important for three reasons. First, experience and knowledge influence understanding. The understanding of prospective teachers determines the practice in the learning process; the activities carried out are derived from the beliefs of the previously owned construction of knowledge (Changwong et al., 2018; Gómez and Suárez, 2020).

Second, understanding prospective teachers has significant feedback to develop professionalism affects what will be learned and how to apply that knowledge in learning practice. Knowing this understanding is essential to developing training designs that can improve the ability of prospective teachers to operate critical and reflective thinking skills. Third, learning the initial knowledge of prospective teachers on issues related to previous critical and reflective thinking skills can be assessed for reflection to create a more appropriate training program (Chee Choy et al., 2019; Jarvis and Baloyi, 2020; Öztürk, 2020). Related research on critical and reflective thinking skills has been interesting and conducted by many researchers, but they are still carried out separately. The research that houses these two types of skills is still not widely carried out. Therefore, research related to these two types of skills in one study will be more interesting. In addition to obtaining information regarding the two types of skills, the slices of the two types of skills can also be known to each other.

Critical Thinking Skills

Critical thinking skills are a process of deep thinking by expressing goals complemented by compelling reasoning about a belief and the activities carried out (Ennis, 1985; Feldman, 2002; Su and Shum, 2019; Tsai, 2019). Critical thinking focuses on the ability and tendency to collect, evaluate, and use information effectively. Sometimes critical thinking is called critical-creative thinking (Latorre-Cosculluela et al., 2020; Toheri et al., 2020; Tsai, 2019). A person is said to be able to think critically if he gives simple explanations, builds basic skills, concludes, and provides further explanations, strategies, and tactics (Boa et al., 2018; Braun et al., 2020; Nitko and Brookhart, 2014). The achievement of critical thinking indicators can be measured through various instruments, one of which was developed by Nitko and Brookhart (Nitko and Brookhart, 2014)

Critical thinking skills today are increasingly emphasized in the education system. Developing critical thinking skills increases higher-order thinking capacity and confidence and great authority to carry out more effective guidance. Critical thinking skills are discussed as important in society and class. The basic concept of critical thinking skills is emphasized as a 21st-century skills center in education, work atmosphere, and social life. However, evidence suggests that critical thinking skills are one of the tricky variables to promote in tutoring (Kriswantoro et al., 2021; Makhene, 2019). This can be understood because critical thinking skills must be achieved further than ordinary academic skills. More technically, applying critical thinking skills is interpreted and operationalized according to the subject's characteristics (Damayanti and Kuswanto, 2021; Purwanto et al., 2022; Syahril et al., 2021). Thus, each subject can establish critical skills as general abilities and fundamentals as minimal competencies that must be met.

Fostering critical thinking skills is an important educational process. These process stages can form effective communication skills, develop logic and working capacity, and actively participate in modern society. The low ability of prospective teachers in this aspect can be a bad record in developing future performance in the capacity of a teacher (Alpaydın and Demirli, 2022; Marco-Fondevila et al., 2022) . Therefore, every prospective teacher needs to be involved in providing critical thinking skills in various subjects. Each subject is designed to practice critical thinking skills and conduct deliberate evaluations to produce the character of original thinking skills that can reason, formulate, analyze, and find solutions to each problem faced.

Reflective Thinking Skills

So are reflective thinking skills, reflective thinking skills are a learning style that provides an important rearrangement as a reflective observation by teachers who review the final state of many individuals and make objective judgments (Aydoğmuş and Kurnaz, 2022; Guo et al., 2022; Zach and Ophir, 2020). A person is said to have reflective thinking skills if he meets at least four indicators: habitual action, comprehension, reflection, and critical reflection. To measure the achievement of reflective thinking skills can use instruments developed by Kember (2000). A person's reflective thinking skills can be a benchmark for problem-solving success. An important thing related to critical thinking skills is reflective thinking skills. Reflective thinking skills are imaginative abilities to form opinions from historical events or events as an anticipatory action against failure. It is a way of thinking and acting on a new understanding.

Developing reflective thinking skills in prospective teachers can accelerate understanding, support abstract change, and encourage critical evaluation and knowledge transfer. Reflective thinking skills to integrate acquired understanding into one's experience to allow better choices or behaviors in the future and improve one's overall effectiveness. Reflective thinking skills can be described in four situations, the first two situations, habitual action, and understanding, are considered reflexive, while reflection and critical reflection are reflective. The act of habit and understanding refers to conditioning without being significant or with little awareness (Kember et al., 1999, 2000; Tseng and Hill, 2020). It is characterized when a person follows the procedure without involving serious thoughts in it. Meanwhile, in the position of reflection and critical reflection, one not only achieves an accurate understanding but can also reflect on experiences for future activities (Antonio, 2020; Barton and Ryan, 2020). Finally, as the highest position of reflective thinking, the position of critical reflection implies a metamorphosis of one's perspective on beliefs about the understanding of conception. The flow of thinking in this research can be seen in Figure 1.

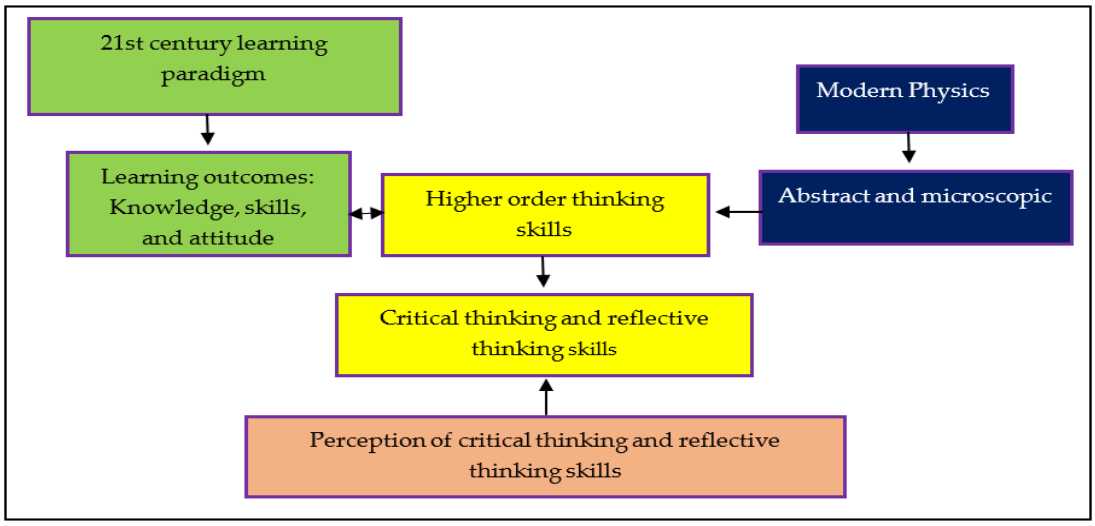


Figure 1. Conceptual frameworks perception of critical thinking and reflective thinking skills

This research was conducted at a modern physics lecture, the content of modern physics concepts belongs to the abstract and microscopic categories (Hermann, 2020; Arabatzis, 2017), which can be felt but cannot be seen. Since the beginning of the 20th-century modern physics has experienced very rapid development, until now the development of modern physics content continues to be enriched through research such as Compton scattering, electron scattering and electron momentum (Xu et al., 2019); Talmantaite et al., 2019), wave packet scattering (Khomitsky and Kulakov, 2020); electron diffraction (Kulygin et al., 2020); electron temperature and bremsstrahlung Zeemen effect (Al et al., 2020); and the nonlinear Schrodinger equation (Rashkovskiy, 2019). However, most of this research is carried out by scientists in developing physics. Given the content of abstract and microscopic modern physics, it is very necessary to know prospective teacher perceptions regarding the learning process of modern physics. This study aims to analyze the perception of prospective teachers towards the ability to think critically and reflectively in modern physics.

Method

Research Design

This research includes quantitative research using the cross-sectional survey method. The cross-sectional survey method is suitable for knowing and examining current beliefs, attitudes, and perceptions/opinions or practices (Creswell & Creswell, 2018). Questionnaires have been used to collect data from participants who have taken modern physics in several regions in Indonesia. The focus of this study is to obtain information about prospective teachers' perceptions of critical and reflective thinking skills. Based on the research objectives, the cross-sectional survey method is very suitable for collecting data based on current phenomena.

Participants

Students who have studied modern physics participated in this research. The questionnaire is distributed openly through Google Forms, making it possible to reach a large area with many respondents. After the data was collected, it was recorded that ninety-seven participants filled out a questionnaire. Table 1 shows a description of the demographic characteristics of participants.

Table 1. Description of the demographic characteristics of participants

Demographic		Frequency	%
Gender	Male	15	15
	Female	82	85
	2018	8	8
	2019	48	50
	2020	41	42
University area	*Nusa Tenggara Barat*	57	59
	Jambi	2	2
	Kalimantan	4	4
	Sulawesi	12	12
	Jawa Barat	22	23

The vast territory of Indonesia with a very large population, of course, the distribution of areas that are the source of participants does not adequately reflect regional representation. But as an initial illustration of student perceptions related to critical and reflective thinking skills in modern physics lectures are considered quite representative. Participants from their respective provinces reflected on the conditions experienced during modern physics lectures. The questionnaire was packaged in a Google Form and distributed through the researcher's network of colleagues at several universities in Indonesia. The respondents were prospective physics teachers who voluntarily completed the questionnaire after taking a modern physics course. Based on the collected data, there were 97 respondents who filled out the questionnaire and agreed to participate in this research. As an illustration of the distribution of participants in each province in this study, it can be seen in Figure 2 below.

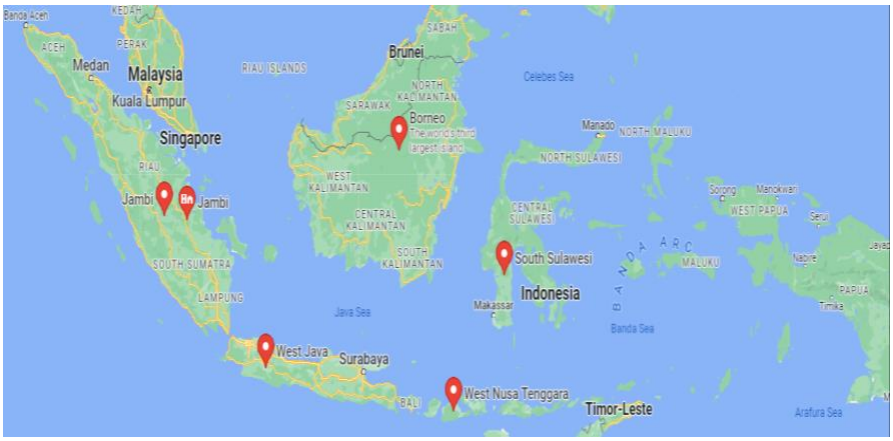


Figure 2. Distribution area of research participants

Data Collection

Data on critical and reflective thinking skills were collected using developed questionnaires. A total of 20 questionnaire items were to measure critical thinking skills that concern five aspects. The five aspects are providing simple explanations, building basic skills, inferring, providing further explanations, and strategies and tactics (Nitko and Brookhart, 2014). As for reflective thinking skills, there were 24 questionnaire items with four indicators. The four indicators are habitual action, understanding, reflection, and critical reflection (Kember et al., 2000). Both questionnaires use a four-point Likert-type scale: strongly agree, agree, disagree, and strongly disagree. With the gradation of each category, that is, strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1.

Data Analysis

After the data is collected, then proceed with data analysis. Before the data is analyzed, coding is first done with the help of Microsoft Excel. Data coding aims to classify data according to the desired characteristics so that it is easily read by analysis tools. For example, gender, institutional origin, and so on. After the coding process is complete, the data is analyzed using the Rasch model.

Results and Discussion

Based on the results of data analysis of perceptions of critical and reflective thinking skills using the WINSTEPS 4.6.1 program. The average value of person measurements for the perception of critical thinking skills is +2.32. This suggests that respondents were more likely to approve of the questionnaire provided. A standard deviation (SD) value of 2.09 logit indicates that the spread of person capabilities is quite wide on the logit value continuum. The average item value of 0.00 logit is the ideal item condition. The standard deviation of the item (SD) of the item is 0.67, and this suggests that it is not very broad across the logit scale regarding the problem's difficulty.

For reflective thinking skills, the average value of person measurements is +1.62. This suggests that respondents were more likely to approve of the questionnaire provided. A standard deviation (SD) value of 1.37 logit indicates that the spread of person capabilities is quite wide on the logit value continuum. At the same time, an average item measuring the value of 0.00 logs is the ideal item condition. The item's standard deviation (SD) is 1.04, which indicates quite widely across the logit scale regarding the difficulty of the question. If the average logit person is positive (far exceeding the average logit item), then it is said that the person has a good mentality toward the item (Wicaksono, 2021). For SD logit, the greater the value, the better the measurement dissemination data (Wei et al., 2020; Widhiarso and Sumintono, 2016). Table 2 shows the data on the perception of critical and reflective thinking skills of prospective physics teachers.

Table 2. Summary (logit) value of person and item for the perception of critical and reflective thinking skills

	Critical thinking skill		Reflective thinking skill	
	Person	**Item**	**Person**	**Item**
N	97	20	97	24
Measures				
Mean	2.32	0.00	1.62	0.00
SD	2.09	0.67	1.37	1.04

The results of data analysis of these two types of thinking skills are shown in Table 2. The average score of persons for critical and reflective thinking skills looks different. The greater the average value of a variable indicates the total number of scores a large person has. In this regard, it is said that the perception of the prospective teacher toward critical thinking skills is stronger than that of the prospective teacher towards reflective thinking skills. Likewise, if you look at the standard deviation (SD). A larger SD value indicates a wider distribution of persons within the existing continuum range is broader than the distribution of prospective teachers to the perception of reflective thinking skills. However, this is different from SD items. SD reflective thinking skill items are larger than SD critical thinking skill items. This suggests that the distribution of reflective thinking skill items is broader than critical thinking skill items for detecting the diversity of people. However, regardless of the difference between the two variables, the average and SD values. Empirical facts show that the average value of the two variables is greater than the average value of the item. Therefore, it can be said that the respondents can understand the points of both instruments (Adams et al., 2022; Ling Lee et al., 2021).

Perception of Critical and Reflective Thinking Skills

The perception of critical and reflective thinking skills is categorized into three parts: low, moderate, and high, as shown in Table 3. The division into three categories is based on a separation person value of 2.91. This categorization is intended to determine the level of perception of prospective physics teachers towards modern physics courses. Regarding critical thinking ability, 16 persons or 17% of respondents have a low perception, 66 persons or 68% have a moderate perception, and 15 persons or 15% have a high perception. As for the perception of reflective thinking skills, 11 persons or 11% of respondents had low perception, 75 persons on 78% had moderate perception, and 11 persons or 11% had high perception; categorization is shown in Table 3. The categorization of perceptions is determined based on the value of the person's Logit (LVP) (Adams et al., 2022; Planinic et al., 2019; Widhiarso & Sumintono, 2016). Categorization is performed on the average logit person combined with standard deviation (SD).

Table 3. Categories of perception of critical and reflective thinking skill based on the logit value of the person (LVP)

Thinking skills	Low LVP ≤ +0.23	Moderate +0.23 < LVP <+4.41	High LVP ≥ +4.41
Critical	16	66	15
	Low LVP ≤ +0.25	Moderate +0.25 < LVP <+2.99	Hight LVP ≥ +2.99
Reflective	11	75	11

The analysis results show that the largest percentage is in the "moderate" category, above 50%, on the perception of critical and reflective thinking skills. That is, the prospective teacher does not yet have too strong self-confidence to have critical and reflective thinking skills. The diversity of prospective teachers' perceptions towards critical and reflective thinking skills is inseparable from the conditions of modern physics lectures experienced in each place. The availability of infrastructure and learning environment also impacts the perception of prospective teachers (Lu et al., 2021; Wästberg et al., 2019) . An individual's life experiences and knowledge greatly influence their perception of a situation (Reeder et al., 2024). Additionally, emotions, motivation, and interests also influence how a person perceives something (Perera and Abeysekera, 2022). Thus, other factors that cause differences in perception include experience and knowledge, emotions, motivation, and interests.

Individual Conformity

The ideal response given by the respondent is largely determined by his ability. The higher the respondent's ability, the higher the response indicates high approval. But sometimes, the opposite is true. In this case, the Rasch Model can detect inappropriate individual response patterns, i.e., differences in answers based on respondents' abilities compared to the ideal model (Wei et al., 2020). Data analysis found that a person's misfit or a person's response patterns did not match the questionnaire on critical thinking skills and reflective thinking skills. About 64 persons had unique or inappropriate response patterns in the critical thinking skills questionnaire: an example of a response can be seen in Figure 4 (a). The reflective thinking skills of 53-persons misfit showed the questionnaire in the questionnaire, and the response pattern can be seen in Figure 4 (b). Details of a person's incompatibility with critical and reflective thinking skills can be seen in Table 4.

Table 4. Misfit person of critical and reflective thinking skills based on the person statistic: misfit order

Demographic		Thinking skills	
		Critical	Reflective
Gender	Male	16	12
	Female	48	41
University area	*Nusa Tenggara Barat*	36	31
	Jambi	2	2
	Kalimantan	2	2
	Sulawesi	5	8
	Jawa Barat	19	10
	Total	64	53

The respondents were classified as misfits for providing responses that did not fit the model. For example, respondents with codes 59M7, 12F2, and 27M3 to the critical thinking skills questionnaire. Respondents with the code 59M7 have the same response for all items. This suggests that respondents likely did not read the questionnaire seriously or did not even read the statement at all. Likewise, respondents with codes 12F2 and 27M3 had the same response pattern. Based on the responses provided, respondents with codes 12F2 and 27M3 were classified as less observant. Because it scores three lower on the easiest items compared to scores on harder items. The left-to-right order of items indicates a low level of approval to a high level of consent or, in other languages, indicates the item's difficulty.

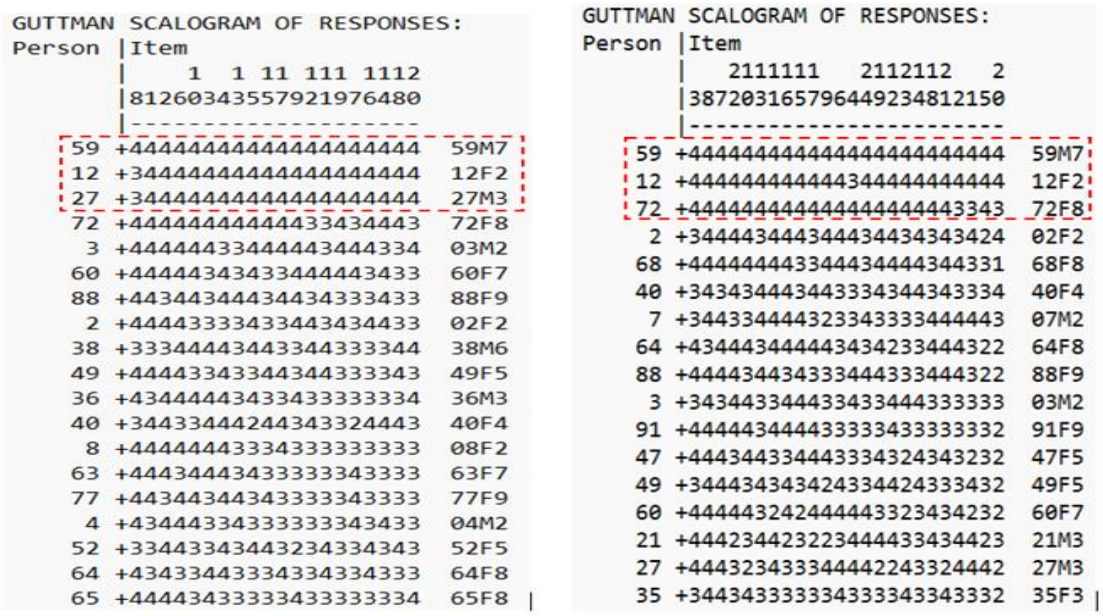


Figure 3. (a) Scalogram of critical thinking skills, (b) Scalogram of reflective thinking skills

The same character is seen in Figure 3 shows most people are in the overfit area. This indicates that most scores produced by high people are even too high, so it is suspected that these scores do not reflect the real condition of the person. Therefore, it can be said that there are problems experienced by prospective teachers in perceiving critical and reflective thinking skills. In another form, it can be shown in Figure 4.

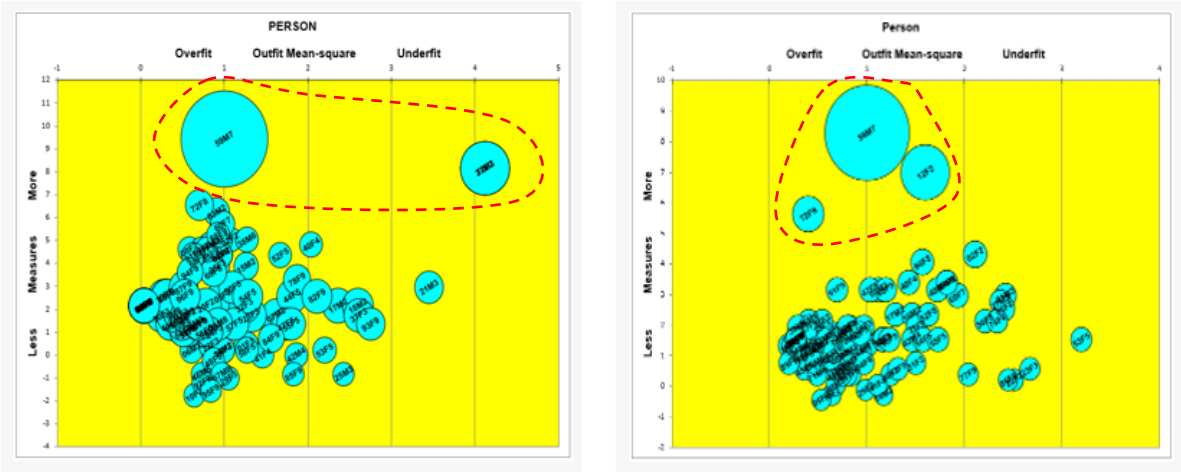
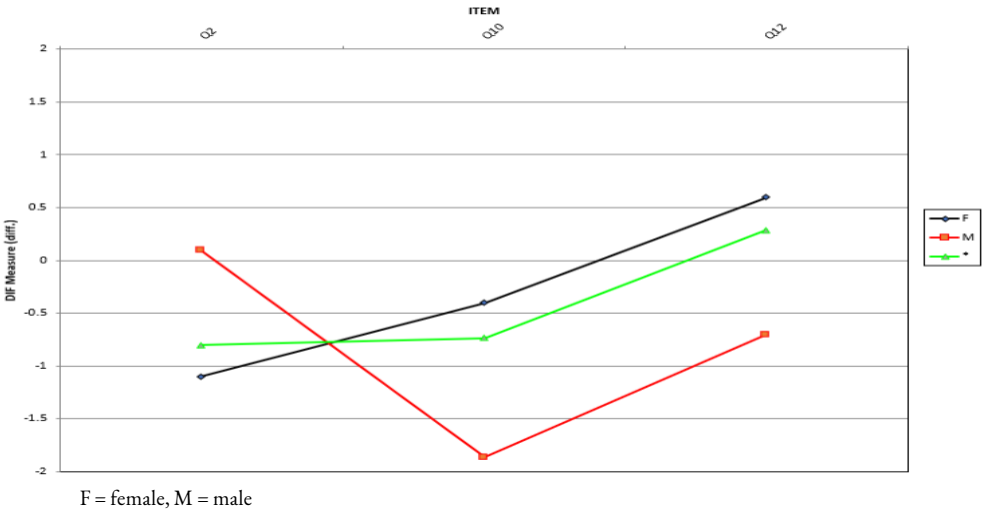


Figure 4. Bubble chart for critical and reflective thinking skills

In Figure 5 for critical thinking skills (left image) people with codes 59M7, 12F2, and 27M3 are far apart from their group and have a larger round than others. The distant position and the circle are larger than the others indicating that the person has different characteristics (Juandi et al., 2023; Planinic et al., 2019; Purnami et al., 2021; Rusland et al., 2020) Person code 59M7 is in the overfit area while person codes 12F2 and 27M3 are in the underfit area. Likewise, for reflective thinking skills (right image), people with codes 59M7, 12F2, and 72F8 are far apart from their group and have larger roundabouts than others. This indicates that these people are abnormal or problematic.

Differential Item Functioning (DIF)

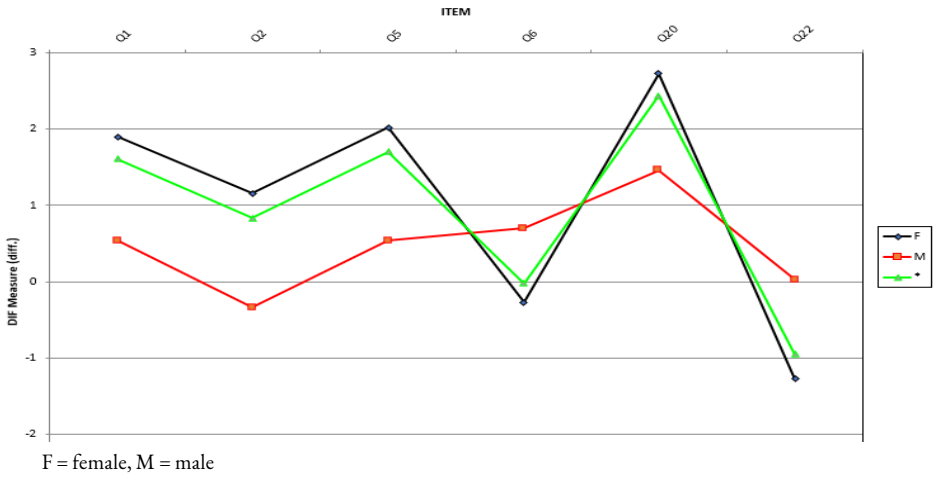
In this section, we will describe the demographic differences of respondents between the sexes with a questionnaire on critical thinking and reflective skills. These data have been analyzed using differential item functioning (DIF), this analysis shows respondents from separate subgroups respond differently to some items (Andrich and Marais, 2019; Boone and Staver, 2020). The DIF gender with critical thinking skills can be seen in Figure 5.



F = female, M = male

Figure 5. Person DIF plot based on gender for critical thinking skill on gender

Figure 6 shows only 3 items detected by DIF out of 20 questionnaire items for critical thinking skills, i.e., items with codes Q2, Q10, and Q12. This means that men are more able to ask questions that fit the arguments of friends/lecturers about modern physics concepts (Q10), are more able to define problems, formulate solutions, see the total problem then take action and evaluate those actions (Q12) than women. On the other hand, women feel more given the opportunity to assess the credibility of modern physics sources derived from books, the internet, or others (Q2) than men. Then DIF for reflective thinking skills detected 6 items out of 24 questionnaire items, DIF visualization of these items is shown in Figure 6.



F = female, M = male

Figure 6. Person DIF plot based on gender for reflective thinking skill on gender

Based on Figure 6, men are more prepared to take time to repeat learning that has been done on campus for deeper understanding (Q6), and more aware that understanding learning content while studying can do tasks well (Q22) than women. But women are more accustomed to doing modern physics problems without having to think long (Q1), are more observant in finding misconceptions that were previously believed to be true (Q2), more confident in giving the right answer to a problem so that there is no need to think again (Q5), more sufficient to focus on learning so that there is no need to look for additional information (Q20) than men.

More details for each of the second categories of perception thinking skills are in Table 3. Prospective teachers' perceptions of critical thinking skills show 17% from the low category, 68% from the moderate category, and 15% from the high category. If you pay attention, the percentage of low and high categories has a very wide range against the medium category. That is, the number of prospective teachers who have a "low" and "high" perception of critical thinking skills is very small compared to prospective teachers who have a "moderate" perception. However, if this is confirmed by the results of the person fit order analysis, it is found that the number of misfit persons is very large, reaching 64 or 66% of the total respondents. This indicates that it is likely that prospective teachers who fall into the

"moderate" category and even the "high" category are among the unworthy persons. A large number of misfit persons means that most respondents, in this case, prospective teachers, do not reflect the ideal model of score results (Wicaksono, 2021). Therefore, the perception of each prospective teacher in a "moderate" and even "high" position deserves further study.

Table 3 also provides detailed information on the categorization of the perception of prospective teachers toward reflective thinking skills. 11% look low, 78% look medium, and 11% respond high. There is a very long range between the "low" and "high" categories against the "medium" categories. This shows that the number of prospective teachers in both categories is quite small compared to the "moderate" category. However, if confirmed by the analysis of the order fit person, there is a large percentage of misfit persons, 53 or 67% of the total respondents. This means that prospective teachers in the category of "moderate" or even "high" reflective thinking tend to be indicated as inappropriate. So, conducting a more in-depth study is necessary to ascertain the truth of these allegations.

After a more in-depth study of the data of non-conforming persons on both thinking skills. Found a misfit of 50 persons in the moderate category and a misfit of 6 persons in the high category for critical thinking skills. As for reflective thinking skills, 43 persons were found in the medium category, and six misfit persons in the high category. These findings confirm that most of the data in the "moderate" category indicate a person's incompatibility. Even the "high" category data also has some misfit persons. Thus, it can be presumed that prospective teachers' critical and reflective thinking skills are still low. Therefore, it is necessary to strengthen in the form of treatment, training, or workshops to instill the confidence of prospective teachers to have strong critical and reflective thinking skills.

Learning interactions should refer to the development of technology and science and the needs of the present and the future. Technology information continues to develop and update educational applications (Prieto et al., 2019; Tang and Hai, 2021; Tseng and Hill, 2020). Students feel comfortable using digital technology and adopt new technologies easily and quickly. The rapid development of technology and science requires teaching staff to have high 21st-century literacy skills (Damaianti et al., 2020; Mutohhari et al., 2021). There are many obstacles to developing literacy skills, especially reading literacy and developing high-level thinking tests (Damaianti et al., 2020; Nelson-Hurwitz and Buchthal, 2019). So sometimes, teaching staff are not familiar with the literacy of higher order thinking skills, making it difficult to apply in learning. Educators' knowledge of higher-order thinking skills and literacy creates a learning atmosphere that can accommodate 21st-century skills.

In today's digital era, learning *outcomes* must refer to the competencies needed in the 21st century. Such competencies, such as critical thinking skills, problem-solving skills, collaboration skills, and communication skills, are known as higher-order thinking skills (Bao and Koenig, 2019; Su and Shum, 2019; Tijsma et al., 2020). So far, the provision of higher-order thinking skills has not been carried out massively in educational institutions and units, causing teaching staff to be unfamiliar with higher-order thinking skills tests (Pham et al., 2020; 2019; Wale and Bishaw, 2020). So, the evaluation of learning often carried out is limited to checking low-thinking skills, given the lack of provision of critical and reflective thinking skills. There is a low perception of these two skills. More intense training, workshops, and education for educators and aspiring educators should be needed. Many life skills are needed in the 21st century, including critical and reflective thinking skills.

Conclusion

The results of the data analysis show that prospective teachers' perceptions of critical and reflective thinking skills are mostly in the moderate category. In detail, 17% of prospective teachers perceive low critical thinking skills, 68% moderate perception, and 15% high perception. As for reflective thinking skills, 11% of prospective teachers have a low perception, 78% of prospective teachers have a medium perception, and 11% of prospective teachers have a high perception. However, there are many misfit persons, 66% for critical thinking skills and 67% for reflective thinking skills. This means prospective teachers do not have strong perception beliefs in both thinking skills. Therefore, it needs to be strengthened through treatment, training, or workshops to further train both skills.

Recommendations

Based on the results of data analysis, it is known that the perceptions of prospective teachers on critical and reflective thinking skills vary. Most perceptions of prospective teachers are in the moderate category, but given the number of people who are misfits, this category is suspected to contain doubts. Therefore, it is necessary to do further research to obtain more convincing results.

Acknowledgements

Thanks very much to Lembaga Pengelola Dana Pendidikan (LPDP), Indonesian Ministry of Finance, and Hamzanwadi University for providing me with financial support during my study at Indonesia University of Education, Indoensia.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Journal for the Education of Gifted Young Scientists, 12(3), 151-164, Sept 2024
e-ISSN: 2149- 360X
jegys.org
dergipark.org.tr/jegys

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Research Article

Postgraduate theses published in the field of preschool music education in Turkiye: a bibliographical study

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Article Info

Received: 19 July 2024
Accepted: 12 Sept 2024
Available online: 30 Sept 2024

Keywords
Early childhood music
Graduate theses
Preschool
Preschool music

Abstract

Preschool music education is an important field that affects and shapes the whole life of the individual. Preschool music education, which has not become a separate discipline for many years, has become a separate field of study both in preschool departments and in units such as music education departments and music departments with the development of the university structure and the diversification of departments. Rapidly increasing scientific studies and new approaches every year indicate the need for this field. At this point, graduate theses that contribute to the literature are important. In this study, which aims to examine graduate theses published in the field of preschool music education in Türkiye from a bibliographic point of view, all theses between 1985, the date of the first thesis, and the present day were included in the study. The study sample was limited to theses registered in the Thesis Documentation Center of the Council of Higher Education and open to access, and 94 theses were included in the sample. In the study, theses were examined in terms of university, distribution according to the years they were written, types, institute, method used, research design, sample selection, sample scope, data collection tools and analysis methods used. Frequency (f) and percentage (%) were used to analyze the data and the results were shown in tables and figures. As a result of the research, it was found that most of the theses were written in 2019 at Gazi University, within the scope of Educational Sciences Institutes, and that quantitative methods were mostly used as methods in the theses, experimental models were used, sample selection was determined randomly, and children between 26-72 months were generally studied. While questionnaires were mostly used as data collection methods, it was concluded that frequency and percentage analysis methods were used. In line with the results of the research, it is thought that conducting bibliometric studies at certain intervals will contribute to the literature.

To cite this article:

Ucer, O., Goksel, R.E., and Sonsel, O.B. (2024). Postgraduate theses published in the field of preschool music education in Turkiye: a bibliographical study. *Journal for the Education of Gifted Young Scientists*, *12*(3), 151-164. DOI: http://dx.doi.org/10.17478/jegys.1519175

Introduction

The educational process in the first years of life covers an important period in their development, as it is a process in which the needs of the individual are met for the first time after the family and the foundations of their educational life are laid (Kurnaz, Göreli, Coşkun, Sert & Altun, 2024, p. 443). This period of the first years of life is an issue to which different societies are sensitive. Various researches and studies on this subject have increased from the past to the present and the idea that the effects of the first five years of children's lives continue throughout their lives has become more and

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more widespread (Oktay, 1983, p. 3). When approaching this period in terms of education, it can be said that this period corresponds to the pre-school period. According to the Basic Law on National Education, preschool education is the education of children who have not reached the age of compulsory primary education. The aims and duties of pre-school education, in accordance with the general aims and basic principles of national education, are to ensure that children develop their body, mind and emotions and acquire good habits, to prepare them for primary education, to create a common growth environment for children from disadvantaged backgrounds and families, and to ensure that children speak Turkish correctly and beautifully (MoNE, 1973).

With the establishment of the Republic, one of the most important reforms in all fields was undoubtedly education. In the transition to the young Republic, some educational institutions were renewed according to the conditions and requirements of the day, some educational institutions terminated their activities, and some educational institutions were established from scratch in order to catch up with modern education. The first policies of the young Republic, despite the fact that it had emerged from the war, wounded on all fronts and economically collapsed, were related to education. According to Atatürk, the policy adopted was to "nurture national ideals, create a free and national state, and establish a dynamic and modern society" (Çetin & Gülseren, 2003, p. 2). The rapid innovations made in all areas of education also manifested themselves in art education, and the "Music Teachers' School (Musiki Muallim Mektebi)" was officially established on 1 November 1924. This first and only institution had the mission of meeting both the need for music teachers and the need for artists in the country in those days. For thirteen years between 1924 and 1937, until the Ankara State Conservatory was officially established in 1936 and started education in 1937, Music Teachers' School contrary to its name, had to concentrate on performance education (Özeke, 2003, p. 2). In 1924, this branch of education, which came into existence with the opening of the Music Teachers' School, tried to take root and develop under the roof of institutions such as Ankara State Conservatory and Gazi Education Institute, and the opinions and cooperation of local and foreign experts were needed during the search for new structuring (Kalyoncu, 2004). According to the first published Music Teachers' School Instruction (Musiki Muallim Talimatnamesi), the courses planned to be taught at the school were as follows, theory (musiki nazariyatı), musical reading (musiki kıraati), harmony, composition, counterpoint, history of music, vocal, Turkish literature, aesthetics (bediiyat), general civilisation history, history of Turkish civilisation, geography of Türkiye, ruhiyat (psychology), fenn-i terbiye (educational sciences) and special teaching methods (usul-i tedris), French, nature study, applied wisdom (practice, internship) and chemistry, scientific and applied calculus and hendese (applied mathematics and geometry), general and applied hygiene (health), patriotism and professional ethics, physical education (terbiye-i bedeniye) (Music Teachers' School, 1925). In addition, final year students were also subjected to an internship practice called the "practice" period. These students were called "assistant teacher" (Muallim Muavini) and worked as interns in their own schools with a salary of 10 penny (kuruş) (Tangülü & Becerikli, 2020, p. 461). As can be seen from the courses, the institution started its education life with a programme that aimed to train a music teacher in a multifaceted way in terms of both field skills and cultural and vocational courses. However, the fact that the content of the field courses was generally oriented towards secondary education caused a restrictive situation for the trained music teachers to teach at different levels because the institution was established with the aim of training music for secondary education (Öztürk, 2014, p. 10). From the Music Teachers' School) founded in 1924 to the Music Department of Gazi Institute of Education in 1937, to the Music Departments of Gazi, Atatürk and Buca Education Institutes in the 1960s, to the Music Departments of Higher Teacher Training Schools with the regulations in 1978-1979, and finally to the Music Education Departments of the Faculties of Education, which were affiliated to universities with the radical regulation in 1982, and today to the Music Education Departments. In the first quarter of the foundation of the Republic, both bureaucrats assigned by the state and local and foreign artist experts determined to carry out music reforms created art forms and institutions such as orchestra, opera, conservatory and theatre out of nothing. The foundations of today's understanding of music education were laid in that period, and the process following this period has risen on the foundations laid (Şimşek, 2018, p. 249).

Music education in Türkiye has taken many years to incorporate the needs of different age groups into its programmes, taking into account the possibility of teaching at different levels of education. Prior to the establishment

of today's preschool institutions, the institutions established to continue the education of these children included Primary School (Sıbyan Mektepleri), Islahhanes and Darüleytams, whose establishment dates back to the Karahan and Seljuk periods (Akyüz, Uygun & Kafadar, 2005, p. 150). General music education, which today covers the process from pre-school education to the end of high school, had a more limited scope until the 1950s. Pre-school education and music education were separate fields, not included in each other's programmes. Although the roots of pre-school education go back to the Ottoman Empire, no institutional initiative was taken until the 1927-1928 academic year after the establishment of the Republic. The "Main Teachers' School" (Ana Muallim Mektebi), which was reopened in Ankara at that time, was closed in 1932 (Bardak, 2023, p. 2). These schools, which trace their roots back to Darülmuallimat (an educational institution opened in 1870 in the Ottoman Empire to train teachers for primary and secondary girls' schools), include a variety of different courses, including "Song (gına) and Piano" lessons. The content of these courses included general information about music, sheet music, school songs, two-part singing, violin and piano exercises, reading music in the key of G, and reading unison and two-part pieces (Güler & Öztürk, 2003, p. 271). In the early years of the Republic, it became important for all Turkish citizens to be literate with the alphabet revolution, and a large part of the country's resources were spent on adult education by transferring them to "National Schools" (Millet Mektepleri). Preschool education was limited to the family and local administrations (Çelik & Gündoğdu, 2007, p. 177).

Although there had been some attempts at pre-school education in the past, without good results, kindergartens began to be opened in 1915 with the Ordinance on Kindergartens. Although the desired efficiency could not be achieved in the first years of the Republic, the importance of pre-school education was discussed at the IVth meeting of the Council of the Ministry of National Education in 1949 and the relevant regulations in this direction were prepared at the Vth meeting of the Council of the Ministry of National Education in 1953. In addition to the above-mentioned developments, one of the important steps taken in this context was the establishment of the Child Development and Education Departments of the Girls' Technical Higher Teacher Training Schools in 1960 to train teachers in this field. In the following years, studies on the subject continued, and with the enactment of the National Basic Education Law No. 1739 in 1973, pre-school education took its place in formal education. Looking at the institutions that were opened and the council meetings that were held during this process, it can be said that the XIV Council of the Ministry of National Education in 1993 was the first council where detailed decisions on pre-school education were made for the first time (Öztürk, 2008, p. 12).

In the field of pre-school education programmes, general framework programmes and principles were established in Türkiye until the 1900s. The first draft programme in the field of preschool education was adopted and implemented in 1953. The 1989 programme, which was implemented after the 1953 programme, is the first and only programme prepared with a thematic approach in the field of pre-school education. The 1994 programme, implemented in 1994, is the first developmental programme and includes specification tables. The 2002 and 2006 programmes, which were implemented after this programme, aimed to raise the child's behaviour to a higher level in all areas of development. The kindergarten programme was included in the programme that was implemented in 2013, the importance of family education and participation was emphasised in the updated programme, and the "Family Support Education Guide Integrated with the "Ministry of National Education Preschool Education Programme" and the "Family Support Education Guide" were prepared for the first time in the said programme. The Preschool Education Programme, which was last updated in 2024, is based on the child-centred design approach based on the progressive philosophy and is structured according to the process model among the programme models. This structuring is gaining importance as the most effective framework to support the development of the individual model required by the 21st century (MoNE, 2024). It is well known that music has been used both as an educational field and as an educational tool from the past to the present. This issue has attracted the attention of famous thinkers such as Confucius, Plato, Farabi, as well as educators such as Rousseau, Pestaloozzi and Dewey. At the same time, different names such as Gesell, Bühler and Piaget, who contributed to the development of pedagogy, emphasised the importance of using music and art as an educational method (Başer, 2004).

In early childhood, it aims to stimulate children's love for music with basic musical skills, develop their rhythmic feelings and auditory skills, and contribute to the development of their aesthetic feelings so that they can create a general music culture (Özkut & Kaya, 2012, p. 167). In this context, it is of great importance to pay due attention to preschool music education as the preschool period is the first step of general music education. The music education to be given to children should take into account their level of development and attention should be paid to providing music education that supports all areas of development (Yüksel, 1996, p. 59). It is also proved by studies in the literature that the use of musical activities that give pleasure to children in terms of including play in better understanding and understanding the inner world of children in early childhood supports different developmental areas of children (Deleş & Kaytez, 2020, p. 7).

It is also stated by researchers that the use of music as an educational tool in the preschool period contributes to children's mental, physical and psychomotor, cognitive and language, spiritual and creative, emotional and social development (Kabataş, 2017, p. 156). In the preschool period, which is a critical period in terms of children's development and learning, children should be supported and motivated towards musical activities with various sound and rhythm exercises, singing activities, etc., where they can express their imagination and creativity through music without restricting their freedom and abilities (Yüksel, 1996, p. 54). In this direction, it can be stated that preschool music education using different methods and techniques has an effect on the development of students' listening, perception, imitation, singing, creative thinking, cognitive, affective, emotional and language development (Denizkurdu & Eker, 2023, p. 256). In addition, it can be stated that the musical education to be given to children in kindergartens will contribute to the development of their personality by developing them physically and mentally, and will also contribute to the formation and development of their musical tastes (Şen, 2006, p. 342).

It is very useful for pre-school music education to find a place as a field today and for pre-school music education to be planned scientifically and pedagogically. The Hungarian composer and music pedagogue Zoltan Kodaly underlined the importance of early childhood by pointing out that musical education begins in the womb (Cary-Göktürk, 2012). Nowadays, the number of academics and educators working on combining these two disciplines is increasing every day, and scientific studies are being published every day. A periodical review of academic studies in this field will serve as a guide for educators and researchers and will provide a measure of the progress made over time. Based on all this information, the problem statement of this research is; What is the appearance of the postgraduate theses published in the field of preschool music in Turkiye?

In the light of this main problem, the research sought answers to the following sub-problems;

- How are the published postgraduate theses in terms of publication year?
- How are the published postgraduate theses in terms of universities?
- How are the published postgraduate theses in terms of institute diversity?
- How are the published postgraduate theses in terms of thesis type?
- How are the published postgraduate theses in terms of the method used?
- How are the published postgraduate theses in terms of research design?
- How are the published postgraduate theses in terms of sample selection?
- How are the published postgraduate theses in terms of sampling scope?
- How are the published postgraduate theses in terms of data collection tools?
- How are the published postgraduate theses in terms of the analysis techniques used?

Method

Research Design

A model is defined as “a summarised version of the actual situation, which is representative of a system and an ideal environment, including only the variables considered important” (Karasar, 2009, p. 76). This research, which aims to examine the postgraduate theses published in the field of preschool music in Türkiye from various perspectives, was conducted in accordance with the document analysis technique, which is one of the qualitative research methods. In

qualitative research, “qualitative data collection techniques such as observation, discourse analysis, interview, document analysis are generally used. In addition, qualitative research, which is based on in-depth examination of human perceptions and events in social reality and natural environment, has a holistic perspective that combines different disciplines” (Hatch, 2002; Merriam & Grenier, 2019; cited in Baltacı, 2019, p. 370). Bibliometric research is an analytical method that sheds light on the developments and problems in a related discipline or makes suggestions by determining the current status of the discipline (Ball & Tunger, 2006), it is the numerical analysis of the relationships between publications proposed by institutions or individuals in a given region within certain periods (Broadus, 1987, p. 374).

Population and Sample

While the universe refers to all the objects, objects and individuals that are in the field of any study, research or observation, sampling is the process of selecting a part that can represent it in the most accurate way from this universe (Kaptan, 1998, pp. 116-118). The population of this study consists of all postgraduate theses published in the field of preschool music education in Türkiye between 1985 and 2024. The sample of the study was determined by simple random sampling method, which is one of the sampling methods. Büyüköztürk defines simple random sampling method as "a study in which each sampling unit is given an equal probability of selection" (Büyüköztürk, 2012). In determining the sample of the study, the master's, doctoral and diploma theses registered at the Thesis Documentation Centre of the Council of Higher Education were searched with the keywords 'preschool', 'preschool music', 'early childhood music', 'kindergarten and/or preschool music', 'music education in the age group 3-6/4-6/5-6' and 99 postgraduate theses were obtained. While the population of the study consisted of these 99 dissertations, the sampling of the study was limited to 94 dissertations due to the fact that one dissertation was out of scope and 4 dissertations were not accessible.

Data Collection Process and Data Analysis

In order to collect the data for the study, 99 postgraduate theses conducted between 1985 and 2024 were reached as a result of the search in the National Thesis Data website of the Higher Education Institution with the keywords “pre-school”, “pre-school music”, “early childhood music”, “kindergarten and/or pre-school music”, “3-6/4-6/5-6 age group music education”. As a result of the search, 94 theses, including 79 master’s, 13 doctoral and 2 proficiency in art theses, were included in the scope of the study because one thesis was out of scope and 4 theses were inaccessible. The studies included in the scope of the study were classified according to years, universities, thesis types, methods and designs, sample selection and sample scope, data collection tools and analysis techniques used. Maxqda 24. package programme was used in the content analysis of the data obtained and the results of the analysis were shown under the relevant tables.

Findings

Findings and Comments Related to the Sub-Problem

In the first sub-problem of the research, the findings related to the question “How is the distribution of postgraduate theses in the field of preschool music education according to years?” are presented.

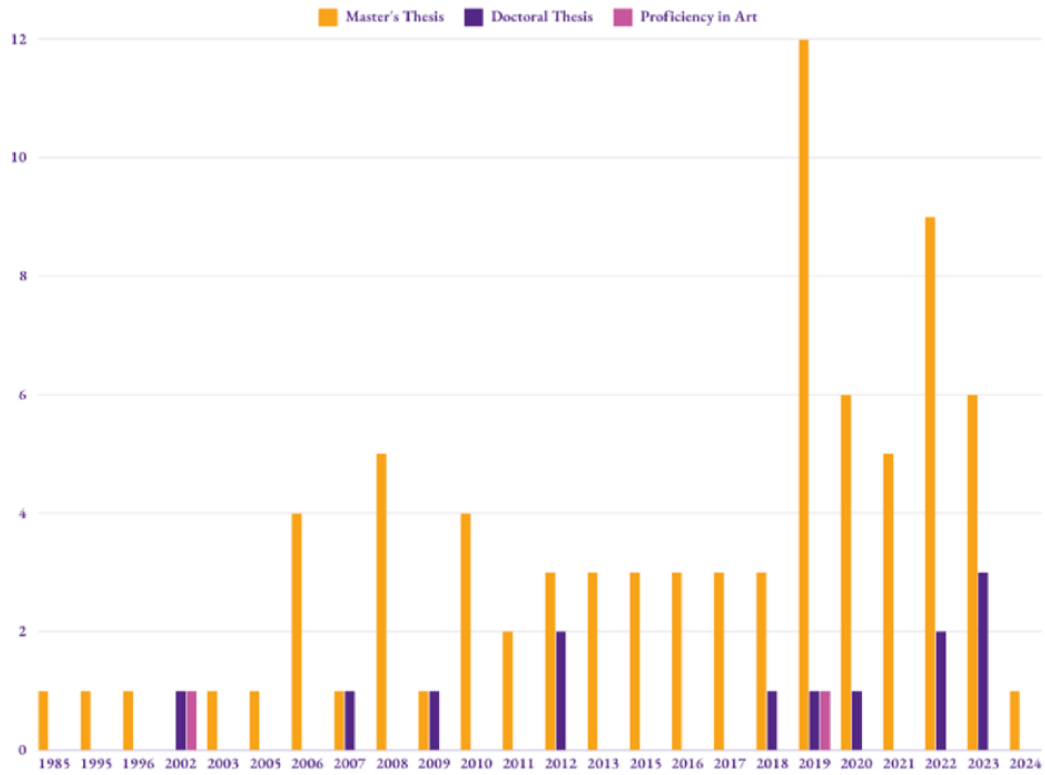

Figure 1. Distribution of postgraduate theses according to years

Looking at Figure 1, it was determined that most master's theses were written in 2019 (12), most doctoral theses were written in 2023 (3), and proficiency in art theses were written in 2002 and 2019. In addition, it was seen that the most postgraduate theses were written in 2019 (14). postgraduate studies in the field of pre-school music education can be examined in 3 periods. 1985-2009 is the first period in which the number of theses is numerically low and the process is static. While the 2010-2018 period emerged as the second period in which the theses gained momentum, it can be considered as the third period in which the momentum of the theses from 2019 to the present has increased. The total number of postgraduate theses in the first two periods is less than the theses in the third period. This shows that preschool music education has found more place in the academy in 2019 and after.

Findings and Comments Related to the Sub-Problem

In the second sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to universities?" are presented.

Table 1. Distribution of postgraduate theses according to universities

University	Master's Thesis		Doctoral Thesis		Proficiency in Art		Total	
	f	%	*f*	%	*f*	%	*f*	%
Gazi University	13	16.46	4	30.77	-	-	17	18.09
Marmara University	13	16.46	2	15,38	-	-	15	15.96
Ondokuz Mayıs University	5	6.33	1	7.69	-	-	6	6.38
Atatürk University	3	3.8	-	-	-	-	3	3.19
Cumhuriyet University	3	3.8	-	-	-	-	3	3.19
Pamukkale University	3	3.8	-	-	-	-	3	3.19
Selçuk University	3	3.8	-	-	-	-	3	3.19
Uludağ University	3	3.8	1	7.69	-	-	4	4.25
Adıyaman University	2	2.53	-	-	-	-	2	2.12
Ankara University	2	2.53	1	7.69	-	-	3	3.19
Haliç University	2	2.53	-	-	-	50	3	3.19
İnönü University	2	2.53	1	7.69	-	-	3	3.19
İstanbul Okan University	2	2.53	-	-	-	-	2	2.12
Mehmet Akif Ersoy University	2	2.53	-	-	-	-	2	2.12
Yıldız Teknik University	2	2.53	-	-	-	-	2	2.12
Abant İzzet Baysal University	1	1.27	-	-	-	-	1	1.06
Afyon Kocatepe University	1	1.27	-	-	-	-	1	1.06
Akdeniz University	1	1.27	-	-	-	-	1	1.06
Anadolu University	1	1.27	-	-	-	-	1	1.06
Bahçeşehir University	1	1.27	-	-	-	-	1	1.06
Balıkesir University	1	1.27	-	-	-	-	1	1.06
Çukurova University	1	1.27	1	7.69	-	-	2	2.12
Dokuz Eylül University	1	1.27	-	-	-	-	1	1.06
Fatih Sultan Mehmet V. University	1	1.27	-	-	-	-	1	1.06
Hacettepe University	1	1.27	-	-	-	-	1	1.06
İstanbul University	1	1.27	-	-	1	50	2	2.12
Müzik ve Güzel Sanatlar University	1	1.27	-	-	-	-	1	1.06
Necmettin Erbakan University	1	1.27	1	7.69	-	-	2	2.12
Niğde University	1	1.27	-	-	-	-	1	1.06
Trabzon University	1	1.27	-	-	-	-	1	1.06
Trakya University	1	1.27	-	-	-	-	1	1.06
Ufuk University	1	1.27	-	-	-	-	1	1.06
Üsküdar University	1	1.27	-	-	-	-	1	1.06
Van Yüzüncü Yıl University	1	1.27	-	-	-	-	1	1.06
İstanbul Teknik University	-	-	-	7.69	-	-	1	1.06
Toplam	**79**	**100**	**13**	**100**	**2**	**100**	**94**	**100**

Table 1 shows that the highest number of master's theses were conducted at Gazi University and Marmara University (13). While the highest number of doctoral theses were conducted at Gazi University (4), this number was followed by Marmara University. In addition, it was determined that the proficiency in art theses were conducted at Haliç and Istanbul Universities. The fact that Gazi University is the first teacher school in the history of the republic and Marmara University is the second institution and their history is based on very old times can be considered as an indicator of the high number of theses made in these schools.

Findings and Comments Related to the Sub-Problem

In the third sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to the institute?" are presented.

Table 2. Distribution of postgraduate theses by institute

Institutes	Master's Thesis		Doctoral Thesis		Proficiency in Art		Total	
	f	%	*f*	%	*f*	%	*f*	%
Institute of Educational Sciences	47	59.49	9	69.23	-	-	56	59.57
Institute of Social Sciences	22	27.84	2	15,38	1	50	25	26.59
Institute of Postgraduate Education	6	7.59	1	7.69	1	50	8	8.51
Institute of Health Sciences	2	2,53	-	-	-	-	2	2.12
Institute of Music and Fine Arts	1	1.27	-	-	-	-	1	1.06
Institute of Fine Arts	1	1.27	-	-	-	-	1	1.06
Institute of Science	-	-	1	7.69	-	-	1	1.06
Total	**79**	**100**	**13**	**100**	**2**	**100**	**94**	**100**

Table 2 shows that the majority of the postgraduate theses were conducted in the institutes of educational sciences (58) and social sciences (25). The reason why most of the theses were conducted in the institutes of education and social sciences can be explained by the fact that the scope of the research is education-oriented. It is thought that the reason why there are so few theses in the field of postgraduate, music and fine arts is due to the fact that it is newer than other institutes.

Findings and Comments Related to the Sub-Problem

In the fourth sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to their types?" are presented.

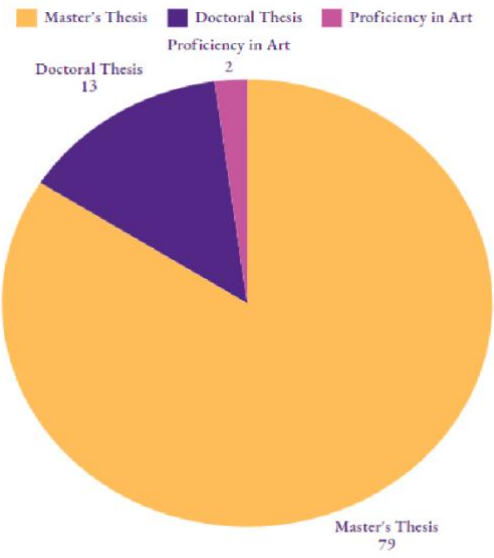

Figure 2. Distribution of postgraduate theses according to their types

Figure 2 shows that 79 master's theses, 13 doctoral theses and 2 proficiency in art theses were conducted. It is thought that the reason why there are more master's theses here is that there are master's programmes in almost every university.

Findings and Comments Related to the Sub-Problem

In the fifth sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to the method?" are presented.

Table 3. Distribution of postgraduate theses according to method

Method	Master's Thesis		Doctoral Thesis		Proficiency in Art		Total	
	f	%	*f*	%	*f*	%	*f*	%
Quantitative Methods	54	68.37	6	46.15	2	100	62	65.96
Qualitative Methods	17	21.52	3	23.07	-	-	20	21.28
Mixed Methods	4	5.1	3	23.07	-	-	7	7.45
Unspecified	4	5.1	1	7.69	-	-	5	5.32
Total	**79**	**100**	**13**	**100**	**2**	**100**	**94**	**100**

When Table 3 is examined, it is seen that quantitative methods are mostly used in the choice of method in the postgraduate theses.

Findings and Comments Related to the Sub-Problem

In the sixth sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to the research design?" are presented.

Table 4. Distribution of postgraduate theses according to research design

Method	Research Design	*f*	%
Quantitative Methods	Experimental	31	32,98
	Survey	24	25,53
	DescriptiveSsurvey	8	8,51
Qualitative Methods	Case Study	9	9,57
	Phenomenological	4	4,26
	Action Research	3	3,19
	Descriptive Survey	2	2,13
	Surver	2	2,13
Mixed Methods	Explanatory Sequential Design	2	2,13
	Convergent (Variant) Design	1	1,06
	Unspecified	5	5,32
Unspecified		3	3,19
Total		**94**	**100**

When Table 4 was analysed, it was seen that the most common experimental design (31) was used in quantitative method designs and the most common case study (9) was used in qualitative method designs. However, it was seen that the design used in the postgraduate theses in which mixed design research approach was used was not specified (5) and it was determined that no information was given about the design used in 3 theses.

Findings and Comments Related to the Sub-Problem

In the seventh sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to sample selection?" are presented.

Table 5. Distribution of postgraduate theses according to sample selection

Sample Selection	*f*	%
Random Sampling	18	19,15
Convenience Sampling	15	15,96
Purposeful Sampling	14	14,89
Cluster Sampling	7	7,45
Criterion Sampling	4	4,26
Maximum Variation Sampling	1	1,06
Unspecified	35	37,23
Total	**94**	**100**

When Table 5 is analysed, it is determined that the most common sampling techniques used in postgraduate theses are random sampling (18), convenience sampling (15) and purposeful sampling (14). However, in 35 postgraduate theses, there was no information about which sampling technique was used during sample selection.

Findings and Comments Related to the Sub-Problem

In the eighth sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to the sample levels?" are presented.

Table 6. Distribution of postgraduate theses according to their sampling scopes

Sample Scope	***f***	***%***
3-6 years old (36-72 months old)	38	40,43
Preschool teacher/Music teacher/Academician	32	34,04
Music lesson programs/Books/Theses	8	8,51
Preschool/Music teacher candidate	5	5,32
Preschool and Classroom Teacher	3	3,19
Parent	2	2,13
0-6 years old	1	1,06
Parent and Kindergarten Teacher	1	1,06
Preschool Teacher Candidate and Preschool Teacher	1	1,06
Preschool and Child Development Teacher Candidate	1	1,06
Unspecified	2	2,13
Total	**94**	**100**

When Table 6 is examined, it was determined that most of the sample scopes used in graduate theses were preschool children aged 3-6 years (36-72 months) (38), preschool/music teacher/academician (32) and music lesson programmes/books/theses (8), respectively. However, there were 2 postgraduate theses in which the scope of the sample was not specified.

Findings and Comments Related to the Sub-Problem

In the ninth sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to the data collection tools used?" are presented.

Table 7. Distribution of data collection tools used in postgraduate theses

Method	**Data Collection Tools**	***f***	***%***
Quantitative Methods	Survey	29	28,43
	Scale	19	18,63
	Achievement, Screening, and Skill Scale/Test/Inventory	19	18,63
	Lesson Observation/Evaluation Form	2	1,96
Qualitative Methods	Semi-structured Interview Form	10	9,80
	Document Analysis	7	6,86
	Structured Interview Form	4	3,92
	Observation Form	1	0,98
Mixed Methods	Scala	3	2,94
	Structured Interview Form	2	1,96
	Achievement and Skill Scale/Test	2	1,96
	Semi-structured Interview Form	1	0,98
Unspecified		3	2,94
Total		**102**	**100**

When Table 7 is analysed, it is seen that surveys (29) are mostly used in quantitative method data collection tools, semi-structured interview form (10) is used in qualitative method data collection tools and scale (3) is used in mixed method data collection tools. The reason why the number of data collection tools is higher than the number of postgraduate theses is due to the fact that more than one data collection tool is used together in some studies.

Findings and Comments Related to the Sub-Problem

In the tenth sub-problem of the research, the findings related to the question "How is the distribution of postgraduate theses in the field of preschool music education according to the analysis techniques used?" are presented.

Table 8. Distribution of postgraduate theses according to the analysis techniques used

Analysis Techniques			***f***	***%***
Quantitative Methods	Descriptive Statistics	Frequency/Percentage	33	20,37
		Mean, Standard Deviation	7	4,32
		Graphical Representation	6	3,70
	Inferential Statistics	Mann-Whitney U test	26	16,05
		Independent Samples T-test	15	9,26
		Wilcoxon Signed-Rank Test	14	8,64
		Analysis of Variance (ANOVA)	10	6,17
		Kruskal-Wallis H test	8	4,94
		Paired Samples T-test	7	4,32
		Chi-square (χ^2)	6	3,70
		Correlation/Regression	4	2,47
		Pearson's r	1	0,62
Qualitative Methods		Content Analysis	16	9.88
		Descriptive Analysis	6	3.70
Unspecified			3	1.85
Total			**162**	**100**

In Table 8, when the distribution of analysis techniques used in graduate theses is examined, it is found that in quantitative method studies, frequency/percentage (33) is most commonly used in descriptive statistics, and Mann-Whitney U test (26) is most commonly used in inferential statistics. In qualitative method studies, it is observed that content analysis (16) is most frequently utilized. However, in 3 graduate studies, the analysis technique used was not specified.

Conclusion, Discussion and Recommendations

In this study, it was tried to determine how the postgraduate theses published in the field of preschool music in Türkiye from 1985 to the present. In this direction, 94 theses were analysed in terms of the variables considered within the scope of the study.

When the theses were analysed according to the years in which they were conducted, it was found that the most thesis studies were conducted in 2019. Other studies in the literature are similar to the findings of the study (Belge, 2021; Çetinkaya, 2023; Katıtaş, 2021; Özparlak, 2020; Wang et al. 2022). In 2019, the reason for conducting more studies can be said to be due to the increased interest of researchers in the field of preschool music.

According to the findings obtained regarding the universities, it was found that the most thesis studies were carried out at Gazi University. The studies in the literature also show similarities with the findings of the research. Danacı, 2023; Kösreli, 2020; Özay, 2020; Üstün, 2020, concluded in their studies that the fact that Gazi University is the first teachers' school in the history of the Republic and its history is based on old times may be due to the fact that more postgraduate theses are carried out at this university.

When the distribution of theses according to the institutes was analysed, it was found that most of the thesis studies were conducted in the Institute of Educational Sciences. It can be thought that the fact that the institute in question is mostly located within universities and its establishment is based on a longer history compared to other institutes is the reason why more studies are carried out in this institute. When other studies in the literature are examined, they are similar to the findings of the study. Dursun and Bahadır, 2023; Kalkanoğlu, 2020; Kıvılcım and Çelik, 2023; Topaloğlu, 2023, determined that the most thesis studies were conducted in the institute of educational sciences.

In this context, when the distribution of the theses evaluated according to their types was examined, it was found that most thesis studies were carried out in the Master's programme. When the studies examining the current postgraduate theses in the field of music in the literature are examined, a similar result is obtained. Bak, 2023; Dönmez,

2022; Güler & Toptaş, 2022; Karaoğlu, 2024, reached the conclusion that the most master's theses were carried out in their studies. The reason why master's theses are more than the theses carried out in other programmes may be due to the fact that almost every university has a master's programme. The fact that there are more enrolment quotas for master's programmes compared to doctorate and proficiency in art programmes, and that not all doctorate and proficiency in art programmes exist within the institutes may also explain the higher number of master's theses.

When analysed according to the methods in which the theses were written, it was seen that quantitative methods were mostly used in the choice of method in postgraduate theses. Similar studies in the literature support this finding. Aydınlı-Gürler, 2021; Boyraz & Yazıcı, 2019; Düzbastılar & Koçal, 2021; Özer & Onuray-Eğilmez, 2021, found that the most commonly used method in postgraduate theses was quantitative method.

When the designs used in the theses were analysed, it was determined that the experimental design was used more. Ertekin-Kaya's (2023) study also supports this finding.

When the sampling choices of the theses were analysed, it was found that random sampling was mostly used. The study conducted by Aydınlı-Gürler (2021) is similar to the findings of this study. In addition, when the theses were analysed according to the sample levels, it was found that children between 36-72 months were generally studied. The findings of Yazıcı and Topalak (2019) in their study are similar to the findings of this study. When the data collection tools used in the theses were analysed, it was found that questionnaires were mostly used as data collection tools. The studies in the literature also support this finding. İldinç and Akkaş, 2023; Özer and Onuray-Eğilmez, 2021, concluded that questionnaires were mostly used in their study.

When the analysis techniques used in the theses were examined, it was found that frequency/percentage calculation technique was mostly used in the analysis of the data. Aksoy and Göklen, 2022; İldinç and Akkaş, 2023; Özer and Onuray-Eğilmez, 2021; Soycan, 2021, reached similar findings.

Looking at the results of the research in general, it was found that most of the dissertations were written in 2019 at Gazi University, within the framework of Educational Sciences Institutes, mostly quantitative methods were used as methods in the dissertations, experimental models were used, sample selection was determined randomly, and children between 36-72 months were generally studied. While the questionnaire was the most commonly used method of data collection, it was concluded that the frequency and percentage analysis method was the most commonly used method of analysis.

As a result of the results of the research, repeated studies can be carried out at certain intervals to provide a source for other scientific studies. In addition to this study, which includes dissertations published in the field of preschool music, articles and papers written in the related field can also be examined. Individuals graduating from Master's degree programmes can be encouraged to include studies on pre-school music education in their doctoral and arts programmes. Considering the existence of universities in all geographical regions of Türkiye, it can be ensured that universities more often include studies in the field of music related to preschool, which is a widespread educational institution.

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ISSN: 2149-360X