Mehmet Akif Ersoy University Journal of Education Faculty e-ISSN:2146-5983 Year: 2025 Issue: 73 Pages: 684-711

CULTURO-TECHNO-CONTECTUAL APPROACH: SAMPLE IMPLEMENTION STEPS FOR TEACHING SOCIOSCIENTIFIC ISSUES[1]

KÜLTÜREL-TEKNO BAĞLAMSAL YAKLAŞIM: SOSYOBİLİMSEL KONULARIN ÖĞRETİLMESİNE YÖNELİK ÖRNEK UYGULAMA ADIMLARI

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Received: 30.11.2023 Accepted: 31.01.2025 DOI: 10.21764/maeuefd.1398648

Abstract: The current study aims to evaluate, conceptualize, and provide a sample implementation of the culturo-techno-contextual approach (CTCA) on the basis of artificial intelligence as a socioscientific issue in teaching culture-based issues in science education. CTCA is a new approach, which has a conceptual history of only ten years, where culture, technology and context are handled in a pot. In this study, an exemplary implementation process for this approach, which may be suitable for socioscientific issues (SSIs) in terms of its local characteristic, was created. It is hoped that this sample implementation will provide a guiding framework for researchers in the teaching of SSIs, which have an important place in science education. In the study, the implementation steps are named to make it more usable for researchers. As CTCA is still a relatively new approach, it is recommended that readers critically read these steps and detect possible shortcomings in the sample implementation and address them in new studies, if any.

Keywords: C*ulturo-techno-contextual approach, socioscientific issues, artificial intelligence, sample implementation*

Özet: Bu çalışma, fen eğitiminde kültür-temelli konuların öğretilmesinde yeni bir yaklaşım olan kültürel-tekno bağlamsal yaklaşımın (KTBY) sosyobilimsel bir konu olan yapay zekâ odağında değerlendirilmesi, kavramsallaştırılması ve uygulama basamaklarına yönelik bir örneğin sunulmasını içermektedir. KTBY henüz on yıllık bir kavramsal geçmişe sahip olan, kültür, teknoloji ve bağlamın bir potada ele alındığı yeni bir yaklaşımdır. Bu araştırmada yerel özelliği bakımından sosyobilimsel konular (SBKlar) için uygun olabilecek bu yaklaşıma dair örnek bir uygulama süreci oluşturulmuştur. Bu örneğin fen eğitiminde önemli bir yer tutan SBKların öğretilmesinde araştırmacılara yol gösterici bir çerçeve çizmesi umulmaktadır. Çalışmada uygulama basamakları araştırmacılar için daha kullanılır hale getirmek amacıyla isimlendirilmiştir. KTBY henüz oldukça yeni bir yaklaşım olduğundan, okuyucuların bu basamak isimlendirmeleri veya verilen uygulama örneğinde olası eksiklikleri eleştirel bir gözle okumaları ve varsa eksiklikleri düzeltmek için yeni çalışmalarda tartışmaları önerilir.

Anahtar Sözcükler: *Kültürel-tekno bağlamsal yaklaşım, sosyobilimsel konular, yapay zekâ, uygulama örneği*

[1]A part of this study was presented as an oral presentation at the 10th Eurasian Educational Research Congress held between 8-11 June 2023.

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Introduction

From the middle of the 19th century to the present, studies to improve students' performance in science education have been conducted with some differences in each period and still continue to be in the focus of research. Constructivist approaches such as cooperative learning, analogies, and metaphors have become the subjects that researchers have investigated in their studies in these periods (Awaah, 2023). Lin, Lin, Potvin and Tsai (2019), in their study investigating trends in science education every five years since 1998, stated that research in the last 20 years has changed a lot. While the most important subjects were conceptual understanding, and conceptual change between 1998 and 2002, subjects such as inequality in science education, STEM education and undergraduate research experiences was in the foreground between 2013 and 2017 (Lin et al., 2019). When studies on teacher training are examined, it is seen that there is an increasing tendency toward pedagogical content knowledge, questioning, and problem solving, (Aldahmash, Alshamrani, Alshaya & Alsarrani, 2019). In current studies, the focus be on 21st century skills including subjects such as digital literacy, problem solving, information literacy, and critical thinking and the need for constantly developing digital competence (Silber-Varod, Eshet-Alkalai & Geri, 2019).

Zeidler and Abd-El-Khalick (2017) see the investigation of local and global effects in science education research as a developing research area. Here, socioscientific issues (SSIs) are the issues that best connect science education with its social aspects, both locally and globally. When the studies conducted in the last 20 years are reviewed, it is seen that SSIs have a great impact on the development of scientific literacy (Zeidler, Herman & Sadler, 2019). As a complement to the STEM initiative, which has been very popular in science education in recent years, SSIs offer opportunities to address various science issues (for example, epistemological maturation, socio-ethical discourse, emotional reasoning, character education, nature of science and argumentation). This requires researchers to adopt a sociocultural perspective (Zeidler et al., 2019).

Students come to science classes with various beliefs. Although these beliefs are not directly related to the understanding of science taught in lessons, students associate these beliefs with science (Patel, 1997). It is common for students from different cultural backgrounds to be in the same class. Türkiye has a multicultural structure encompassing seven geographical regions with diverse demographic characteristics in terms of language, religion, ethnic identity, socioeconomic status and refugee capacity (Kotluk & Kocakaya, 2018). Therefore, in Türkiye, which has a multicultural structure, having students with different perspectives in the classroom will promote diversity in science lessons. On the other hand, during the Covid-19 pandemic, starting from March 2020, students across all levels of education, from elementary school to university, continued their studies through distance education in Türkiye for approximately one and a half years. Furthermore, the earthquake disaster that happened in February 2023 also necessitated university students to continue their courses through distance education for a term. The process of distance education has demonstrated the necessity of increased use of technology in such situations. As seen, culture and technology-based applications have become essential both in the classroom and in distance education.

Many studies indicate that cultural or local knowledge is effective in teaching science. Moreover, both in rural and urban areas, the most preferred support teachers and students want in their classrooms is technological equipment (Oladejo et al., 2023). Therefore, in science education, there is a growing tendency to prioritize technological and socio-cultural issues in current research. Although researchers have been focusing on how students can learn science better in science education for many years, the performance in science education has not yet developed sufficiently (Awaah, 2023). According to Oladejo and Ebisin (2021), one of the most serious problems arises from content-context disconnection in classrooms, especially in teaching STEM subjects. Strong research needs to be done for students to learn science more effectively (Awaah, 2023). Okebukola (2020) proposed the culturo-techno-contextual approach (CTCA), which is based on establishing connections with local knowledge and cultural practices, to address this deficiency. This study was designed to reveal the place of CTCA, which has a history of ten years, in science education. The place of CTCA in science education, its applicability, its conceptualization in science education, and its interaction with SSIs are discussed in this study.

Culturo-Techno-Contextual Approach

The culturo-techno-contextual approach (CTCA) is an African-based teaching approach introduced by Okebukola in 2015. CTCA was created to teach science because of more than 40 years of work to find solutions to problems that prevent science from being learned in a meaningful way (Okebukola, 2020). This approach has three components: (a) the cultural context in which students are engaged or immersed; (b) mediation of technology that teachers and students gradually depend on and (c) regional context where each educational institution has its own identity and which plays a strong role in local and sample case studies in science courses (Figure 1).

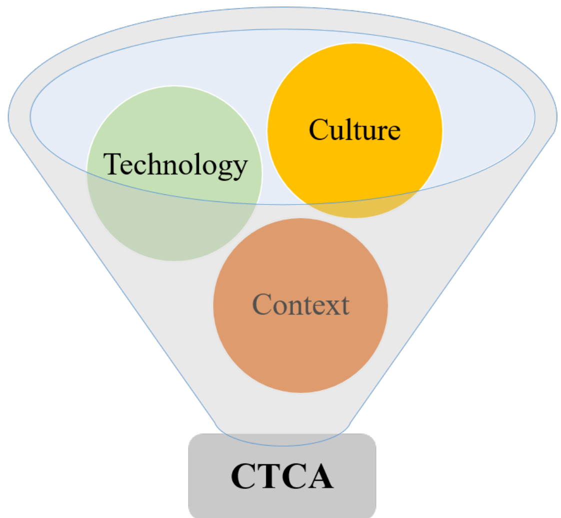

Figure 1.
Culturo-techno-contextual approach (Okebukola, 2020)

As can be seen in Figure 1, culture, technology, and context are handled in the same pot in CTCA. CTCA is an approach that emphasizes local culture as the basis for understanding human behaviour (Ademola et al., 2022). Kwame Nkrumah's understanding of ethnophilosophy for the cultural element, Martin Heidegger's understanding of technophilosophy for the technological element, and Michael Williams' understanding of contextualism for the contextual element are the base of the approach (Onowugbeda et al., 2022). The cultural context refers to the local knowledge that individuals are in. Here, as local knowledge, it is emphasized that individuals should acquire knowledge about the world order and evaluate how they can use this knowledge to improve their own quality of life through their own filters. According to Onowugbeda et al. (2022), CTCA is linked to students' local knowledge and cultural practices for all subjects, not just for science lessons. In this context, the synthesis of local knowledge and culture can have a positive effect on students' interest in science and perhaps contribute to the maintenance of the culture (Perin, 2011). According to Okebukola (2020), certain conceptual misconceptions arising from culture can lead individuals to think differently in scientific terms. Okebukola (2020) gives the following example for this: In some circles, albinism is seen as a punishment given to people with albinism, and people with albinism are less intelligent. However, there is no indication that albinism has a significant effect on the level of intelligence. The level of melanin is responsible for albinism in the body and is not related to intelligence. However, since melanin deficiency can cause visual impairment, individuals with albinism may have visual impairments that can affect learning outcomes (Okebukola, 2020). The cultural dimension of CTCA is important in this respect. Seen from another perspective, the universal nature of science involves explaining how science can exist in any culture as embedded in individuals' local, indigenous or cultural knowledge, and how this understanding can be used to meet people's needs. CTCA prioritizes culture by encouraging students to contextualize every course within their local background information or cultural practices and make meaning related to their lifestyle from what is taught in science courses (Oladejo et al., 2022).

In terms of the technological context, especially with the COVID-19 pandemic, technology-integrated lessons have come to the fore at every education level, from primary school to university (Terenko & Ogienko, 2020). Technology-enhanced interactive lessons have been tried to be made widespread in science education as well (Ademola et al., 2022). In a study conducted by Bakioğlu and Çevik (2020) to investigate the views of science teachers on distance education during the COVID-19 pandemic, it was found that teachers' use of materials in their lessons changed and that the use of educational technologies increased. Similarly, teachers expressed that distance education practices in science lessons provided access to different resources, facilitated individual learning, and saved time and energy (Akçöltekin, Özdemir, Genç & Şevgin, 2022). The implementation of technology-enhanced education in science courses will continue to show progress with each day.

Since the term CTCA is a relatively new term, the first research on its use in a Turkish context was presented at a congress by the authors of the current study (Tekin & Aslan, 2023). Below are examples to show the difference between CTCA and other approaches and its importance on a cultural basis.

Comparison of CTCA and Other Approaches on a Cultural Basis

In recent years, most studies in science education have focused on learning-context, teaching and learning-concepts (Lin et al., 2019). Here, concepts that are handled in a certain context in science education come to the fore. There are many approaches in science education such as the nature and philosophy of science (Çilekrenkli & Kaya, 2022), argumentation (Martins & Macagno, 2022), STEM (Ortiz-Revilla, Greca & Arriassecq, 2022) or SSIs (Herman, Owens, Oertli, Zangori, & Newton 2019). In order to be able to compare CTCA with current approaches in science education, information about studies conducted on culture-based STEM/nature of science/socioscientific issues is given below (Table 1).

Table 1

Sample Studies Conducted in Cultural Context

Approaches	Author(s)-year	Result
STEM	Yuecheng (2023)	Through the combined application of traditional culture and STEM education, participants' understanding of scientific/technological knowledge and the development of human civilization.
	EL-Deghaidy et al. (2017)	It is aimed to determine the views of science teachers about the pedagogy of STEM education and its interdisciplinary nature. Seven themes are created. One of these themes is "STEM as linked to life (local/international)". The following examples are given under this theme: - Use of robots in industry and regionally in the electrified subway. - Designing buildings that produce the alternative types of energy using wind and solar power.
	Nugroho et al. (2019)	It is aimed to investigate the effects of a STEM approach based on local wisdom on the development of sustainability literacy in Indonesia. As a result, the importance of the environments that pre-service teachers will directly experience by using the local potential with the help of STEM education is emphasized.
SSIs	Ladachart and Ladachart (2021)	Thai pre-service biology teachers' culture-based SSIs-related decision making, and informal reasoning are investigated. They conclude that the participants in the presence of various perspectives on the SSIs. As a result, culture- and technology-based SSIs should be used appropriately to foster science learning.
	Chang Rundgren and Rundgren (2010)	It is a study investigating different dimensions of SSIs. According to the study, the dimensions of SSIs are Sociology/culture, Environment, Economy, Science, Ethics and Politics (SEE-SEP).
	Zeidler et al. (2013)	The study examines students' epistemological reasoning about SSIs and to identify interactions of cultural and scientific identity. It is concluded that there is an inductively consistent cross-cultural tendency in justice, pragmatism, emotional reasoning, utility, and religious issues.
NOS	Wan et al. (2018)	This study investigates the views of pre-service teachers about the nature of science (NOS) and how their culture affects these views. As a result, it is concluded that many participants have alternative and contemporary views on NOS, but very few of them have classical views. Suggestions are made to develop, design, and contextualize appropriate local strategies for the training of science teachers. It is emphasized that students' views on NOS in non-Western contexts should be investigated further.

Herman et al. (2019)	The study examines the relationship between students' trophic cascade explanations and NOS views after place-based SSI teaching. In the study, it is seen that there are significant and medium correlations between the accuracy and contextualization of students' views on NOS and the complexity of their trophic cascade explanations.

According to Table 1, studies conducted on STEM, SSIs, and NOS in a cultural context, culture, especially its "locality", is emphasized (Lin et al., 2019). The importance of students, teachers, or pre-service teachers using the characteristics/emotions/context specific to the region they are in is emphasized in science education. However, it should be noted that the number of culture-based studies is quite limited (Lin et al., 2019). For example, STEM, which has a very popular place in science education, has come to the fore recently as an approach based on improving the science-technology-engineering-mathematics education of especially disadvantaged individuals. Social-psychological characteristics and structural components in family, school and wider cultural settings are factors that affect STEM education (Xie, Fang & Shauman 2015). In the study of Li, Wang, Xiao and Froyd (2020), in which they examined studies on STEM education, they stated that only 78 (9.77%) of 798 studies included cultural, social, and gender issues. Thus, one of the least researched areas in STEM education is the importance of the cultural relationship in STEM. For this reason, there are difficulties experienced in teaching and learning STEM concepts in the cultural environment of students (Onowugbeda et al., 2023). It can be observed that there is a tendency in studies on STEM education toward integrating one or more components of science-technology-engineering-mathematics, which are essentially the building blocks of STEM (Falloon, Hatzigianni, Bower, Forbes & Stevenson, 2020), developing some applications (Çiftçi, Topçu & Foulk, 2022) or creating a conceptual framework (Chu, Martin & Park 2019). While these studies make significant contributions to science education, they show that there is a need for culture-based approaches in science education. As an approach based on culture, CTCA can perhaps include all the components of STEM education. In this respect, although culture is closely related to STEM components, it remains in the background in applications. Although the argumentation approach, which is at the forefront in the discussion of SSIs, is effective in teaching cultural issues in this respect, it may not be enough to provide the expected effect since it does not put culture into the centre.

According to Culturally Relevant Pedagogy, using cultural resources to transmit knowledge, skills and attitudes provides a pedagogy that empowers students in many area that will support their individual development (Ladson-Billings, 2021). Educators who use this method see culture as a power and believe that this power will help students be more successful in school and in their social lives (Ladson-Billings, 2022). Mashoko (2022) examined the integration of local knowledge into the physics curriculum in Zimbabwe and stated that there is a large gap between the science taught in schools and students' local knowledge. Local knowledge can be beneficial for not only physics teaching and learning but also for developing students' cultural identities. More importantly, local/cultural knowledge can be used to integrate cultural issues into school science in both theoretical and applied fields (Mashoko, 2022). According to Smith, Avraamidou and Adams (2022), disadvantaged individuals are more affected by the difficulties arising from current SSIs such as poverty, inequality, climate crises, and global epidemics. For this reason, scientists who approach science education with a critical point of view emphasize the importance of different views in scientific knowledge production and decision making processes. Therefore, it is possible to promote development by integrating the decision-making experiences of individuals coming from diverse cultural backgrounds. In science education, these studies, referred to as "culturally relevant/responsive and sustaining pedagogies (CR-SP)" embrace a multicultural approach by supporting the participation of marginalized students in science and promoting a culturally inclusive learning environment (Smith et al., 2022). Integrating CTCA into the education systems of countries with different local cultures can enable students to become more competent in areas such as scientific literacy or citizenship skills.

CTCA, which enables cultural and technological studies to progress by influencing each other in science lessons, can also help in teaching the subjects on which societies have dilemmas. SSIs, which are at the forefront with their controversial nature in science education, may be the most appropriate issues to be used in the application of this approach. Therefore, the interaction of CTCA with SSIs is discussed below.

Culturo-Techno-Contextual Approach and Socioscientific Issues

Socioscientific issues (SSIs) are open-ended, controversial social issues with a scientific dimension (Sadler & Zeidler, 2005). Issues such as the textile industry, plastic pollution, energy transitions and the internet of things are SSIs. SSIs support students in conducting better discussions, reflecting on values, developing different perspectives, forming conscious ideas, and making decisions (Klaver, Walma van der Molen, Sins & Guérin, 2022).

In the historical process, starting with the transition from a positivist view to constructivism, the interaction between science and culture began to gain importance in the 1960s. In the 1970s, the Science-Technology-Society (STS) movement emerged, highlighting the social aspect of science education and focusing on the relationship between its constituent components. In the 1990s, with the integration of environmental and moral development aspects, the STS movement expanded its scope in science education and became known as the Science-Technology-Society-Environment (STSE). However, the fact that ethical-moral development took an important place in science education in the 2000s showed that this framework was not sufficient for the development of science education. However, in the 2000s, the growing importance of ethical and moral development in science education indicated that the existing STSE framework was insufficient for the progress of science education. Subjects such as moral reasoning, nature of science, argumentation, emotional development and culture have an important place in science education, making SSIs an important umbrella concept of science education (Sadler, 2004). Topçu (2015) summarized the historical change from the STS movement to SSIs as in Figure 2.

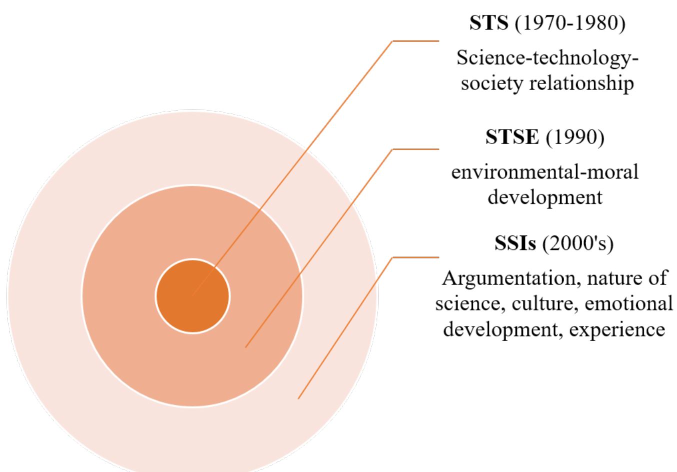

Figure 2.
The historical process from STS movement to SSIs (Topçu, 2015)

Although culture is considered as one of the components in SSIs, this component has largely been overlooked in studies. Studies investigating SSIs as the results of SSIs-based education (Hodson, 2020; Karahan & Roehrig, 2019) or using SSIs as the main component of the teaching process (Altmeyer & Dreesmann, 2020; Sadler, Foulk & Friedrichsen, 2017) show the areas where SSIs have been popularly researched in science education. However, according to Klaver et al. (2022), since they have a social aspect, students may already be following the news about SSIs, talking about these issues, feeling their effects, or taking action to solve them. Therefore, there may be a need for research on new approaches in teaching SSIs. While SSIs are issues that affect individuals on a global scale, they can also be discussed locally by societies (Çapkınoğlu, Yılmaz & Leblebicioğlu, 2020). In this respect, approaches where culture is at the centre of lessons containing SSIs can be useful in effective lesson designs.

Influenced by students' daily life experiences, socioscientific discussions can be closely related to the events occurring in their lives, such as controlling animal populations or building power lines (Ladachart & Ladachart, 2021). Balgopal, Wallace and Dahlberg (2017) suggest that during the discussion of SSIs, various cultural frameworks should be created for students with diverse cultural experiences to discuss the same SSIs. According to Ladachart and Ladachart (2021), it is essential to deal with SSIs arising from the dilemmas between cultural beliefs and scientific knowledge. However, there are few attempts to address such dilemmas. Chang Rundgren and Rungren (2010) proposed the SEE-SEP framework to provide a holistic approach to the multidimensional nature of SSIs in everyday life. Later, Eş and Öztürk (2021) expanded on these dimensions and referred to them as SEE-STEP. Accordingly, SSIs have sociology/culture (S), environment (E), economy (E), science (S), technology (T), ethics (E) and politics (P) dimensions.

As seen, while the component of culture is important in SSIs, it is also powerful enough to shape science education with a cultural focus. CTCA can be an effective approach in teaching SSIs that best explain the social aspect of science, as it prioritizes culture and enables the subjects to be discussed in a context. In the next section, the implementation steps of CTCA are given and explained over a sample SSI.

Implementation Steps of CTCA

Teaching science in relation to culture is an effective method for improving students' achievement levels, higher-order thinking skills, and a sense of citizenship responsibility. A single teaching strategy may not contribute to the development of similar knowledge, skills or feelings in all the students at the same time, but developing a plan to teach culture-supported lessons regularly will help attract the attention of students from diverse backgrounds. This highlights the fact that science teaching should be contextualized and culturally grounded (Onowugbeda et al., 2023). Therefore, as an instructional strategy that takes students' cultural backgrounds into consideration and that extensively uses technology, examples of CTCA applications can be employed in effective classroom practices.

When implementing CTCA, students engage in social interaction in two ways, as required by Vygotsky's theory of social constructivism: (a) interacting with a more knowledgeable person to learn about local/cultural practices related to the concept under consideration and (b) establishing group interactions with other students. These two ways of interaction create foundations that encourage students to learn meaningfully with CTCA (Onowugbeda et al., 2022). Based on these two basic interactions, Okebukola (2020) suggested five-step implementation for CTCA in the classroom setting (Figure 3).

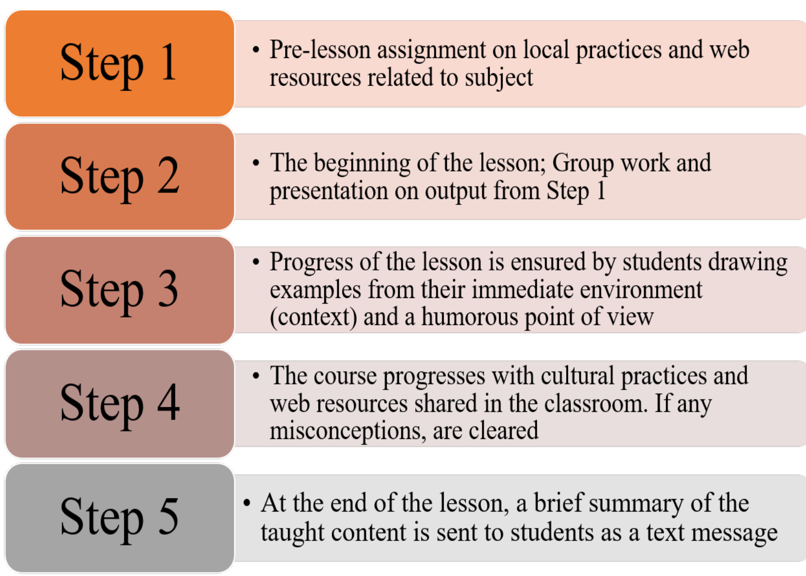

Figure 3.
Implementation steps of CTCA (Okebukola, 2020)

There are studies investigating various issues using the application steps shown in Figure 3 for the implementation of CTCA in science education (Adebayo et al., 2022; Ademola et al., 2022; Adeosun et al., 2022; Oladejo et al., 2022). For example, Adebayo (2022) conducted a study with secondary school students on genetics-related issues, Ademola et al. (2022) on ecology-related issues, and Oladejo et al. (2022) on physics-related issues.

Since CTCA is a fairly new approach, there are few examples of its implementation. For this reason, in the current study, an example in which artificial intelligence, which is a SSI, is used as a context, is given to demonstrate the implementation steps of CTCA. Artificial intelligence, like other SSIs, is one of the subjects that closely concerns individuals and will be at the forefront with its social aspect in the near future. Artificial intelligence focuses on computers and machines that can perform cognitive activities such as problem solving or learning as the product of the human mind or the development of such machines (Zeide, 2019). Artificial intelligence affects societies in many fields, from health to education, from law to security, from banking to political science (Türer, 2020). In addition, concerns that artificial intelligence can exceed human intelligence and manage humanity remain up-to-date. Therefore, AI is one of the subjects that individuals frequently encounter in daily life. This may enable AI to be handled in a cultural context in terms of its presence in the close environment of individuals. Steps of the sample implementation for the use of CTCA in teaching artificial intelligence in two course hours (40+40 minutes) are given Table 2.

Table 2

Steps of CTCA Implementation and Sample Contents

Implementation Steps	Sample Contents
Step 1 (Get the assignment and research) (15 minutes)	(a) Students are informed in advance that the subject of artificial intelligence will be covered in the classroom. (b) Students are asked to think about local aspects of artificial intelligence, its cultural practices or beliefs. They are informed that they will share their thoughts, which will be formed because of these studies, with their classmates. (c) They are asked to research the subject on the internet through a device with internet access.
Step 2 (Discuss with the group and share the result) (25 minutes)	Mixed-ability students are gathered in different groups to ensure the sharing of various cultural practices and information obtained from the web. They were asked to select the group leader. The argumentation or the discussion process is initiated within the group, and cultural/web-based documents are presented by the group leader. The teacher completes the step by sharing local/cultural practices related to artificial intelligence.
Step 3 (Draw and develop sense of humour) (15 minutes)	The lesson goes on through drawings on artificial intelligence. Drawings can be made using pencil paper or they can be created using online cartoon drawing tools (such as Canva or Storyjumper). At this step, it is important to give examples of the use of artificial intelligence in daily life. For example, the use of artificial intelligence in language operating systems, smart assistants, e-commerce and medicine-health can be enriched with examples from individuals' daily lives. This step may contain some humour. When necessary, the teacher can leave the drawings unfinished and allow the development of the drawings with the participation of the students. An example of a drawing that can be created in this step is presented in Appendix A.
Step 4 (Make sense of the concepts and clear the misconception) (10-15 minutes)	The importance of local/cultural practice to make sense of concepts is reminded in class. It is ensured that students create their own concepts by associating them with drawings/cartoons. If students have misconceptions, teacher corrects the misconceptions. If necessary, misconceptions are cleared using Web 2.0 supported applications and tools such as concept maps, mind maps, or concept cartoons. An incomplete sample concept map is presented in Appendix B.

Step 5 (Summarize and send a message) (10-15 minutes)	Towards the end of the course, the teacher sends the summary containing a certain number of characters about artificial intelligence to the students via text message/mail or a web-based application. Web 2.0 tools such as Whiteboard and Socrative can also be used to familiarize students with technology-enhanced applications. In the following lessons, it is ensured that the group leaders convey the group's decision to the teacher as a text message, and then the teacher conveys the summary topic to the students. The number of mutual sharing can be increased with web-supported applications. An example of this is given in Appendix C.

As can be seen in the example above, we created short descriptions for easier classification of the implementation steps and summarized them in a diagram (Figure 4).

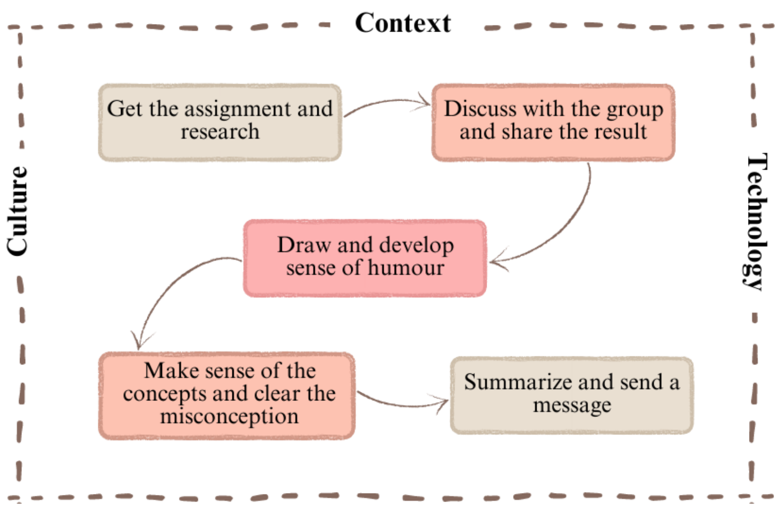

Figure 4.
Implementation steps diagram of CTCA

According to Figure 4, the application steps can be named as follows: Get the assignment and research, discuss with the group and share the result, draw and develop sense of humour, make sense of the concepts and clear the misconception, summarize and send a message.

In this study, the example given to demonstrate the implementation of CTCA is given over artificial intelligence, which is an SSI. Using these steps, researchers, teachers, or pre-service teachers can apply CTCA in the teaching of different SSIs or other science subjects.

Results and Implications

This study includes an in-depth examination of the culturo-techno-contextual approach (CTCA), which is an approach that prioritizes culture in science education, and the presentation of an example that can be implemented in teaching SSIs. CTCA is an African-based approach recommended for subjects that are difficult to learn in science education. When the relevant studies were examined, it was realized that this approach could be suitable for all subjects of science education. This approach is a perfect fit for the teaching of SSIs, especially with its focus on local aspects such as the effects of culture, social environment, and experiences. In this connection, a sample implementation that can be used in teaching artificial intelligence, which is a current issue, is included in the study. The progress made by the SSIs since the STS movement may lead to the start of a new movement based on the cultural focus of CTCA. In this respect, as researchers, we suggest that this aspect of CTCA should be investigated in depth in different studies.

Although conceptually it is still a relatively new approach, because of its emphasis on culture, it is estimated that it will be an effective approach to be used in different regions of Türkiye having a multicultural structure. It can be an effective approach for all countries, not only in Türkiye, to learn science more meaningfully based on their local/cultural characteristics. For this reason, we as researchers suggest using different SSIs in different regions to disseminate the application of this approach and compare the results. Mashoko (2022) proposes six themes related to the integration of local knowledge into physics education: regional philosophy, cultural views and local language, cultural contexts and local settings of the region, local resources, local teaching and learning methods, and local context approach to assessment. Among these themes, especially local environments and resources can be very effective in establishing cultural bonds in terms of the integration of CTCA with SSIs.

On the other hand, distance education and technology-enhanced applications are widely used in science classrooms. When it comes to cultural issues, the effectiveness of these applications can be a matter of curiosity. In this respect, not only the technology-enhanced applications mentioned here but also different Web-based applications can be employed in future studies. We think that this approach is important in terms of the intensive use of technology and prioritizing culture in teaching SSIs. We attach great importance to the use of technology as the primary tool in ensuring the interaction between teachers and students in the classroom. In this respect, we think that this approach will contribute to the development of classrooms enhanced by various technologies.

Although this approach was proposed primarily for science education, it was stated that it could be applied in the teaching of different majors. For this reason, its interaction courses can be investigated. In addition, its advantages and disadvantages at different education levels can be discussed by comparing it with various approaches that were highly effective in science teaching in the past.

Finally, since studies on the conceptualization of this approach are limited, there may be deficiencies in the naming of both the approach and the implementation steps. In this respect, it is recommended that researchers read this study critically and discuss the necessary corrections if any.

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Genişletilmiş Özet

Giriş

19. yüzyılın ortalarından günümüze kadar fen eğitiminde öğrencilerin performanslarını geliştirmeye yönelik çalışmalar her dönem farklılık göstererek araştırma odağında olmaya devam etmektedir (Awaah, 2023). Lin ve diğerleri (2019), 2013-2017 yılları arasında fen eğitiminde eşitsizlik, STEM eğitimi ve lisans araştırma deneyimleri gibi konuların vurgulandığını ifade etmektedirler. Öğretmen eğitimi ile ilgili çalışmalar incelendiğinde, pedagojik alan bilgisi, sorgulama, problem çözme ve düşünme yöntemlerine yönelik artan bir eğilim olduğu (Aldahmash vd., 2019); 21. yüzyıl becerileri ile ilgili araştırmalar incelendiğinde, dijital okuryazarlık, problem çözme, bilgi okuryazarlığı ve eleştirel düşünme gibi konulara eğilim olduğu ve sürekli gelişen dijital yeterlik ihtiyacının ön plana çıktığı görülmektedir (Silber-Varod vd., 2019). Zeidler ve Abd-El-Khalick (2017), fen eğitimi alanındaki çalışmaların yerel ve küresel etkiler altında araştırılmasını gelişen bir araştırma alanı olarak görmektedirler. Burada fen eğitiminin hem yerel hem de küresel olarak sosyal yönüyle bağlantısını en iyi sağlayan konular sosyobilimsel konulardır (SBKlar).

Çok kültürlü yapıya sahip Türkiye'de her öğrencinin farklı görüşlerle sınıfta yer alması, fen derslerinde çeşitliliği sağlayacaktır. Bununla birlikte, Covid-19 salgını ve Şubat 2023'te meydana gelen deprem felaketi de öğrencilerin belirli bir dönem derslerine uzaktan eğitimle devam etmelerini gerektirmiştir. Uzaktan eğitim süreci, bu gibi durumlarda teknolojinin daha yaygın kullanılması gerekliliğini ortaya koymaktadır. Hem kırsal hem de kentsel alanda öğretmenlerin ve öğrencilerin sınıflarında en çok tercih edeceği destek teknolojik donanımdır (Oladejo vd., 2023). Dolayısıyla, fen eğitiminde güncel çalışmalar teknolojik ve sosyo-kültürel konuları önceleyen bir eğilimde ilerlemektedir. Okebukola (2020), bu gereklilik için yerel bilgi ve kültürel uygulamalarla bağlantıyı esas alan kültürel-tekno bağlamsal yaklaşımı (KTBY) ortaya atmıştır. Bu çalışma henüz on yıllık bir geçmişe sahip olan bu terimin fen eğitimindeki yerini ortaya koymak için oluşturulmuştur.

Kültürel-Tekno Bağlamsal Yaklaşım

Kültürel-tekno bağlamsal yaklaşım (KTBY) 2015 yılında Okebukola tarafından Afrika merkezli olarak ortaya atılmış bir öğretim yaklaşımıdır. Bu yaklaşımın çerçevesi üç bileşen ile çizilebilir: (a) öğrencilerin meşgul olduğu (içinde bulunduğu) kültürel bağlam; (b) öğretmenlerin ve öğrencilerin aşamalı olarak bağımlı oldukları teknoloji-aracılığı ve (c) her eğitim kurumunun kendine has bir kimliği olan ve fen dersleri için örnek ve yerel vaka incelemelerinde güçlü bir rol oynayan bölgesel bağlam. KTBY'de kültür, teknoloji ve bağlam aynı potada ele alınmaktadır. KTBY kavramı henüz oldukça yeni bir terim olduğundan Türkçede kullanımına yönelik ilk araştırma, bu çalışmanın yazarları tarafından bir kongrede sunulmuştur (Tekin & Aslan, 2023). Terimi oluşturan kelimelerin fen eğitiminde kullanımı Türkçe ifadelere uygun görülmektedir.

KTBY, Diğer Yaklaşımlar ve SBKların Kültürel Temelde Karşılaştırılması

Fen eğitiminde bilimin doğası (BD) ve felsefesi (Çilekrenkli & Kaya, 2022), argümantasyon (Martins & Macagno, 2022), STEM (Ortiz-Revilla vd., 2022) gibi çeşitli yaklaşımlar veya SBKlar bağlamında bu yaklaşımların kullanıldığı (Herman vd., 2019) çok sayıda araştırma bulunmaktadır. Çalışmalar incelendiğinde, STEM, SBKlar ve BD ile kültürel bağlamda gerçekleştirilen çalışmalarda kültürün özellikle "yerelliği" üzerinde durulmaktadır. Özellikle SBKlar temelinde incelendiğinde, kültür SBKlarda bileşenlerden birisi olmasına rağmen, gerçekleştirilen çalışmaların kültürü önceleyen yönü arka planda kalmıştır. Öğrenci, öğretmen veya öğretmen adaylarının bulundukları bölgeye has özellikleri/duyguları/bağlamı kullanmalarının fen eğitimindeki önemi vurgulanmaktadır. Ancak kültür-temelli çalışmaların sayısının oldukça az olduğu dikkat çekmektedir. KTBY kültürü önceleyen yönüyle, bilimsel okuryazarlığın temel bileşenlerini oluşturan bu yaklaşımları bir arada tutan bir bağlam olarak etkili olabilir.

KTBY Uygulama Basamakları

Okebukola (2020) KTBY'yi sınıf ortamında uygulamaya yönelik beş adımdan oluşan uygulama basamakları önermiştir:

1. Adım: Konuyla ilgili yerel uygulamalar ve internet kaynakları üzerine ders öncesi ödev verilir.

2. Adım: Dersin başlangıcı; 1. adımdaki ödev üzerinde grup çalışması ve sunum yapılır.

3. Adım: Öğrencilerin yakın çevrelerinden (bağlamdan) örnekler çizmeleri ve mizahi bakış açısı ile dersin ilerlemesi sağlanır.

4. Adım: Ders, kültürel uygulamalar ve sınıfta paylaşılan web kaynakları ile ilerler. Yanılgı varsa giderilir.

5. Adım: Dersin sonunda, öğretilen içeriğin kısa bir özeti öğrencilere kısa mesaj olarak gönderilir.

KTBY henüz oldukça yeni bir yaklaşım olduğundan, uygulanmasına yönelik az sayıda örnek bulunmaktadır. Bu nedenle bu çalışmada KTBY adımlarının daha net uygulanabilmesi için sosyobilimsel bir konu olan yapay zekânın bağlam olarak kullanıldığı bir örneğe yer verilmiştir. Ayrıca uygulama adımlarının daha kolay sınıflandırılması için kısa tanımlamalar oluşturulmuş ve bir şemada özetlenmiştir. Buna göre uygulama adımları sırasıyla şu şekilde adlandırılabilir: Ödev al ve araştır, grupla tartış ve sonucu paylaş, çiz ve mizah geliştir, kavramları anlamlandır ve yanılgıyı gider, özetle ve mesaj gönder.

Sonuç ve Çıkarım

Bu çalışma, fen eğitiminde kültürü önceleyen bir yaklaşım olan KTBY'nin derinlemesine incelenmesini ve SBKların öğretilmesinde uygulanabilecek bir örneğin sunulmasını içermektedir. Gerçekleştirilen çalışmalar incelendiğinde, fen eğitiminin tüm konuları için uygun olabileceği fark edilmiştir. Ancak özellikle SBKların kültürden, sosyal çevreden ve geçmiş yaşantılardan etkilenmesini içeren yerel özelliği ile bu yaklaşımın SBKların öğretilmesinde biçilmiş bir kaftan olduğu söylenebilir. Fen eğitiminin kültürel yönünü ortaya koyan Fen-Teknoloji-Toplum (FTT) hareketinde, fen, teknoloji ve toplumun birbiri ile etkileşimi sağlanırken; KTBY'de toplumu da yakından ilgilendiren kültürün ön plana çıkarılması vurgulanmaktadır. Özellikle SBKların yerel özelliği, bireylerin günlük hayatta ve yakın çevrelerinde sıklıkla karşılaştıkları durumları gösterdiğinden, bu çalışma için tercih edilmiştir. Bu açıdan güncel bir konu olan ve sıklıkla karşılaşılan yapay zekâ bağlam olarak ele alınarak, örnek bir uygulamaya yer verilmiştir. SBKların FTT hareketinden itibaren kat ettiği ilerleme, KTBY odağında yeni bir hareketin başlamasına yol açabilir. Bu açıdan araştırmacılar olarak farklı çalışmalarda KTBY'nin bu yönünün derinlemesine araştırılmasını öneriyoruz.

Henüz kavramsal olarak oldukça yeni bir yaklaşım olsa da kültürel özelliği ön planda olduğundan, Türkiye'nin çok kültürlü yapısına uygun şekilde, farklı kültürel bölgelerde çalışılmak üzere etkili bir yaklaşım olacağı tahmin edilmektedir. Yalnızca Türkiye'de değil tüm ülkelerin yerel/kültürel özelliklerine dayanarak feni daha anlamlı öğrenmeleri için etkili bir yaklaşım olabilir.

Öte yandan fen sınıflarında uzaktan eğitim ve teknoloji-destekli uygulamalar oldukça yaygın olarak kullanılmaktadır. Kültürel konular ön plana alındığında, bu uygulamaların etkililiği de merak konusudur. Bu açıdan yalnızca burada belirtilen teknoloji-destekli uygulamalar değil, farklı Web tabanlı uygulamaların kullanıldığı çalışmalar da çeşitlendirilebilir. Teknolojinin sınıf içinde öğretmen ve öğrencilerin birbirleri ile etkileşiminin sağlanmasında birinci araç olarak kullanılmasını oldukça önemsemekteyiz. Bu açıdan çeşitli teknolojilerle desteklenen sınıfların gelişiminde de bu yaklaşımın katkısının olacağını düşünüyoruz.

Son olarak, henüz bu yaklaşımın kavramsallaştırılmasına dair çalışmalar kısıtlı olduğundan hem yaklaşımın hem de uygulama basamaklarının isimlendirilmesi konusunda eksiklikler olabilir. Araştırmacıların bu yönüyle bu çalışmayı eleştirel bir gözle okumaları ve varsa gerekli düzeltmeler konusunda tartışmaları önerilir.

Ethical Approval

In this study, the introduction of a new teaching approach and its sample implemention are given. Therefore, due to the "descriptive/theoretical" study, ethical approval is not required as the study was not conducted with humans.

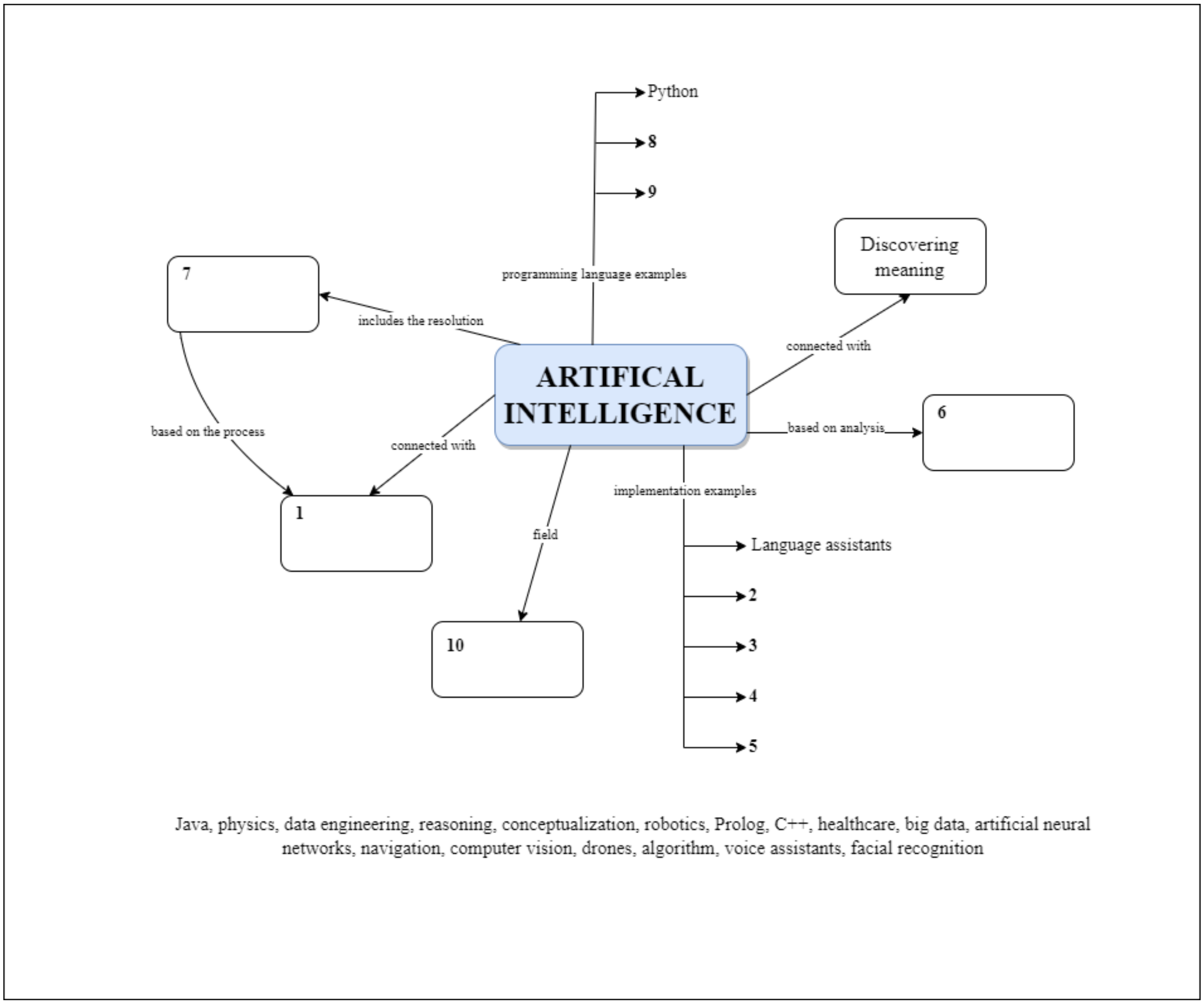
Appendices

Appendix A

An example of a drawing that can be created by a group with the help of Canva program in the "Draw and develop sense of humour" step (If the teacher draws, the contents of the titles can be left blank and the groups can be asked to complete)

Appendix B

An example of incomplete concept map created with the help of draw.io program for the "Make sense of the concepts and clear the misconception" step (Answer key: 1: reasoning, 2: navigation, 3: healthcare, 4: voice assistants, 5: facial recognition, 6: big data, 7: algorithm, 8: Java, 9: C++, 10: data engineering)



Appendix C

An example word cloud created with the help of wordclouds program for the "Summarize and send a message" step