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Designing During the Pandemic: Understanding Teachers' Challenges in eTwinning Projects

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Abstract
eTwinning projects support teachers and students from different countries to engage with each other through online learning. In 2020, the world started to battle with the pandemic and this shifted educational practices from face to face to online learning. In this study, we tried to understand how the pandemic influenced the activity planning, design process, teacher connections, and in-class interactions from the teachers' viewpoint. To achieve this goal, we worked with a core group of eight elementary teachers who conducted eTwinning projects before and during the pandemic. These elementary teachers started developing eTwinning projects in 2019 by using a book designed to support interdisciplinary thinking with an emphasis on design with second grade students. When we examined the activities developed by these teachers, their emphasis on design and interdisciplinary connections continued during the pandemic with the same group of students when they were in third grade. While the mindset did not change for activity planning, the complete shift to online learning created several challenges for teachers. Teachers stated that their support for the design decreased during the pandemic and they were more comfortable with assisting their students in face-to-face classes. The pandemic also reduced the connections among teachers and supporting group work became a challenge. When these aspects were combined, students had to complete an individual design experience during the pandemic and this resulted in several students missing the interdisciplinary connections in their design products.

Keywords
eTwinning projects, COVID-19 pandemic, elementary teachers, interdisciplinary thinking, design process

Introduction
In late 2019, the COVID-19 virus emerged as a health crisis in China and in March 2020 schools and universities around the world began to close in response to the pandemic, leading to drastic changes in the way school education is offered. In such a circumstance, education could only occur remotely, and hence the use of cloud-based software and services in education became a must all of a sudden (Scully et al., 2021). This situation led schools and universities to change their traditional learning and teaching methods and migrate to fully online education. This is referred to as emergency remote teaching by Hodges et al. (2020), who distinguish between planned online learning experiences and online learning provided in response to a crisis without adequate preparation or instructional design.

Green et al. (2020) note that the rapid transition to a fully online mode has challenged even the most experienced educators by requiring them to quickly redesign their courses they had prepared to fit the new mode with new tools. Adedoyin & Soykan (2020) suggest that the migration process should be viewed from the students' and educators' level of digital competence. Digital competence of teachers and students is perceived as an area in need of development for quality online learning and teaching (Adedoyin & Soykan, 2020; Scully et al., 2020). Another challenge experienced by teachers was student engagement (Dreamson, 2020). Ewing & Cooper (2021) revealed that engagement for teachers during emergency remote teaching took central priority over curriculum. However, engagement was their greatest challenge. Makamure and Tsakeni (2020) indicated that teachers teaching science, technology, engineering, and mathematics (STEM) subjects had some pedagogical challenges during online instruction, such as implementing activities that needed hands-on practice, which made online platforms more teacher-centered than face-to-face learning. Furthermore, teachers faced challenges such as converting course materials into the online platform (Dreamson, 2020; Makamure & Tsakeni, 2020). Students also felt some challenges, such as technological limitations and socioeconomic status (Adedoyin & Soykan, 2020), losing hands-on activities (Ramlo, 2021), feeling it was hard to stay motivated (Ewing & Cooper, 2021) and decreased engagement and interaction with peers (Ewing & Cooper, 2021; Ramlo, 2021).

On the other hand, Baptista et al. (2020) revealed that students' knowledge of digital technologies improved and the integration of knowledge between technology and science was activated. Besides, students developed autonomy and self-directed learning skills during the pandemic (Baptista et al., 2020; Penn & Mavuru, 2020). Students also expressed some other opportunities, such as flexibility (Makamure & Tsakeni, 2020; Ramlo, 2021), continuity of learning and teaching (Scully et al., 2021) and cost-effectiveness (Penn & Mavuru, 2020).

Martins (2021) stated that the pandemic has forced institutions, students, teachers, and designers to rethink the usual protocols (p.104) and suggested the pandemic will challenge long-established practices in teaching and designing. Dreamson (2020) noted that the worldwide pandemic has changed the landscape of design education by accelerating its transition to online education. Online education presents a particular challenge for design education, referred to as one of the most resistant disciplines to fundamental pedagogical change (Brown, 2020). Yorgancioglu (2020) discussed the three fundamental changes that design studio pedagogy faced during online education. The surface features of a design studio, which were a shared space through social interactions, were replaced by virtual design platforms. Besides the change in surface features, the pedagogical forms of design studios have also differed by generating changes in the pedagogical roles of students and educators, the way they interact, as well as the methods and practices. Furthermore, the epistemological principles of design studios have varied during the pandemic. It is now considered critical to identify the challenges and potential of both types of teaching, as well as to develop a new approach for post-pandemic design education (Yorgancioglu, 2020).

Ioannou (2017) stated that many design students and practitioners believe that online design education could be ineffective since design education is traditionally a studio-based discipline and online education lacks direct social interaction. In another study implemented before the pandemic by Fleischmann (2020a), it was revealed that 75% of the students would not prefer to

study the design subject fully online for reasons such as lack of face-to-face interaction and the nature of design education requiring immediate feedback and dialogical learning.

Marshalsey and Sclater (2020) noted that the move to online design education has become a testing experience for all parties involved. Studies examining the effectiveness of online design education and the perceptions of teachers and students during the pandemic have been conducted. Fleischmann (2020b) investigated how higher education design students and educators responded to online design education resulting from the pandemic and revealed that most of the students were content with online design education, yet they experienced some challenges, such as lack of motivation and peer interaction, and difficulty in collaborating in group projects. Educators complained about a lack of communication and participation. They also believed online design courses were limited in teaching skills that required tactile sense and actual hands-on practice. In a similar study done by Dilmac (2020), the challenges and opportunities experienced by undergraduate students in online art and design courses were unearthed. The challenges were lack of practice, instant feedback, motivation, and interaction, whereas the opportunities were flexibility of time and place, more samples and resources, increased interest, reduced spending on the lesson, more comprehensible lessons, and increased responsibility for learners. In another study conducted by Marshalsey & Sclater (2020), it was revealed that students found it hard to convey creative ideas and physical prototyping online and that online design education prevented them from achieving their artistic goals. Furthermore, Iranmanesh & Onur's (2021) study indicates significant improvements in students' computer-aided design skills and their ability to conduct independent research, yet the results show a considerable decline in informal peer learning among students.

Up until now, design education studies have primarily focused on higher education (Dilmac, 2020; Fleischmann, 2020b; Iranmanesh & Onur, 2021; Marshalsey & Sclater, 2020). Departing from the dearth of studies in elementary design education, this study will depict the experiences of elementary teachers collaboratively working on supporting design practices before and during the pandemic. To achieve this goal, we will investigate eight teachers' eTwinning experiences that took place in two different years.

Central Concepts Focused in eTwinning Projects

eTwinning is a free platform for European teachers. eTwinning network has almost one million teachers and more than 200,000 schools. Teachers can create their own projects and search for partners, or they can also join projects in other countries (https://www.etwinning.net). eTwinning projects in this study were created by a core group of teachers actively using the eTwinning network for creating joint projects.

The eTwinning projects in this study focused on three central concepts: interdisciplinary thinking, problem solving, and computational thinking. In both projects, students were required to complete the design process using interdisciplinary connections. Interdisciplinary thinking equips students with the knowledge and skills to see the world through multiple lenses, view the connections among disciplines, synthesize knowledge from different disciplines, transfer knowledge and skills acquired in one field to another, and develop multiple points of view (Cotantino et al., 2010; Styron, 2013). Ashby and Exter (2019) believe that integrating

interdisciplinarity thinking into the curriculum allows students to address problems and find solutions by implementing knowledge and skills from multiple disciplines. Furthermore, through the use of interdisciplinary thinking, students may develop critical thinking by evaluating and synthesizing disciplinary knowledge, problem solving, creative thinking, as well as collaboration and communication skills (Cowden & Santiago, 2016; Styron, 2013).

The role of interdisciplinary thinking is underlined in different design education studies (Nae, 2017; Self et al., 2019) and recent reports continue to underline the growing interest in K-12 design education (National Academies of Sciences, Engineering & Medicine [NASEM], 2019). In this study, our main goal was to investigate interdisciplinary thinking in the design process for elementary teachers and students. To achieve this goal, we put the design process and student inquiry at the center (NASEM, 2019) and provided different problems for students. Li et al. (2016) found that the design process supports elementary students' problem solving skills. Connected with this, Lie et al. (2019) stated that the design process starts with finding the problem.

Teachers also focused on computational thinking to scaffold problem solving. As stated by Hsu et al. (2018), computational thinking helps identifying and defining the problem when students are engaged in problem solving. More importantly, Bocconi et al. (2016) stressed the link between design and computational thinking, observing that European countries are still searching for ways to include computational thinking in compulsory education. The projects created in this study present the continuum of including design in K-12 education with an emphasis on computational thinking (Bocconi et al., 2016) and problem solving (NASEM, 2019).

The projects in this study were created from a book that aimed to support the interdisciplinary thinking and design process starting in elementary grades (Gulbahar et al., 2020). *Supporting Computational Thinking with an Interdisciplinary Approach* was supported by the Turkish Ministry of National Education and Google. The book presents different design projects for elementary teachers with an interdisciplinary approach. Teachers created two eTwinning projects by using the examples presented in the book. The activities in both projects supported students' problem solving and computational thinking by connecting what they are learning in different disciplines/courses.

Planning eTwinning Projects with Elementary Teachers

The first eTwinning project (Saving the World) was implemented with second grade students. This project included face-to-face activities because it began before the pandemic. The activities of this project aimed at achieving a clean future. Throughout the project, students conducted research on water sources (e.g. calculating how the amount of water has changed in the last 50 years) and jobs of the future. They were asked to write stories about pollution and design a project to create ecological homes by using compost materials.

Students worked on the following problem before the pandemic: *What can we do to have a cleaner planet in the future?* The goal of this project was to emphasize recycling for students. During this project, students explored the jobs of the future by making connections to Life Sciences. They did research about recycling technologies and created sketches for their ecological homes (see Figure 1).

Figure 1. Sample student sketches before the pandemic

After creating the sketches, students completed their ecological homes by using compost materials (see Figure 2).

Figure 2. Sample student design products for Ecological Homes (Ekolojik Evler) before the pandemic

During the pandemic, the same group of teachers created another eTwinning project called Super Healthy Kids. These teachers continued to work with the same group of students and the activities were planned for third grade students. Third grade activities included students discussing the meaning of healthy habits in different countries. Students also conducted

research on healthy food, created shopping carts and planned their budgets. Students calculated the price of a meal in different countries (see Figure 3) and they used Scratch to design a healthy habit game (see Figure 4). During the pandemic, teachers primarily organized computer-based activities in the design process. All the students participating in this study had computers in their homes, and they did not have any issues related to accessing the Internet. When creating healthy plates, students used the fruits they had in their homes.

During the pandemic, teachers continued to support the design process. Students worked on the following problem: What can you do to have a healthy body? When working on this problem, students started exploring their healthy habits (Life Sciences). In this project, students used math to calculate the price of each healthy meal (see Figure 3).

Figure 3. Calculating the price of a meal (adding the cost of each ingredient to cook spinach)

Students also created healthy plates, made shopping lists and used Scratch to design a healthy habit game (see Figure 4).

Figure 4. Sample student design products during the pandemic

Aim of the Study

The nature of eTwinning projects is online (Gajek, 2018), but the pandemic forced teachers and students to complete these projects entirely online, with no face-to-face interaction. In this process, it is crucial to understand how these interactions have an impact on completing the design process. Our main goal in this study was to understand how the pandemic influenced activity planning, design process, teacher connections, and in-class interactions from the teachers' viewpoint. Connected with this goal, we examined the following research questions:

1) How did the teachers create activities in eTwinning projects before and during the pandemic?
2) How did the pandemic influence the interdisciplinary connections in student design projects?
3) How did the pandemic influence interactions among teachers during eTwinning projects?
4) How did the pandemic influence in-class interactions before and during the pandemic?

Method

We employed a case study in this research. As Yin (2018) underlined, case study methodology enables the researchers to answer how and why questions in tracing of operational processes over time (p. 44). Yin (2018) also stated that case studies can be structured in a comparative way. Connected with this, we created a case study in which participants can compare their experiences by working with the same group of teachers in two different years. In the first year, the year before pandemic, teachers conducted an eTwinning project called Saving the World. In the second year, the year during pandemic, teachers created another eTwinning Project called Super Healthy Kids. Our case study included participants who were involved in both projects to explore and compare the similarities and differences in these two projects with an emphasis on activity planning, design process, teacher connections and in-class interactions.

Super Healthy Kids eTwinning project was completed with 12 elementary teachers. Eight of these teachers were Turkish, and we focused on these teachers' experiences before and during the pandemic, since they worked together for two years. Two Bulgarian teachers and two Portuguese teachers were not involved in the former eTwinning Project; however, they collaboratively worked with the Turkish teachers to complete the latter project during the pandemic. We only collected data from Turkish teachers since the main aim was to investigate how the same group of teachers were influenced by the pandemic. We asked participants to compare their experiences before and during the pandemic.

Data were collected through an interview form prepared by the researchers. A total of twenty questions were prepared. Two experts who specialized in Curriculum and Instruction presented their opinions on the draft form and the final interview form included 17 questions. In the first part of the form, the first question asked teachers to discuss the similarities and differences in their design practices before and during the pandemic. Then, teachers responded to six questions requiring them to rank the interdisciplinary connections in student design projects, interaction among teachers, and in-class interactions before and during the pandemic. All these rankings provided a scale from 1 (no interdisciplinary connections, weak teacher connections,

weak in-class interactions) to 10 (strong interdisciplinary connections, strong teacher connections, strong in-class interactions). Teachers provided their own understanding in these rankings. Also, five questions were asked in the second and third part of the interview form, with the former focusing on the pre-pandemic project and the latter during the pandemic project. Part two and three included questions about choosing a sample student design product presenting interdisciplinary thinking, what teachers did to support the design process and interdisciplinary thinking among teachers, and what teachers did to improve the design process and interdisciplinary thinking for their students.

Descriptive and content analysis were performed for analyzing the open ended questions in the interview. Descriptive analysis is employed when the data is organized and presented according to the themes which emerge out of the research questions. The themes are usually concealed in the research questions or developed in the researcher's mind during the research process (Denscombe, 2007). Content analysis refers to any qualitative data analysis to find similarities and differences to create themes (Patton, 2002). In the first step of the analysis, the authors (1st and 2nd author) used descriptive analysis by rereading the data to get a general understanding of the data. Then, both authors used content analysis and coded the data independently. The creation of themes, sub-themes and codes involved a balance of deductive coding (derived from the philosophical framework) and inductive coding (themes emerging from participants' discussions) (Fereday & Muir-Cochrane, 2006, p.91). Both authors compared their codes and organized several meetings to resolve all disagreements until they achieved 100% inter-coder reliability (Miles & Huberman, 1994). As a result of this comparative analysis, a total of 34 codes were created and these codes were categorized under four themes. Each theme also has two sub-themes to present the changes in different eTwinning projects: before and during the pandemic. All themes (activity planning, design process, teacher-teacher connections, in-class interactions), sub-themes (before the pandemic, during the pandemic) and codes are presented under each research question under the findings section.

All the questions were reviewed by the Ethics Committee before conducting the interviews. Ethical permission was obtained from the Usak University Ethics Committee (Decision #2021-09). In order to protect the privacy of the participants, each teacher was represented by a code such as T1, T2. When selecting the design examples from students, we only included students whose parents gave permission to be part of the study. We removed student identifiers from the sample design products.

Findings

Findings are presented in line with the research questions and under each research question we have added a list of themes, sub-themes, and codes.

Research Question (RQ) 1. How did the teachers create interdisciplinary activities in eTwinning projects before and during the pandemic?

The findings related to RQ1 are presented under the activity planning theme. This theme has two sub-themes (before and during the pandemic). This is the only theme that we did not find changes in codes between sub-themes (see Table 1).

Table 1. Sub-themes and codes for activity planning

Theme	Sub-themes	Codes
Activity planning	Before the pandemic	-Emphasis on problem-solving -Emphasis on inquiry -Emphasis on computational thinking -Emphasis on interdisciplinary connections
	During the pandemic	-Emphasis on problem-solving -Emphasis on inquiry -Emphasis on computational thinking -Emphasis on interdisciplinary connections

Before the Pandemic

Teachers started planning their activities by placing problem solving and inquiry at the center:

> *"Students solved a problem by conducting research." (T4)*

Activities before the pandemic also emphasized interdisciplinary connections and computational thinking. For instance, one of the teachers (T8) discussed the importance of making connections between different disciplines to support students before the pandemic:

> *"We were trying to develop thinking skills by connecting with the knowledge in different lessons we had learned before." (T8)*

Another teacher (T2) summarized these connections before the pandemic as:

> *"There was usually reading involved in the introduction part of lesson plans that was linked to the goals of language classes. Environmental and conservation awareness were linked to the goals of science classes. Including measurements was connected with the mathematics classes. International children's day activities were associated with the music classes, and designing a time machine was connected with the visual arts classes." (T2)*

Teachers also stated the emphasis on computational thinking before the pandemic. T4 stated this as

> *"The importance of technology in accessing information for computational thinking skills was covered." (T4)*

During the Pandemic

Activity planning continued in the same mindset during the pandemic. One of the teachers (T4) stated that:

> *"Activities were planned to enable students to engage in problem solving and inquiry. We created links between the learning gains and most lessons in order to help students reach an understanding by solving thinking problems." (T4)*

Another teacher (T8) added the following about the interdisciplinary connections during the pandemic:

> *"We tried to show different ways of thinking by associating Science with Mathematics and other courses." (T8)*

T3 discussed the importance of computational thinking as

> *"It was ensured that students integrate their computational thinking skills into the lessons." (T3)*

To summarize, teachers' interdisciplinary activity planning was always at the center during the pandemic:

> *"Since our school is an International Baccalaureate school, we already planned the units with interdisciplinary connections. We continued the process by integrating eTwinning projects into the units." (T5)*

When creating these activities, teachers used an existing book to start their eTwinning projects (Gulbahar et al., 2020), but they also created two e-books for these projects. Looking at the sample e-book created during the pandemic (Super Healthy Kids, 2020), we can see that teachers are capable of creating learning environments supporting interdisciplinary thinking, problem solving, and computational thinking. The pandemic did not create a change in activity planning or structure for teachers. Teachers continued to create activities with the same mindset before and during the pandemic.

RQ 2. How did the pandemic influence the interdisciplinary connections in student design projects?

Table 2 presents the sub-themes and codes for the design process. In this section, we will discuss how the change in teacher support influenced student design products.

Table 2. Sub-themes and codes for design process

Theme	Sub-themes	Codes
Design process	Before the pandemic	-In-class design environment -More effective control mechanism -More effective feedback -More interdisciplinary connections in student design products
	During the pandemic	-Support through online meetings -Lower interdisciplinary thinking in student design products -Lower creativity -Lower attention period -Teacher adaptation to online teaching -Less time allocated for project -Individual design process

Before the Pandemic

Teachers' responses presented a broader support mechanism that emphasized different aspects of the design process before the pandemic. Several teachers stated that a support mechanism was created inside the classroom. One of the teachers created (T6) in-class design environments and another teacher (T7) organized design workshops.

Another important idea emerging from teacher interviews was the importance of the control mechanism:

> *"We operated control mechanisms throughout the design process. Giving feedback throughout the process supported students." (T1)*

T3 also added the importance of feedback mechanisms:

> *"We were more effective at student monitoring and follow-up during face-to-face education." (T3)*

The main difference teachers underlined before the pandemic was the role of teachers in supporting the design process:

> *"We (teachers) were providing an idea of how to progress (in the design process) while the work was being done." (T4)*

T8 reiterated this idea by stating:

> *"We were examining the sample products created before starting the design. We decided what we could do by explaining the work we would do. We were giving an idea about how to proceed while the work was being done and we were completing the design process." (T8)*

Teachers addressed in-class design environments, feedback and control mechanisms only in the eTwinning project conducted before the pandemic. These aspects had an influence on the student outcomes. T8 stated that the interdisciplinary connections were stronger in student design products before the pandemic. Figure 5 presents that four teachers provided a higher score and three teachers provided the same score when ranking the interdisciplinary connections in student design products before the pandemic. On the other hand, one teacher provided a higher ranking for the interdisciplinary connections in student design products during the pandemic.

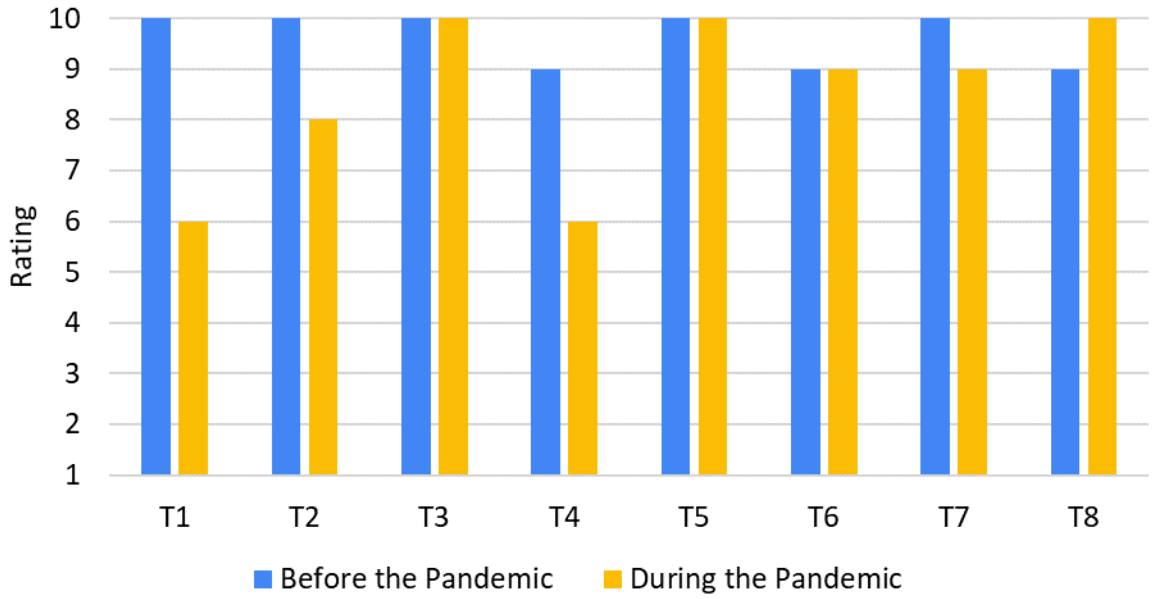

Figure 5. Each teacher's rating for interdisciplinary thinking in student design products (1: no interdisciplinary connections, 10: strong interdisciplinary connections).

During the Pandemic

Both eTwinning projects emphasized the design process and the design process was influenced by the pandemic. During the pandemic, teachers organized online meetings (T7 & T8) with their students and used different online tools:

> *"We provided information about the design process through showing similar examples in live lessons and through WhatsApp groups." (T1)*

Another teacher (T2) introduced Web 2.0 tools, and more specifically, the Canva platform was used to create a common design language (T6).

Students were engaged with the design process in two different years, but the pandemic had a negative influence on the interdisciplinary connections in student design products:

> *"While our students were more successful in interdisciplinary studies during face-to-face training before the pandemic, the success rate decreased during the pandemic." (T1)*

Further, detailed investigation of the codes emerging from the qualitative analysis identifies several reasons for this change.

The first reason stated by the teachers was a lack of creativity. T1 stated,

> *"I think being on the screen constantly causes their creativity to decrease." (T1)*

Connected with this, another teacher also added that

> *"The brainstorming step was missing during the design process." (T6)*

The second reason was the decreased attention of students:

> *"In online education, it has become a little difficult for students to make connections in designs, depending on their attention." (T8)*

The third reason was teachers' lack of adaptation to the completely online learning environment:

> *"I could not guide students as productively as I did in the face-to-face classes during the design process." (T8)*

The fourth reason was the decreased time given for completing the project:

> *"The time we allocated to the project in the live lessons decreased a little." (T2)*

The last reason was the individual design process:

> *"We planned more individual studies appropriate for distance education." (T3)*

RQ 3. How did the pandemic influence interactions among teachers during eTwinning projects?

Table 3 presents the codes for the teacher-teacher connections theme. This section discussed connections among project members and included other connections teachers stated during the interviews.

Table 3. Sub-themes and codes for teacher-teacher connections

Theme	Sub-themes	Codes
Teacher-Teacher connections	Before the pandemic	-Online meetings among project members -More frequent meetings among project members -Additional collaboration among project members in the same school -Support from teachers working in other disciplines - Additional face to face meetings
	During the pandemic	-Continuity of online meetings among project members -Support from other teachers working in other disciplines -Less connection among teachers in the same school

Before the Pandemic

The nature of the eTwinning projects requires teachers to create online collaborations with other teachers. Before the pandemic, teachers used WhatsApp and organized webinars. When comparing their experiences, T3 stated the frequency of meetings before the pandemic:

> *"We were having more frequent meetings among teachers. We continued our work with the 5E model joint planning." (T3)*

In addition to the frequent meetings among project members, teachers also created additional collaborations that could take place inside the school between teachers before the pandemic. T2 underlined this idea by stating the continuous discussions happening in the teachers' room.

Teachers also received support from teachers from other disciplines:

> *"Before the pandemic, we asked for help from our teachers in other disciplines when we needed it." (T8)*

Finally, several teachers (T6 and T7) also stated that additional face-to-face meetings were helpful for them in the design process. As presented in Figure 6, four teachers provided a lower ranking for their experience during the pandemic, with an emphasis on teacher connections. On the other hand, the remaining four teachers provided the same score when comparing teacher connections.

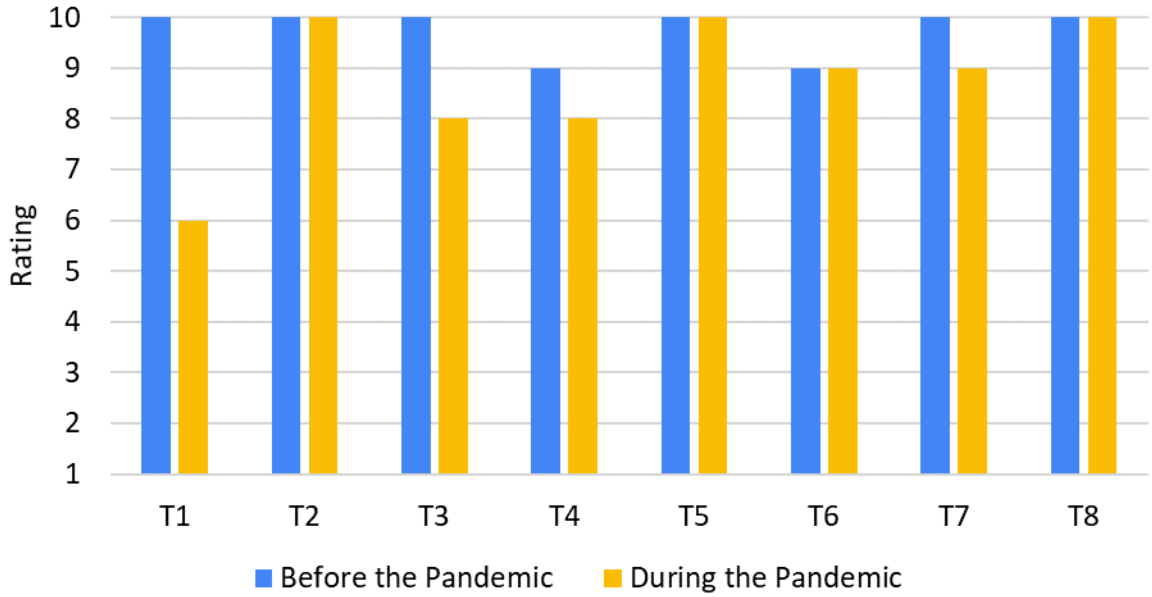

Figure 6. Each Teacher's Rating for Teacher Connections Before and During the Pandemic (1: weak teacher connections, 10: strong teacher connections)

During the Pandemic

During the pandemic, teachers continued their online meetings:

> *"We communicated through webinars, chatroom conversations, and WhatsApp calls." (T8)*

Teachers' planning during these online meetings continued in relation to the project tasks:

> *"In online meetings, we divided the groupwork and collaborated on e-book writing and creating videos." (T7)*

It is important to underline that teachers also continued to collaborate with teachers from other disciplines during the pandemic:

> *"In order to use the Scratch program, we got support from the Information Technology teachers. For foreign languages, we got support from our English teacher." (T8)*

Teacher 8 added that this communication was related to fulfilling the project duties:

> *"By participating in the meetings, we supported the use of the Scratch program by fulfilling our duties of writing e-books and creating videos." (T8)*

As stated in the previous section, the frequency of meetings has changed during the pandemic. In addition to missing additional face-to-face meetings with project members, teachers also stated a decreased connection with their colleagues working at the same school:

> *"We used to exchange ideas with our project friends at school during the breaks." (T5)*

RQ 4. How did the pandemic influence in-class interactions before and during the pandemic?

Table 4 presents the codes for in-class interactions. In this section, we will discuss how in-class communication was facilitated before and during the pandemic.

Table 4. Sub-Themes and Codes for In-Class Interactions

Theme	Sub-themes	Codes
In-class interactions	Before the pandemic	-More teacher-student communication -Easy to assist students -Importance of group work
	During the pandemic	-Less teacher-student communication -Lack of group work -Increased parental involvement -Increased use of digital tools

Before the Pandemic

Teachers stated that face-to-face classes created more opportunities for in-class interactions:

> *"Before the pandemic, being together with my students in the classroom was more efficient in terms of communication. There was a better environment in terms of directing them and sharing ideas with each other." (T2)*

The idea of assisting students was also underlined by other teachers:

> *"We carried out the activities face to face in the classroom environment. I tried to support them when they struggled." (T5)*

Connected with this, T8 also underlined that guiding students was easier before the pandemic.

Finally, T5 stated the importance of collaborative learning. T3 also stated that:

> *"Face-to-face education increased group interaction and supported collaborative work." (T3)*

To add to this idea, T6 and T7 stated that they organized activities supporting group work. Another teacher reiterated this idea by describing how group participation helped students advance their ideas:

> *"It was easier for students to bring together the knowledge and skills that could shed light on the problem or subject from different aspects before the pandemic." (T4)*

Figure 7 presents each teacher's ranking for in class interactions. This is the aspect where we observed the biggest difference in teacher ratings. Six out of eight teachers provided a lower ranking for in-class interactions during the pandemic. Two teachers provided the same score when comparing in-class interactions.

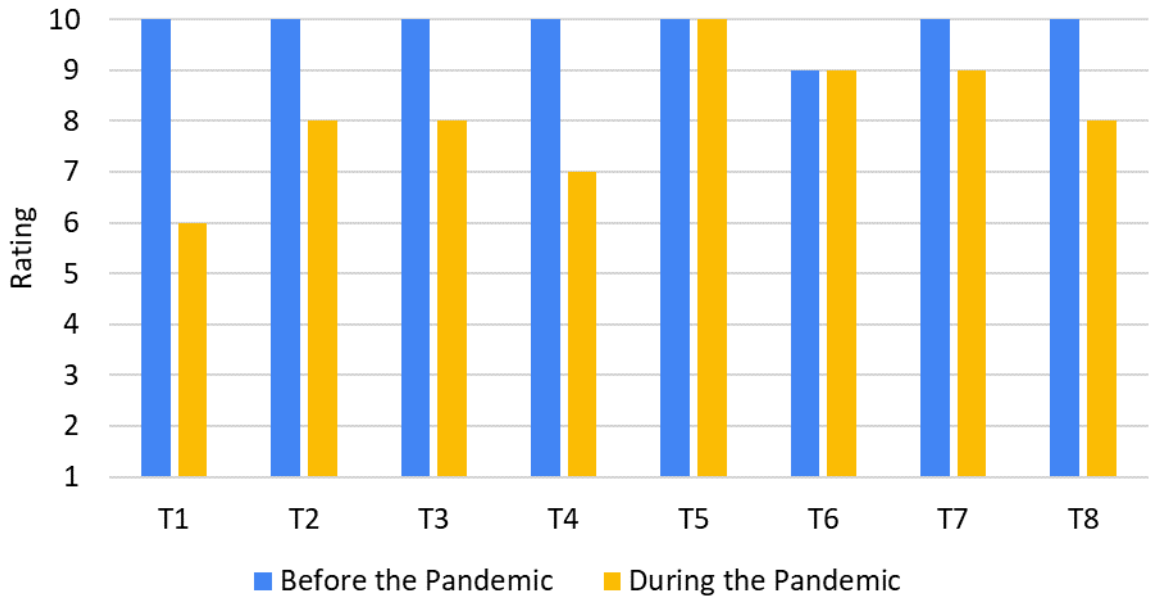

Figure 7. Each Teacher's Rating for In-class Interactions Before and During the Pandemic (1: weak in-class interactions, 10: strong in-class interactions)

During the Pandemic

T8 stated that communication between teachers and students decreased during the pandemic. Another result emerging from the challenges faced during the pandemic was the lack of participation in group activities. T3 stated that this was the main difference between the two eTwinning projects:

> *"This process (the pandemic) just affected the groupwork, the activities were individual." (T4)*

This underlined that missing the contribution of group activities had a negative impact on collaborative learning. Overall, teachers stressed the fact that in-class interactions decreased during the pandemic. To overcome this challenge, one teacher contacted the parents:

> *"We communicated with the children through the parents, and this led students to expect everything on a silver plate." (T2)*

During the pandemic, teachers relied on using online tools (T4, T6 and T7) to communicate with their students. T2 stated that students' increased use of digital tools had a positive outcome for students:

> *"Students made progress in using Web2.0 tools during the pandemic period." (T2)*

Discussion

Design is an interdisciplinary practice (Nae, 2017; Self et al., 2019). In an earlier study of engineering education, Hirsch et al. (2001) prepared an interdisciplinary design project. This idea has been transferred to K-12 education and Chiang et al. (2020) created interdisciplinary activities for elementary students. When supporting design in elementary grades, Chiang et al. underlined the importance of problem solving. In our study, teachers created activities supporting interdisciplinary thinking and problem solving. Teachers' activity planning also made connections with computational thinking to increase the efforts to support computational thinking in compulsory education (Bocconi et al., 2016).

As stated by the Next Generation Science Standard (NGSS, 2013), the design process starts with a problem and continues with designing and testing solutions. In both eTwinning projects, teachers gave different problem situations (What can we do to have a cleaner planet in the future? What can you do to have a healthy body?) Students were engaged in creating their own design products to solve these problems. Engaging students in the design process at the elementary level continues to receive attention from recent studies (Dickes et al., 2020; Jocius et al., 2020). However, it is important to underline that completing this process would be challenging in the elementary grades for teachers (Mangiante et al., 2020; Tank et al., 2020; Yang et al., 2020). The pandemic added another layer to these challenges by influencing the level of support teachers provided during the design process. Teachers stated that during the pandemic, their control of the design process decreased when supporting students' design process to give feedback. Testing solutions in the design process (NGSS, 2013) is a vital step in improving design products. Unfortunately, teachers could not support that aspect in a way they did before the pandemic.

Completing the design process at the elementary level does require scaffolding provided by the teachers, and elementary teachers might need support from other teachers. For instance, Tank et al. (2020) asked elementary teachers to collaborate with student teachers and engineering students. Similarly, Pleasants et al. (2020) also teamed elementary teachers with engineering students. In a regular implementation, it might not be possible to team elementary teachers with experts in the field. Another potential support mechanism in the design process is to seek help from peers by making collaborations with other teachers (Capobianco & Rupp, 2014). Teachers also help each other during the activity planning (Guzey et al., 2016; McFadden & Roehrig, 2017) to support the design process. In the current study, teachers stated that they had frequent meetings before the pandemic with their colleagues. The pandemic did create a decrease in the number of these meetings and also limited the additional connections teachers would make with their colleagues working in the same school.

In an eTwinning project engaging with project-based learning to design games in a computer science lesson, Gulmez (2018) revealed that students considered the project as an opportunity to collaborate, communicate with peers from different countries, and see their mistakes by getting feedback from their classmates. In addition, Fleischmann (2020b) argues that design is a collaborative process and sharing design ideas with peers and teachers is a critical element of studio-based design education. However, as also revealed in the current study, the pandemic made the social aspect of the design process difficult to handle. When comparing two different eTwinning projects, the teachers presented the biggest differences in the in-class interactions.

In the design process, it is important to support students working in teams (Gillespie Rouse & Rouse, 2019; Siverling et al., 2019). Elementary teachers stated the lack of groupwork during the pandemic and activities became individual tasks for each student.

Conclusion

As stated by several studies, understanding how to support design practices online will be a test for the field (Marshalsey & Sclater, 2020; Martins, 2021) and previous studies have presented examples from higher education (Dilmac, 2020; Fleischmann, 2020b; Iranmanesh & Onur, 2021; Marshalsey & Sclater, 2020). In this study, our goal was to understand how these examples were translated into elementary education. Although eTwinning projects support distance learning experiences (Gajek, 2018), our case study with the same group of teachers revealed that shifting these projects to a completely online learning environment had some consequences for the design process. The first one was related to missing additional opportunities for teachers to guide students through the design process. Previously, Yorgancioglu (2020) underlined that making design an online process may lose shared space when engaging in design. When elementary teachers could not work collaboratively in a shared space (creating in-class design environments, working with their colleagues in the same school), design became an individual process for students. Supporting collaborative groupwork in online education is a challenge in higher education (Fleischmann, 2020b), and it has also become a challenge for elementary teachers. In this process, students also need instant feedback to improve their designs (Dilmac, 2020; Dreamson, 2020) and teachers discussed how they could provide feedback more frequently before the pandemic when activities were conducted face to face. The pandemic created challenges, but it also presented room for improvement since students spent more time with digital tools. Connected with the studies conducted in higher education (Baptista et al., 2020; Iranmanesh & Onur, 2021), one of the teachers in this study also underlined the improvements students made in using Web 2.0 tools.

In the current study, teachers' activity planning remained the same before and during the pandemic. The pandemic had an influence on teachers' implementation, but it is important to underline that our case included a limited number of elementary teachers engaging their students in the design process through eTwinning projects. Our goal was to compare the same group of teachers. We could not add an international viewpoint from other countries. We only presented the influence of the pandemic from the teachers' viewpoint. Therefore, no general conclusions can be drawn about how these changes would also influence teachers' practices or students' ideas in other classes. Future studies may add comparisons across countries by including different student groups to get a better understanding of the pandemic's influence on design education and eTwinning projects.

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