Empowering K-12 Learners for Global Challenges Through STEAM(M): Reflections from a Turkish Context

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ABSTRACT: STEM and STEAM practices in K-12 curriculums educate learners to be competent, adaptable, resilient, critical, and globally considerate and conscious individuals who use information from different sources as a necessity of the fast-paced digital and complex world. As an innovative approach, STEAM visibly combines school subjects, whereas media, which interconnects the world in this era, does so *invisibly*. It is essential to integrate media into STEAM (henceforth STEAM(*M*)) in K-12 education so 21st-century learners can meet emerging global challenges. With this study, we aimed to highlight the need to integrate media into STEAM and stimulate interest among both teachers and students. In doing so, we share our reflections on STEAM practices emphasising the visibility of media in K-12 formal education with its drawbacks and potential benefits. The project followed the framework of a collaborative action research project with two researchers from a university and five K-12 teachers and their 7th-grade learners from a secondary school in Turkey participating in the project. The results implicated that K-12 teachers must be provided with practical training on STEAM(*M*) applications and the resources needed to create appropriate environments for collaboration within the school. We conclude with reflective remarks concerning the integration of media and STEAM practices in the K-12 curriculum in Turkey.

Keywords: Global challenges, K-12 education, media, STEAM, 21st-century learners
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STEAM(M) Aracılığıyla K-12 Öğrencilerini Küresel Zorluklar için Yetkinleştirmek: Türkiye Bağlamından Yansımalar

ÖZ: K-12 müfredatlarındaki STEM ve STEAM uygulamaları, öğrencileri hızlı gelişen dijital ve karmaşık dünyanın bir gerekliliği olarak farklı kaynaklardan edindikleri bilgileri kullanan, yetkin, uyumlu, dirençli, eleştirel ve küresel düşünen ve bilinçli bireyler olarak yetiştirmeyi amaçlamaktadır. Yenilikçi bir yaklaşım olarak STEAM, konuları görünür bir şekilde birleştirirken, bu çağda dünyayı birbirine bağlayan medya bunu görünmez bir şekilde yapmaktadır. K-12 eğitiminde medyanın STEAM'e (bundan böyle STEAM(M) olarak anılacaktır) entegre edilmesi, 21. yüzyıl öğrencilerinin ortaya çıkan küresel zorlukların üstesinden gelebilmeleri için elzemdir. Bu çalışma ile medyayı STEAM'e entegrasyonu ihtiyacını vurgulayıp hem öğretmenler hem de öğrenciler arasında bu konudaki ilgiyi artırmayı amaçladık. Bunu yaparken, medyanın K-12 örgün eğitimindeki görünürlüğünü, dezavantajları ve potansiyel faydaları ile vurgulayan STEAM uygulamaları hakkındaki düşüncelerimizi paylaşıyoruz. Bu proje, bir üniversiteden iki araştırmacıyla birlikte Türkiye'deki bir ortaokuldan beş K-12 öğretmeni ve onların 7. sınıf öğrencilerinin katıldığı işbirlikçi bir eylem araştırması projesi çerçevesini takip etmiştir. Sonuçlar, K-12 öğretmenlerine STEAM(M) uygulamaları konusunda uygulamalı eğitim verilmesi ve okul içinde işbirliği için uygun ortamların yaratılması için gerekli kaynakların sağlanması gerektiğini ortaya koymuştur. Türkiye'deki K-12 müfredatında medya ve STEAM uygulamalarının entegrasyonuna ilişkin yansıtıcı görüşlerle sonuçlandırılmaktadır.

Anahtar Sözcükler: Küresel zorluklar, K-12 eğitimi, medya, STEAM, 21. yüzyıl öğrencileri
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1. Introduction

Throughout the world, one of the primary challenges that has faced educators and school administrators has been the overhaul of often outdated curriculum in order to provide students with the knowledge and skills that they will need to compete successfully in the twenty-first century and beyond (Yakman, 2008; Khine & Areepattamannil, 2019). It is the case that the majority of educational systems, in any nation, are still operating from curricula that were initially developed in the early twentieth century, when the demands of the world were far different. However, in the current day and age, it is not only essential that all students are provided with a well-rounded education that includes robust training in science, technology, and mathematics, but also provides them with a grounded framework within the humanities so that they can be best suited to meet the challenges of working within a newly globalised world.

With these new educational challenges in front of the entire academy, the early twenty-first century has seen the global development of a new educational movement, which is often referred to simply as STEAM, an acronym that represents (S)cience, (T)echnology, (E)ngineering, (A)rts, and (M)athematics (Taylor, 2016).

The STEAM curriculum movement has been particularly popular across the world and within Turkey, which has been actively seeking ways to update its own public education system to ensure that its young people can be highly competitive in the global marketplace of tomorrow (Long & Davis, 2017). Despite the increasing research interest in integrating and implementing STEAM into K-12 education, it accommodates a very important 21st-century skill, media literacy, only invisibly. Media literacy instruction helps students become active consumers of information, identify reliable sources, and use media effectively without being manipulated. This study was carried out to guard the necessity of integrating *M* (for Media) into STEAM in educating individuals of the 21st century. Our ultimate aim in this study is to share our reflections on STEAM practices emphasising the *visibility* of Media in K-12 formal education with its drawbacks and potential benefits.

2. Literature Review

2.1. STEAM in K-12 Education

The heavy emphasis placed on mathematics, science, and engineering in all national curricula over the last two decades as a result of global competitiveness has meant the notion of creativity and resourcefulness has often been overlooked. Upon closer examination of the STEAM approach to education, Liao (2016) argued the primary contribution of this curriculum is that it teaches students to be creative thinkers. Liao also noted the transdisciplinary emphasis of the STEAM approach encourages students to be more flexible, which will be a necessary skill in a highly evolving and advancing world economy.

Similarly, Yakman and Lee (2012) argued the primary benefit to the adoption of the STEAM educational approach is the emphasis on creative thinking that it engenders in children and adolescents. In particular, Yakman and Lee posited the excessive emphasis on math and science education in South Korea could be partly mediated through the adoption of the STEAM approach, which was initially developed in the United States. In their examination of the implementation of the STEAM approach within the United States, Herro et al. (2017) found that an emphasis on the arts within this curriculum helped the majority of students become more efficient and effective in solving problems in mathematics and science. Often, students who have difficulty learning mathematics and the physical sciences do so because of the linear, black and white manner in which these disciplines are traditionally taught in K-12 curricula. Notably, Herro et al. found that integrating creative thinking concepts within mathematics and science lessons greatly helped students understand the material.

2.2. Media Literacy and Critical Skills

The second "M" within the STEAM(M) acronym represents media literacy. In this context, media literacy can be defined as the ability to critically assess all media provided by, for example, official news outlets, governmental sources, or social media platforms for bias, the accuracy of the content provided, and the potential for outright disinformation campaigns (Karahan, Bilici & Unal, 2015). Indeed, people in the modern world are constantly bombarded with various sources of information that has not been properly fact-checked, has an underlying agenda, or is simply political or commercial propaganda (Potter, 2015). Given that the average person is confronted with an enormous amount of media information on any given day, it can be almost impossible to ascertain which sources are fully credible and which should be subject to further scrutiny and scepticism (Bennett, McDougall & Potter, 2020).

As such, it is more crucial than ever that all children and adolescents are adequately trained in media literacy and critical skills from an early age forward. If recent global events have proven anything,

the consequences of media illiteracy can be disastrous, crippling, and debilitating to societies and economies and may even lead to potentially noxious and incurable scenarios. Many of these negative consequences are directly traceable to the fact that the global adults of today rarely received any means of formal education in the critical assessment of such information sources, and almost every nation in the world is witnessing the deleterious outcomes of this fact (Donovan et al., 2014). However, moving forward, it is essential to incorporate robust media literacy and critical thinking education into the K-12 curricula so the dangers of misinformation and propaganda can be properly mitigated. To help K-12 students become more aware when consuming media, we must include lessons in the STEAM curriculum that teach them how to determine what sources offer a positive representation (McDougall & Ward, 2017; McDougall et al., 2018).

2.3. Integrating "M" for Media into STEAM

As discussed, the media aspect of K-12 education is a relatively new but necessary addition to the STEAM educational curriculum. Fortunately, it is quite simple to incorporate the concept of media literacy into a typical STEAM curriculum because media is an integral part of our life. As Potter (2015) said, we "swim in media daily" in a manner that is genuinely transdisciplinary and advantageous to all of the disciplines included in education. To raise conscious individuals in this age of information production and consumption, media literacy or related courses should be added to the K-12 curriculum to develop critical thinking skills (Phenow, 2018) – this is perhaps the arena in which critical thinking skills regarding various forms of media can be most efficiently cultivated (Buckingham, 2003; McDougall et al., 2018). For instance, students may be asked to closely examine and dissect various news articles from different news outlets that cover the same event and discuss how language is used to persuade the reader in one direction or another (Perignat & Katz-Buonincontro, 2019).

Moreover, in this context, students can be taught to effectively evaluate the sources that any given news outlet or journalist uses so that the student is aware that, in cases of doubt, it is always wise to check the provided sources that are given for any published work. Additionally, students should be able to comprehend that almost all news outlets and social media platforms have one form of political bias or another. Since media has become intertwined with all aspects of our lives, it must be systematically integrated into the school curriculum with STEAM (Potter, 2015; McDougall & Ward, 2017).

3. The Study

3.1 Context and Participants

This study was conducted in a secondary school in Turkey with two researchers from a university who are also the authors of this paper, five K-12 teachers, and their twelve 7th-grade learners in this school. Given that the teachers at this school have a rigorous timetable, we did not want to make any further impositions on their time. Consequently, we opted to undertake the study during an extracurricular time, labelled "Club Time," which takes place for two hours every Friday. Through this arrangement, we could ensure that teachers from a variety of different disciplines and subjects could drop in and contribute to the project at their convenience.

3.2 Research Process of the Study

Following a collaborative action research design, the study was conducted in three stages: development of a framework in the preparation stage, implementation of the STEAM(*M*) lessons, and reflections based on the implementations. In the preparation stage, the team had regular meetings and piloted some STEAM(*M*) lessons based on scenarios that illustrate real-life challenges. These lessons were ameliorated by the external adviser's input concerning media integration, and a framework was developed. According to the framework, students are informed about a global challenge (e.g. global warming) and asked to search current media sources for information on this topic.

The students then select a role to assume for the project, each of which represents one of the subjects of STEAM(*M*). For example, the student who selects to be the media (*M*) person becomes is responsible for sharing the STEAM project stages through media and designing a media campaign to explain to citizens how this project's product would benefit them. Hence, the 5A model (Access, Awareness, Appreciation, Action, Assessment) proposed by Mihailidis (2014) could be followed, as highlighted by the external adviser (Julian McDougall). In other words, the students were given opportunities to develop *awareness* on how the challenge was represented in the media considering their *access* to it, *assess* and *appreciate* how different media depicts the issue differently, and take *action* to

spread their voice on the issue.

Our pilot studies and discussions among the research team led us to implement a scenario that focused on climate change and its effects on stray animals in Turkey. The project was titled Providing a Living Space for Stray Animals. To begin, we engaged in a brief overview of the topic of climate change and stray animals with the 7th graders and asked them to select a sub-theme to work on, since we would ask them to produce their own media project in teams. Additionally, we developed a targeted series of questions regarding media literacy to help participants focus their attention on the necessary material.

4. Implementations and Reflections

This section outlines and presents our process and our reflections on the implementations.

4.1 Phase 1 – Generating Ideas

During the first week of this study, we met with the STEAM(*M*) club students for the first time and introduced them to all of the topics that we would cover. We showed the students a video that depicts animals in challenging situations due to severe hot or cold weather and asked them to share their perceptions of these videos. We then introduced the project and the purpose of the study.

We proceeded to explain the importance of the project for society to encourage a sense of ownership and investment in the project, which would then ostensibly raise the students' levels of interest (Harris & de Bruin, 2017). Following this explanation, we asked the students to research how to create a sustainable living space for the animals, which they would present at the next meeting. We also introduced the following roles, and asked students which role they would like to adopt for this project:

Crazy *S*cientist
*T*ech Guru
*E*ngineering Problem Solver
Creative *A*rtist
*M*aths Mastermind
*M*edia Maestro

Overall, the students appeared enthusiastic and excited about the project. However, it was also necessary for us to keep in mind that all of these participants were volunteers and were thus self-selected into the study.

4.2 Phase II – The Baby is Born

In the second week, the students shared their research findings related to a sustainable living space for stray animals. They also proposed ideas for the living space. For example, one student suggested the space should not be conspicuous, as she believed some 'bad' people may abuse animals. Supporting this idea, a few students added the space should not be portable either. Another student suggested multiple spaces could be created around restaurants so that the members of restaurant staff could regularly monitor and feed food scraps to the animals. Another student thought that an animal feed vending machine could be built in the space for donation.

During the brainstorming, one concept stood out. Two of the students designed a three-dimensional living space for the animals on Tinkercad. This space included six beds and four food and water cups inside. Additionally, the students took pains to ensure that dogs and cats each had separate living spaces. All of the students decided that they wanted to work further on this design, and one of the students mentioned the necessity of considering the comfort of disabled animals. In the meantime, the students all chose their respective roles for this study.

4.3 Phase III – The Baby is Grown Up!

In the following few weeks, each student contributed both individually and collaboratively to the development of the project in line with the role they had selected. Within this process, the subject teachers guided these students. For example, the science teacher asked the students to search for insulation materials. After some search and discussions with the teacher and the other students, *Crazy Scientist* decided to make use of styrofoam as the insulation material. The students then decided to experiment with styrofoam on a small box to understand how much this material could protect from cold and hot weather. They were happy with the results of this experiment, so they started to develop the product. The math teacher guided *Engineering Problem-Solver* and *Maths Mastermind* for the dimensions of the space. Arts and Technology teachers helped *Tech Guru* and *Creative Artist* to work on the design;

they discovered that cats prefer to play with round, red mobile objects, so they made necessary changes to the design. In the meantime, *Media Maestro* tried to be involved in all steps by researching media.

This design process was a bit burdensome; at times, students struggled to understand the limits and responsibilities of their roles, and they kept asking questions about these professions. For example, *Crazy Scientist* and *Engineering Problem-Solver* did not differentiate between the responsibilities they had. We had to explain how some professions work separately but also collaboratively to reach a product. The other problem was related to the teachers' heavy workloads. They visited the students and helped them when they had time, but this was not enough for the students. It was obvious that although some teachers wanted to devote more time to STEAM lessons, they could not because of all the other work they were required to do.

Unfortunately, because of COVID-19 closures, we had to end the project at this stage. We observed that the inclusive learning environment created by the STEAM application distanced students from rote learning and created a problem-solving, participatory, and holistic learning environment. However, the integration of media, which was the main goal of our project, was only successful in the product design process. We could not complete further work related to the dissemination of media.

5. Conclusion

Overall, this STEAM(*M*) project was successful, even though the students ran out of time to complete their project because of the COVID-19 outbreak. We also contemplated whether it was possible to use the STEAM(*M*) approach throughout the school site. One of the main takeaways of this study is that students can become interested in any media literacy study if the subject matter is personally valuable to them (Quigley & Herro, 2016). In our project, we tried to ensure that all students, and especially *Media Maestro*, could use media critically and reach credible sources. This study revealed a need to integrate media in the STEAM educational approach. While this approach idealistically proposes a transdisciplinary pedagogy, this does not always translate into reality at school sites. Often, the teachers' work schedules in any given field are so hectic and regimented that it may simply be impossible to get arts teachers to take an active role in a science project and vice versa. Accordingly, teachers in all disciplines should make a concerted effort to include media literacy and critical thinking instruction in their lesson plans.

Integrating media in a STEAM approach and developing a framework focusing on global challenges is indispensable to help 21st-century learners be competent and self-aware of the world around them (McDougall & Ward, 2017). Within this framework, students need to be shown scenarios illustrating 21st-century global challenges in line with their school subjects and allowed to adopt distinct roles for each subject of STEAM(*M*) based on their interests and desires. By doing this, they engage in a creative process that connects their knowledge gained from the school subjects to the global challenges they will face. Therefore, more research and applications are needed to integrate media into STEAM education to empower learners.

List of abbreviations
STEAM: Science, Technology, Engineering, Arts, and Mathematics
K-12: Kindergarten through 12th Grade

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