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Metaphorical Perceptions of Secondary School Students Regarding New-Generation Mathematics Questions

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Abstract

This research aims to examine the perceptions of secondary school 7th and 8th grade students about new-generation mathematics questions through metaphors. This phenomenological research involved 350 students enrolled in 7th and 8th grades from secondary schools through criterion-sampling. The students were asked to come up with three metaphors as well as their justifications to reveal their perceptions on new-generation mathematics questions. The metaphors were analyzed through the content analysis method to discover the underlying meanings behind their perceptions. The findings suggest that the perceptions of the students can be grouped under four main themes: complicated, troublesome, motivating, and comprehensive. The complicated theme highlights that students find these questions incomprehensible, insurmountable, and ambiguous. The troublesome theme underscores the difficulty students associate with new-generation mathematics questions. Interestingly, some students find new-generation mathematics questions motivating. They see these questions as realistic, instructive, manageable, and even entertaining. The perception of new-generation mathematics questions as comprehensive implies that they cover a broad range of topics or require students to consider various aspects when solving them. These findings indicate that students have diverse opinions and experiences when it comes to new-generation mathematics questions. While some may find them daunting and complex, others see them as stimulating and relevant to their learning.

Keywords: New-generation question, skill-based question, 21st century skills

Ortaokul Öğrencilerinin Yeni Nesil Matematik Sorularına İlişkin Metaforik Algıları

Özet

Bu araştırmada ortaokul yedinci ve sekizinci sınıf öğrencilerinin yeni nesil matematik sorularına ilişkin algılarının metaforlar aracılığıyla incelenmesi amaçlanmaktadır. Bu fenomenolojik çalışma, yeni nesil matematik sorularına yönelik metaforları ve bunların kökenlerini keşfetmeye odaklanmıştır. Araştırmaya ölçüt örnekleme yöntemiyle belirlenen yedinci ve sekizinci sınıflarda öğrenim gören 350 öğrenci katılmıştır. Öğrencilerden yeni nesil matematik sorularına ilişkin algılarını belirlemek amacıyla üç metafor ve bu metaforların gerekçelerini yazmaları istenmiştir. Metaforlar, öğrenci algılarının altında yatan anlamları ortaya çıkarmak için içerik analizi yöntemiyle analiz edilmiştir. Bulgular, öğrencilerin yeni nesil sorulara ilişkin algılarının karmaşık, uğraştırıcı, motive edici ve kapsamlı olmak üzere dört ana tema altında toplanabileceğini göstermektedir. Karmaşık teması, öğrencilerin bu soruları anlaşılmaz, üstesinden gelinemez ve belirsiz bulduklarını vurgulamaktadır. Uğraştırıcı teması, öğrencilerin yeni nesil matematik soruları ile ilişkilendirdiği zorluğa yöneliktir. Araştırmanın ilginç olan bir bulgusu, bazı öğrencilerin yeni nesil matematik sorularını motive edici bulmasıdır. Öğrenciler bu soruları gerçekçi, öğretici, üstesinden gelinebilir ve hatta eğlenceli bulmaktadırlar. Yeni nesil matematik sorularının kapsamlı olarak algılanması, bunların geniş bir konu yelpazesini kapsadığı ya da öğrencilerin çözerken çeşitli yönleri dikkate almasını gerektirdiği anlamına gelmektedir. Bu bulgular öğrencilerin yeni nesil matematik soruları konusunda farklı görüş ve deneyimlere sahip olduklarını göstermektedir. Bazıları bunları göz korkutucu ve karmaşık bulsa da, diğerleri onları teşvik edici ve öğrenmeleriyle alakalı bulmaktadır.

Anahtar Kelimeler: Yeni nesil soru, beceri temelli soru, 21. yy becerileri

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Introduction

In the 21st century, learning has become one of the most important agents of economic development, thus making human resource development a lifelong process (Tupe, 2019). The definitions and categorization of 21st-century skills are carried out by various researchers (Dede, 2010; van Laar et al., 2017; Voogt & Roblin, 2012) and organizations (OECD, 1997; Partnership for 21st-Century Learning-P21 [P21], 2009; UNESCO, 2018; European Commission [EC], 2019). Based on the OECD-sponsored project Definition and Selection of Competencies [DeSeCo] (1997), skills and competencies students should have discussed under three headings i) using tools interactively, ii) interacting in heterogeneous groups, and iii) acting autonomously (Ananiadou & Claro, 2009). In a similar vein, EC (2019) argues that lifelong learning is characterized by a combination of knowledge, skills, and attitudes, namely literacy competence, multilingual competency, mathematical and scientific competency, digital competence, personal, social, and learning to learn competence, citizenship competence, entrepreneurship competence, cultural awareness, and expression competence. The scope of information technology competencies defined by UNESCO (2018), which focuses on teacher training in the use of digital technologies at all levels, including primary, secondary, and higher education, includes teaching and learning, school management, continuing professional development, and classroom practices that align with institutional and national priorities.

One of the frameworks frequently used in the literature on 21st-century skills belongs to P21 (2019). According to this framework, 21st-century skills are divided into three categories: i) learning and innovation skills; ii) information, media, and technology skills; and iii) life and career skills. Learning and renewal skills include critical thinking, problem-solving, communication, and collaboration skills in order to adapt to increasingly complex living and working environments. The framework states that today's life flows in the focus of technology and media, which includes information literacy, media literacy, and information and communication technologies literacy skills. Finally, life and professional skills can be developed in complex living and working environments in order to become more flexible and adaptable, entrepreneurial, self-directed, social and intercultural, productive, and responsible (P21, 2019).

As 21st-century skills have been analyzed from different perspectives, their link to self-actualization has been found to differ significantly from 20th-century skills. Dede (2010) argues that it is necessary to differentiate the evaluation of related skills. With all of these changes and transformations in education, both the skills students need to gain and the assessment methods for demonstrating these skills have changed. According to the Ministry of National Education [MoNE] (2018), one of the steps to be taken toward achieving the 2023 Education Vision is the transition to a competency-based assessment and evaluation system. With the help of this system, it is intended to uncover models that relate to students' proficiency levels. Additionally, it was emphasized that arrangements would be made regarding the purpose, contents, and types of questions students would be expected to take in order to advance their learning. Rather than just considering the results, emphasis has been placed on developing a method of assessment that considers the process as well as the outcome.

In this context, it is seen that the central exams incorporate new-generation/skill-based questions. A skill-based question, also known as a new-generation question, measures knowledge, skill, and competence together. Depending on the context, these questions may also be expressed visually through figures, tables, or graphics (Erden,

2020). Questions usually begin with information on how to solve them and which procedures to use in the solution. Moreover, it involves demonstrating mathematical skills through real-life situations that students are required to use. In addition to acquiring basic skills, new-generation questions allow students to develop their knowledge (Sanca et al., 2021). Additionally, it appears to have a structure that is based on associating basic mathematical concepts as well as using new-generation questions to measure high-level skills (Atasoy, 2019; Kertil vd., 2021). Moreover, new-generation questions activate high-level skills processes in the same way as international exam questions such as PISA and TIMSS (Bayburtlu, 2021). A new-generation of questions also supports critical thinking, problem-solving, and association skills by giving students the opportunity to use their experiences in complex environments. Demir (2022) asserts that analytical thinking skills are the predictor of critical thinking skills, hence all thinking skills may have an effect on each other.

A variety of skill-based questions are regularly published by the Ministry of National Education. Teachers and students can use them in their lessons. In the 7th grade, a new-generation question (Figure 1) examines algebraic expressions using a plot and context from everyday life. The students were given an explanation describing the problem with the following statement at the beginning of the question: "The following figures are obtained by making use of screws and screw nuts whose horizontal and vertical positions are shown in the image.". It is evident from the new-generation question that there are visuals showing screw and screw nut positions vertically and horizontally. According to the representations of the screw and screw nut in different positions, students are expected to judge how the length/thickness changes. Students are supposed to use their association skills in order to answer this question.

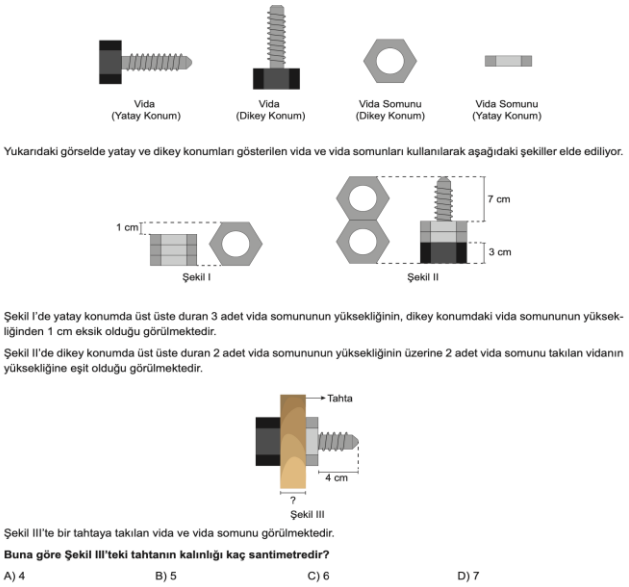

Figure 1. Example of new-generation mathematics question on algebraic expressions (MoNE, 2023a)

The Ministry of National Education has published another example of a new-generation mathematics question (Figure 2) that describes operations with square roots at the 8th grade level, and illustrates how a utility knife consists of a main part, spare parts, and an image related to it. A statement is included explaining how the utility knife tip is renewed when it becomes dull: "It is produced by joining the main parts end-to-end to break the tip and renew it.". This new-generation question requires calculating the length

of the utility knife's main part based on the lengths of the spare parts. Therefore, students should estimate the length of the main part based on the number of spare parts and make calculations about how long it should be based on the number of spare parts.

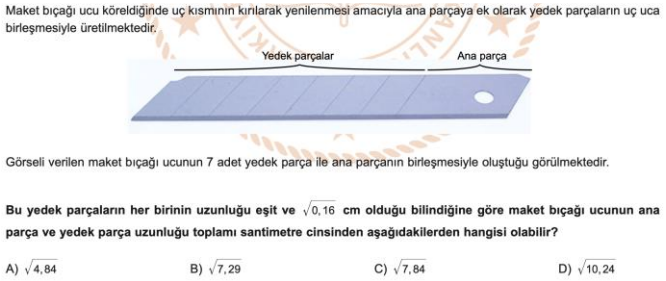

Figure 2. Example of new-generation mathematics question on operations with square roots (MoNE, 2023b)

A literature review of new-generation questions, a popular topic in recent years, indicates that studies are being conducted on the following topics: Examining perspectives on new-generation questions from teachers and/or students (Biber et al., 2018; Güler et al., 2019; Erden, 2020; Karakaya et al., 2020; Ulusoy, 2020; Kablan & Bozkuş, 2021; Kertil et al., 2021); examining 8th graders' metaphors about new-generation questions (Şad & Aydın, 2023); examining secondary school students' attitudes towards new-generation questions and mathematics lessons (Türker et al., 2023); evaluation of new-generation questions according to the Revised Bloom Taxonomy (Sanca vd., 2021); developing a student attitude scale towards new-generation questions (Kılcan, 2021); examining the effects of teaching supported with new-generation mathematics questions on student' academic success and their views (Taş & Akgün, 2021); presenting strategies for solving new-generation mathematics questions more easily (Atasoy, 2019). As a result, Karakaya et al. (2020) examined the opinions of teachers working in various branches of science high schools regarding the central exams. It was determined that teachers thought the new-generation question type in the exams would enable them to make more in-depth evaluations of the subjects with the use of the new-generation question type. Teachers believe they help students develop high-level skills in mathematics, according to Kablan and Bozkuş (2021), but their perceptions of teaching approaches are incompatible with the approaches that should be in place. However, students expressed frustration and boredom when solving new-generation questions. Şad & Aydın's (2023) study found common metaphors used by middle school 8th grade students including the brain, climbing a mountain, ladder, space, dream, impossible labyrinth, steep rock, strategy wars, and the Sirat bridge. Sanca et al. (2021) analyzed a total of 180 new-generation questions prepared by the MoNE at the secondary school level according to the Revised Bloom Taxonomy. The authors determined that 14.4% of the questions were at the remembering level, 77.9% at the understanding level, 1.6% at the applying level, 1.1% at the analyzing level, and 5% at the creating level.

In the current study, students' perceptions of this change in assessment are examined through metaphors with the idea that it is important to find out what the new-generation question type means for them. This study is timely, considering that the evaluation method of 21st-century skills, which emerged with the changes and transformations that accompanied the gainings of the present era, should be revised. It is predicted that the study will be an original one because it will consider secondary school students' perceptions of new-generation mathematics questions through metaphors, which are ways of expressing ideas (Lakoff & Johnson, 2005). In this regard, it is expected that the results

of this study on the perceptions of 7th and 8th grade secondary school students regarding new-generation mathematics questions will be contributory. In this context, the aim of this research is to examine the perceptions of secondary school 7th and 8th grade students about new-generation mathematics questions through metaphors.

Method

Research Design

This research is based on a phenomenological design, which is a qualitative research approach. Phenomenological studies are those that explore the meaning found in the lived experiences of individuals concerning a particular phenomenon or concept (Creswell, 2007). A phenomenological approach seeks to understand in depth the nature of everyday experiences (Patton, 2001). Additionally, phenomenology studies have an interpretive dimension, which researchers develop as they collect and analyze data (Creswell, 2007). It can be deduced that phenomenology focuses on facts that are not fully understood despite being aware of them. Accordingly, phenomenology was used in the research in order to discover the metaphors and their origins for new-generation mathematics questions.

Participants

The research involved students in 7th and 8th grade from secondary schools. Due to the criterion that participants should have a problem-solving experience on new-generation questions, these two grade levels were chosen. Thus, the study group comprises 350 students, 70 of whom are in 7th grade and 280 of whom are in 8th grade. A total of 208 female students make up the study group, 45 of whom are 7^{th} graders and 163 of whom are 8th graders. The remaining 142 are male students, 25 of whom are 7th graders and 117 of whom are 8th graders.

Data collection

Metaphor-based data collection methods often use the sentence "I think...; because...". Accordingly, data for the perceptions of the participants about the new-generation mathematics questions were collected by creating a sentence consisting of two parts: “I think the new-generation mathematics questions are like..., because...”. Students were asked to write a metaphor for the concept of a new-generation math questions in the first part, while the second part of the sentence asked them to explain why they likened it to the concept they likened to. Students were asked to come up with three analogies to explain the elliptical sentence. Students in three secondary schools took an average of ten minutes to complete the forms distributed to them.

Data analysis

Analysis of metaphors obtained from secondary school students was carried out using content analysis. As Patton (2002) put it, content analysis is the process of trying to determine the meaning of qualitative data by reducing them to their most basic aspects (Patton, 2001). This study examined metaphors derived from secondary school students in depth along with their reasons for using them and the underlying meanings behind their perceptions. An analysis process with three stages was employed for this purpose.

To begin with, the encodings of each participant were entered in an Excel file during the editing of the data set so that the code and metaphor created by each participant could be compared side by side. After the subsequent examination, any irrelevant answers were removed and the sorting process was complete. As a result, the study excluded 352 sentences out of a total of 1050 obtained from each of the 350 participants. Therefore, a

total of 698 sentences were included in the data analysis. We examined the relationships between the metaphors written by participants and their reasons in depth in the second stage, in which sub-themes appropriate to each metaphor were identified. After finding sub-themes related to each other, they were combined to form themes. The findings are supported by quotations from the participants' answers, including metaphors and justifications. Whenever citations are used, participants' codes are included in parentheses. A combination of sequence number, grade level, and gender was used to create these codes. As an example, the code 16-8K indicates that the 16th participant is a female student studying in 8th grade. Data analysis was completed with the use of different attempts for the purpose of ensuring validity and reliability at the end. A detailed description of the research process is provided. The findings are supported by quotes from participants. Additionally, two independent researchers examined and coded the forms in order to determine encoder reliability. Based on these results, an intercoder consistency coefficient of .93 was determined between researchers. The researchers then reached a consensus on the coding differences.

Findings

Table 1 presents the findings regarding the theme, sub-theme, and frequency obtained regarding the concept of the new-generation mathematics question.

Table 1. *Themes and sub-themes*

Theme	***Sub-theme***	***f***
Complicated	Incomprehensible	91
	Insurmountable	72
	Ambiguous	62
Troublesome	Difficult/challenging	87
	Effortful	52
	Tricky	27
Motivating	Realistic	68
	Instructive	46
	Manageable	37
	Entertaining	10
Comprehensive	Detailed/long	62
	Unlimited/boundless	62
	Extensive	22

As shown in Table 1, there were four themes identified as a result of the content analysis of 698 metaphors produced by 350 participants and incorporated into the data analysis: complicated (f=225), troublesome (f=166), motivating (f=161), and comprehensive (f=146). Based on their responses, students generally stated that new-generation mathematics questions are complex. Sub-themes of complicated include incomprehensibility (f=91), insurmountability (f=72), and ambiguity (f=62). This analysis revealed that students most frequently stated that the new-generation mathematics questions were complex due to their incomprehensibility and insurmountability. Another theme, troublesome, contains subthemes that are difficult/challenging (f=87), requiring effort (f=52), and requiring attention (f=27). As a result, students in secondary school 7th and 8th grades were most likely to report that new-generation mathematics questions were troublesome because they were hard and challenging. Among the sub-themes in the motivating theme are realistic (f=68), instructive (f=46), manageable (f=37) and entertaining (f=10). Due to the new-generation

of mathematics questions being both realistic and instructive, it was determined that students found these questions motivating. Additionally, there are sub-themes of having detailed/long features (f=62), having unlimited/boundless features (f=62), and having extensive features (f=22) in relation to the comprehensive theme. The results indicate that secondary school students think that the new-generation of mathematics questions are comprehensive because they are detailed/long and unlimited. Table 2 presents the sub-themes, metaphors, and justifications for the theme of complicated.

Table 2. *Findings regarding the "complicated" theme*

Sub-theme	***Participant***	***Metaphor***	***Justification***
Incomprehensible	1-7M	Labyrinth	There are very complex sentences and information.
	74-7M	Chinese	It's too complicated.
	25-7F	Da Vinci's code	It's very complicated.
	3-8F	Salad	It's so messy.
	8-8F	World	They are as complicated as the confusion of the World.
	23-8F	News	Everything is on top of each other, side by side, too complicated.
	42-8F	Coquettish person	When you want to ask something, it confuses you so much that it doesn't give you what the question wants to tell you.
	66-8F	Love	As soon as you see it, your mind will be confused.
	67-8F	Scribble	I get confused as soon as I see it.
	100-8F	Washing machine	It's so confusing it makes my head spin.
Insurmountable	9-7M	Dead end	The result will never come out.
	15-7M	Saving the universe	The universe cannot be saved, and those questions cannot be solved either.
	23-8M	Climbing Everest	It's almost impossible.
	72-8M	QR code	It can never be solved with the eye.
	14-8F	Farewell to life	You're giving up your soul trying to figure it out.
	45-8F	Torture	Doing even only one question in the essay is painful.
	66-8F	Death	There is no cure.
	70-8F	Sırat bridge	You cannot balance yourself.
	82-8F	Needle in the sea	It is impossible to find.
	112-8F	Water well	We can't get out of the well, these questions are the same.
Ambiguous	93-7F	Space	There are unknown things in space, as in new-generation questions.
	67-8M	Black hole	You never know where it will end.
	2-8F	Obscurity	You start the question without knowing where and how to find what.
	44-8F	Gemini	It is not clear what it will do.
	82-8F	Watermelon	It is completely different inside and out.
	83-8F	Crossword	It's not clear what it is.

The complex theme can be addressed using four sub-themes under metaphors related to new-generation mathematics questions, as shown in Table 2. Incomprehension, insurmountability, and ambiguity comprise these sub-themes. The new-generation mathematics questions are perceived as complex by secondary school 7th and 8th grade students due to the complexity of their expressions when the sub-theme of being incomprehensible is examined. It is evident when examining the sub-theme of being insurmountable that students perceive the new-generation mathematics questions as complex questions that can never be solved. Furthermore, when the sub-theme of ambiguity is examined, it is seen that students perceive new-generation mathematics questions as complex, since it is impossible to know where to start and what to do first with unknown expressions. Table 3 presents the sub-themes, metaphors, and justifications for the theme of troublesome.

Table 3. *Findings regarding the "troublesome" theme*

Sub-theme	***Participant***	***Metaphor***	***Justification***
Difficult/challenging	58-7F	Rubik's Cube	It is very difficult to solve.
	2-8F	Brain teaser	One who does not know it cannot do it.
	27-8F	Four-leaf clover	It's hard to find answers just as finding a four-leaf clover.
	139-8F	Loop	Just as it is very difficult to solve the knot, so is solving new-generation questions.
Effortful	15-7M	Winning trophies	If we work, we win.
	1-7F	Art	You have to work to develop art.
	31-7F	Report card	If you have to work to get your report card to be good, you should also try to solve these questions.
	132-8M	Galaxy	As you research, new planets and systems are found in the galaxy. These questions also require effort.
	37-8F	War	It cannot be won without struggle.
	89-8F	Rose	You can reach it when you put up with its thorns.
	91-8F	Riding a bike	It is taught by doing repeatedly.
Tricky	17-7F	Cactus	If we approach these questions carefully, just as it is necessary to approach the spines of the cactus carefully, we will not be hurt.
	1-8F	Life	If you miss the slightest piece, you will not find the right way.
	26-8F	Detective	You need to study and search for the question thoroughly.
	88-8F	Game	If you don't follow the rules, the whole game will be messed up and you will be upset.

Table 3 illustrates how metaphors can be developed under the challenging theme for new-generation mathematics questions. They are categorized as being difficult/compelling, requiring effort, and tricky as they require attention. In an examination of the subtheme of being difficult/challenging, secondary school students

perceive the new-generation mathematics questions as challenging because it is very difficult to find answers. Studying another sub-theme, effortful, reveals that students believe new-generation mathematics questions can be answered if they study and that they are challenging because they require more experience. The students who emphasize the need for careful reading and processing of the questions perceive the new-generation mathematics questions as tricky. Table 4 presents the sub-themes, metaphors, and justifications for the theme of motivating.

Table 4. *Findings regarding the "motivating" theme*

Sub-theme	***Participant***	***Metaphor***	***Justification***
Realistic	14-7M	Technology	It's everywhere.
	12-7F	Flying birds	It is heard everywhere.
	56-8M	My future	It is everywhere in life.
	3-8F	River	It goes away.
	13-8F	Life	Life has its challenges too.
	144-8F	Oxygen	We will always need it.
	197-8F	Obstacle	We cannot do math without solving those questions, we have to overcome our obstacles.
Instructive	6-7M	Encyclopedia	As there is an explanation in every question.
	18-7F	Food	You have to learn it because you have to do it, you will need it.
	24-7F	Chaining	No matter what profession we are in in the future, we need to learn it because we will need it.
	30-7F	Dictionary	There you get knowledge of life.
	76-8M	Book	It moves us forward.
	83-8M	water in the middle of the desert	It explains a lot.
	99-8M	Teacher	It teaches new things.
	152-8F	Tree	As we learn new information as we study, our branches expand and our knowledge increases.
	160-8F	Duster	Every time we make a mistake, it actually teaches us new information.
	193-8F	Book	It is useful and allows us to learn new things.
Manageable	28-7F	Chili pepper	It is painful at first, but then you get used to it and it's not as hard as it used to be.
	33-7F	Therapy	As you solve the questions, you seem to get rid of your problems, you will reach the solution.
	2-8M	Life	You always overcome obstacles.
	5-8M	Everything	You can do this too.
	42-8M	Game	*You go through it level by level.*
	2-8F	Adventure	You will find the result by progressing layer by layer.
	16-8F	Riddle	The answer seems very difficult, but it is actually very easy.
	40-8F	Easy sledding	When you hold the end of the rope, the rest comes.
Entertaining	4-7M	Funfair	The questions amuse me.
	14-7F	Game	Trails are made up of problems.

	133-7F	Storybook	At first, you get bored, but as you progress, you start to enjoy or achieve.

The motivating theme in Table 4 shows four sub-themes involved in metaphors related to new-generation mathematics questions. Sub-themes include realism, instructiveness, manageability, and entertainment. It can be seen that in accordance with the sub-theme of being realistic, 7th and 8th grade students are motivated by the new-generation mathematics questions, based on their explanations, which include the difficulties of life, the constant presence of needs, and their presence everywhere. It is seen that students perceive the new-generation mathematics question as motivating as these questions contain information similar to that found in a book, encyclopedia, or dictionary. In examining another sub-theme, manageability meaning that overcoming obstacles, secondary school students perceive new-generation mathematics questions to be motivating for reasons including the fact that even though obstacles are present, they can be overcome by working and can be achieved by striving. Moreover, the students perceive the new-generation math questions as motivating because of the fun aspects included in them, like what you would find in a park in relation to the sub-theme of entertainment.

Table 5 presents the sub-themes, metaphors, and justifications for the theme of comprehensiveness.

Table 5. *Findings regarding the "comprehensive" theme*

Sub-theme	***Participant***	***Metaphor***	***Justification***
Detailed/long	8-7M	Tree	Like these questions that get longer and longer, the tree gets longer.
	19-7F	Mixture	There are many substances in mixtures and the rules for creating them. There are many procedures and rules in these questions in the same way.
	12-8M	Text	It is based on understanding.
	64-8M	Quest	*Quests take time as in these questions.*
	94-8M	Adventure	It's like a long journey with lots of adventures in it.
	3-8F	Pomegranate	It covers different topics.
	122-8F	Carpet weaving	It is long and detailed, since it is prepared according to the new kinds of problems which require skills.
	204-8F	Novel	Like novels, the questions are too long.
Unlimited/boundless	18-7F	A bottomless pit	You can't figure it out once you get into it.
	10-8M	Cliff	Just like how a bottomless abyss does not end.
	2-8F	Sky	*It is endless, never-ending just like the new-generation questions.*
	20-8F	Black hole	It takes people in.
	158-8F	Tunnel	It has no boundaries, like an endless tunnel.
Extensive	10-7F	Chain	New-generation questions include all questions just as mathematics is the mother of all subjects.

	13-7F	Matryoshka	Same but smaller matryoshkas come out of the matryoshka. In these questions, as the operations progress, the same difficulty emerges.
	23-7F	Science	In science, different answers come out of different research and they all cover a subject, and different operations in mathematics work in the same way.
	16-8F	Ivy	*Many things are interrelated and connected.*

Based on the results shown in Table 5, we can conclude that metaphors that can be used to answer new-generation mathematics questions can be divided into three sub-themes, which are all grouped under the comprehensive theme. The sub-themes that can be identified are being detailed/long, being unlimited/boundless, and being extensive. The sub-theme of being detailed or long is examined in this study and it is determined that secondary school students in 7th and 8th grades perceive the new-generation math questions comprehensively, suggesting that it is based on reading comprehension, contains a lot of detailed information, and generates long paragraphs of text. However, when the subtheme of being unlimited/boundless is examined, the new-generation questions of the students seem to be a vast and endless tunnel that continues into nowhere. Considering the analogies that the students use to describe them, it is evident that they perceive them as being comprehensive. Furthermore, the examination of the sub-theme of being extensive resulted in secondary school students providing reasons such as the fact that new-generation questions contain interrelated parts and are hosted together in one place, and therefore, they can be compared to the old-generation questions.

Discussion

These study findings shed light on how students perceive new-generation mathematics questions, highlighting four main themes: complicated, troublesome, motivating, and comprehensive. The complicated theme highlights that students find these questions incomprehensible, insurmountable, and ambiguous. Students view these questions as complicated, suggesting that they find them to be intricate and challenging to understand. This complexity might stem from the nature of the questions, which could involve advanced concepts or convoluted problem-solving approaches. Moreover, students may think that the length of the question texts makes it difficult to read and understand the questions. Şad and Aydın (2023) concluded with the same findings in their study regarding student perceptions of new-generation questions. Researchers found that students considered the questions confusing, difficult to understand, and impossible to solve, comparing them to labyrinths. The perception of ambiguity suggests that students may struggle with understanding the context or requirements of these questions. The ambiguous aspect of the questions stems from the complexity of the texts, and as a result students don't know "where to start." According to Kablan and Bozkuş's (2021) study, the students believed that the questions were extensive, what they wanted wasn't fully understood, and forms of expressions made it difficult for them to understand. Moreover, as the skill-based questions require a high level of reading skill (Miller et al., 2009), the students may think of these questions as complicated.

The troublesome theme underscores the difficulty students associate with new-generation mathematics questions. They perceive these questions as demanding,

requiring significant effort and mental exertion to solve them. The sub-themes like "difficult," "effortful," and "tricky" suggest that students may find these questions more challenging compared to traditional mathematics problems. While students are familiar with the topic, they don't know how to use this information and how to answer the question. The students have a perception that in order to solve the question they will have to make an effort and that even the smallest of expressions will be of great importance for getting the answer. Kablan and Bozkuş (2021) reached the conclusion that in addition to finding the questions difficult, the students also have difficulty interpreting the questions. In the same way, Şad and Aydın (2023) put forth that the students believe that the questions can be solved by understanding and interpreting the information provided correctly and following the correct steps in the question. Moreover, the metaphor of balloons for the new-generation questions in the same study supports the theme of being tricky found in the current study and implies that the student were being extremely careful while solving the questions. It is also reported that teachers define these problems as qualified, stylistically different, difficult, long, and not easy to understand (Korkmaz et al., 2020).

Interestingly, some students find new-generation mathematics questions motivating. They see these questions as realistic, instructive, manageable, and even entertaining. This suggests that these questions may engage students in a way that traditional math problems might not. The term "realistic" implies that these questions may be more applicable to real-world scenarios, enhancing students' perception of their relevance and practicality. Using analysis and decision-making skills, these questions help students form solutions to daily problems by providing them with contexts based on the situations they encounter in their lives (Erden, 2020). The students perceive new-generation mathematics questions as instructive, since they mostly include an informative introduction. Hence, even if the students don’t solve the question, they think that they learn through effort. This is achieved through the use of reading, understanding, and interpreting information in a variety of contexts. Additionally, the idea that they are instructive and manageable suggests that students see potential for learning and growth in tackling these questions. Kablan and Bozkuş (2021) argue that the difficulties encountered while solving these questions provide opportunities for students to make an effort and that the strategies and approaches they develop to overcome them contribute to their success. Some of the students found new-generation questions entertaining, due to the pleasure of solving a difficult problem. During the learning process, solving challenging, authentic problems or cooperating may be important factors for students' academic enjoyment (Pekrun, 2006). As a result of being challenged mathematically and completing challenging tasks, Russo and Hopkins (2017) found the participants felt satisfied. The students' willingness to attempt challenging tasks was another important theme that emerged from their analysis.

The perception of new-generation mathematics questions as comprehensive implies that they cover a broad range of topics or require students to consider various aspects when solving them. The sub-themes "detailed, unlimited, and extensive" suggest that these questions may encompass a wide spectrum of mathematical concepts, possibly encouraging a holistic understanding of mathematics among students. The fact that new-generation questions require more than one skill and their content is comprehensive may have caused this theme to emerge. Compared to previous years' questions, skill-based questions require more higher-order thinking skills. The study by Kablan and Bozkuş (2021) claims that students experience anxiety due to the length and images in the

questions. It has been reported by students that new-generation questions are quite comprehensive and long when compared to the previous generation. Several mathematics teachers also stated that both students and teachers found these questions difficult and there was a lack of adequate curricular materials (Güler et al., 2019).

These findings indicate that students have diverse opinions and experiences when it comes to new-generation mathematics questions. While some may find them daunting and complex, others see them as stimulating and relevant to their learning. The comprehensiveness of these questions may contribute to a more comprehensive understanding of mathematics, encompassing a broader scope of mathematical concepts and problem-solving skills. Educators and curriculum developers should consider these perceptions when designing and implementing new-generation mathematics questions to optimize the learning experience for students. Additionally, providing adequate support and resources for students to tackle these questions can help address the challenges they may encounter. Skill-based questions, known also as new-generation questions, must be examined from an understandability standpoint since reading comprehension has become crucial in today's world. Analyzing skill-based questions comprehensively means taking into account the authenticity of their contexts, the understandability of their texts, and their compatibility with the curriculum. What is more, the students perceive new-generation questions as complex, difficult, and incomprehensible due to their length and visuals. Students should practice with new-generation questions that they can overcome, and they should be provided with guidance on how to solve such questions.

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