DOKUZ EYLÜL ÜNİVERSİTESİ
EĞİTİM BİLİMLERİ ENSTİTÜSÜ

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Examination of the Process Components of Learning Outcomes in the Türkiye Century Maarif Model Middle School Mathematics Curriculum Based on the SOLO Taxonomy

Türkiye Yüzyılı Maarif Modeli Ortaokul Matematik Dersi Öğretim Programı (5-8. Sınıflar) Öğrenme Çıktılarına Ait Süreç Bileşenlerinin SOLO Taksonomisine Göre İncelenmesi[1]

Kamer ARSLAN, Reasearch Assistant, Ankara University, kmrarslan@ankara.edu.tr

Ahmet ISIK, Prof. Dr., Gazi University, isikahmet@gazi.edu.tr

Geliş tarihi - *Received:* 1 August 2025
Kabul tarihi - *Accepted*: 20 April 2026
Yayın tarihi - *Published*: 28 August 2026

[1] This study was presented orally by the first author at the ERPA Congresses between September 13-15, 2024.
Arslan, K. ve Işık, A. (2026). Türkiye Yüzyılı Maarif Modeli ortaokul matematik dersi öğretim programı (5-8. sınıflar) öğrenme çıktılarına ait süreç bileşenlerinin SOLO taksonomisine göre incelenmesi. *Batı Anadolu Eğitim Bilimleri Dergisi,* 17(2), 1049-1069. DOI. 10.51460/baebd.1756337

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Abstract. This study aims to examine the process components of learning outcomes in the Türkiye Century Maarif Model Middle School Mathematics Curriculum, published in April 2024, within the framework of the SOLO Taxonomy. The research design employs the document analysis technique, which allows for the systematic review and evaluation of electronic and printed materials. The data for the study consists of the learning outcomes from the newly published middle school mathematics curriculum. In this context, the process components of the learning outcomes in the 2024 middle school mathematics curriculum were examined within the framework of the SOLO Taxonomy. The findings revealed that, across all grade levels, the process components of learning outcomes were predominantly at the Relational (RL) and Extended Abstract (EA) levels, while only a small portion were classified under the Uni-structural (US) and Multi-structural (MS) levels. Based on the research findings, it is recommended that the process components in the corrected mathematics curriculum be structured considering students' developmental levels and grade levels.
Keywords: The Türkiye Century Maarif Model, SOLO taxonomy, Mathematics curriculum learning outcome, Process component.

Öz. Bu çalışmada 2024 yılı nisan ayında yayınlanmış olan Türkiye Yüzyılı Maarif Modeli Ortaokul Matematik Dersi Öğretim programı öğrenme çıktılarına ait süreç bileşenlerinin SOLO taksonomisi bağlamında incelenmesi amaçlanmıştır. Araştırma deseni olarak elektronik ya da basılı materyallerin, sistematik bir şekilde gözden geçirilmesi ve sorgulanması yoluyla analiz edilmesine imkân tanıyan doküman incelemesi tekniği kullanılmıştır. Araştırmanın verilerini yeni yayınlanmış olan ortaokul matematik öğretim programına ait öğrenme çıktıları oluşturmaktadır. Bu bağlamda bu çalışmada 2024 ortaokul matematik öğretim programında yer alan öğrenme çıktılarına ait süreç bileşenleri SOLO taksonomisi bağlamında incelenmiştir. Çalışma kapsamında incelenen verilerin analizinde ise içerik analizi tekniği kullanılmıştır. Ulaşılan bulgular incelendiğinde bütün sınıf seviyelerinde öğrenme çıktılarına ait süreç bileşenlerinin ağırlıklı olarak ilişkisel yapı (İY) ve soyutlanmış yapı(SY) düzeyinde bulunduğu, çok az bir kısmının ise tek yönlü yapı (TYY) ve çok yönlü yapı (ÇYY) düzeyinde bulunduğu saptanmıştır. Araştırma sonuçları doğrultusunda yenilenen matematik öğretim programında yer alan süreç bileşenlerinin, öğrencilerin gelişim düzeyleri ve sınıf seviyeleri dikkate alınarak düzenlenmesi önerilmektedir.
Anahtar Kelimeler: Türkiye Yüzyılı Maarif Modeli, SOLO taksonomisi, Matematik dersi öğretim programı, Öğrenme çıktısı, Süreç bileşeni.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Genişletilmiş Özet

Giriş. Günümüzde devletler toplumsal gelişimi sağlayabilmek için birçok alanda gerçekleşen yenilikleri takip ederek toplumun gelişimini üst seviyeye çıkarmayı amaçlamaktadır. Bu yeniliklerin merkezinde ise elbette insan kaynaklarının oluşturulmasına yönelik ilerlemeler ve kaliteli bireylerin topluma kazandırılması yer almaktadır. İnsan kaynaklarının ve bireylerin topluma kazandırılması ise eğitim politikaları ile sağlanmaktadır. Bu noktada bireylerin ihtiyaç ve becerilerinin çağın getirdiği koşullar bakımından karşılanabilmesi için eğitim sisteminin niteliği hayati önem taşımaktadır. Bu niteliği artırmak için yapılan girişimlerden birisi kaliteli öğretim programlarının tasarlanarak uygulanmasıdır. Öğretim programı okulda ya da okul dışında öğrencilere öğretilmesi hedeflenen bir derse yönelik tüm etkinlikleri ifade eden bir yaşantı düzeneğidir (Demirel, 2017). Öğretim programları hedef, içerik, öğrenme-öğretme süreci ve değerlendirme ögelerini içermektedir (Gürbüz, 2023). Hedef olarak ifade edilen öge ülkemizde 2005-2018 yılları arasındaki öğretim programlarında kazanım olarak ifade edilmektedir (Ayvacı, Alev v Yıldız, 2014). Başka bir ifadeyle 2018 öğretim programında öğrencilerin öğretim süreci sonunda kazanmış olması gereken bilgi beceri, tutum ve değerleri doğrudan kazanımlar olarak ele alınmıştır (MEB, 2018). Ancak 2024 yılında yayınlanmış olan öğretim programında öğrencilerin öğretim süreci sonunda kazanmış olması gereken bilgi beceri, tutum ve değerler, öğrenme çıktıları olarak ele alınmıştır. Kazanımlar ise öğrenme çıktılarına ait süreç bileşenleri (bilgi, beceri ve yetkinlik) olarak ifade edilmiştir (MEB, 2024). Nitelikli bir öğretim programının tasarlanabilmesi için kazanımların öğretim basamaklarına uygun olması gerekir (Zorluoğlu vd., 2016). Bu nedenle kazanımlar öğrencilerin düzeyleri dikkate alınarak belirli bir hiyerarşide derecelendirilir (Tutkun ve Okay, 2012). Bu noktada ise kazanımlar genellikle Bloom taksonomisi, yenilenmiş Bloom taksonomisi ya da SOLO taksonomisi vb. olacak şekilde birçok şekilde derecelendirilebilir (Arı, 2023). Bahsi geçen bu taksonomilerden SOLO [Structure of the Observed Learning Outcomes] taksonomisi öğrencilerin sahip olduğu öğrenme çıktılarını açıklamak amacıyla Biggs ve Collis (1982) tarafından geliştirilmiştir. SOLO taksonomisi öğrencilerin istenilen alana yönelik kavrama düzeylerini bilişsel olarak değerlendirmeyi amaçladığı için öğretim programı öğrenme çıktılarını değerlendirmek için oldukça uygundur (Doğan, 2020). SOLO taksonomisi temel olarak hiyerarşiye bağlı olmak koşuluyla beş düzeyli bir yapı olarak tanımlanmakta ve bu yapılar; yapı öncesi, tek yönlü yapı, çok yönlü yapı, ilişkisel yapı ve soyutlanmış yapı olarak adlandırılmaktadır (Çetin ve İlhan, 2016). Literatür incelendiğinde geçmiş yıllara yönelik SOLO taksonomisi bağlamında öğretim programlarının incelendiği pek çok çalışmaya rastlanmaktadır (Acar ve Peker, 2023; Alsaai, 2001; Ağçam ve Babanoğlu 2018; Dönmez ve Zorluoğlu 2020; Fensham ve Bellocchi, 2013; Göçer ve Kurt 2016; Gezer ve İlhan, 2014; Gezer ve İlhan 2015; Korkmaz ve Ünsal 2017).

Ancak ülkemizde hali hazırda yürürlükte olan 2018 öğretim programı, 2024 yılında yenilenmiş ve Milli Eğitim Bakanlığı internet sitesinde kamuoyunun erişimine açılmıştır. Devamında ise yeni programının 2024-2025 eğitim öğretim yılında 1., 5. ve 9. sınıf seviyesinde uygulanacağı duyurulmuştur. Ülkemizde matematik öğretimi ile ilgili zorlukların yaşanıyor olması sebebiyle hali hazırda yayınlanan matematik öğretim programı öğrenme çıktılarının incelenmesine yönelik çeşitli çalışmaların yapılması gerekmektedir. Bu nedenle yapılan bu çalışmada alana katkı sağlaması ve önceki öğretim programıyla karşılaştırılması bakımından 2024 yılı ortaokul matematik dersi öğretim programının SOLO taksonomisinin bağlamında incelemesi hedeflenmiştir. Bu hedef doğrultusunda 2024 öğretim programı öğrenme çıktılarına ait süreç bileşenlerinin sınıflandırılmasında SOLO taksonomisinden faydalanılabilir. Bu amaç kapsamında yapılan bu çalışmada; "Türkiye Yüzyılı Maarif

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Modeli Ortaokul Matematik Dersi Öğretim Programı (5-8. sınıflar) süreç bileşenlerinin SOLO taksonomisi düzeylerine göre dağılımları nasıldır?" sorusuna yanıt aranmıştır.

Yöntem. Bu çalışma, nitel araştırma yöntemlerinden doküman incelenmesi tekniği kullanılarak gerçekleştirilmiştir. Doküman inceleme yöntemi araştırılması hedeflenen durumlar hakkında bilgi içeren birincil ve ikincil kaynaklar olarak adlandırılan elektronik ya da basılı materyallerin sistematik bir şekilde gözden geçirilmesi ve sorgulanması yoluyla analiz edilmesi olarak tanımlanır (Bowen, 2009; Özkan, 2021; Yıldırım ve Şimşek, 2016). Doküman incelemesinde veri toplama aracı olarak günlükler, otobiyografiler, mektuplar vb. kişisel dökümanlar kullanılabilirken; nüfus istatistikleri, toplumsal kayıtlar, öğretim programları gibi kamuya açık dökümanlar da kullanılabilir (Bryman, 2012; Merriam, 2009). Bu bağlamda yapılan bu çalışmada doküman incelmesi tekniğine başvurulmuş ve 2024 Türkiye Yüzyılı Maarif Modeli Matematik Dersi Öğretim Programı içerinde yer alan öğrenme çıktılarına ait süreç bileşenleri incelenmiştir. Doküman incelemesi araştırmalarında etik kurul iznine ihtiyaç duyulmadığı için etik kurul izni alınmasına gerek duyulmamıştır. Araştırmanın veri toplama aracını MEB (2024) tarafından yayınlanan (5-8. sınıflar) Ortaokul Matematik Dersi Öğretim Programı içeriği oluşturmaktadır. Araştırmada kullanılan veriler ise içerik analizi tekniği yoluyla analiz edilmiştir.

Bulgular. Tüm sınıf seviyelerinde matematik öğretim programında yer alan öğrenme çıktılarına ait süreç bileşenlerinin sırasıyla ilişkisel yapı, soyut yapı, çok yönlü yapı ve tek yönlü yapı düzeyinde olduğu tespit edilmiştir. Başka bir ifade ile güncellenen programda öğrenme çıktılarının tüm sınıf seviyelerinde ağırlıklı olarak İY ve SY düzeyinde yoğunlaştığı saptanmıştır.

Tartışma ve Sonuç. Tüm sınıf seviyelerinde öğrenme çıktılarına ait süreç bileşenlerinin ağırlıklı SY ve İY düzeylerinde yer aldığı görülürken çok az kısmının ÇYY ve TYY düzeylerinde yer aldığı sonucuna ulaşılmıştır. Tüm sınıf seviyelerinde süreç bileşenlerinin en fazla İY düzeyinde bulunduğu bunu takiben sırasıyla SY, ÇYY ve TYY düzeylerinde yer aldığı görülmüştür. Öğretim programlarında yer alan kazanımların sınıf seviyelerine bağlı olarak homojen bir dağılıma sahip olması ve sınıf seviyesi arttıkça anlamlı bilginin öğretilmesi hedeflenerek üst düzey kazanımların sayısının aşamalı bir şekilde arttırılması gerekir (Anderson ve Krathwol, 2001). Nitekim yürürlükte olan öğretim programı ile öğrenme süreçleri sarmal ve bütüncül bir şekilde ele almak amaçlanmıştır. Bunun yanı sıra programda benimsenen sarmal yapı ile öğrencilerin mevcut bilgileri üzerine yeni bilgilerin inşa edilmesi, ilkokulda kazandırılan temel yeterliliklerin, ortaokul ve lise seviyelerinde daha karmaşık ve soyut yeterliliklerle desteklenmesi hedeflenmektedir. Diğer bir taraftan bu hedef Piaget'nin gelişim basamakları ile de uyumludur. Bu bağlamda yapılan revizyonlarda her bir sınıf seviyesinde yer alan kazanımlara ait dağılımların sarmal yapıya uygun olarak, homojen bir dağılım gösterdiği düşünülmektedir. Tüm bunlara ek olarak SOLO taksonomisi YÖ, TYY ve ÇYY düzeyleri algoritmaya odaklanan yüzeysel öğrenme çıktılarını ifade ederken İY ve SY düzeyleri kavrama odaklanan derin öğrenme çıktılarını ifade eder (Houghton, 2010). Bu bağlamda tüm sınıf seviyesinde yer alan süreç bileşenlerine ait dağılımların ağırlıklı olarak İY ve SY düzeyinde yoğunlaşmasının gelişim basamaklarını ve sarmal yapıyı yansıtması açısından ortaokul düzeyine uygun olduğu düşünülmektedir.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Introduction

Today, states aim to elevate the progress of society to the highest level by keeping up with innovations in various fields. At the core of these innovations lie advancements in the development of human resources and the integration of qualified individuals into society. The incorporation of human resources and individuals into society is closely linked to educational policies. At this point, the quality of the education system is of vital importance to meet individuals' needs in accordance with the conditions of the era. One of the initiatives to enhance this quality is the design and implementation of high-quality curricula that align with contemporary advancements and technology. The element expressed as a goal is referred to as an attainment in the curriculum currently in effect in Türkiye (Ayvacı et al., 2014). In other words, in the curriculum prepared in 2018, the knowledge, skills, attitudes, and values that students are expected to acquire by the end of the instructional process were directly considered as attainments (MEB, 2018). However, in the curriculum published in 2024, these elements that students are expected to acquire by the end of the instructional process have been considered as learning outcomes. Attainments, on the other hand, have been defined as the process components of learning outcomes (knowledge, skills, and competencies) (MEB, 2024). The curriculum aims to equip students with both individual skills and the competencies necessary to function as members of society. Additionally, when the curriculum is designed in accordance with students' cognitive levels, it enables the effective acquisition of the intended attainments (Tyler, 1949). Moreover, for a qualified curriculum to be designed, attainments must be aligned with instructional stages (Zorluoğlu et al., 2016). Therefore, attainments are ranked in a specific hierarchy based on students' levels (Tutkun and Okay, 2012). Therefore, learning outcomes are often categorized using various taxonomies, such as Bloom's Taxonomy, Revised Bloom's Taxonomy, Marzano's Taxonomy, ECRIF Taxonomy, MATH Taxonomy, or SOLO Taxonomy, among others (Arı, 2023). Among these taxonomies, the SOLO (Structure of the Observed Learning Outcome) Taxonomy was developed by Biggs and Collis in 1982 with the idea that concepts can be interpreted more deeply in both quantitative and qualitative terms.

The SOLO Taxonomy consists of developmental stages comprising five levels that encompass phases of thinking. In this respect, the stages of the SOLO Taxonomy share similarities with Piaget's cognitive development stages, which he proposed in 1950. The first four levels of the SOLO stages correspond to Piaget's cognitive development periods. However, Biggs and Collis, based on existing studies in the literature (Case, 1985; Fischer and Sylvern, 1985), introduced a fifth stage of thinking, which differs from Piaget's original stages. This additional stage corresponds to the post-abstract period, as defined by Biggs and Collis (1985). The stages of SOLO thinking levels that correspond to Piaget's cognitive development periods are presented in Table 1 (Çelik, 2007).

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Table 1.
SOLO Stages Corresponding to Piaget's Cognitive Development Periods (Çelik, 2007).

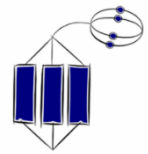
Piaget's Cognitive Development Periods	**SOLO Stages**
Sensory-Motor	Sensory-Motor
Preoperational	Imaginary
Concrete Operational	Concrete-Symbolic
Formal Operational	Abstract
–	Post-Abstract

The SOLO Taxonomy was fundamentally revised and developed by Biggs and Collis (1989) to address the shortcomings in Piaget's cognitive development stages. However, over time, the focus of this taxonomy shifted from cognitive development stages to classifying individuals' responses to a given problem (Pegg and Tall, 2005).

Since the SOLO Taxonomy aims to cognitively assess students' comprehension levels in a given field, it is highly suitable not only for evaluating responses to problems but also for assessing learning outcomes in the curriculum (Doğan, 2020). The SOLO Taxonomy is fundamentally defined as a five-level hierarchical structure, consisting of the following levels: Pre-structural (PS), Uni-structural (US), Multi-structural (MS), Relational (RL), and Extended Abstract (EA). Additionally, while PS, US, and MS levels represent quantitative knowledge, RL and EA levels correspond to qualitative knowledge (Çetin and İlhan, 2016). The levels of the SOLO Taxonomy and their characteristics are presented in Table 2.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Table 2.
Levels and Characteristics of the SOLO Taxonomy

	Level		Characteristics
Quantitative	Level 1	Pre-structural 	No understanding or possessing incorrect knowledge and comprehension.
	Level 2	Uni-structural 	Concrete, superficial understanding; focusing on a single aspect of a complex concept or situation. Following only one approach to problem-solving.
	Level 3	Multi-structural 	Focusing on multiple aspects of a topic, concept, or situation but failing to establish connections. Considering multiple dimensions in problem-solving.
Qualitative	Level 4	Relational 	Considering multiple dimensions of a topic or concept and establishing relationships among them. Generating multiple solutions to a problem and establishing connections between them at different levels.
	Level 5	Extended Abstract 	Not only establishing connections among multiple dimensions of a topic or concept but also adapting and generalizing relationships to different situations. Drawing conclusions for different cases based on acquired knowledge.

In Table 2, the Pre-structural (PS) level represents the lowest tier of classification, where students' responses provide little to no contribution to problem-solving (Leung, 2000). At this level, students are far from understanding the topic or solving the problem. They either lack knowledge of the subject or possess information that is irrelevant to the topic. Consequently, during the instructional process, students at this level either fail to grasp the topic entirely or struggle significantly to acquire the necessary information. When presented with a problem, they tend to provide responses that are incorrect or significantly incomplete (Biggs and Collis, 1982; Burnett, 1999; Biggs and Tang, 2011; Doğan, 2020; Hook, 2016).

The Uni-structural (US) level describes students who evaluate a given problem with a narrow perspective, perform simple operations, and focus only on a single aspect of the problem (Çetin and İlhan, 2016; Leung, 2000). At this level, students approach the topic and its solution superficially, concentrating on just one dimension of the subject or problem. They are unable to learn multiple aspects of a topic simultaneously and tend to focus on only one concept or operation at a time.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Additionally, students at this level cannot establish connections between the learned concept and other concepts, topics, or problems. However, they can remember, apply, and execute simple instructions and procedures that they have learned (Biggs and Collis, 1982; Burnett, 1999; Biggs and Tang, 2011; Doğan, 2020; Hook, 2016).

The Multi-structural (MS) level refers to students who focus on multiple aspects of a given problem but fail to establish relationships between them (Biggs and Collis, 1991). At this level, students approach the topic and its solution from a multi-dimensional perspective, considering various aspects of the subject or problem simultaneously. They can learn multiple dimensions of a concept at the same time, but they cannot make inferences by establishing connections between these dimensions. Additionally, students at this level possess skills such as sequencing, combining, classifying, applying, and structuring (Biggs and Collis, 1982; Burnett, 1999; Biggs and Tang, 2011; Doğan, 2020; Hook, 2016).

The Relational (RL) level describes students who analyze a problem from multiple perspectives and can establish connections between the points they understand (McGill, 2013; Lake, 1999). At this level, students can synthesize related information, characterize operations and outcomes related to a concept or problem, and develop a cause-and-effect understanding through categorization, inquiry, integration, and ultimately, establishing relationships. Additionally, students at this level can apply an existing theory to a relevant field, but they cannot progress further to make generalizations (Biggs and Collis, 1982; Burnett, 1999; Biggs and Tang, 2011; Doğan, 2020; Hook, 2016).

The Extended Abstract (EA) level is the final and highest stage of the taxonomy, where students not only analyze a problem from different perspectives, establish connections, and make generalizations but also re-evaluate the problem and propose new ideas (Lake, 2002). In other words, students at this stage can go beyond existing knowledge, draw inferences, and apply acquired information to new situations, allowing them to make universal judgments. Additionally, students can now form hypotheses based on assumptions, engage in higher-order evaluation and discussions, and apply a given theory to a new domain (Biggs and Collis, 1982; Burnett, 1999; Biggs and Tang, 2011; Doğan, 2020; Hook, 2016).

It is evident that the SOLO Taxonomy enables a detailed examination of an individual's cognitive process related to concepts within a subject, their level of thinking regarding their knowledge and skills, as well as an in-depth analysis and explanation of their responses to questions (Lian and Yew, 2011).

In the literature, researchers have identified verbs that indicate the levels of the SOLO Taxonomy. Since there is no learning process at the first level of the SOLO Taxonomy, Pre-structural (PS), no indicator verbs have been defined for this stage. The verbs used to define the levels of the SOLO Taxonomy in the literature (Acar and Peker, 2023; Biggs and Collis, 1982; İlhan and Gezer, 2017; Gezer and İlhan, 2014) are presented in Table 3.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Table 3.
Defined Indicator Verbs for SOLO Taxonomy Levels *(*Biggs and Collis, 1982*)*

Uni-structural (US)	**Multi-structural (MS)**	**Relational (RL)**	**Extended Abstract (EA)**
Describe	Classify	Distinguish	Design
Convey	Integrate	Categorize	Create
Mention	Number	Inquire	Judge
Order	List	Combine	Hypothesize
Count	Define	Relate	Evaluate
Express	Plan	Apply	Discuss
Recall	Clarify	Analyze	Reflect
Notice	Symbolize	Compare	Generalize
Name	Specify	Outline	Theorize
Repeat	Qualify	Predict	Make high-level prediction
Identify	Explain the meaning	Evaluate	Conduct an in-depth analysis
Recognize	Assign metaphorical meaning	Summarize	Apply theory to a new field
Label	Follow an algorithm	Observe	
Memorize	Apply a method	Synthesize	
		Explain causes	
		Establish cause-effect relationships	
		Apply a theory to a desired field	

When Table 3 is examined, the indicator verbs corresponding to each level can be observed. In the literature, numerous studies have been conducted on analyzing the learning attainments in curricula using the SOLO Taxonomy (Aktı Aslan, 2023; Acar and Peker, 2023; Alsaai, 2001; Ağçam and Babanoğlu, 2018; Cihan and Doruk, 2024; Dönmez and Zorluoğlu, 2020; Fensham and Bellocchi, 2013; Göçer and Kurt, 2016; Gezer and İlhan, 2014; Korkmaz and Ünsal, 2017).

At the international level, various studies related to the SOLO classification have been conducted in this field. Alsaadi (2001) compared the mathematics curricula of Qatar and England, analyzing the attainments within the curriculum using the SOLO Taxonomy. The study concluded that expectations for 7- and 11-year-old students were higher in England. Fensham and Bellocchi (2013) analyzed the learning attainments of the 12th-grade Chemistry Curriculum in Australia and the exam questions related to the course using the SOLO Taxonomy. Their study found that both the curriculum attainments and the assessment questions in chemistry education were at lower cognitive levels. Various studies related to the SOLO classification within the curriculum of Türkiye, where our study was conducted, can be found in the literature Gezer and İlhan (2014) analyzed the attainments of the Citizenship and Democracy Education course within the framework of the SOLO Taxonomy. Their study revealed that the distribution of attainment levels in the curriculum was not homogeneous. Korkmaz and Ünsal (2017) conducted a study on the curriculum, examining the attainments of the Sociology

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Course Curriculum and the assessment questions in textbooks within the framework of the SOLO Taxonomy. The findings indicated that the targeted knowledge level of the curriculum attainments was low and superficial, while the assessment questions in textbooks aimed to evaluate lower-order cognitive processes. Another curriculum analysis study conducted within the framework of the SOLO Taxonomy was carried out by Dönmez and Zorluoğlu (2020). The researchers examined the attainments in science education in terms of SOLO levels. The findings revealed that the curriculum attainments were predominantly at lower levels according to the SOLO Taxonomy, and only a small portion of them targeted higher-order thinking skills. Another study examining the 2019 Turkish Language Curriculum for grades 5-8 within the framework of the SOLO Taxonomy was conducted by Aktı-Aslan (2023). The findings of the study indicated that the majority of the attainments for grades 5-8 were at the RL level.

A review of the literature reveals that numerous studies have examined the mathematics curricula of MEB within the framework of the SOLO Taxonomy. Accordingly, it is observed that the 2018 primary school mathematics curriculum (Doğan, 2020), the 2018 middle school mathematics curriculum (Acar and Peker, 2023), and the 2024 high school mathematics curriculum (Cihan and Doruk, 2024) have been analyzed in terms of the SOLO Taxonomy. Doğan (2020), in a study conducted at the primary school level, found that most of the attainments in the curriculum were at the US and MS levels, containing superficial knowledge. In contrast, attainments at the RL and EA levels, which involve deeper knowledge, were found to be insufficient in number. Similarly, Acar and Peker (2023) determined that the majority of the attainments in the middle school mathematics curriculum were also at the US and MS levels, while only a small portion were at the RL and EA levels. At the high school level, Cihan and Doruk (2024) examined the learning outcomes of the Türkiye Century Maarif Model High School Mathematics Curriculum within the framework of cognitive demand levels and the SOLO Taxonomy. The findings revealed that, in terms of the SOLO Taxonomy, the learning outcomes were predominantly at the RL and MS levels. Additionally, the cognitive demand levels were found to be at higher demand levels, specifically in mathematical reasoning and connected demand categories.

The SOLO Taxonomy has been proposed not only for analyzing responses to problems but also as a theoretical framework that helps structure and evaluate curricula comprehensively by categorizing learning outcomes into levels, thereby reducing complexity (Biggs and Collis, 1989). Additionally, the levels of the SOLO Taxonomy align with Piaget's stages of cognitive development. According to these stages, primary school students are expected to be in the concrete operational stage, while middle school students are in the transition phase to the formal operational stage (Piaget, 1950). İn this context SOLO taxonomy is highly valuable as it provides a foundation for relational and deep learning among students.

In response to the need for deep and meaningful learning, the 2018 curriculum, which was previously in effect in Türkiye, was revised in 2024 and made publicly accessible on the official website of the Ministry of National Education (MEB). It has been announced that the pilot implementation of this revised curriculum will take place in the 2024-2025 academic year for 1st, 5th, and 9th-grade levels, while the 2018 curriculum will remain in effect for other grade levels. Although curriculum updates are periodically made in Türkiye, the ongoing difficulties in mathematics education highlight the need for further studies analyzing the learning outcomes of the newly published (2024)

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

mathematics curriculum. This is particularly important as mathematics plays a crucial role in developing problem-solving, critical thinking, and reasoning skills.

The Türkiye Century Maarif Model Middle School Mathematics Curriculum, published in 2024, aims to develop students' conceptual skills and higher-order thinking skills to facilitate meaningful learning. Additionally, the curriculum objectives emphasize analyzing mathematical concepts from multiple perspectives, establishing connections between these dimensions, skills, and different disciplines, as well as fostering hypothesis formation, validation, and generalization. At this point, a detailed evaluation is necessary to determine whether the curriculum meets its intended objectives. Considering this need, the SOLO Taxonomy provides a robust framework for assessing the extent to which these objectives are achieved. In this context, analyzing the process components of the curriculum using the SOLO Taxonomy is crucial for understanding the extent to which the curriculum supports higher-order thinking skills and for guiding potential revisions and improvements.

Considering the importance and complexities discussed above, this study aims to analyze the 2024 currented mathematics education curriculum, updated by MEB, within the framework of the SOLO Taxonomy. In line with this objective, the SOLO Taxonomy was utilized to classify the process components of the learning outcomes in the 2024 curriculum. Accordingly, this study aims to answer the following research question: “How are the process components of the 2024 Türkiye Century Maarif Model Middle School Mathematics Curriculum distributed across the SOLO Taxonomy levels?”

Method

Research model

The document analysis method is defined as the systematic review and evaluation of electronic or printed materials containing information about the phenomena under investigation (Bowen, 2009; Özkan, 2021; Yıldırım and Şimşek, 2016). In document analysis, personal documents such as diaries, autobiographies, and letters can be used as data collection tools, while public documents such as population statistics, social records, and curricula can also be utilized (Bryman, 2012; Merriam, 2009). For this reason, the document analysis technique was employed in this study, and the process components of the learning outcomes within the 2024 Türkiye Century Maarif Model Mathematics Curriculum were examined. Since document analysis research does not require ethical committee approval, no such approval was obtained for this study. The document analysis method is defined as the systematic review and evaluation of electronic or printed materials containing information about the phenomena under investigation (Bowen, 2009; Özkan, 2021; Yıldırım and Şimşek, 2016). In document analysis, personal documents such as diaries, autobiographies, and letters can be used as data collection tools, while public documents such as population statistics, social records, and curricula can also be utilized (Bryman, 2012; Merriam, 2009). For this reason, the document analysis technique was employed in this study, and the process components of the learning outcomes within the 2024 Türkiye Century Maarif Model Mathematics Curriculum were examined. Since document analysis research does not require ethical committee approval, no such approval was obtained for this study.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Data collection tool

The aim of this study is to examine the process components of the learning outcomes in the Middle School Mathematics Curriculum. Therefore, the content of the Middle School Mathematics Curriculum, published by the Ministry of National Education (MEB) in 2024, was used as the data collection tool.

Data source

The data of the study is composed of Middle School Mathematics Curriculum learning outcomes published by Ministry of National Education in 2024. By analyzing 100 learning outcomes in the curriculum, the levels of process component according to SOLO taxonomy are examined. Within this context, a total of 487 process components were examined during the study; 107 of them are at the 5th-grade, 125 of them are at the 6th-grade, 107 of them are at the 7th and 8th-grade.

Data analysis

The data used in this study were analyzed using the content analysis technique. Content analysis refers to the systematic examination and quantification of data from written or visual sources within a specific research framework (Aziz, 2015; Fraenkel and Wallen, 2000). The process components of the learning outcomes in the mathematics curriculum were analyzed within the framework of the SOLO Taxonomy, and the level of each process component was determined. However, since none of the process components were classified at the Pre-structural level, which is the lowest level of the SOLO Taxonomy, this level was excluded from the analysis. Table 4 presents an example analysis of the levels of the process components of the learning outcomes.

Table 4.
Example Analysis of the Levels of Process Components in Learning Outcomes

Grade	Process Components of Learning Outcomes	Level
5th Grade	MAT.5.2.4.a. Analyzes the algorithmic structure in situations involving basic arithmetic operations.	US
6th Grade	MAT.6.1.8.a. Identifies the numerical and operational components in fraction, decimal, and percentage-related four-operation problems.	MS
7th Grade	MAT.7.1.4.c. Converts problem contexts involving addition, subtraction, multiplication, and division with rational numbers into appropriate representations (e.g., figures, number lines).	RL
8th Grade	MAT.8.2.3.b. Examines the relationships between different linear functions in the Cartesian coordinate system and makes generalizations.	EA

When Table 4 is examined, the process component "*MAT.5.2.4.a. Analyzes the algorithmic structure in situations involving basic arithmetic operations*", found at the 5th-grade level, is categorized under the US level because it focuses on a single dimension of basic arithmetic operations. Similarly, the 6th-grade process component "*MAT.6.1.8.a. Identifies the numerical and operational components in fraction, decimal, and percentage-related four-operation problems*" is classified under the MS level, as it aims to identify procedural steps across different mathematical concepts. Similarly,

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

the 7th-grade process component, "*MAT.7.1.4.c. Converts problem contexts involving addition, subtraction, multiplication, and division with rational numbers into appropriate representations (e.g., figures, number lines)*", is categorized under the RL level, as it aims to establish connections between multiple mathematical concepts through mathematical representations. Finally, the 8th-grade process component, "*MAT.8.2.3.b. Examines the relationships between different linear functions in the Cartesian coordinate system and makes generalizations,*" is classified under the EA level, as it focuses on making generalizations related to the given mathematical concept.

Validity and reliability of the study

To ensure the validity and reliability of the research data, two researchers independently coded the data during the analysis phase. The reliability coefficient formula proposed by Miles and Huberman (1994) was used to compare the coding results, and the consistency rate was calculated as 98%. In cases where discrepancies occurred between the coders, the relevant process components were re-evaluated, and an agreement was reached to assign them to the most appropriate level. For instance, the process component "*MAT.5.1.2.b. Determines the relationship between the given and required operations in a problem*" was initially coded differently by the two coders. However, after reaching a consensus, it was assigned to the RL level.

Results

In the Türkiye Century Maarif Model Mathematics Curriculum, 100 learning outcomes from the 5th to 8th-grade levels were analyzed, and a total of 487 process components were examined to determine their corresponding levels within the SOLO Taxonomy. These findings are presented using figures and tables for each grade level

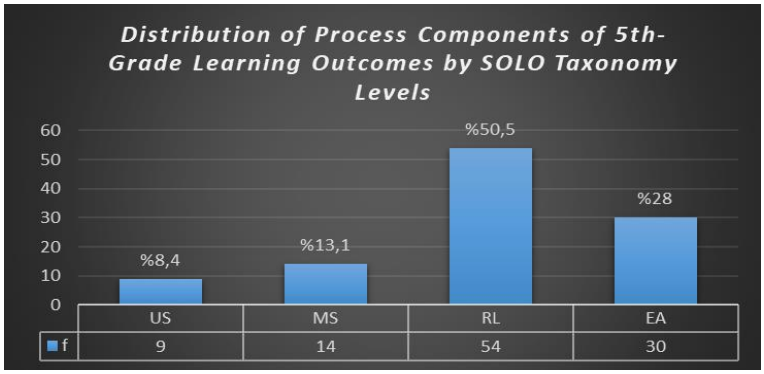


Figure 1. Distribution of Process Components of 5th-Grade Learning Outcomes by SOLO Taxonomy Levels

Figure 1 indicates that the process components of the 5th-grade learning outcomes are distributed across the SOLO Taxonomy levels as follows: 50.5% at the RL level, 28% at the EA level, 13.1% at the MS level, and 8.4% at the US level. If an example is provided for each process component at the 5th-grade level, *"MAT.5.2.4.a. Analyzes the algorithmic structure in situations involving basic arithmetic operations."* is classified at the US level. *"MAT.5.1.1.b. Identifies common properties*

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

between the periods and the pronunciations of numbers." falls under the MS level. *"MAT.5.2.4.c. Verbally expresses the mathematical relationships contained in the transformed algorithmic structure."* belongs to the RL level, while *"MAT.5.2.3.c. Tests whether the generalizations made about relationships satisfy their assumptions."* is categorized under the EA level.

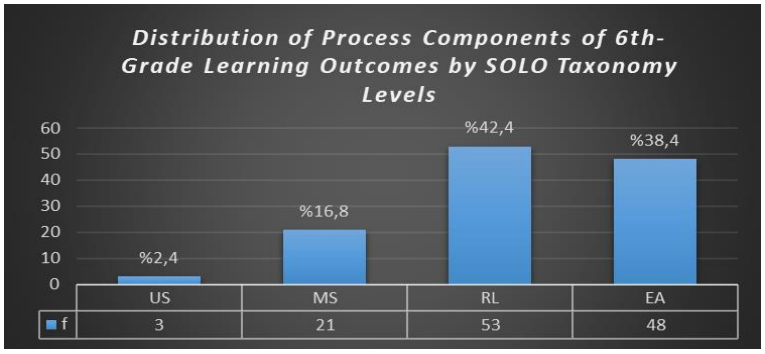


Figure 2. Distribution of Process Components of 6th-Grade Learning Outcomes by SOLO Taxonomy Levels

An examination of the process components at the 5th-grade level reveals that the RL and EA levels are predominant. At this grade level, a student is expected to analyze a concept or problem from multiple perspectives, recognize various aspects of a topic or concept simultaneously, and establish connections between these dimensions. However, as can be seen in the figure, while the number of process components classified under the RL level is considerably high, the number of components at the MS level is relatively low. Recognizing multiple dimensions of a topic, concept, or problem facilitates the ability to establish connections between concepts. Therefore, the MS level should be increased at this grade level.

Figure 2 indicates that the process components of 6th-grade learning outcomes are distributed across the SOLO Taxonomy levels as follows: 42.4% at the RL level, 38.4% at the EA level, 16.8% at the MS level, and 2.4% at the US level. If an example is provided for each process component at the 6th-grade level, *"MAT.6.5.1.d. Collects data using a survey or accesses pre-existing data."* is classified at the US level. *"MAT.6.3.4.a. Identifies mathematical components (such as shape, angle measurement, side length, parallelism, and perpendicularity) in problems related to angles of triangles, trapezoids, parallelograms, rhombuses, rectangles, and squares."* falls under the MS level. *"MAT.6.4.1.a. Observes the relationships between length and area measurement units."* belongs to the RL level, while *"MAT.6.3.4.ğ. Generalizes the strategy or strategies used to solve different problems."* is categorized under the EA level.

An examination of the process components at the 6th-grade level reveals that the RL and EA levels are predominant. Moreover, the number of process components at the RL level, which aims to establish relationships between different dimensions of a topic, concept, or problem, is particularly high. Compared to 5th grade, there is an increase in the number of process components at the US, MS, and EA levels, although the overall distribution remains similar to that of 5th grade.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

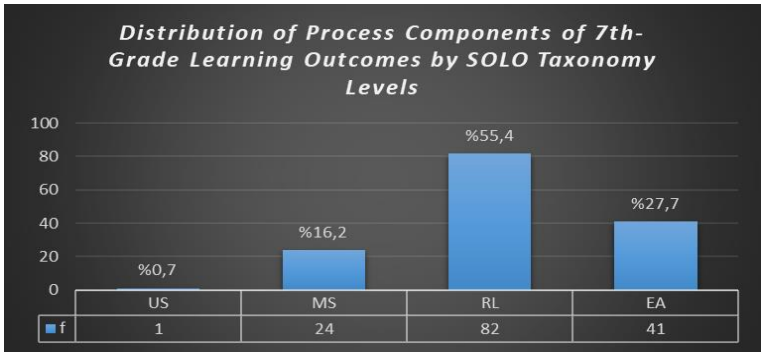


Figure 3. Distribution of Process Components of 7th-Grade Learning Outcomes by SOLO Taxonomy Levels

Figure 3 indicates that the process components of 7th-grade learning outcomes are distributed across the SOLO Taxonomy levels as follows: 55.4% at the RL level, 27.7% at the EA level, 16.2% at the MS level, and 0.7% at the US level. If an example is provided for each process component at the 7th-grade level, *"MAT.7.1.1.a. Examines integers."* is classified at the US level. *"MAT.7.1.4.a. Identifies numerical and operational components in problems involving addition, subtraction, multiplication, and division with rational numbers."* falls under the MS level. *"MAT.7.1.5.b. Determines that a ratio is a multiplicative relationship between two quantities based on real-life situations."* belongs to the RL level, while *"MAT.7.2.3.c. Tests whether the identified patterns satisfy the assumptions."* is categorized under the EA level.

An examination of the process components at the 7th-grade level reveals that the RL and EA levels are predominant. Additionally, the majority of the process components are classified at the RL level, which aims to establish relationships between different dimensions of a topic, concept, or problem. While an increase in the number of RL and EA level process components is expected as grade levels progress, the table suggests that the number of EA-level process components, which aim to foster higher-order thinking and generalization, remains insufficient.

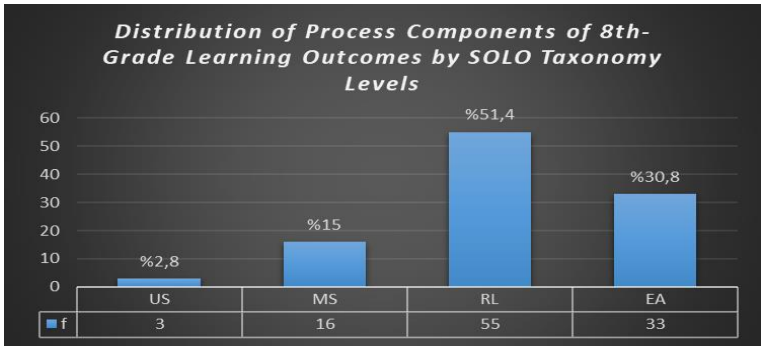


Figure 4. Distribution of Process Components of 8th-Grade Learning Outcomes by SOLO Taxonomy Levels

Figure 4 indicates that the process components of 8th-grade learning outcomes are distributed across the SOLO Taxonomy levels as follows: 51.4% at the RL level, 30.8% at the EA level, 15% at the

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

MS level, and 2.8% at the US level. If an example is provided for each process component at the 8th-grade level, *"MAT.8.7.1.a. Determines the purpose of decision-making regarding the probability of an event."* is classified at the US level. "*MAT.8.3.6.a. Identifies the relevant mathematical components (such as angle measurements, side lengths, and shapes) in problems involving angle-side relationships in triangles, the triangle inequality, and the Pythagorean theorem."* falls under the MS level. *"MAT.8.4.1.b. Identifies the relationships between the shapes found in the net diagrams of right prisms, rectangular pyramids, right circular cylinders, and right circular cones." belongs to the RL level, while "MAT.8.5.2.a. Makes assumptions about the changes in the coordinates of points in geometric shapes during translation and reflections across axes."* is categorized under the EA level.

An examination of the process components at the 8th-grade level reveals that the RL and EA levels are predominant. Given that students at this level are expected to have more developed higher-order thinking skills, it would be expected that the majority of process components would be classified at the EA level, which aims to foster higher-order thinking and generalization. However, the findings indicate that the process components are more concentrated at the RL level, which focuses on establishing relationships between different dimensions of a concept or topic.

Table 5.
Overall Distribution of Process Components of Learning Outcomes by SOLO Taxonomy Levels

Grade Level	**US**		**MS**		**RL**		**EA**		**Total**
	F	***%***	***F***	***%***	***f***	***%***	***f***	***%***	***f***
5th Grade	9	8.4	14	13.1	54	50.5	30	28.0	107
6th Grade	3	2.4	21	16.8	53	42.4	48	38.4	125
7th Grade	1	0.6	24	16.3	82	55.1	41	27.7	148
8th Grade	3	2.8	16	15.0	55	51.4	33	30.8	107
Total	16	3.0	75	15.3	243	50.0	152	32.0	487

An examination of Table 5 reveals that, across all grade levels, the process components of the learning outcomes are predominantly at the RL and EA levels, respectively. Following this pattern, the MS and US levels contain fewer process components across all grade levels.

Conclusions and Recommendations

In the 2018 mathematics curriculum, the attainments at the 5th-grade level were predominantly at the US and EA levels (Acar and Peker, 2023). On the other hand, in the Türkiye Century Maarif Model Mathematics Curriculum, the process components of the 5th-grade learning outcomes were mostly at the RL and EA levels, with only a small portion classified at the US and MS levels. This shows that the Türkiye Century Maarif model education program is designed with more deep mathematical understanding than the previous program (Doruk and Cihan, 2024). According to Hartman (1998), the higher cognitive level is significant in education process, as it directly affects the application of knowledge of the individual. On the other hand, an examination of the 2018 mathematics curriculum at the 6th-grade level reveals that, unlike the 5th-grade attainments, they were primarily at the US and MS levels (Acar and Peker, 2023). In the Türkiye Century Maarif Model

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Curriculum, the process components of 6th-grade learning outcomes were found to be predominantly at the RL and EA levels, similar to those in 5th grade. However, while the number of RL-level process components was significantly higher than that of EA-level process components in 5th grade, in 6th grade, the number of RL and EA level process components was nearly equal. Kuzu, Çil and Şimşek (2018) examined the 2018 mathematic education programs in the context of Bloom taxonomy, and they found that acquisitions in the steps of solution, evaluation and creation that involve high level skills are quite limited in middle school mathematics curriculum. Furthermore, in contrast to the findings of Acar and Peker (2023), the 2024 Türkiye Century Maarif Model Curriculum shows that 6th-grade attainments are not predominantly at the US and MS levels, but rather at the RL and EA levels. Çelik, Kul and Çalık Uzun (2018), examined the 2018 middle school mathematics curriculum in the context of revised Bloom taxonomy, and they found that acquisitions that involve high level skills are quite limited in middle school mathematics curriculum, reaching the similar findings of Kuzu, Çil and Şimşek (2018). A similar pattern is observed in 7th grade, as in 5th and 6th grades. While in 6th grade, the number of RL level process components was slightly higher than that of EA level process components, in 7th grade, the number of RL level process components is significantly higher compared to those at the EA level. The ability of students to use their prior knowledge, conceptual understanding, and past learning experiences plays a crucial role in enabling them to solve complex problems and establish connections between concepts (Biggs and Collis, 1989). Therefore, one of the prerequisites for meaningful learning is ensuring that students have acquired fundamental knowledge at the basic level. Additionally, incorporating attainments aimed at developing relational thinking skills in mathematics curricula is essential (Chapman, 2012; McGill, 2013; Ünal, 2023).

In addition, it was seen that there is a necessity for increasing the number of process components at the EA level in the Türkiye Century Maarif model curriculum for mathematics at this grade level. A similar pattern is observed in 8th grade, showing a similar pattern to the previous grade levels. Once again, the majority of process components at this grade level are classified under RL, followed by EA, with only a small portion falling into the MS and US levels. However, the number of EA level process components remains insufficient, and increasing the number of attainments at this level is expected to facilitate students' transition to EA level thinking (Biggs and Collis, 1989).

When making a general evaluation covering all grade levels, it is observed that the process components of learning outcomes are predominantly at the EA and RL levels, while only a small portion are classified under the MS and US levels. Across all grade levels, the highest concentration of process components is at the RL level, followed by EA, MS, and US levels, respectively (Cihan and Doruk, 2024). These findings indicate that priority is given to RL and EA level process components in the curriculum. These process components correspond to metacognitive thinking skills, which are essential for higher-level problem-solving processes. Successful problem solvers not only apply problem-solving strategies effectively but also possess strong metacognitive thinking skills (Xie, Lei, and Xie, 2022). Metacognition enables students to develop a deeper understanding of problem-solving approaches, making it a critical factor in achieving success in problem-solving processes (Lee, Ng, and Yeo, 2019).

On the other hand, it is not preferable completely that the vast majority of learning outcomes of all grade levels to be at the high level, however, since the current education program is designed to include a spiral structure, the process components of each grade level show homogenous distribution

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

in the related grade level. It is needed to increase the number of high-level acquisitions gradually by aiming the equal distribution of education program acquisitions in accordance with the grade levels and aiming to teach reasonable knowledge as the grade level increase (Anderson and Krathwol, 2001). The current curriculum aims to approach learning processes in a spiral and holistic manner. Moreover, with the spiral structure adopted in the program, it is aimed to build new knowledge on the existing knowledge of the students and to support the fundamental skills acquired in elementary school with more complex and abstract acquisitions at the middle and high school levels. Meanwhile, this aim is consistent with the development stages of Piaget. In this context, it is believed that distributions of acquisitions at each grade level show homogeneity in line with the spiral structure, in the revisions made. In addition to these, PS, US and MS levels of SOLO taxonomy refer to superficial learning outcomes focused on algorithms, while RL and EA levels refer to deep learning outcomes focused on comprehension (Houghton, 2010). Within this context, the fact that distributions of all process components at the class level are mainly concentrated at the RL and EA level is believed to be appropriate for middle school level in terms of reflecting the stages of development and spiral structure.

Recommendations

Researchers who wish to conduct studies using the SOLO Taxonomy may consider the following recommendations: This study examined the attainments (process components of learning outcomes) in the newly published Türkiye Century Maarif Model Middle School Mathematics Curriculum. In this context, a similar study could be conducted at the primary school and high school level. Additionally, a comparative study could be carried out to analyze the Türkiye Century Maarif Model and other countries' curricula within the framework of the SOLO Taxonomy. Furthermore, this study focused solely on the process components of learning outcomes in the Türkiye Century Maarif Model. Future studies could examine the activities included in middle school mathematics textbooks within the SOLO Taxonomy framework. In addition, the updated curriculum can be analyzed by using different taxonomies. During the analyses, the themes of the curriculums can be examined in detail by considering which themes are placed at which levels. Within this context, studies can be carried out in terms of comparing Türkiye Century Maarif model with different curricula of different countries.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Kaynakça

Acar, S. ve Peker, B. (2023). 2018 Ortaokul matematik dersi öğretim programı kazanımlarının SOLO taksonomisine göre incelenmesi. *İnönü Üniversitesi Eğitim Fakültesi Dergisi, 24*(2), 1155-1171. https://doi.org/10.17679/inuefd.1220514

Aktı Aslan, S. (2023). Türkçe Dersi Öğretim Programı'nın 5., 6., 7. ve 8. sınıf kazanımlarının Solo Taksonomisine göre incelenmesi. *Trakya Eğitim Dergisi, 13*(1), 682-694. https://doi.org/10.24315/tred.1084426

Alsaadi, A. (2001). A comparison of primary mathematics curriculum in England and Qatar: The SOLO taxonomy. *Research into Learning Mathematics, 21*(3), 1-6.

Anderson, L. W., and Krathwohl, D. R. (Eds.). (2001). *Taxonomy for learning, teaching and assessing: A revision of bloom's taxonomy of educational objectives.* Needham Heights, MA: Allyn and Bacon.

Arı, S. (2023). SOLO taksonomisi temelinde Hayat Bilgisi Dersi Öğretim Programı kazanımlarının incelenmesi. *Anadolu Dil ve Eğitim Dergisi, 1*(2), 58-68. https://doi.org/10.5281/zenodo.10445720

Ayvacı, H. Ş., Alev, N. ve Yıldız, M. (2014). Öğrenme kazanımlarının tasarlanma sürecine ilişkin lisansüstü öğrencilerinin zihinsel modellerini belirlemeye yönelik bir çalışma. *Kastamonu Eğitim Dergisi, 23*(3), 1013-1030.

Aziz, A. (2015). *Sosyal bilimlerde araştırma ve yöntem teknikleri*. Ankara: Nobel Akademik Yayıncılık Eğitim Danışmanlık.

Biggs, J. B., and Collis, K. F. (1991). Multimodal learning and the quality of intelligent behaviour. *Intelligence: Reconceptualization and measurement*, 57-76.

Biggs, J., and Collis, K. (1989). Towards a model of school-based curriculum development and assessment using the SOLO taxonomy. *Australian journal of education, 33*(2), 151-163. https://doi.org/10.1177/168781408903300205

Biggs, J., and Tang, C. (2011). Train-the-trainers: Implementing outcomes-based teaching and learning in Malaysian higher education. *Malaysian Journal of Learning and Instruction*, 8, 1-19. https://doi.org/10.32890/mjli.8.2011.7624

Biggs, J.B. and Collis, K: F: (1982). Evaluating the quality of learning: The SOLO taxonomy. Newyork: Academicpress.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40. https://doi.org/10.3316/QRJ0902027

Bryman, A. (2012). *Social research methods*. Oxford University Press.

Burnett, P. C. (1999). Assessing the structure of learning outcomes from counselling using the SOLO taxonomy: An exploratory study. *British Journal of Guidance and Counselling, 27*(4), 567-580.

Case, R. (1985). *Cognitive Development*. New York: Academic Press.

Chapman, O. (2012). Challenges in mathematics teacher education. *Journal of Mathematics Teacher Education, 15*(4), 263-270.

Cihan, F., ve Doruk, M. (2024). 2024 Ortaöğretim Matematik Dersi Öğretim Programının SOLO Taksonomisi ve Bilişsel İstem Düzeylerine Göre Değerlendirilmesi. *Uşak Üniversitesi Eğitim Araştırmaları Dergisi, 10*(3), 144-157. https://doi.org/10.29065/usakead.1511690

Çelik, D. (2007). *Öğretmen adaylarının cebirsel düşünme becerilerinin analitik incelenmesi* [Doktora Tezi]. Karadeniz Teknik Üniversitesi Fen Bilimleri Enstitüsü, Trabzon.

Çelik, S., Kul, Ü., ve Çalık Uzun, S. (2018). Ortaokul Matematik Dersi Öğretim Programındaki Kazanımların Yenilenmiş Bloom Taksonomisine Göre İncelenmesi. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 18*(2), 775-795. https://doi.org/10.17240/aibuefd.2018.18.37322-431437

Çetin, B., ve İlhan, M. (2016). SOLO Taksonomisi. E. Bingölbali, S. Arslan, ve İ.Ö. Zembat (Ed.), *Matematik Eğitiminde Teoriler* (pp. 861–879). Ankara: Pegem Akademi Yayıncılık.

David Lake (1999) Helping students to go SOLO: teaching critical numeracy in the biological sciences, *Journal of Biological Education, 33*(4), 191-198. https://doi.org/10.1080/00219266.1999.9655664

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Doğan, A. (2020). İlkokul matematik öğretim programındaki kazanımların SOLO sınıflandırmasına göre incelenmesi. *İnsan ve Toplum Bilimleri Araştırmaları Dergisi, 9*(3), 2305-2325. https://doi.org/10.15869/itobiad.768583

Dönmez, H. ve Zorluoğlu, S. L. (2020). Fen bilimleri dersi öğretim programı 6., 7. ve 8. sınıf kazanımlarının SOLO Taksonomisine göre incelenmesi. *Manisa Celal Bayar Üniversitesi Sosyal Bilimler Dergisi, 18*(1), 85-95. https://doi.org/10.18026/cbayarsos.547938

Fensham, P., and Bellocchi, A. (2013). Higher order thinking in chemistry curriculum and ıts assessment. *Thinking Skills and Creativity,* 10, 250-264. https://doi.org/10.1016/j.tsc.2013.06.003

Fischer, K.W. and Sylvern, L. (1985). Stages and individual differences in cognitive development. *Annual Review of Psychology,* 36, 613-48. https://doi.org/10.1146/annurev.ps.36.020185.003145

Fraenkel, J. R., and Wallen, N. E. (2006). *How to design and evaluate research in education*(6th ed.). New York, NY McGraw-Hill.

Gezer, M. ve İlhan, M. (2014). 8. sınıf vatandaşlık ve demokrasi eğitimi dersi kazanımları ile değerlendirme sorularının SOLO taksonomisine göre incelenmesi. *Doğu Coğrafya Dergisi, 19*(32), 193–207. https://doi.org/10.17295/dcd.88376

Hartman, H. J. (1998). Metacognition in teaching and learning: *An introduction, Instructional Science*, 26, 1-3. https://doi.org/10.1023/A:1003023628307

Hook, P. (2016). *First Steps with SOLO taxonomy. Applying the model in your classroom.* Essential Resources Educational Publishers Limited: Strawberry Hills, Australia.

Houghton, W. (2004). *Engineering subject centre guide: Learning and teaching theory for engineering academics.* Loughborough University.

İlhan, M., and Gezer, M. (2017). A comparison of the reliability of the Solo-and revised Bloom's Taxonomy-based classifications in the analysis of the cognitive levels of assessment questions. *Pegem Journal of Education and Instruction, 7*(4), 637. https://doi.org/10.14527/pegegog.2017.023

Kayhan Altay, M. ve Bulut, S. (2023). *Geometri Öğretiminde SOLO Taksonomisi. Geometri Öğretiminde Bilişsel Süreçler*. Vizetek Yayıncılık.

Korkmaz, F. ve Ünsal, S. (2017). Analysis of attainments and evaluation questions in sociology curriculum according to the SOLO taxonomy. *Eurasian Journal of Educational Research*, 69, 75-92.

Kuzu, O., Çil, O., ve Şimşek, A. S. (2019). 2018 Matematik Dersi Öğretim Programı Kazanımlarının Revize Edilmiş Bloom Taksonomisine Göre İncelenmesi. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi, 21*(3), 129-147. https://doi.org/10.17556/erziefd.482751

Lake, D. (1999). Helping students to go SOLO: teaching critical numeracy in the biological sciences. *Journal of Biological Education, 33*(4), 191-198. https://doi.org/10.1080/00219266.1999.9655664

Lake, D. (2002). Critical social numeracy. *The Social Studies, 93*(1), 4-10.

Lee, N. H., Ng, K. E. D., and Yeo, J. B. (2019). *Metacognition in the teaching and learning of mathematics*. Mathematics education in Singapore, 241-268. https://doi.org/10.1007/978-981-13-3573-0_11

Leung, C. F. (2000). Assessment for learning: Using SOLO taxonomy to measure design performance of design and technology students. *International Journal of Technology and Design Education, 10*(2), 149-161. https://doi.org/10.1023/A:1008937007674

Lian, L.H., Yew, W.T. (2012). Assessing algebraic solving ability: A framework from SOLO taxonomy. *Journal of Education and Practice, 3*(15), 177–188. https://doi.org/10.5539/ies.v5n6p177

Mcgill, R. S. (2013). *100 ideas for secondary teachers.* London: Bloomsbury Publishing.

MEB, (2018). *Ortaokul matematik dersi öğretim programı.* Millî Eğitim Bakanlığı.

MEB, (2024). *Ortaokul matematik dersi öğretim programı.* Millî Eğitim Bakanlığı.

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

Miles, M. B., and Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd Ed.). Calif: SAGE Publications.

Ocak, G., Akkaş Baysal, E. ve Yurtseven, R. (2023). *Eğitimde Program Geliştirme.* Pegem Akademi Yayıncılık.

Batı Anadolu Eğitim Bilimleri Dergisi, (2026), 17 (2), 1049-1069.
Western Anatolia Journal of Educational Sciences, (2026), 17 (2), 1049-1069.
Araştırma Makalesi / Research Paper

Özkan, U. B. (2021). *Eğitim bilimleri araştırmaları için doküman inceleme yöntemi.* Ankara: Pegem Akademi Yayıncılık.

Pegg, J., and Tall, D. (2005). Using theory to advance our understandings of student cognitive development. *International Group for the Psychology of Mathematics Education*, 187.

Piaget, J. (1950). *The Psychology of Intelligence.* London: Routledge and Kegan Paul.

Tutkun, Ö. F. ve Okay, S. (2012). Bloom'un Yenilenmiş Taksonomisi Üzerine Genel Bir Bakış. *Sakarya University Journal of Education, 1*(3), 14-22.

Tyler, R. W. (1949). *Basic Principles of Curriculum and Instruction.* University of Chicago Press.

Ünal, H. K. (2023). *Ortaokul matematik ders kitaplarının ilişkilendirme becerisi açısından incelenmesi.* (810988) [Yayınlanmamış Yüksek Lisans Tezi, Pamukkale Üniversitesi]. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Xie, Y., Lei, F., and Xie, R. (2022). From self-regulated learning to metacognitive therapy: A mapping knowledge doamains analysis. *Int J Arts Soc Sci, 5*(5), 66-78.

Yazıcı, H. ve Koca, M. K. (2008). Sosyal bilgiler öğretimi programı. B.Tay, A. Öcal.(eds). *Sosyal Bilgiler Öğretimi*. Ankara: Pegem Akademi Yayıncılık.

Zorluoğlu, S. L., Kızılaslan, A. ve Sözbilir, M. (2016). Ortaöğretim kimya dersi öğretim programı kazanımlarının yapılandırılmış Bloom taksonomisine göre analizi ve değerlendirilmesi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 10*(1), 260-279. https://doi.org/10.17522/nefefmed.22297