

Faculty adoption of online teaching during the Covid-19 pandemic: A lens of diffusion of innovation theory

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During the Covid-19 pandemic, higher education shifted from face-to-face to online education and teachers had various perspectives about remedying the challenges of this mandatory situation. Drawing on the diffusion of innovation theory as a theoretical lens to better understand the change in the adoptions of the faculty during the pandemic, we surveyed 307 academics with an online questionnaire. The results indicated that the adopters in this study were innovators (11%), early adopters (23%), early majority (18%), late majority (22%), and laggards (26%), revealing somewhat different percentages from the values in the theoretical model. This can be explained by the fact that innovations that require an emergency situation bring about changes in the values of the adopter categories. Examining the questionnaire data, we categorised the results as support, functionality, guidance, interaction, adaptation and the features of synchronous lessons influencing the diffusion of innovation during the new emergency teaching condition. The adoption process was discussed through the factors influencing these dimensions. The implications of notable findings and directions for future studies have been provided.

Implications for practice or policy:

- Academics may have better online learning experiences in various designs and applications at universities.
- Academics may be prepared for unexpected teaching situations with adequate and appropriate organisational, technical and learning support to achieve quality outputs.
- All educational institutions, academics, and universities in particular, can be guided to adopt technologies more easily and quickly in such situations as future pandemics, wars, etc.

Keywords: diffusion of innovation, technology adoption, online learning, pandemic

Introduction

The unprecedented Covid-19 pandemic forced a remarkable shift in social interactions as a result of social distancing measures in education. The latest data obtained from the United Nations (Zhong, 2020) reflect that 770 million learners around the world were affected by the closure of schools and universities. Thus, an unexpected shift has been witnessed amongst teachers and students in moving from face-to-face to online teaching. Yan (2020) argued that during this time there has been the largest ever incidence of online education. However, many institutions and teachers were not organised for this sudden shift in the educational life.

The pandemic led to numerous mandatory changes in the work of academics at universities, in that higher education programs switched to online learning, local and central exams were postponed, and many exams were conducted through the web. However, academics were familiar with the use of online teaching systems at various levels. Some teachers had gained extensive experience conducting online courses and programs before, while some have not performed any online practices yet. Thus, transferring all face-to-face courses and evaluation procedures to the online environment by making them mandatory emerged as a new practice for many academics.

The situation diffused among academics through different means. While some academics quickly adapted to this situation, the others remained rather slow in this process, which resulted in differences in terms of achieving the expected benefits of online learning both at the institutional level and at the departmental or course level in higher education. Technology-supported learning environments as innovations for academics were examined in numerous studies and the characteristics of the innovations were observed to diversely affect the perceptions of academics in those studies (Yusof et al., 2017).

The peculiar features of the pandemic period and the mandatory adaptation process to the online learning environment were perceived as new and even distressing to many academics. Therefore, the critical need is to understand such situations and determine the factors that may affect teachers' experiences in these situations so that instructional designers can be guided to determine the necessary measures and tools to manage similar unexpected educational processes successfully.

Online learning as an innovation in the Covid-19 pandemic period

Online learning has garnered great attention in recent decades due to the advancements in digital technologies and the internet. The advancements in the online tools have brought about more active learners in the learning process, with the teachers as facilitators in the teaching process. Verawadina et al. (2020) indicated that institutions should prepare open source facilities such as web-based online learning portals and learning management systems, for example, Moodle, Dokeos, and Edmodo, and the online learning tools within them such as virtual classrooms and teaching rooms.. In such emergency conditions as the Covid-19 pandemic, teachers as facilitators need to be flexible in teaching and learning activities, update teaching materials, control students in online learning activities, and know what activities can or cannot be carried out during online learning (Feladi et al., 2020; Verawadina et al., 2020).

The studies on online learning in the literature focus on similar themes before and during the pandemic, however, the themes in the latter differ somewhat. Before the pandemic, considering learners' and teachers' perspectives, some studies addressed the factors underlying the success or failure of online learning in terms of acceptance, satisfaction, or performances (Liaw & Huang, 2013; Shelton et al., 2017; Weidlich & Bastiaens, 2018). These systematic review studies have provided a better understanding of the online learning research themes around the framework of organisation, course, teacher, and learner in the last three decades. Course environment and learner outcomes were the most studied themes between 1993 and 2004 (Tallent-Runnels et al., 2006). The most often studied themes between 2000 and 2008 were learner characteristics, engagement and interaction, and design issues (Zawacki-Richter et al., 2009). Learner characteristics, interaction, and engagement which were appeared under the sub-themes of presence, interaction, community, participation, collaboration, involvement, and communication, were the most often studied themes between 2009 and 2018 (Martin et al., 2020). In addition to these themes, the studies during the Covid-19 pandemic period chiefly focused on student perspectives of online learning (Adnan & Anwar, 2020; Baczek et al., 2021; Rohman et al., 2020), the challenges (Irfan et al., 2020; Sari & Nayır, 2020; Simamora, 2020), and teaching and learning strategies during the online learning period (Gunawan et al., 2020; Lubis & Sari, 2020; Morgan, 2020). The pandemic situation impacted the education system at all levels, requiring all participants to urgently fit into the new situation.

This observed great struggle in the education community forced all the countries to find their own best ways to undertake online teaching and learning including flipped learning, social media platforms, learning management system collaboration tools, online meeting software, or TV broadcasts. While adapting these techniques with no nationwide definite strategies, some difficulties arose, such as struggling with novel technologies and pedagogies. Wright (2014) claimed that faculty members were the key actors for the successful implementation of online instruction in terms of design, development, and delivery. Another study by Chick et al. (2020) asserted that challenges in online education could be overcome by investing time and effort to make staff familiar with the novel technologies and techniques. However, during the transformation to online education in the pandemic period, academics with heavy workload had to face great unavoidable changes in their teaching practices. The key consideration of this study was whether teachers were organised to accept this change, and whether they were ready or willing to embrace the technological innovations. This is the first knot in the struggle to move forward as the success of the online learning process depends on the teachers' adoption of the new teaching and learning situation.

Rainero and Modarelli (2020) argued that for individuals to persist with working activities, they need to develop complete acceptance for the innovations during the emergency period, even if they were previously averse to adoption. Various theories and models are used for explaining user acceptance and adoption of new technologies, the most prominent of which are, the theory of reasoned action, the theory of planned behaviour, the theory of interpersonal behaviour, the technology acceptance model, and the unified theory of acceptance and use of technology (Taherdoost, 2018). In addition to these models and theories, the diffusion of innovation theory, developed by Rogers (1995), combined the innovation decision process, the characteristics of an innovation, and the characteristics of its potential adopters.

Theoretical framework

When confronted with a new technology, an individual goes through an adoption decision process which includes getting information, testing, and then deciding to add it to their repertoire of skills (Rogers, 1995). The literature on diffusion of innovation provides insights into the factors that may influence teachers' likelihood of utilising online teaching. Rogers (2003) defined diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system, and suggested the four elements of diffusion as innovation, communication channels, time, and a social system. In the theory, Rogers (2003) categorised adopters as innovators, early adopters, early majority, late majority, and laggards, and determined their characteristics according to each of these compliance categories. The categories are shown in Figure 1.



Figure 1. Stages in the innovation-decision process (Rogers, 2003)

According to the theory, the characteristics of an innovation, that is, the main factors that influence adoption of an innovation are relative advantage, compatibility, complexity, trialability, and observability. Each category displays dominant features aimed at theoretical formulation of refusal or adoption of an innovation (Porter & Graham, 2016). Innovators are the first to adopt an innovation, not hesitant to take risks, and with the desire to try the latest trends by examining the innovatory characteristics. They play the key role in the innovation of introducing it to the others. Early adopters are the second to adopt an innovation, and have a level of technical expertise and interest in investigating new technologies. They do not have the resources that innovators have but are respected by the social system which trusts in their experiences with the innovation. Early majority members are generally in communication with the majority of the members of the affected society, yet they are hesitant to adopt an innovation until there is some compelling evidence of its use and value, and credible recommendations are given by the other adopters. Despite being comfortable with the technology, they form their own decisions after observing the decisions of the early adopters, which may vary the adoption times. The late majority members adopt an innovation following the early majority group, only due to peer pressure and increasing economic pressures. Troubled with the technology and requiring support, they do not adopt an innovation until the majority of the social system do so. Laggards are the last group of adopters with limited resources. They resist adopting an innovation by expressing aversion to technology until after the certain success of the innovation (Humbert, 2007; Porter & Graham, 2016; Rogers, 2003; Thackray et al., 2010).

Classification of adopters in terms of innovation

In the diffusion process of innovation theory, Rogers (2003) identified three factors affecting individual adoption of innovation: socio-economic status, personality traits, and communication behaviour. Goh and Sigala (2020) defined five factors in the adoption of innovations: (1) relative advantage, where an innovation perceived as having greater advantage over the existent situation will be accepted more easily, (2) compatibility, where innovations fitting with the needs, values, and previous experiences of an adopter have higher likelihood of being adopted, (3) complexity, where innovations perceived as easier to comprehend and utilise will be adopted more easily, (4) trialability, where innovations which can be experimented with for risks and uses before full implementation are more likely to be adopted, and (5) observability, where innovations with clear and visible outcomes have a higher likelihood of being adopted (Scott et al., 2008).

Prior studies showed that diffusion of innovation was a good way of explaining the adoption process in terms of innovations. For example, Wang et al., (2020) examined the determinants of the willingness of the faculty members to use intelligent tutoring systems from the lens of diffusion of innovation. In another study Richardson et al. (2020) endeavoured to understand the barriers, challenges, and successes of adopting e-learning pedagogy in online learning environments. There are various studies focusing on the adoption of academics regarding the new processes they encounter, which may be a general situation involving the adoption of information communication technologies or a new technology. However, these

studies have mostly emphasised the factors affecting academics that facilitate or prevent the adoption of an innovation (Liu et al., 2020; Martin & Quan-Haase, 2013; Mayowski et al., 2019; Nicolle & Lou, 2008; Porter & Graham, 2016; Shea, 2007).

Unlike the abovementioned studies, this study focused on the pandemic period which required new solutions in the education area, as well as curtailing the educational gap brought about by the restrictions during the period. Therefore, in this study, the adoption of the compulsory innovation by the academics who conducted their courses in online settings was discussed within the framework of diffusion of innovation.

Need for study

Despite the proliferation of online learning during the pandemic period requiring the use of digital technologies especially at the tertiary level of schools, a very limited number of studies focused on adopting these innovations in online learning. Considering the fact that questions, problems obstacles, and disasters are the sources of inspiration for innovations (Ramadani & Gerguri, 2011), this study sought to provide information to assist in the development of successful online learning processes for use in normal education periods as well as periods such as a pandemic. The determinants of academics' acceptance of the online teaching were expected to be different from those of academics in emergency and mandatory situations. In addition, determining the adoption process of the academics in the pandemic period was expected to assist with determining the extent to which online learning is accepted by the teachers with various online learning backgrounds. This was done by addressing the factors that influenced online learning in the pandemic period and making recommendations for higher education institutions to implement before planning their online instructions.

The diffusion literature suggests that the likelihood of adoption is influenced by several characteristics of the technology (Batz et al., 1999; Rogers, 1995). By reviewing these characteristics and considering how they may be manifested in a faculty training program, it may be possible to predict how these factors will influence an academician's response to such technologies. When the dimensions underlying the perceptions are identified, the adoption of online learning can be understood properly and it may provide some new teaching techniques or settings for such situations.

Aim of study

The premise of this study was to investigate the adoption process of online teaching by academics during the pandemic period and to explore the factors influencing their beliefs about online teaching. In line with the overall purpose of the study, the following research questions were distilled:

- To what extent was online teaching been embraced as an innovation by academics in the pandemic?
- What are the factors that influenced the academics' adoption process of online teaching in the pandemic period?

Method

This research was carried out as a survey study. Surveys are used to collect data about people's knowledge, attitudes, and behaviours on a broad range of subjects with the aim of describing, comparing or explaining them (Fink, 2003).

Research group

As in the rest of the world, Turkey witnessed a striking change in the form of the abolition of face-to-face courses due to restrictions, which were therefore conducted through online environments from March 2020 (The Council of Higher Education [CoHE], 2020), when the Covid 19 pandemic was declared. The decision to conduct synchronous or asynchronous lessons during this time was left to each university. The participants of this study included 307 academics teaching during the pandemic period at 18 different universities from all regions of Turkey. The faculties and vocational schools of the participants are presented in Table 1 and the characteristics of the participants in Table 2.

Table 1
Schools/faculties of participants

School/faculty	Participants
Faculty of Education	134
Faculty of Medicine	29
Faculty of Arts and Sciences	18
Vocational School	84
Faculty of Economics and Administrative Sciences	12
Faculty of Engineering and Architecture	14
Other	16

Table 2
Characteristics of the participants

	Participants
Age:	
20-30	23
31-40	154
41-50	106
51 and above	24
Experience (years):	
1-5	87
6-10	92
11-20	92
21 and above	36
Average online lesson time (minutes):	
5-10	3
11-20	7
21-10	152
41 and above	145

Data collection tools

Questionnaire

In the study, a questionnaire was employed to examine the acceptance of online teaching by academics. While constructing the questionnaire, a previous questionnaire developed by Porter and Graham (2016) to determine the adoption of blended learning in higher education was referenced. Their questionnaire was translated into Turkish separately by two EFL teachers. Afterwards, the items of the questionnaire were adapted by four IT professionals, who took into consideration the online learning applications at Turkish universities. Due to the similarities to the objectives of this study, demographics and item 1 in the *Identify category of innovation adopter* section in their study were used without change, but item 2 was adapted to “How much of your lesson time have you conducted synchronously or asynchronously?” and item three 3 was adapted as “Which of the following best describes your overall approach to new technologies?” Items 4, 5, 9, 10,12,13, 14, 16, and 17 in the *Identify factors that influence adoption decision and the extent of influence* section of their questionnaire were adapted. Similar to Porter and Graham (2016), we presented research-based descriptions of the innovation adoption categories and the respondents were required to express the best description depicting them, which formed the basis for the respondents’ self-categorisation. The respondents were also asked about the specific actions they took for online courses, exams, quizzes, discussions, and collaborative tools they used as online materials. The questionnaire was completed by a small pilot group and changes were made in line with their feedback. The final version of the questionnaire consisting of five sections was created. (Appendix A). The first section included demographic information questions. The second section included questions about the situation and experiences of academics using online environments. The third section included items about the social environments for the diffusion of innovation they considered themselves in. The fourth section included questions about the relationships between online applications used in the teaching process carried out during the pandemic period and the factors influencing the adoption of innovation, and the fifth section included questions on the academics’

perspectives about the online classes during the pandemic period. There were open-ended, graded, and multiple-choice items in the questionnaire.

Data analysis

The responses of the participants to the questionnaire were used to identify the strategies adopted in the pandemic period. Adopter categories were created by taking the strategies used by the participants as references in response to the question “Which of the following best describes your overall approach to new technologies?”. The items for determining the adopter categories are presented in Table 3.

Table 3
Item and responses to determine the adopter categories

Adopters	Perspectives of adopters
Innovators	I use many technological innovations constantly. I start using them before anyone else, sometimes even before these technologies are available to the public.
Early adopter	I constantly follow new technological developments and use the best ones. Generally, I think I am one of the first to use innovations, and those around me use them upon my recommendations.
Early majority	I expect the technology to be clearly demonstrated and recommended by those around me before I use it.
Late majority	Generally, I do not think I am one of the first to use technological innovations, but I can say that I use them before a significant number of users.
Laggards	I am not exactly against new technologies. I use these technologies with caution and when I really need to use them. I am aware that my colleagues value new technologies, but I insist on using traditional resources. Even if I have to use technology, I continue to use my available resources.

The categories were formed according to the characteristics of the questionnaire items and the number of items under each category is as shown in Figure 2. The categories of the items were support, functionality, guidance, online teaching experiences, interaction, adaptation, and synchronous lessons conducted during the pandemic process.

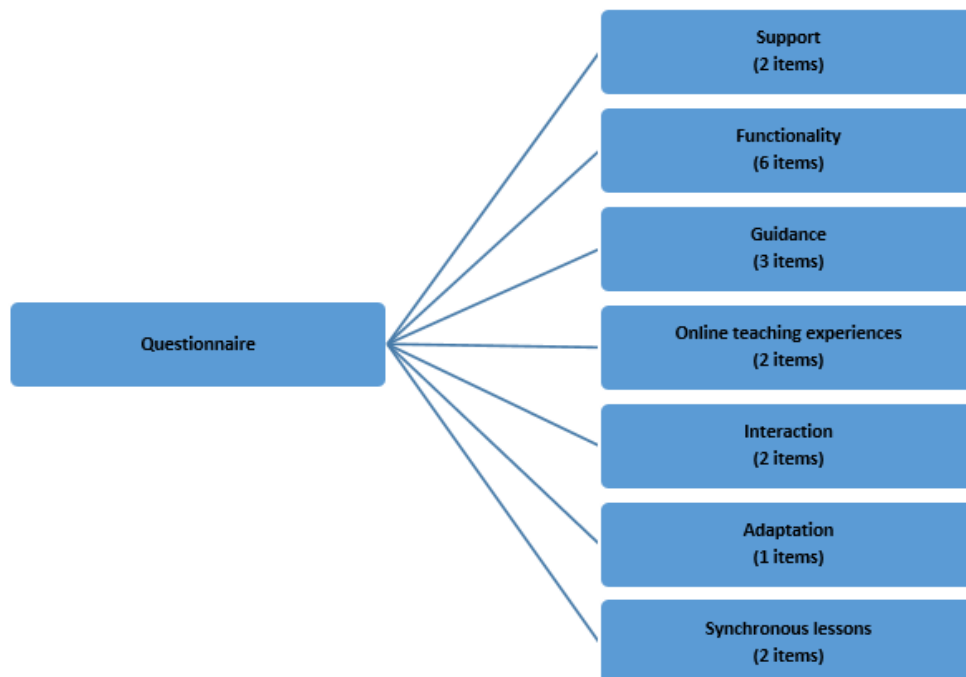


Figure 2. Distribution of the items in the questionnaire

Results

RQ1. To what extent has online teaching been embraced as an innovation by academics in the pandemic?

This study, somewhat differently from the others, first revealed the adopter groups according to their previous experiences and then determined their evaluations in terms of their actual behaviours in the pandemic. As shown in Figure 3, the curve including the percentages of the adopter groups was somewhat different from the Rogers' (2003) groups. The distribution in Rogers' (2003) study of adopters was innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%), and laggards (16%). In this study, the adopters' distribution varied from Roger's adopter categories as follows: innovators (11%), early adopters (23%), early majority (18%), late majority (22%), and laggards (26%). The factors causing this variance may have been due to the emergency nature of the innovation in the pandemic period and the immediate necessity of using online environments to sustain the teaching and learning process. The decrease in the early majority and late majority groups resulted in the increase in the percentages shown the other groups, which illustrates the variance from Roger's adopters curve.

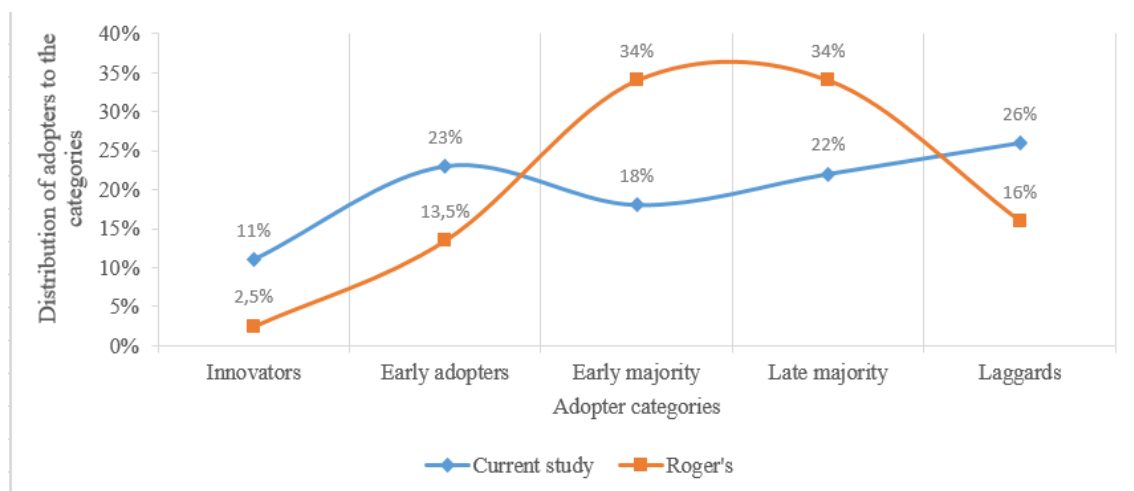


Figure 3. Distribution of adopter groups in the study

RQ2. What are the factors that influence the academics' adoption process of online teaching in the pandemic period?

Support, functionality, and guidance

The responses to the question of what affected the participants' decisions to conduct their lessons online, support, functionality, and guidance factors are presented in Figure 4.

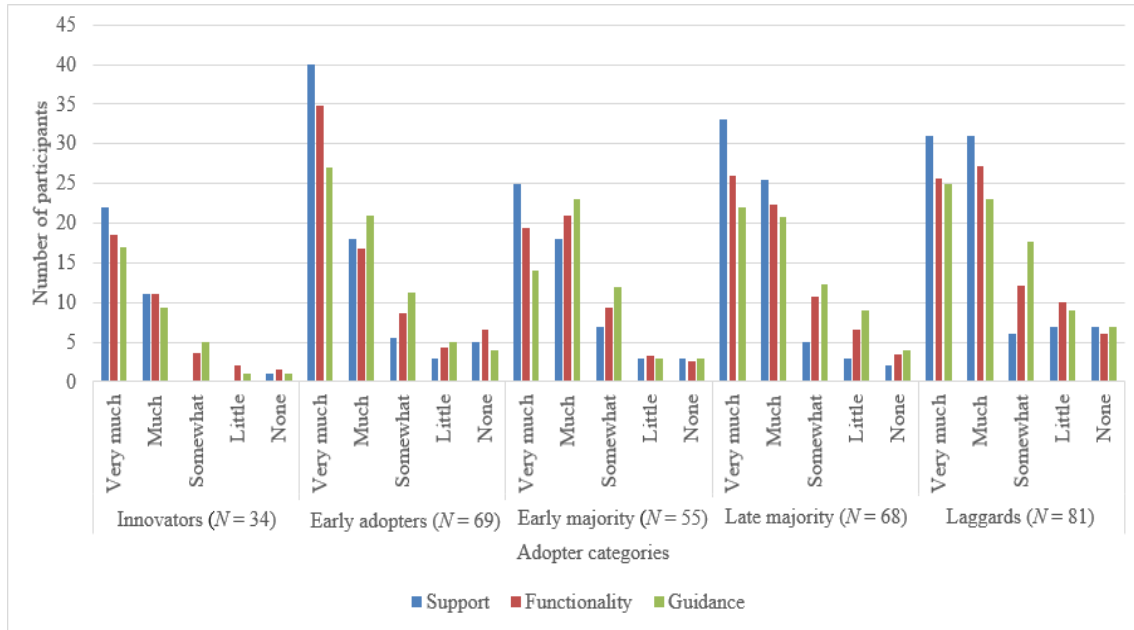


Figure 4. Responses in support, functionality, and guidance factors

In the support factor, 97% (33/34) of the innovators, 84% (58/69) of the early adopters, 78% (43/55) of the early majority, 87% (59/68) of the late majority, and 76% (62/81) of the laggards preferred the *very much* and *much* options, which showed that providing technical and pedagogical support was an important issue for the adopter groups to conduct their lessons online. In addition, innovators did not prefer the *somewhat* or *little* options and the option *none* was chosen only by one academician, which revealed that the support factor was an indispensable element for the participants.

In the functionality factor, 86% (30/34) of the innovators, 74% (51/69) of the early adopters, 73% (40/55) of the early majority, 71% (48/68) of the late majority, and 66% (53/81) of the laggards preferred the *very much* and *much* options, which indicated that providing functional elements such as the flexibility of time and space held for students and scholars with the online medium used in the execution of online courses made functionality an important factor for adopters. In addition, the functional structure of online environments was found to be very important for innovators (86%) and for laggards (66%) as well.

In the guidance factor, 77% (26/34) of the innovators, 69% (48/69) of the early adopters, 67% (37/55) of the early majority, 62% (43/68) of the late majority, and 59% (48/81) of the laggards preferred the *very much* and *much* options, which showed that providing institutional guidance with guidelines and sample practices regarding the online education process was welcomed by those adopter groups. In addition, the incidence of the *very much* and *much* options was greater in innovators than in laggards, potentially indicating a reduced need for providing guidance among the adopter groups in this direction as well.

Online teaching experiences

The answers given by the participants to the items about their previous online experiences in the online teaching experience factor are as shown in Figure 5.

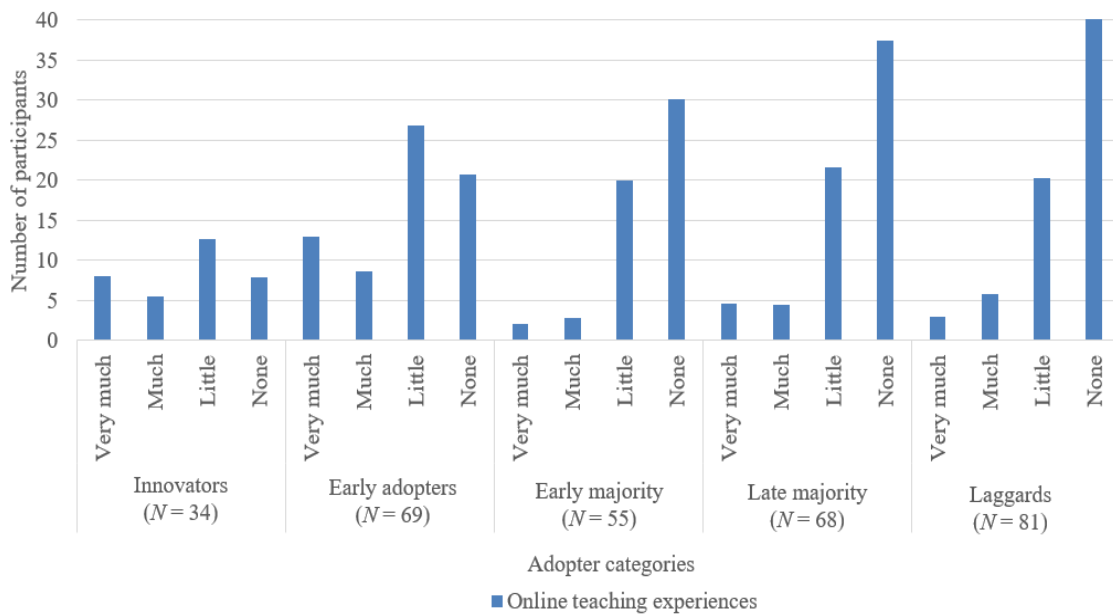


Figure 5. Responses in previous online teaching experiences factor

Regarding the responses of the participants about their online teaching experiences, the rate of preferring the *very much* and *much* options decreased as the sample participants were identified in greater numbers as laggards than innovators. While the preference for the *little* option varied, the preference rate especially for the *none* option increased, which may have been due to the previous online activity experiences of adopter groups. For example, 24% (8/34) of the innovators and 4% (3/81) of the laggards chose the *very much* option for experiences with online activities before the pandemic process. At the same time, 64 % (52/81) of the laggards reported no previous online activities by choosing the option *none*.

Interaction and adaptation

The answers given by the participants to the questions about the online learning process, regarding the availability of recorded lectures, maintaining interaction with students, and adapting to online courses during the pandemic period in the interaction and adaptation factors are shown in Figure 6.

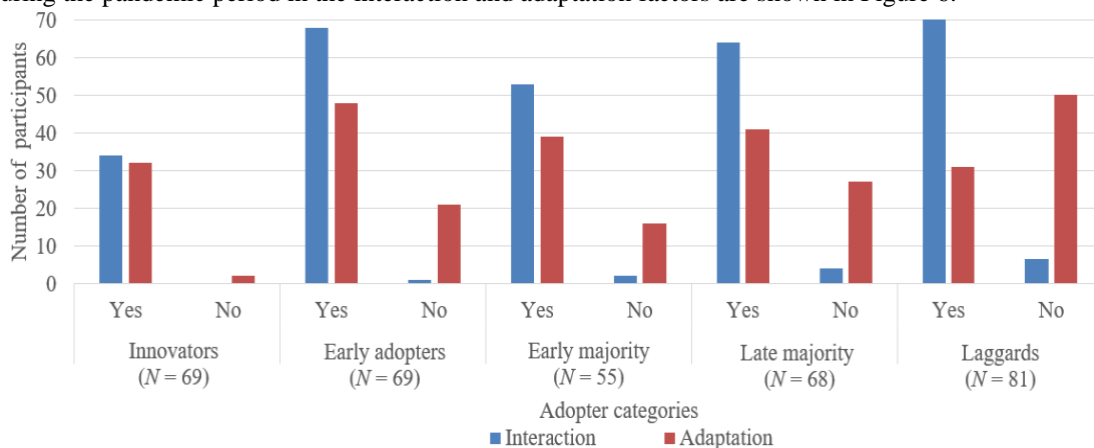


Figure 6. Responses in interaction and adaptation factors

In the interaction factor, all the adopter groups expressed a high level of positive opinion for various interaction elements. The answers showed that 100% (34/34) of the innovators, 99% (68/69) of the early adopters, 96% (53/55) of the early majority, 94% (64/68) of the late majority and 92% (75/81) of the laggards preferred the *yes* option. This indicated that student-teacher interaction was an indispensable element in the online education conducted during the pandemic period.

For the adaptation factor, 94% (32/34) of the innovators, 70% (48/69) of the early adopters, 71% (39/55) of the early majority, 60% (41/68) of the late majority, and 38% (31/81) of the laggards preferred the *yes* option to the question of whether adapting to the new compulsory online teaching situation in the pandemic period. This indicated that the rapid adaptation of the students to the online education process had a positive effect on online courses. The *no* option was chosen by 62% (50/81) laggards stating that students' adaptation process had no positive impact.

Synchronous lessons

The answers given to the question of how much of the academics' lesson time were conducted synchronously during the pandemic process are shown in Figure 7. The *all* option was the most often preferred option in all groups. The incidence of participants who did not have any synchronous lessons was the highest for laggards with 26% (21/81). However, this indicated that the remaining 74% of participants in other adopter categories somehow conducted online courses and 35% of them had all the courses online.

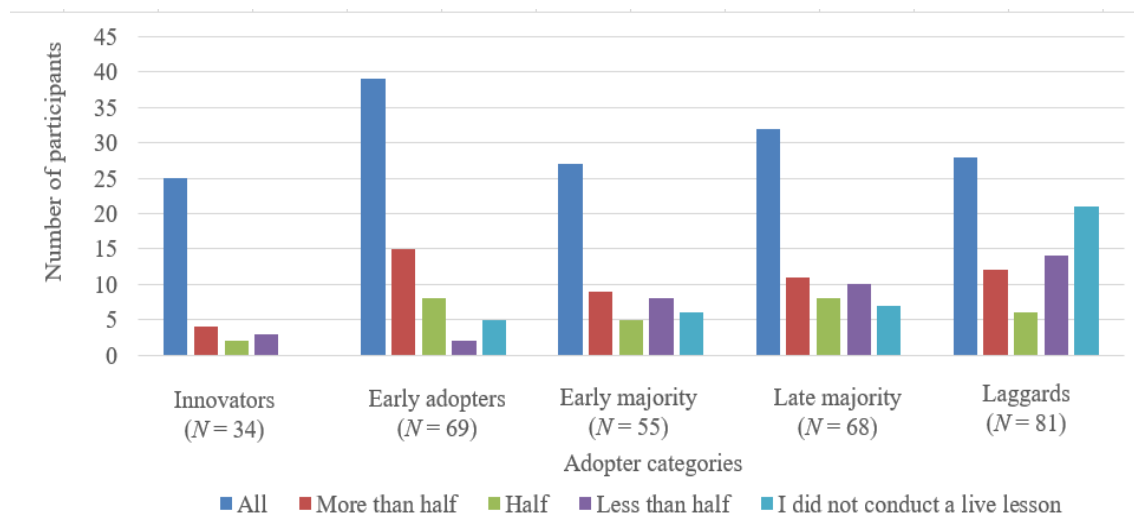


Figure 7. Synchronous lessons

All of the factors affecting the adoption of online learning as an innovation by each adopter group are presented in Figure 8. Factors and prominent evaluations by the majority of the participants in each group were taken into consideration for the figure. Figure 8 illustrates that the majority of innovators and early adopters chose the *very much* option in the support and functionality factors. This showed the importance of technical and pedagogical support in online environments for these groups. In the adaptation factor, the majority of the adopter groups, other than laggards, stated they could adapt to the different education process during the pandemic period. Most of the laggards stated they could not adapt to this situation. With regard to the interaction factor, all the adoption groups expressed the same opinion, which indicated that they all thought interacting with students in online environments was important. In the synchronous lessons factor, most of the innovators and early adopters preferred the *all* option, which showed that more innovators and early adopters carried out all their lessons synchronously compared to the other adopter groups. In the online teaching experiences factor, most of the early majority, late majority, and laggards had not used online teaching environments adequately before.

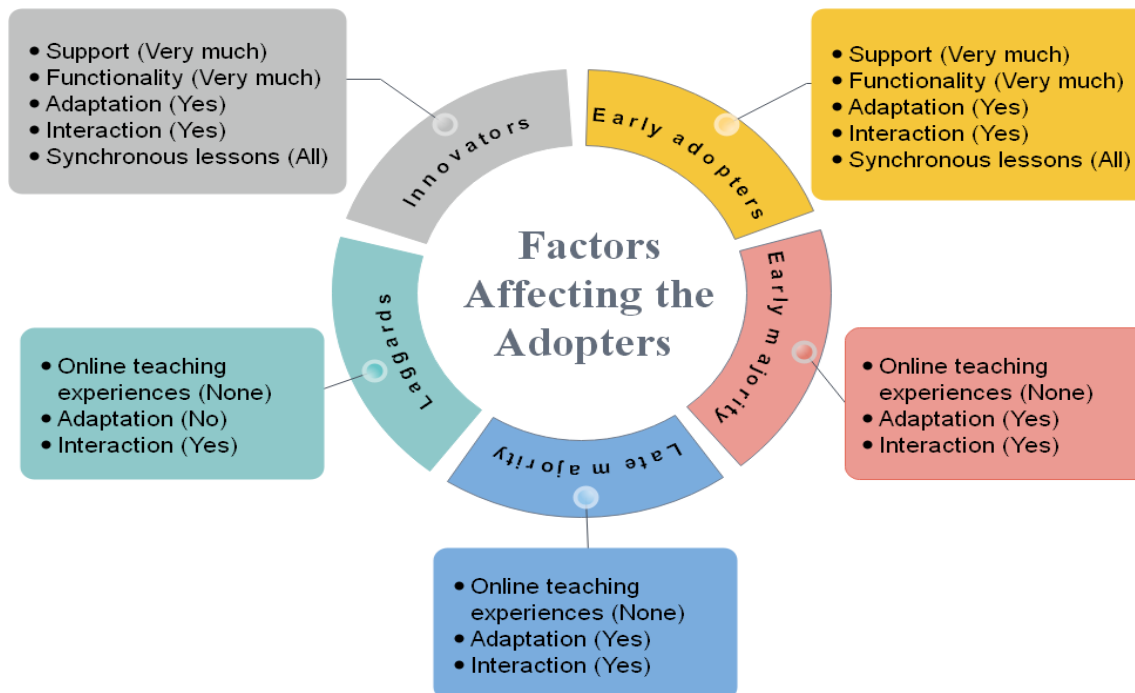


Figure 8. Factors affecting the adopters

Discussion

The compatibility of online learning is positively related to its adoption (Panigrahi et al., 2018). The adoption of an innovation requires administrators to recognise not only different adopter groups but also the impracticality of forcing teachers to adopt a new technology (Goh & Sigala, 2020). With these findings in mind, this study sought to determine the adoption process of the participant adopter groups through the diffusion of innovation framework in the context of the instructional process during the pandemic period.

In this study, the adopter categories of the academics were first assigned based on their answers to the items in the questionnaire. The distribution of the adopters was determined as: innovators 34 (11%), early adopters 69 (23%), early majority 55 (18%), late majority 68 (22%), and laggards 81 (26%). This distribution varied from previous studies by Loogma et al. (2012) who categorised adopters on the basis of their innovativeness on their actual use of ICT tools. Their findings revealed 2.1% more innovators, 3.5% more early adopters, 2.7% more early majority, 10.1% less late majority and 1.7% less laggards than Rogers's (2003) category of adopters. They claimed that the bias towards the earlier adopters might be due to higher levels of teacher competences in the use of e-learning tools. Surprisingly, in this study the distribution was biased towards the earlier adopters and the laggards, not following Rogers's (2003) general pattern of diffusion of innovation. We found, the percentage of the innovators was higher than Rogers' model by 8.5%. This may have been due to the perceptions that it would take less effort to simply resist innovation. Similarly, the percentage of early adopters was higher than Rogers' model by 9.5%. The reason for this may have been the compulsory use of online learning resources and the provision of faculty support in order to support and develop this use. However, in this study, 68 late majority and the laggards (nearly 48% of the whole) showed low adaption to this new situation, which may have been due to the fact that they had to use online learning sources during the pandemic period without having had the time and freedom to realise the opportunities, uses, and benefits of online sources for themselves. This revealed previously held perceptions that innovation and the characteristics of the adopters were strongly associated during the pandemic period. One prominent result was that the total percentage of the early adopters and early majority was 41%, which was close to the total of low level adopters, that is, late majority and laggards combined. In addition, the effects of the ICT tools used in the study of Loogma et al. (2012) on the adoption process were different from the current study, which showed experiences in the pandemic period with synchronous lessons and online platforms. The discrepancy towards innovators might have been due to obligatory use of online tools and having to deal with the difficulties encountered.

Some previous studies considered adoption upon the request of the institution and with a limited number of teachers (Aldunate & Nussbaum, 2013; Ching & Hursh, 2014; Porter & Graham, 2016). However, the obligatory nature of the innovation was unique in this study. Therefore, the positive effect of the interaction among the teachers resulting from this obligation was also remarkable. Thus, the strength of the effect of interactions in this study was stronger than those of the above mentioned studies possibly because there was unavoidable interaction of the participants. However, not all adopters, for examples the laggards in this study, were good at adopting the innovation, which may have been due to their limited previous exposures to online learning tools. Previous experiences, though limited in number, were also influential on the adoption of the innovators and early adopter groups. The findings of this study were similar to Lie et al. (2020) who explored 18 language teachers' online engagement during the Covid-19 pandemic in Indonesia and found that they had learnt the use of ICT for teaching during their formal college education. This led to their willingness in their active role in online learning engagement. In our study, experienced academics in online learning were mostly seen in the categories of the innovators and early adopters but those with limited online experiences were in the early majority, late majority and laggards.

Considering the participants' comfort level with the new technology (Bennett & Bennett, 2003), one major factor in the current study was also the limited time for preparation for online teaching. In the context of an obligatory situation and a whole of organisational effort to deliver the course content, our analysis produced qualitative results in the form of the themes, support, functionality, guidance, online teaching experiences, adaptation, interaction, and synchronous lessons. The opinions of the adopter groups regarding the support, functionality and guidance factors revealed that providing technical and pedagogical support during online teaching led them to adapt to the new situation.

In this study, academics in each group may have needed support for the online tools. Although teachers may have had experiences with other video conferencing programs, they might have been unfamiliar with the synchronous video conference program that the university preferred. As a result, the adopters in various groups may have needed support in terms of understanding the features of learning management systems used by different institutions and using the interaction and presentation related properties of the synchronous lessons and developing special content. It is remarkable that this support was perceived as not about the functionalities of the tools, but implied the need for pedagogical support. Providing guidance to teachers with guidelines and sample practices regarding the online training process were welcomed by all the groups in our study. This may have been due to the positive contributions of academics' previous experiences with new technologies during online teaching and their ability to use different pedagogical strategies through these technologies. Similar findings were documented by Dhawan (2020) who found that teachers' experiences can be changed by providing some teaching strategies (e.g., lectures, case-study, debates, discussions, experiential learning, brainstorming sessions, games, drills).

In the online teaching experiences factor, the innovator group were seen as relatively more familiar with technological integration compared to the other groups. Therefore, it was expected that they had carried out lessons using online tools in virtual classrooms and produced content, or used web 2.0 tools, for evaluation even before the pandemic. Similarly, Bennett and Bennett (2003) reported that the factors affecting adoption of a new technology are mostly related to the relative advantages of that technology and that the technology can enhance teaching and learning processes. Lie et al. (2020) also addressed the importance of experience in online learning by documenting the teachers' inadequate adoption in terms of technology during the Covid-19 epidemic.

The interaction factor, among all categories, had the highest preference by the adopter groups, which revealed that the student-teacher interaction was a key element in online education for the participants. Similar to the findings of this study, Gao (2003) pointed out that a quality learning process cannot be achieved in online learning environments without the key element of interaction.

In the adaptation factor, most of the adoption groups except laggards agreed with the idea that students' adaptation to the online environment contributed positively to the adaptation of academics, which was somewhat related to the experiences of online learning. Schmidt et al. (2013) stated that the more experienced teachers are in online environments, the better they can focus on individual student needs in a course. Similarly, in this study, laggards' lack of previous online teaching experiences impacted their preferences in the adaptation factor. Zamorshchikova et al. (2011) reported that even if the instruction is performed online, teachers can have difficulties in planning lessons and using synchronous online tools. In

this study, the reason for laggards agreeing to the relevant items less frequently than other groups may have been technical difficulties they faced in the processes of planning and use.

Different rates of synchronous lessons among the adoption groups were revealed in this study, which may have been due to each university making different decisions regarding the conduct of the courses during the pandemic. While some universities left this decision to the teachers, other universities used a blended method, in which synchronous and asynchronous courses are conducted together. This may have been the reason why *all* option was so frequent among the answers given to the items in this category.

Overall, it was seen that the curve shape of the adopter groups in this study was different from Roger's typical adopter categories. Rogers's (2003) s-shaped curve, from a study of only few lecturers' adopting a new idea, showed an adoption curve increasing sharply to a maximum until half of the staff in the university had adopted the innovation, and the curve then started to decrease. This illustration of when this critical mass stage is not reached, the innovation is considered as not adopted, and the change has not taken place (Rogers, 2003, p. 343). The critical mass in this study was reached within the early adopters category, resulting in the decrease in the early majority group. We believe that this finding revealed the quick adoption of online learning as an innovation in the pandemic period by the adopters with previous online experiences, while those lacking of online experiences fell behind in the adaptation factor.

This study has limitations. First of all, 307 academics working at different universities in all the regions of Turkey participated in the study. For more generalisation, future studies with international populations are warranted. The participants were chosen purposefully from different universities, which enabled us to obtain data from universities with different perspectives on online teaching to be included in the study.

Consequently, the contribution of this study to online learning through the lens of diffusion of innovation is two-fold. First, the major factors affecting the online teaching in the Covid-19 pandemic were determined. Second, the quantity of adopters in the different adopter categories was addressed. The results suggested that the academics in various adopter groups adopted the new instructional process in the pandemic period somewhat differently than the typical levels of Rogers' (2003) model of diffusion of innovations. The prominent factors influencing this adoption process were external, such as support and interaction, and internal, such as synchronous lessons, adaptation, and previous experience.

Implications and conclusion

This study aimed to examine the change in academics' adoption of an imperative innovation resulting from the pandemic situation, using the diffusion of innovation theory as the theoretical lens. The results showed that it is challenging for teachers to be prepared for unexpected teaching situations. Accordingly, in such situations, appropriate technique and learning support should be provided to teachers, along with organisational support for quality outcomes. It is also recommended that target academics who have positive beliefs and attitudes toward using online technologies as champions of the desired innovation will demonstrate stronger intentions for online teaching. Innovators and early adopters can act as leaders to diffuse online learning in this kind of unexpected situation. Some training sessions preferably for laggards can also be implemented. In addition, upgrading online technologies at universities is crucial for adopting online learning.

In the diffusion of innovation research, the model is generally used to guide the process and to explain the results. However, in this study, we considered the adopter groups at the beginning by considering teachers' previous online teaching experiences. The results provided indicators to use diffusion of innovation for explaining the behaviors or evaluations of the adopter groups. In further studies, the evaluations of the users following the online learning process could be obtained and the status of the adoption of an innovation in that timeframe could be determined. The categories and results determined in this study can be a guide for all educational institutions, especially academics and universities, in order to more easily and quickly adopt technologies that can be used in the educational environment in situations such as future pandemics or wars.

The data collection tool used in this research was developed in order to determine the adoption of academics in cases where online environments were considered as an innovation. This tool was developed by examining similar questionnaires in the literature and taking into account the incidence of such emergencies as a pandemic. For this reason, it is thought that the data obtained in this study can reflect the differences

in teacher views during non-emergency times. To conclude, we hope this study assists teachers who desire to provide better online learning experiences in various designs and implementations at their universities.

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Appendix A Survey

Section 1: Demographics

Section 2:

- How would you describe your frequency of using online tools for lessons prior to the pandemic?
- How much of your lesson time have you conducted synchronously or asynchronously?

Section 3:

Which of the following best describes your overall approach to new technologies?

- I use many technological innovations constantly. I start using them before anyone else, sometimes even before these technologies are available to the public
- I constantly follow new technological developments and use the best ones. Generally, I think I am one of the first to use innovations, and those around me use them upon my recommendations.
- I expect the technology to be clearly demonstrated and recommended by those around me before I use it.
- I do not think I am one of the first to use technological innovations, but I can say that I use them before a significant number of users.
- I am not exactly against new technologies. I use these technologies with caution and when I really need to use them.
- I am aware that my colleagues value new technologies, but I insist on using traditional resources. Even if I have to use technology, I continue to use my available resources.

Section 4:

Identify factors that influence adoption decision and the extent of influence Please indicate the level of influence each of the following would have on your decision to place a portion of your course online (e.g., quizzes, exams, discussions, lectures, learning resources): [The option is to select Very much/Much/Somewhat/Little/None for each].

- Whether faculty, departments, or the institution make policy decisions regarding online course materials (e.g., intellectual property rights)
- The ability to quickly upload and download media/materials on campus
- Whether your university identifies policies and guidelines regarding placing course materials online (e.g., administrators publishing examples of different ways to appropriately combine face-to-face and online instruction)
- Whether institutional administrators encourage placing a portion of your course online
- Whether the institution's reason for promoting technology integration aligns with your own
- The availability of technical support for those placing the whole lesson online
- The availability of pedagogical support for those placing the whole lesson online
- The availability of evaluation data on the effectiveness of placing the whole lesson online
- Whether other faculty members share their success with placing the whole lesson online

Section 5:

- It is important to use online tools in order to maintain interaction with students during the pandemic process. Yes/No
- It is important that students attend online classes asynchronously whenever they wish. Yes/No
- Have you been able to adapt to the online classes during the pandemic process? Yes/No