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STEAM learning through *yapılandırmacı yaklaşım* (constructivist approach): A descriptive study in turkish elementary schools

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ABSTRACT

This study aims to describe the implementation of the constructivist approach (*Yapılandırmacı Yaklaşım*) in STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning in Turkish elementary schools. The study used descriptive qualitative method, involving an in-depth, semi-structured interview with one primary school teacher in Antalya. Data were collected through a literature study and the interview and analyzed using the Miles and Huberman interactive model of analysis. To support the data management, coding, and theme categorization process, NVivo software was utilized, which helped in systematically visualizing the relationships between themes. The findings of this study show that the constructivist approach has been formally adopted in the Turkish national curriculum since 2004 and supports student-centered learning. However, its implementation is not always consistent due to problems such as the characteristics of the subject matter, time limitations, and variations in teacher readiness. Furthermore, STEAM learning is not yet widely known or implemented in state elementary schools, whereas private schools is more well prepared in terms of facilities and curricular flexibility. The result of NVivo visualization clarifies that the integration of STEAM and constructivism is theoretically highly relevant for improving student engagement, creativity, and problem-solving, but at the implementation level, it still requires strengthening teacher capacity, educational policy support, and reforms in teacher education curricula. Therefore, The study concludes that the success of constructivism-based STEAM learning is highly dependent on systemic readiness, which encompasses teacher training, policy support, and the provision of adequate facilities.

INTRODUCTION

The development of 21st-century education emphasizes not only content mastery but also critical thinking skills, collaboration, creativity, and problem solving (Alismail & McGuire, 2015; González-Pérez & Ramírez-Montoya, 2022) STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning approach is one of alternatives that can answer today's educational challenges (Razi & Zhou, 2022; Shrestha et al., 2020) STEAM integrates various disciplines in solving real problems through exploratory, collaborative, and creative activities to help students in learning. In Turkey, STEAM learning has begun to be widely implemented at the elementary

school level as part of a curriculum reform oriented towards developing 21st-century skills (Zerrin Mercan, 2022; Arpaci et al., 2023). However, the success of STEAM implementation is not only determined by the content taught, but also by the pedagogical approach used in the learning process. One approach that is considered to be in line with the spirit of STEAM is the constructivist approach (Yapılandırmacı Yaklaşım), which places students as active subjects in constructing their own knowledge through direct experience, discussion, reflection, and collaboration (Şahiner, 2022). The constructivist approach emphasizes that students construct meaning and knowledge through social and cognitive interactions with their environment (Amineh & Asl, 2015; Rannikmäe et al., 2020). In STEAM learning, it fosters independent and meaningful inquiry, exploration, and problem-solving (Quigley et al., 2020; Jesionkowska et al., 2020) Thus, STEAM learning through a constructivist approach in elementary schools is important to be examined to get deeper understanding of teaching strategies, student engagement, and the challenges and opportunities faced by teachers in classroom practice.

One approach that is considered to be in line with the principles of STEAM is the constructivist approach or Yapılandırmacı Yaklaşım. In Turkish educational literature, this approach has been officially adopted as a learning approach in the national curriculum from 2004 to today, although the curriculum has changed from the 2018 curriculum to the 2024-2025 curriculum (Uysal, 2025; Şahin & Köseoğlu, 2024). Yapılandırmacı Yaklaşım emphasizes the importance of direct experience, active student involvement, and collaboration as part of the process of building meaning. Therefore, this approach is very suitable to be applied in STEAM learning which focuses on the exploration and integration of various disciplines.

The integration of STEAM and constructivist approaches can improve students' learning motivation, cognitive engagement, and critical thinking skills (Küçük et al., 2023). Research by Hawari & Noor (2020) also emphasized that project-based STEAM learning using constructivist principles can build teamwork and creativity in elementary school students. In spite of that Yapılandırmacı Yaklaşım has been adopted in the national curriculum since 2004 (Kozikoğlu & Uygun, 2018), its implementation in STEAM learning still faces various challenges, such as lack of teacher training, minimal conceptual understanding, and limited educational facilities (Belbase et al., 2022; Jesionkowska et al., 2020). Therefore, in-depth empirical research is still needed to explain how the constructivist approach is actually applied in STEAM learning practices in elementary schools contextually and naturally.

This study shows the novelty because this topic is rarely touched on in previous empirical studies that generally focus on secondary education or conceptual aspects alone. Thus, the implementation of constructivist-based STEAM learning (Yapılandırmacı Yaklaşım) at the elementary school level in Turkey is still new. The urgency of this study lies in the need to understand contextually how teachers in elementary schools apply the constructivist approach in the cross-disciplinary integration of STEAM, amidst limited training, facilities, and supporting policies. This study aims to describe in depth the practices, strategies, and challenges teachers face

in implementing constructivist-based STEAM learning in the classroom to contribute to developing more effective teaching strategies based on real needs in the field.

METHOD

This study used descriptive qualitative to provide a deep and comprehensive understanding of the implementation of STEAM learning through a constructivist approach (Yapılandırmacı Yaklaşım) in elementary schools in Turkey. This study aimed to explore how STEAM learning is implemented, the teaching strategies used by teachers, and student involvement in the process.The subject of this study was Merve Çortuk, a teacher at an elementary school in Antalya City who is currently pursuing a doctoral degree at Akdeniz University who completed her undergraduate studies in Elementary School Teacher Education (Sınıf Öğretmenlik) and later pursued a master's degree in Educational Research and Evaluation at Akdeniz University, where she was a classmate of one of the authors. Ms. Çortuk decided to continue her education at the doctoral level in the same department and campus, leaving her position as an elementary school teacher.

This study was conducted in third and fourth grades an elementary school in Antalya City, Turkey. However, in general, the research locations referred to in this study are places where participants have taught elementary school students. Because in addition to government elementary schools, participants have also taught at dershane (preparatory schools). From these places, the participants' teaching experiences then became research data summarized through interviews.

Data were collected through review of related literature and semi-structured interviews. The literature review was conducted to gather an initial understanding of the application of the constructivist approach combined with STEAM in Turkey. Meanwhile, interviews provide deeper insights into experiences and perceptions. The data analysis process in this study follows the interactive analysis model of Miles and Huberman (1994), which consists of three main components: data reduction, data presentation, and conclusion drawing/verification. Data reduction is done by selecting, simplifying, and organizing raw data from interviews into a more structured form. Furthermore, the data is coded deductively based on the research questions, so that each quote is categorized into relevant main themes. Data validity is maintained through triangulation of sources and techniques, as well as the involvement of participants in the member checking process to confirm the accuracy of the researcher's interpretation. This approach allows for the preparation of an in-depth and holistic picture of the implementation of the Yapılandırmacı Yaklaşım-based STEAM approach in the classroom, including the challenges and opportunities faced by teachers and students during the learning process.

RESULTS

Implementation of STEAM learning with a constructivist approach (Yapılandırmacı Yaklaşım) in elementary schools in Turkey. The concept of STEAM is still relatively new and not widely known by teachers in public schools. In addition, the application of the constructivist approach in the context of STEAM is also not optimal due to various obstacles such as limited

training, lack of curriculum support, and minimal practical experience. A summary of the interview findings is presented in Table 1.

Table 1. Implementation of STEAM learning with a constructivist approach

Aspects	Description	Turkish Quote	English
Level of Understanding of STEAM	The concept of STEAM is not widely known among public elementary school teachers in Turkey. It is better known in private schools, although its implementation is not ideal.	*"STEAM'e daha önce çok duydum ama birazcık daha yeni yeni bir kavramdır ki Türkiye'de aslında tam olarak bilinmiyor bile. Yani berli özel okullarda biliniyor..."*	"I've heard a lot about STEAM before, but it's still a relatively new concept, and it's not really well-known in Turkey. I mean, it's known in certain private schools..."
Quality of Implementation	Although there are teachers who try to implement STEAM, the activities carried out do not reflect the true principles of STEAM.	*"...ama yaptıkları tam olarak STEAM'e yaklaşmıyor."*	"...but what they do doesn't really align with STEAM."
Causes of Low Implementation	The absence of STEAM training or courses in teacher education levels makes teachers unprepared to apply this approach.	*"Bunu sorun dışı öğretmenleri duzgun bir eğitim verilmiyor lisansta."*	"This is because subject teachers don't receive proper training in their undergraduate studies."
Association with Disciplines	Teachers tend to associate STEAM only with science and engineering, and do not understand how to integrate it with other subjects.	*"STEAM dediğimiz zaman inanılmaz bir uygulama alanına var, ama aklıma sürekli fen ve mühendişlik geliyor. Diğer derse nasıl entegre yapabildiğimizi bilmiyorum."*	"When we talk about STEAM, there is an incredible range of applications, but what constantly comes to mind is science and engineering. I don't know how to integrate it into other subjects."
Practical Experience	Until now, Ms. Merve has never seen proper STEAM practices in the school where she teaches or in her previous school.	*"Şimdiye kadar... verdiğim okullarda, düzgün bir STEAM etkinlikler görmedim."*	"So far... I haven't seen proper STEAM activities in the schools I've taught at."
General Conclusions	STEAM is considered a potential approach, but due to limited training and understanding, it has not been optimally implemented in public elementary schools..		

Learning strategies used by teachers in integrating constructivist approaches into STEAM learning in the classroom to explore possible learning strategies used in integrating constructivist approaches with STEAM learning, the researcher asked the participant (Ms. Merve) to spontaneously describe her learning plan if she had to implement it. Although she had never applied STEAM directly in the classroom, Ms. Merve suggested the use of the gösterip-yaptırma (demonstration and practice) method as a strategy that is in line with the principles of

constructivism. This strategy is considered relevant because it allows students to learn through direct observation and experience. A summary of Ms. Merve's responses is shown in Table 2.

Table 2. Learning strategies with a constructivist approach to STEAM learning in the classroom

Aspect	Description	Turkish Quote	English
Practical Experience	Ms. Merve has never implemented STEAM directly in a constructivist context in the classroom.	*"Şimdiye kadar okula vermeyeceğim, çalıştım yada verdiğim okullarda, düzgün bir STEAM etkinlikler görmedim."*	"So far, I won't recommend it to any school; whether I've worked at or sent my child to school, I haven't seen proper STEAM activities."
Proposed Strategy	Gösterip-yaptırma or demonstration and practice. The teacher demonstrates first, then students practice and continue independently. This strategy is in accordance with the principles of constructivism.	*"Gösterek yaptırmak bir teknik oluşturuyor, zaten bu da yapılandırmacı yaklaşıma uygulanabilir. Sen yapıyorsun sonra çocuk yapıyor, ama sonra çocuğa bırakırsın."*	"Demonstrating while doing creates a technique, and this can already be applied to the constructivist approach. First you do it, then the child does it, but eventually you let the child take over."
Reason for Strategy Selection	Because STEAM learning, especially in the context of engineering and technology, requires visualization and gradual stages of practice before students can independently explore concepts.	*"STEAM deyince hep mühendislik geldiği için, ve çocuklara biraz göstermen gerekiyor... direk göstermek yaptırmak uygun oluyor."*	*"When we talk about STEAM, it's always associated with engineering, and you need to show a bit to the children... so directly demonstrating and guiding them becomes appropriate."*
Conclusion of Strategy	Demonstrations and practices are considered effective strategies to bridge STEAM concepts and constructivist approaches, especially when students need to observe and experience the process directly.		

Challenges and solutions faced by teachers in implementing a constructivist approach in STEAM learning in elementary to understand the obstacles faced by teachers in implementing STEAM learning based on a constructivist approach (Yapılandırmacı Yaklaşım), the researcher interviewed Ms. Merve, an elementary school teacher in Antalya. From the interview, it was found that the biggest challenges included the lack of formal training on STEAM, minimal support for teacher education curriculum, and limited funds and facilities in public schools. Ms. Merve also offered several solutions, including the importance of integrating STEAM courses into teacher training study programs. A summary of these challenges and solutions is presented in Table 3.

Table 3. Challenges and solutions with a constructivist approach in STEAM learning in elementary schools

Challenges	Proposed Solution	Turkish Quote	English
Lack of formal training on STEAM at undergraduate level	STEAM should be taught in the form of theoretical and practical courses in the faculty of education	*"Sorun dışı öğretmenleri duzgun bir eğitim verilmiyor lisansta… çözüm aslında eğitim fakültelerinde STEAM ile alakalı dersler olmasında…"*	"The problem is that non-subject teachers are not given proper training during their undergraduate education… The real solution is to have courses related to STEAM in education faculties…"
Implementation of STEAM is not in accordance with the actual concept	Provision of special and systematic training for teachers to fully understand the principles of STEAM	*"Yaptıkları tam olarak STEAM'e yaklaşmıyor…"*	"What they do doesn't really align with STEAM…"
Classes are too large and difficult to condition	Ideally, the number of students in a class is reduced so that teachers can apply a more effective participatory approach	*"…kalabalık bir sınıftan dolayı çok şeyi yapamıyoruz…"*	"We can't do many things because of the crowded classroom…"
Limited funds and facilities for STEAM activities	Government support in the form of adequate budget, teaching materials, and educational equipment	*"Bütçeden dolayı çok şeyi yapamıyoruz… öğretmen olarak da çok sınırlı bir bütçen var…"*	"We can't do many things due to the budget… as a teacher, you also have a very limited budget…"
Reliance on teachers' personal initiative due to the absence of national policies that directly support	The government needs to formulate policies that require strengthening of STEAM-based curriculum in elementary schools.		

NVivo Mapping Results

To clarify the relationship between themes and categories found in this study, visual mapping was conducted using NVivo software. This visualization aims to systematically display how the main concepts, subthemes, and relationships between categories are interconnected in the context of implementing STEAM learning based on a constructivist approach (Yapılandırmacı Yaklaşım) in elementary schools. Figure 1 below is a project map that shows the thematic structure of the results of qualitative data coding, including challenges, strategies, solutions, and the role of teachers in the learning process. This map is a visual representation of the complexity of the issues identified during the data analysis process.

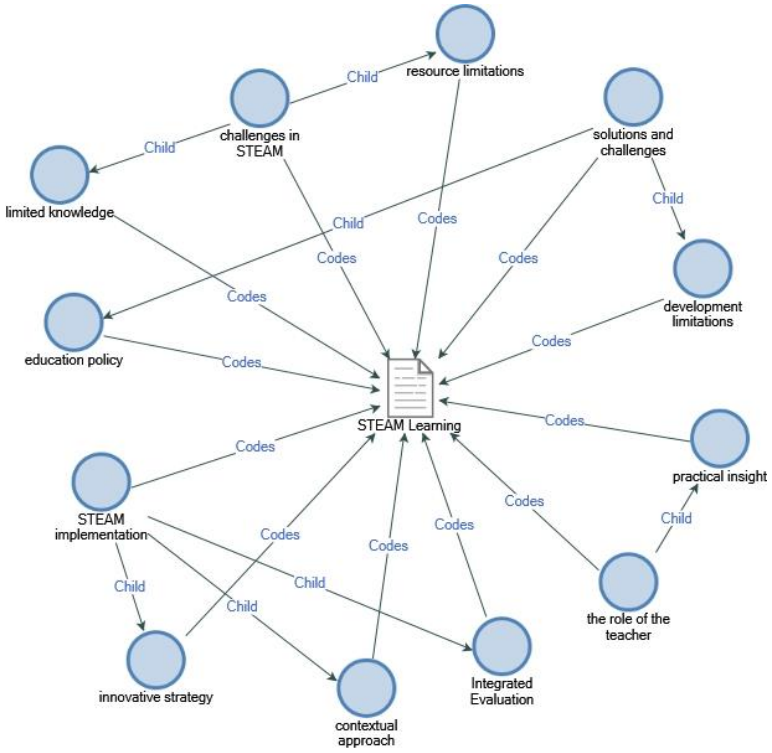

Figure 1. NVivo results

The results of the NVivo analysis visualized through a project map show that the implementation of STEAM learning based on a constructivist approach in elementary schools involves a number of interrelated main themes, such as resource constraints, lack of teacher knowledge, challenges in education policy, and innovative strategies in teaching. This map illustrates that the center of the analysis is STEAM Learning, which is coded with various categories such as implementation limitations, policy solutions, contextual approaches, integrated evaluation, and teacher roles. Each connected node reflects crucial aspects of the interviews and documents analyzed, including the need for professional training, policy support, and teaching strategies based on real experiences. Thus, the results of this NVivo confirm that the success of STEAM learning does not stand alone, but is determined by the complex interaction between teacher capacity, education policy, and institutional readiness in creating a learning environment that supports active and reflective cross-disciplinary learning.

DISCUSSION

The interview results showed that the main challenge in implementing STEAM learning based on the constructivist approach (Yapılandırmacı Yaklaşım) in elementary schools is the lack of formal training on STEAM at the teacher education level. There is no specific course on STEAM in the undergraduate teacher training program taken by the participants, so that understanding of STEAM concepts and practices is minimal. This condition is in line with the findings of Koç Akran and Aşiroğlu (2018) who stated that many teachers in Turkey have difficulty implementing

STEM/STEAM-based learning because they have not received adequate pedagogical and methodological training. A similar thing was also conveyed by Yustina et al. (2021), who emphasized that teachers need to receive continuous training to understand the synthesis between the constructivist approach and STEM methods effectively. In addition, Ulubey and Aykaç (2017) stated that the teacher education curriculum in Turkey still needs to be adjusted to the interdisciplinary learning paradigm to prepare teachers to face the complexity of 21st century learning.

The lack of formal education causes teachers' understanding of the STEAM concept to be incomplete and tends to be limited to a combination of science and engineering, while aspects of technology, art, and mathematics are rarely touched on in depth. This condition has an impact on the limited application of STEAM across disciplines, so that teachers more often associate STEAM with science experiments alone, without designing learning activities that integrate various scientific fields in an integrative manner (Erol & Erol, 2023). This conceptual limitation is further exacerbated by structural challenges such as the high ratio of students per class, which makes it difficult to implement constructivist-based learning that emphasizes active participation, collaboration, and independent exploration. Yıldırım Yakar (2022) emphasized that the implementation of the constructivist approach is highly dependent on the ideal proportion between the number of teachers and students so that learning interactions run effectively. In addition, Trisna, Hatta, and Budiyanto (2022) showed that without professional training and supportive learning design, teachers will have difficulty creating learning that combines constructivism and STEAM in a balanced manner. This is reinforced by Çevik, Bakıoğlu, and Temiz (2024), who stated that the quality of STEAM implementation is largely determined by the readiness of the learning system, including the availability of facilities, time, and teacher understanding. In a broader context, Gunduz and Hursen (2015) suggested that the integration of modern learning theories and learning practices needs to be strengthened in teacher education to avoid gaps between curriculum policies and classroom practices.

As an alternative solution, the development of teacher education curricula needs to be carried out structurally by including STEAM courses that cover theory and practice, accompanied by the provision of constructivism principles as a pedagogical foundation. This change must be designed legally and systematically in higher education policies so that prospective teachers have adequate conceptual readiness and practical skills in facing the complexity of 21st century learning (Astrid et al., 2012). Not only at the level of higher education institutions, active government involvement is crucial in supporting the successful implementation of constructivism-based STEAM. Without top-down policy interventions in the form of national regulations, funding allocations, and ongoing training programs, implementation at the school level will continue to rely on individual teacher initiatives that are sporadic and uneven (Mowlaie & Rahimi, 2010). In this context, strengthening teacher capacity through integrated training is essential, as emphasized by Arslan & Genc (2024), that teacher skills in integrating constructivism-based STEM principles can be improved through systematic learning that combines theoretical approaches and field practices. In addition, the integration of curriculum design, professional training, and supportive policies needs to be developed synergistically and sustainably to create a learning environment that truly encourages

active and reflective cross-disciplinary learning (Strachan et al., 2023; Klein, 2022). Thus, teacher education reform and integrated policy support are key to creating effective constructivism-based STEAM implementation in elementary schools.

CONCLUSION

Based on the research findings and interview results, it can be concluded that the implementation of STEAM learning based on the constructivist approach (Yapılandırmacı Yaklaşım) in elementary schools in Turkey still faces various challenges, both in terms of conceptual, structural, and policy. Limited teacher understanding of the STEAM concept, the absence of formal training at the teacher education level, limited facilities and infrastructure, and the high ratio of students in class are the main factors that hinder optimal implementation. Although the constructivist approach has been adopted in the national curriculum, its implementation in the field is still not fully consistent, especially in the context of cross-disciplinary learning such as STEAM. Comprehensive reforms are needed in teacher education, the formulation of supportive policies, and the provision of continuous facilities and training to ensure effective, relevant, and 21st-century learning. The impact of this study is to provide empirical contributions to the development of teacher education policies and the design of field-based training needs to strengthen the implementation of constructive STEAM at the elementary school level.

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