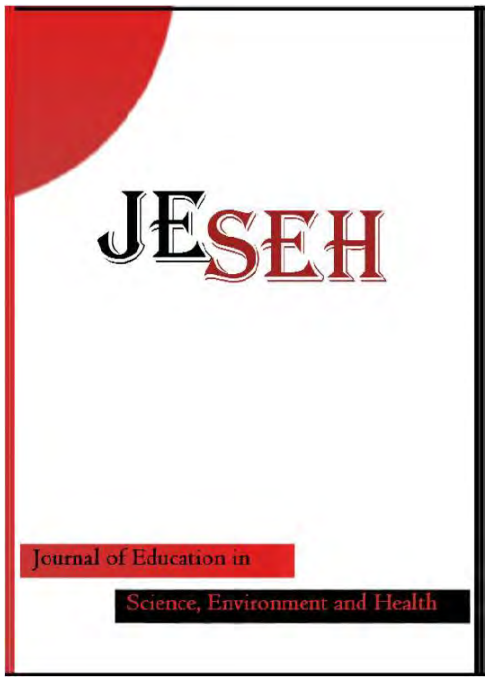

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Abstract

STEM education has an important place in recent studies. With the Covid 19 pandemic, distance education applications have gained importance all over the world. STEM education applications have also turned into distance STEM education with the Covid-19 pandemic. The purpose of this study is to better understand STEM teachers' perceptions of online group education and how they perceive group education expectations. In this study, semi-structured interviews were conducted with secondary school STEM teachers. The interview was aimed at illuminating teachers' perceptions of the role and purpose of teachers, and students' expectations from a group science lesson. Themes arising from the thematic analysis of interviews were determined. The themes that emerged from the analysis are as follows: Teachers' perceptions of their teaching role, teachers' perceptions of students' psycho-social needs, and teachers' perceptions of students' educational needs. Promoting student interaction in online synchronous education was identified as a challenge. Besides, some discrepancies were observed between teachers' perceptions of students learning expectations and their preferred approaches, and it was found that students expect a didactic experience rather than an interactive one.

Introduction

In recent years, developments in education have focused on improving the student experience to maximize student achievement. For example, the *Teaching Excellence Framework* is a serious driving force aiming to deliver excellent education and ensure face-to-face accountability (Campbell et al., 2019). Education should provide an environment that enables students to develop the 'social skills' they will need in all areas of their lives. This environment must include the vital development of the student's learning ability as well as critical thinking, teamwork, and analysis skills (Frankham, 2017). Whether it is campus-based or distance-based, the traditional way educational institutions address this aspect of education is to provide education in groups. While educators consider the need to develop social skills for student groups to enrich the learning experience, they also aim to ensure that the needs of individual students are met (Westhuizen, 2016; Wilson, 1996). Understanding the perceptions of teachers and students can give us insights into the discrepancies between expectations and practice. By examining such differences, it can enable staff to develop more effective forms of support.

During the COVID-19 pandemic, which first appeared in 2019 and affected the whole world, the distance education system was introduced in many countries, including the USA and European countries (Can, 2020). With this change, teachers had the opportunity to change the design and implementation of teaching materials, including style and content. In this study, we look at teachers' current perceptions of the role and purpose of tutorials in STEM disciplines at various institutions, as well as teachers' understanding and perceptions of students' expectations. The problems that arise are related to interdisciplinary and cross-sectoral relations, and particularly to institutions offering distance or online education.

Educational Context

During the COVID-19 pandemic, which the whole world faced, educational institutions have become distance education providers and their role is to interact with students one-on-one, help students with their homework, and help them work on their own, and contribute to group tutorials. These tutorials can be face-to-face, online synchronized, or a mix of both. Teachers decide on the content of in-class activities and which teaching method to use to support students at certain points in a course in most disciplines (Campbell et al., 2019).

Although previous studies have been conducted to analyze the higher-level objectives of the tutorials (Thorpe, 2002), it is thought that there are perceptions and practical approaches of experienced STEM teachers who determine the content and style of educational presentations for individual student groups. As such views emerge as a result of environmental factors and teachers' experience, students' expectations from teaching will likely change over time (Sander et al., 2007).

The use of synchronous communication technologies such as "BigBlueButton", which enables both voice and written communication simultaneously while teaching on a virtual board is increasing in online education. While such technologies contain some features of face-to-face education, they also offer some features specific to online education (White et al., 2010; Chen et al., 2005; Cunningham, 2014; Wang et al., 2017). Findings from studies with secondary school students continuing online distance education in Turkey revealed that online synchronous courses have shortcomings in subjects such as student interaction, social presence of students in lessons and student participation (Akgül & Oran, 2020; Canpolat & Yıldırım, 2021). The findings of Cavanaugh (2001)'s meta-analysis study on online education in secondary school were found to be like those of studies in Turkey. Although findings indicate that the developments in this area have been slow, teachers working in this field can still overcome students' social presence problems (Haresnape et al., 2020).

The characteristic feature of group activities in the online education model is that student participation is optional. However, teachers state that the rate of participation is generally low and many students prefer not to participate in the online courses. Therefore, it is very important to understand students' perceptions about group education. Although it is not the primary purpose of the current study, revealing student expectations as perceived by teachers may also provide useful information. To discover other variables that shape the views of teachers, the researchers adopted a holistic approach to identify factors that influence teachers' perceptions of the purpose of courses in the online education system. The purpose of this study is to better understand STEM teachers' perceptions of online group education and how they perceive group education expectations.

Table 1. Semi-structured interview questions (Campbell et al., 2019)

Category	Question
Teacher background (Closed questions)	Which courses did you teach?
	Did you study in other faculties, such as STEM?
	What teaching experience do you have?
Teaching purposes (Open-ended questions)	What are your thoughts on group teaching?
	What was your understanding of the purpose of group teaching?
	Have your expectations for group teaching goals changed or improved since you first started?
Delivery mode (Closed questions)	Can you mention us the mode of delivery for your group tuition?
	How do you manage group activities in your course?
Objectives (Open-ended questions)	What are your objectives for group teaching?
	To what extent did your course team guide you about the goals of group teaching?
	What factors do you consider when deciding what to include in their tutorials?
	When will you present the tutorials?
Other opinions (Open-ended questions)	In terms of the course team, your line manager, and other teachers, what are your thoughts on group teaching?
Student views perceptions (Open-ended questions)	How do you believe group teaching benefits students?
	What do you believe students perceive the purpose of group teaching to be?
	How does this affect the way you plan your education?

Method

In the data collection process, a qualitative approach consisting of semi-structured recorded interviews with 50 STEM teachers from different institutions who have taken STEM courses and voluntarily participated in the study was adopted. STEM teachers carried out activities related to STEM education to help students better understand the subjects. Some of these activities as follow: Fruit yogurt activity, making a thermometer, recycling machine, and classification of living things. STEM teachers also benefit from group training programs in their courses. The interviews were conducted over the phone, face to face interview and via Zoom's online synchronous software. The participants were asked open-ended and closed questions. A similar pattern was followed in each interview. The history and experience of school education were examined, then focused on the perception of the goals of group education in the context of the school. The teachers were then asked about other perspectives, particularly students' perspectives, and whether this affects their method of educational design and delivery. Campbell et al.'s (2009) interview questions were also used. Table 1 shows the questions used. First, the questions were given to all interviewees, giving them time to think ahead and prepare.

Unlike similar studies (e.g. Jelfs et al., 2009), in the current study, the themes were identified inductively and in an open-ended manner, rather than conforming the analysis to the existing theoretical frameworks in advance. Hence, a grounded theory-interpretative approach (Glaser & Strauss, 1967) was adopted to analyze the data. In this respect, an embedded theory-interpreter approach was adopted for the analysis of the data. The Grounded Theory is expressed as creating a new theory through the systematic collection of data and analysis within the research process (Strauss & Corbin, 1998). The GT aims to show the relationships between conceptual categories and to show in detail what theoretical relationships these are (Charmaz, 2002). As in the present study, when the purpose of a study is to learn about the perceptions of participants and the data collected is primarily qualitative and descriptive, the GT provides a perfect structure (Cohen et al., 2001). In this study, the continuous comparative analysis method is adopted. First, the teachers were asked the questions in Table 1 and their opinions were obtained. The data were analyzed immediately after they were collected. In doing this analysis, the teachers in the sample were shared 50/50 by the researchers.

Records of each interview were transcribed and then analyzed by the researchers. The first independent thematic analysis by researchers included an iterative review of scenarios, with occasional review of records. The open coding method was used in the coding of the data obtained during the analysis phase. The constant-comparison analysis was carried out by the researchers carefully to perform the coding and reveal the emerging key themes. To ensure reliability, the coding of the researchers was compared, and the inter-rater reliability was found to be satisfactory. The themes were then obtained from the encoding. These themes are presented in detail in the Findings and Discussion section.

Participants

The ages of the interviewees ranged from 38 to 60 (Table 2). The interviewees were secondary school science teachers who taught STEM. They had attended STEM training courses and received certificates. Many had substantial tutoring knowledge at higher levels, across subjects, and schools (Table 3). They had also participated in out-of-school activities. They also gave training on various subjects such as professional development, vocational education, basic literacy.

Table 2. Participants' age distribution

Age	Number of teachers
0-34	0
35-45	10
46-55	23
56-65	17

Table 3. Participants' teaching experience

Years	Number of teachers
0-5	8
6-10	17
11-20	20
20+	5

Table 4. How many years the participants worked as STEM teachers

Years	Number of teachers
0-5	36
6-10	14

Results and Discussion

The results are analyzed under the heading Emerging Themes which focuses on teacher perceptions, by discussing specific problems arising from the data.

Emerging Themes

Several major themes emerged from the analysis of the teacher interviews. These emerging themes are given in Table 5.

Table 5. Themes emerging from the interviews with teachers

Themes
Teachers' perceptions of their teaching role
Teachers' perceptions of students' psycho-social needs
Teachers' perceptions of students' educational needs

Teachers' Perceptions of Their Roles

Facilitator Roles

Relying on the framework of Kember (1997), the teachers interviewed can be said to have a student-centered and learning-oriented approach. All the STEM teachers interviewed within the scope of this study, including technology teachers, stated that they thought they facilitated students' learning. Since all of the teachers who participated in the study were teachers who voluntarily chose to become STEM teachers, they are thought to have a greater interest and a more reflective view of the lesson compared to other teachers. One teacher defined her role as:

> As STEM teachers, our task is to help students learn the subjects in the course more easily. We do this by using materials.

According to King (1993), the role of an educator is to work as a guide. The educator accomplishes this by enabling interaction with the presented material, drawing attention to the importance of facilitation, enabling students to participate on their own, permitting students to share information, and allowing students to make lessons for themselves.

Vocational Skills and Experiences

Providing qualified education to students is the principal purpose of all education systems. One component of qualified education is qualified teachers (Bümen et al. 2012). Teachers who are well-trained professionally can provide positive learning conditions for their students and support them with guided activities in areas where students are struggling (Seferoğlu, 2004). The participants stated that they supported their students by teaching them some concepts and skills. A teacher stated the following on the subject:

> We perform guided practices so that students can benefit from strengthening of concepts.

Vocational experiences help teachers anticipate students' difficulties and misunderstandings and thus design a more appropriate education:

> After learning the system and the course subjects, I can easily guess the points where they will have difficulties and misunderstandings.

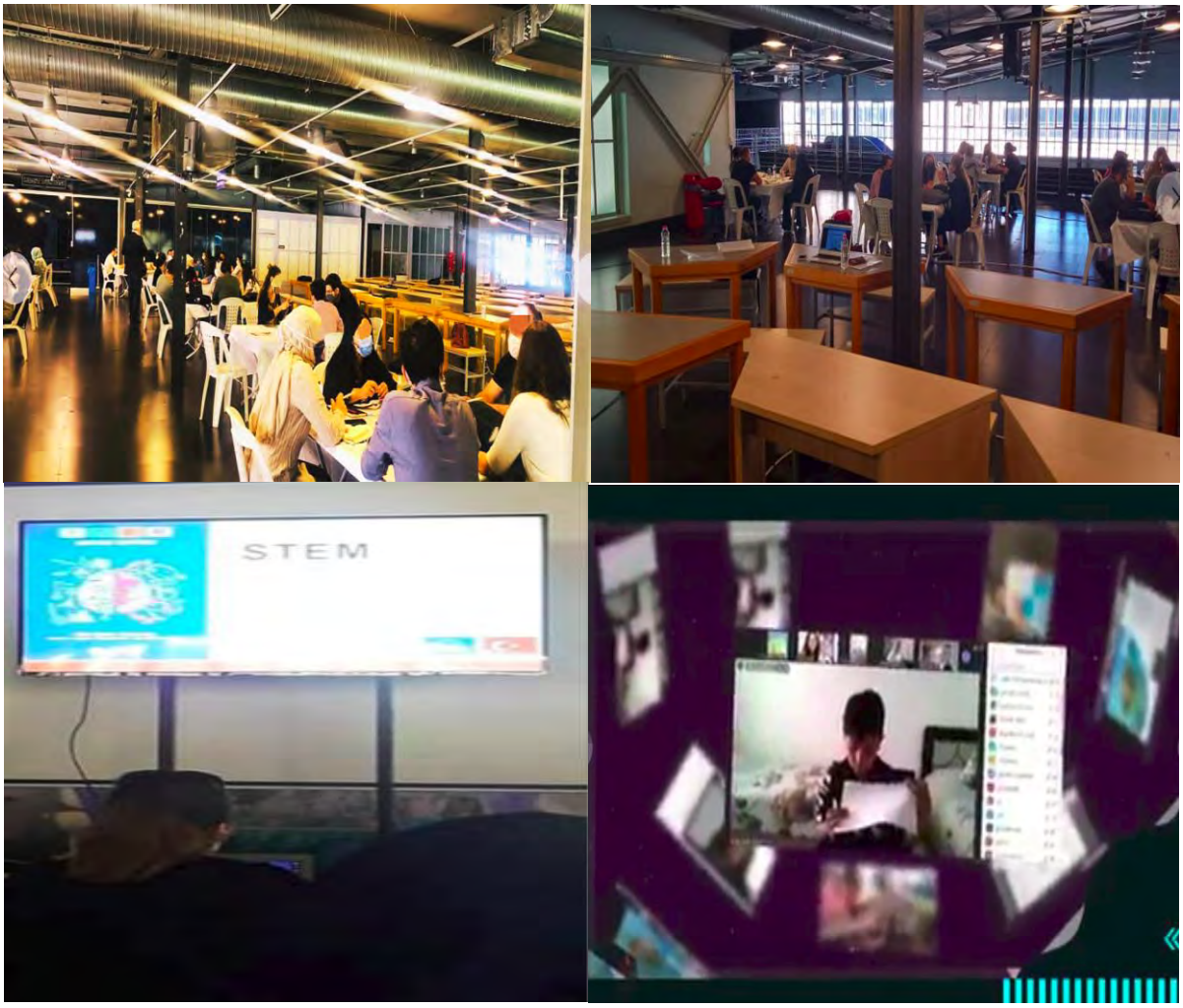

Figure 1. Examples of the applications with teachers

Learning is viewed as an opportunity to develop the fundamental abilities that students will require in their future studies and employment. Such skills are developed through education. Vocational skills are the main ones. Teachers support students in this situation:

> Most students are struggling in areas such as mathematics and science. In the courses, we support students to develop these skills that they will use effectively in their future professional life.

Empathy

Taking advantage of their interactions with students, each teacher who was interviewed tried to express her/his point of view on students' perspectives:

> It's good to get student feedback during the teaching process. But we don't always get feedback from students. In such situations, we try to understand how students feel in class, what subjects they are struggling with, and how I will be more useful to them.

Educational background and experiences

Most of the teachers interviewed said they shaped their courses based on their educational backgrounds and past experiences:

> I still remember how useful some of the lessons I attended were, so I guess I'm trying to model some aspects of my practice around what was useful to me when I was a student.

Assignment

Most of the teachers stated that they expected the students to concentrate on the lessons and prepare their homework. A common answer is as follows:

> Although students are struggling in distance education, we expect that they will participate in the course activities and complete their homework.

Teachers assign their students homework to improve their learning experience. However, the fact that students do not want to do their homework makes this difficult:

> I want to give them a wide range of homework. They help students reinforce their learning of the subjects. However, students do not want to study after the lessons are over.

Teachers' Perceptions of Students' Psycho-social Needs

Build Motivation and Trust

Student motivation was identified as an important component of the educational context by three-quarters of the interviewees:

> Sometimes you have to motivate students to participate in the classes and activities, make them feel what they can do.

Building student trust is viewed as an important outcome of group education, something especially needed in the context of distance education. Teachers expect their students to be open to seeking assistance and "not to be afraid of asking questions or making mistakes. More than half of the participants emphasized the significance of developing students' self-confidence and were fully cognizant that their assistance was useful in this process:

> Sometimes students say they can't manage it. In this case, when we support the students, they see what they can achieve.

Social Interaction

According to the responses of the twenty-nine people polled, social interaction is an important goal of group lessons for students. This observation is consistent with the findings of Oliver et al. (2009), as well as those of Campell et al (2019).

> Students can feel lonely during this pandemic when we are all in our homes. We see the lessons as an opportunity for students to communicate with us and other friends and we encourage this.

Teachers stated that it is important to make students feel a sense of belonging and inclusiveness, and especially group activities leave positive impressions on students. At the same time, they stated that this situation is important for the socialization of the students and that the interaction of the students especially with other students will ensure that the teaching is carried out much more effectively.

Teachers' Perceptions of Students' Educational Needs

Changing of Students' Expectation

As technology has improved, students' expectations of the courses have changed. The majority of the teachers interviewed stated that they structured their courses according to the changing expectations of the students:

> We try to use visual and auditory technological tools more in our courses so that students can benefit more from the courses.

Collaboration

Collaboration is a skill which can be developed through group work (Bates & Poole, 2003; Jonassen, 2005). Forty-five of the teachers interviewed stated this as follows:

> Providing students with the opportunity to work as a group is quite useful.

Also, these teachers stated that collaboration and group projects help students learn more effectively by allowing them to interact with one another:

> Our courses provide the opportunity to interact with our students who do not have the opportunity to meet face-to-face during the pandemic. We are also trying to support peer learning by taking this opportunity to encourage students to collaborate and do group work.

Problems Arising in Online Presentation

The interviews aimed to determine the participants' group teaching perceptions. Besides, two areas that are important to meet the stated goals were emphasized: The first of these are online problems, and the second is the possible mismatch between student and teacher expectations regarding the purpose of the course.

Online Issues in Education

Although the participants were not specifically asked about the effect of online presentations, most of them stated this directly or indirectly. There are some problems with online teaching, especially about interaction, which teachers see as a key strategy in facilitating learning or helping students with threshold concepts. According to Paechter and Maiter (2010), although students tried to interact by using online communication methods in online education, they found face-to-face interaction as vital to maintain learning motivation. According to Cornelius (2014), students describe learning in virtual classrooms as an intense or challenging experience in terms of concentration.

The situations that prevent the continuation of interaction are seen as problematic by most of the teachers participating in the study. The interviewed teachers reported that they tried to develop interaction with students in online sessions. However, efforts to improve interaction in the sessions have so far been disappointing for many.

> I put a lot of effort into making students more interactive in online sessions with tools like questions and surveys. However, it is very difficult to get students to talk and to get them to do activities (whiteboard, projection, etc.).

Therefore, although teachers make efforts to develop teaching materials that require feedback from students, students' participation in interaction is at a limited level. It was stated by the participants that the inability to receive feedback from students caused problems both in the communication of teachers with students at an individual level and in determining whether the students understood the subjects.

Interaction during the lessons is seen by teachers as an important factor in helping students improve their self-confidence. The transition to the online education system had no positive impact on interaction between teachers and students. The reason is that online teaching is not as effective as face-to-face teaching.

> I don't think online education is as effective as face-to-face training. The students think that they know what they are doing and can do it together only because they are in the same class.

Some teachers observed it can be helpful to watch online sessions recordings:

> I think recording online lessons is beneficial as it allows students to watch and repeat lessons.

Widespread difficulties for interaction in online education can be encountered, some teachers considering this style of presentation to be beneficial, resulting from increased participation in the learning activities. The variable nature of students' context was stated as a factor causing changes in student expectations by almost all

the teachers. Teachers believe that teaching materials and teaching methods have changed with the development of technology and that the expectations of students from the courses have similarly changed. The teachers often stated that students use technological tools more often to meet such expectations. However, because teachers do not yet have enough experience in the use of certain technological tools and distance education, it creates some challenges for them.

The importance of face-to-face education in facilitating independent learning is mentioned by many educators. However, often there are some difficulties in attending face-to-face classes and this can be seen as a disadvantage. Online programs can help achieve stronger participation. Students' ease of access to online activities enables more participation than face-to-face training. Although it has still some problems, Teachers stated that the positive features of online education dominant than the negative features.

Differences between Teacher and Student Expectations from Courses

Another area of interest is the variation between teachers' perceptions of themselves and students' expectations from these teachers. The mismatch between expectations can cause concern in any service-providing organization. According to Byrne et al. (2012), if these expectations are not met in an educational institution, students may fail, withdraw or not participate fully in classes. Most of the teachers interviewed stated students expect more traditional teaching ways in the course instead of more interactive ways. It can be stated that this is because students expect a lecture-style presentation and teachers prefer a more interactive approach. Also, these findings overlap with Stevenson et al.'s (1996) findings. Although the subject area, level, and presentation style are very different, most students expect distance education lessons to be taught like face-to-face lessons.

On the other hand, teachers see interaction as an important key for students to better understand threshold concepts (Price et al., 2010) because this is thought to provide a way to understand and guide improvisation to meet the needs of students. Particularly given the difficulties in online interaction mentioned above, the majority of teachers stated that students' unwillingness to participate actively in classes posed difficulties in the educational model. Besides, skills that can be developed during training such as collaboration and group work, which are considered important for the workplace by teachers, can be difficult to include or even fail if students are reluctant to embrace them. It is unclear whether this reluctance in participation is due to students' choice of lecture-style presentation, or the inhibition of social presence caused by the online perimeter (Kear et al., 2012). However, lecture style, presentation, focused group work, and well-mediated discussion are valuable for students in face-to-face environments (Yacci, 2000). When the appropriate activities are given, students can participate and value online group work.

The issue of extracurricular evaluation activities is another incompatibility. Almost all of the teachers interviewed stated that they expected students to attend their classes and complete their assignments. Teachers want students to learn the subjects in the courses at a level that will equip them with the targeted skills and competence. However, students expect to learn the subjects at a minimum level, just enough to pass the exams. Teachers, who are experts in their lessons, are aware of the need for students to participate in the lesson intellectually and to expand their learning experience beyond the study materials. When these areas emphasized by teachers were closely examined, it was found that overall these findings were similar to the findings by Campbell et al. (2019), who studied online university STEM tutors.

Conclusion

This study intends to explore the perceptions of secondary school STEM educators and the anticipations of student groups regarding their learning within the distance learning model. Using semi-structured interviews and adopting a qualitative approach, not only teacher perceptions of the objectives of the lessons but also the difficulties they face while teaching was identified. STEM teachers think educational activities are to improve students' knowledge and skills by benefiting basic skills such as teamwork and collaboration. Teachers use their previous training to decide on content (concepts and skills) and to select appropriate learning activities. These interviews revealed two major problems faced by teachers. First of all, there were some difficulties in creating effective interaction in the transition to online education using synchronous systems, creating obstacles in the communication between the teacher and students. Secondly, some discrepancies between teachers' perceptions of educator demands and student expectations were identified.

The challenges above need to be further explored and addressed. Online education cannot be simply delivered by directly copying its face-to-face equivalent, and alternative approaches to teaching should be introduced to make the learning environment more relevant and interesting for the student. Institutional strategies on how students should take on a more active role in education need to be developed. This might help students to find out the role that best works with a group (peers and teacher) in their learning progress and can help better achieve the results expected from group training.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

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