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# The Relationships among TPACK, the TAM and Online Education Satisfaction: Structural Equation Modelling

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## ABSTRACT
Online education faculty satisfaction plays an important role in online education achievement. However, research investigating faculty satisfaction in online educational setting is rather scarce. This study aims to provide deeper insight into the issue by examining structural relationships among Technological Pedagogical Content Knowledge (TPACK) and faculty satisfaction within the framework of the Technology Acceptance Model (TAM). The study is quantitative in nature, and the data were collected from 170 faculty members during the emergent online education on lockdown due to COVID-19 pandemic. The analysis revealed that TPACK variable explains 23% of the TAM ($\beta$ =.48, p<.01) and the TAM variable explains 50% of the satisfaction ($\beta$ =.71, p<.01), which means when teachers with high levels of TPACK have higher levels of TAM, the result could be significantly increased online education satisfaction. The researchers suggest some implications to improve learning and teaching with technology and to increase the faculty satisfaction in the context online language education.

**Keywords:**TAM, TPACK, online education satisfaction, teaching online, COVID-19

## INTRODUCTION
Technology has started to occupy a greater place in educational settings thanks to the technological development, however, the tremendous spread of COVID-19 in the beginning of 2019 has unexpectedly accelerated the process. Schools and colleges, in order to compensate for the face-to-face lessons which were out of question at the time, had to fully shift to online education without prior preparation. Accordingly, the emergent online education has captured researchers' interest and the issue has been investigated from different perspectives.

Due to the outbreak of the pandemic, online education has become a reality in any educational setting, therefore, Technology Acceptance Model (TAM), which explains the acceptance of new technologies has been widely investigated in the related research. Technological Pedagogical Content Knowledge (TPACK), on the other hand, has also gained importance as teachers suddenly had to merge their content knowledge with theirtechnological assets. The overall purpose of the emergent online education was to provide learners with adequate knowledge during the lockdown. TPACK and TAM have been used in studies which confirm a relationship between the two (Jang, Ko, Shin & Han, 2021; Joo, Park & Lim, 2018; Yang, Wang, Wang, Huang & Ma, 2021). Because teachers play an indispensable role in the quality of education, factors related to teachers such as TPACK, TAM and online education satisfaction need to be investigated to be able to understand the relationships among them for enhanced online education outcomes. However, little research has employed TAM, TPACK and online education satisfaction altogether to shed further light on the issue. Therefore, this study serves as an important attempt to contribute to the related research by extending the TAM with faculty members' TPACK and online education satisfaction.

## LITERATURE REVIEW
### Tpack
For effective teaching, teachers need to possess certain knowledge of the content they teach. However, content knowledge on its own might not guarantee the efficiency of the lessons. Shulman (1986) argued that content knowledge is what teachers know inside their heads and they can find the best way to transfer the knowledge to their students only via their pedagogical content knowledge (PCK). The world, then, witnessed an era where technology became an integral part of educational settings. Teachers are now expected to combine their content knowledge with their pedagogical technological knowledge as well. Mishra and Koehler, after years of research, developed Schulman's model to include technology. With the inclusion of technology, they developed the theoretical framework TPACK in 2006 (Koehler & Mishra, 2009). The inclusion of technology, however, does not guarantee efficient teaching as teachers need to pay attention to the interplay between all the basic concepts

including pedagogical, technological, and content knowledge. There needs to be a harmony between these concepts (Archambault & Barnett, 2010).

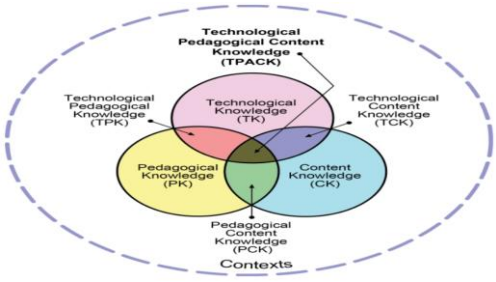


**Figure 1: Schema of Technological Pedagogical Content Knowledge (TPACK) by Koehler & Mishra (2009)**

Studies descriptively investigating TPACK levels among both pre-service and in-service teachers revealed relatively high TPACK levels (e.g., Sarıçoban, Tosuncuoğlu&Kırmızı, 2019; İşler&Yıldırım, 2018). A recent contrastive study by Sulaiman (2021) examined the TPACK of pre-service and in-service teachers. The quantitative analyses showed that both groups had moderate levels of TPACK, however, their scores in all 7 domains were significantly different. Therefore, an appropriate training for pre-service and in-service teachers might help them increase their TPACK levels and thus their ability to efficiently combine their technological, pedagogical, and content knowledge.

The influence of TPACK is also investigated in the studies on technology integration. Raygan and Moradkhani (2020) recently carried out their research with the participation of 209 Iranian EFL teachers. The analyses of the data through structural equitation modelling revealed that TPACK, as well as attitude, are significant predictors of technology integration. Higher levels of TPACK are likely to result in higher levels of satisfaction with the use of technology among teachers. Likewise, the study by Mailizar, Hidayat, and Al-Manthari (2021) also highlights the connection between TPACK and TAM. According to the results, the teachers' acceptance of technology could not be limited to their knowledge of technology as their pedagogical knowledge also has a role in the relationship. A study with parallel results was carried earlier by Joo, Park, and Lim (2018). TPACK was found to be correlated with TAM constructs; however, no connection was discovered between TPACK and intention to use technology.

**Online Education Satisfaction**

Faculty satisfaction has no clear definition in the literature as it is a complex issue, however, it obviously plays an important role in the success of online education (Wasilik&Bolliger, 2009). In this study, 'faculty satisfaction' refers to faculty members' perceptions of how beneficial and effective the ongoing teaching in an online educational setting is (Bolliger&Wasilik, 2009).

One of the few existing studies regarding faculty satisfaction in an online educational context investigated the indicators of faculty satisfaction. McLawhon and Cutright's study (2012) was carried out with the participation of 110 online instructors. The researchers found out a significant difference in faculty satisfaction based on the participants' preferred learning styles. Aural learners, in the study, reported lower levels of satisfaction with online education. The results suggested that certain learning preferences might affect the satisfaction with the technological tools and facilities during the online education process. Instructors, therefore, may need support in differing nature to ensure higher levels of satisfaction.

The study by Wasilik and Bolliger (2009) on the online faculty satisfaction also yielded interesting results. The participants in the study reported moderate satisfaction with online teaching. In addition, approximately 40% of the participants expressed that they are more satisfied with teaching online when compared to other teaching platforms including face-to-face education. This result, like the result of the above-mentioned study, suggests that personal preferences might influence instructors' perceptions regarding the satisfaction they get from various educational settings. Another important result of the study points out that instructors with higher levels of satisfaction are more likely to interact with their students. Therefore, for a healthy teacher-student relationship in online education, faculty satisfaction should be ensured.

Studies in the literature suggest a positive relationship between online education satisfaction and TAM. A recent study by Han and Sa (2021), for example, investigated the online education satisfaction within the framework of TAM. The results pointed those higher levels of TAM had a positive impact on the online education satisfaction and confirmed the results of several previous studies (Ilgaz&Aşkar, 2013; Hammouri& Abu-Shanab, 2018; Joo, So & Kim, 2018).

There is a lack of literature regarding the relationship between teachers' online education satisfaction and TPACK. Of the few studies investigating the relationship between TPACK and online education satisfaction, Ladendorf, Muehsier, Xie, and Hinderliter (2021) found a positive relationship between TPACK scores and

overall teacher satisfaction in online educational setting. The study by Kritz and Shonfeld (2018), on the other hand, examined the satisfaction in online courses from students' perspective and concluded that teachers' TPACK levels are correlated with learners' online education satisfaction.

**Theoretical Framework**

TAM stands for technology acceptance model and was developed by Davis (1989) building upon the theories of Schultz and Slevin (1975). Perceived usefulness (PU) and perceived ease of use (PEoU) as well as attitude towards using and intention to use were the main constructs in the original form of the TAM. The two important constructs in the TAM, PU and PEoU are respectively related to individuals' perceptions regarding the degree to which they can benefit from the given technology and the level of ease of use (Surendran, 2012).

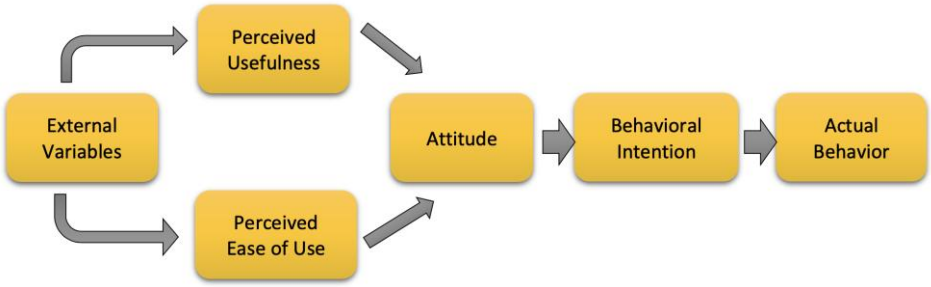


**Figure 2: Original TAM model by Davis (1989)**

The TAM is widely used in the literature since it is specifically designed to measure user acceptance regarding technologies (e.g., de Oliveira Neto, Law & Kang, 2023; Ibrahim, Sheng & Yan, 2022; AlDakhil&AlFadda, 2022). It is also popular for being highly validated and is supported by a large amount of empirical data (Yousafzai, Foxall& Pallister, 2007). Therefore, this study benefitted from the TAM to explain the structural relationships between the TPACK, online education satisfaction, and the TAM. For the purpose of the study, the following hypotheses were formulated for the research questions:

RQ1: What is the relationship between faculty members' TPACK and online education satisfaction?

H1. TPACK is correlated with online education satisfaction.

RQ2: What is the relationship between faculty members' TAM and online education satisfaction?

H2. TAM (PU and PEoU) is correlated with online education satisfaction.

RQ3: Does faculty members' TAM (PU and PEoU) play a mediating role in the relationship between TPACK and online education satisfaction?

H3. TAM (PU and PEoU) plays a mediating role in the relationship between TPACK and online education satisfaction.

Based on the research questions and hypotheses, the following model is proposed:

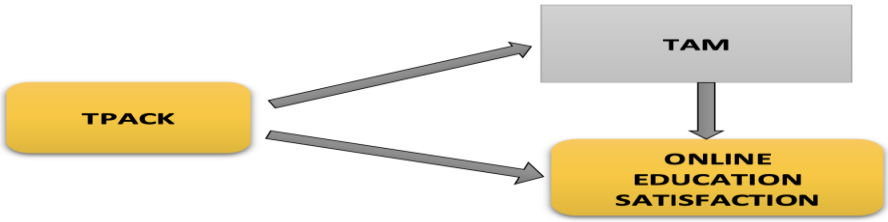


**Figure3:The proposed model**

**METHOD**

**Participants**

The participants were faculty members teaching EFL courses around the country. The form prepared to gather the data were sent to the faculty members via e-mail which included a Google Forms link to the questionnaire. Since the data collection procedure took place in the middle of the COVID-19 pandemic, face-to-face data collection was out of question. The data were obtained during the time when all the participants had to teach their lessons online. Emailing process took approximately one month. Of the 2000 faculty members who were emailed, a number of 170 returned the e-mails and filled in the form. A majority of the participants (66,8%) were female, and %72,4 of the participants taught English for 11-20+ years.

**Instruments**

In this study, to measure the online education satisfaction, Online Faculty Satisfaction Survey (Bolliger&Wassilik, 2008) was used. The survey consisted of 28 likert-type items and included 3 sub-scales: student-related, instructor related, and institutional related issues. The Cronbach-alpha value for the survey was measured to be 0.85, which means the scale is reliable.

TPACK scale used in this study included 5 items and was adapted from its original form (Bostancıoğlu& Handley, 2018) to only include the items that are directly related to TPACK (Liu, 2019). The scale was measured to be internally consistent ($\alpha$ =0.85).

The TAM survey included 9 items, and 2 sub-scales: PU and PEoU. The scale was based on the original TAM provided by Davis (1989) and was adapted to fit the context of online education (Gibson, Harris &Collaric, 2008). Internal consistency was measured as $\alpha$ = .594 for PU and $\alpha$ = .859 for PEoU.

**Procedure and Analysis**

Data collection process of the study was conducted as online by Google Forms and was completed in approximately 30 days. The data were analyzed in IBM SPSS20. Before the analysis, Mahalanobis and Skewness-Kurtosis extreme value analysis, normality and homogeneity analyzes were employed to determine whether the data set met the prerequisites for parametric analyses. Accordingly, the data of 5 participants including extreme values were excluded from the data set. In the next phase, univariate and multivariate analysis of normality was analyzed with Kolmogorov-Smirnov tests. Confirmatory measurement model analysis, which is the prerequisite analysis of structural equation modeling, was conducted for the data set determined to meet the parametric conditions. In the confirmatory measurement model, three different latent variables, namely TPACK, distance education satisfaction and TAM, and 10 different indicator variables represented by these latent variables were included in the model. Fit indices of the measurement model ($\chi$2/sd=2.47; REMSEA: .067, RMR: .058, SRMR: .067, NFI: .956 CFI: .98, GFI: .94) show that the constructed model was verified and that all implicit variables have a fit well with the indicator variables they represent and other latent variables (Tabachnick&Fidell, 2013). After the verification of the measurement model, the models designed in line with the purpose of the research were tested. In this research process, the mediating role of the TAM between TPACK and online education satisfaction variables in EFL instructors was examined. In testing the intermediary models, a four-step process was carried out as suggested by Baron and Kenny (1986). Examining the findings related to the structural equation modeling given in Figure 1, correspondingly, it can be seen that the 4-step process suggested by Baron and Kenny (1986) are implemented : 1. independent variable should be associated with the dependent variable; 2. independent variable should be associated with the mediating variable; 3. the mediating variable should be associated with the dependent variable; and 4. if the effect of the mediating variable on the dependent variable is controlled, there should a be a significant decrease in the relationship between independent and dependent variables.

For the purpose of the research, the models given below were tested respectively:

In Model 1, the predictive relationships between TPACK and online education satisfaction were examined.

In Model 2, the TAM variable was included in the model that deals with the predictive relationship between TPACK and online education satisfaction, and the change in the correlation coefficients between the variables was examined.

In Model 3, it was examined whether the TAM variable had a complete mediating role in the predictive relationship between TPACK and online education satisfaction.

**FINDINGS**

In this study, the mediating role of the TAM between TPACK and online education satisfaction variables of EFL instructors was examined. Accordingly, three different models designed to analyze whether the TAM has a mediating role were analyzed separately and the findings are presented in Figure 3.

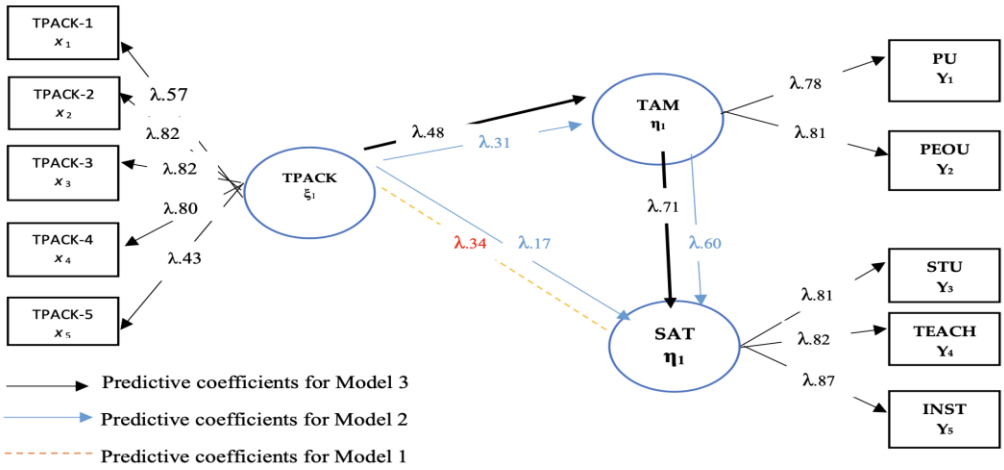


**Figure 3:Structural equation modelling and mediation relations**

When the predictive coefficients given in Figure 1 are examined, it can be said that the predictive coefficients between the independent variable TPACK and online education satisfaction variables in Model 1 were significant (β=.34, p<.01) and Model 1 was verified (χ2 /sd=2.94); CFI=.96; TLI=.94; RMSEA=.068; GFI:.95).The findings regarding Model 1 show that the first procedure suggested by Baron and Kenny (1986) is performed. After performing the first step of the mediation analysis, the structural equation model defined as Model 2 in which the mediator variable was included, was tested. When the mediator variable is included in the model in the mediation analysis, it is expected that there will be a significant decrease in the predictive coefficients between the independent and dependent variables in Model 1 or that the correlation coefficient becomes insignificant. When the predictive coefficients for Model 2 are examined in Figure 1, it can be seen that there is a significant decrease in the prediction coefficients between TPACK and online education satisfaction variables compared to Model 1 after the inclusion of the TAM as a mediator variable (β =.17, p<.01) and thereby, the constructed model indicates a good level of fit (χ2 /sd=2.77; CFI=.95; TLI=.93; RMSEA=.072; GFI:.95). Based on this finding in Model 2, it can be interpreted that the TAM may have a significant mediating role between these two variables. In addition, Model 3 which deals with the complete mediating role of the TAM variable was tested. The results given in Figure 1 show that the TPACK variable explains 23% of the TAM (β =.48, p<.01) and the TAM variable explains 50% of the online education satisfaction (β =.71, p<.01). These values given in Figure 1 show that the TAM has a significant mediating role in the relationship between TPACK and online education satisfaction of ELT faculty members (χ2 /sd=2.14; CFI=.97; TLI=.97; RMSEA=.062; GFI:.96). Examining the model fit indices of Model 3, it is seen that the fit index values are at a better level compared to Model 1 and Model 2, suggesting that if the TAM perceptions of ELT instructors with high TPACK are also high, their online education satisfaction will be significantly higher. Otherwise, even if the TPACK of ELT instructors is high, online education satisfaction is expected to be low or limited if their TAM is rather low.

**DISCUSSIONS and CONCLUSION**

This study examined the structural relationships between TPACK, TAM and online education satisfaction of Turkish EFL instructors. Particularly, the researchers tried to explore the mediating role of the TAM between TPACK and online education satisfaction variables designing three different models. The results of the study indicated that all proposed hypotheses were supported. While Model 1 showed the predictive relationship between TPACK and online education satisfaction, Model 2 indicated that TAM may have a significant mediating role between TPACK and online education satisfaction components. Compared to Model 1 and Model 2, however, Model 3 confirmed a strong relationship between faculty members' TPACK and online education satisfaction, especially in the presence of TAM. In other words, the provided model showed complete mediating role of TAM in the relationship between TPACK and online education satisfaction of EFL faculty members.

Although previous studies have not examined the relationship and role between these three available variables, there are limited number of studies interchangeably conducted with either of these variables accompanying various components. Thus, the present study builds on the previous research on the relationship between TPACK and TAM (Mailizar, Hidayat& Al-Manthari, 2021; Joo, Park & Lim, 2018; Raygan&Moradkhani, 2020), TPACK and satisfaction (Ladendorf, Muehsier, Xie &Hinderliter, 2021; Raygan&Moradkhani, 2020) as well as TAM and satisfaction in online education (Al-Azawei& Lundqvist, 2015; Al-hawari&Mouakket, 2010; Joo, So & Kim, 2018; Salimon, Sanuri, Aliyu, Perumal &Yusr, 2021) by examining the structural relationships of the above-mentioned variables. Few of these studies, however, were employed with teachers/

instructors(Ladendorf, Muehsier, Xie &Hinderliter, 2021; Mailizar, Hidayat& Al-Manthari, 2021; Raygan&Moradkhani, 2020; YildizDurak, 2019).

This study showed the significant mediating role of TAM in the relationships between TPACK and online education satisfaction while previous research showed the significant role of TPACK in teachers' TAM, particularly their behavioral intention to use technology in the classroom (Yildiz-Durak, 2019). Moreover, Mailizar, Hidayat and Al-Manthari (2021) supported this role of TPACK on teachers' online teacher professional development (OTPD)containing TAM. Additionally, the current study suggesting that if the TAM of EFL instructors with higher TPACK is also higher, their satisfactions with online education will be also higher both supported and extended the findings of the studies by Ladendorf et al., (2021) and Raygan and Moradkhani (2020). Correspondingly, it was found a significant relationship between the integration of technology in language education and TPACK proficiency of language teachers(Bostancıoğlu& Handley; Paneru, 2018).

As previously mentioned, there was a lack of studies investigating the structural relationship between TPACK, TAM and online education satisfaction of EFL faculty members. Therefore, this studyconducted at a time of COVID-19 crisis, when university education as well as primary and secondary education was firstly compelled to continue teaching completely online without any direct contact between student-instructormay be the first study which examined the mediating role of TAM in the relationship between TPACK and online education satisfaction in EFL context. Hence, this study suggests that TAM is not only significant predictor of EFL instructors' TPACK for the teaching process but also it is a well-grounded framework to examine online education satisfaction of instructors. Moreover, technological knowledge has a critical role in instructors'TPACK since for increased satisfaction, simply working on TPACK would be insufficient without improving faculty members' TAM.

The findings of the study suggest some important implications for both policy makers and higher education institutions to improve learning and teaching with technology and to increase the faculty satisfaction in the context online language education. Adoption and acceptance of educational technology has become pivotal especially with the COVID-19 pandemic.Therefore, higher education institutions should allocate time and make efforts for the technology integration and acceptance that will support their members for professional development. They should conduct various programs informing faculty members about new technologies and including how to integrate technological tools or applications in language teaching in higher education level and in the first years of the professional life. In addition, technological and academicinfrastructure should be revised and supported to encourage instructors to use and improve knowledge and skills by providing effective learning environmentand to support educational institutions to enhance the TPACK proficiency.Moreover, memberships to different platforms where instructors can follow the developments of educational technologies and innovations should be provided. Finally, the applied workshops and teamwork should also be conducted so as to help faculty members improve their technological and pedagogical knowledge 'until reaching the knowledge of technological pedagogical content" (TPACK), and continuous teacher professional development (TPD)' (as cited in Abilleira et al., 2021, p. 9). The teachers' acceptance of technology should not be limited to their knowledge of technology as their pedagogical knowledge also has a role in the relationship.

This study is not without limitations. Firstly, the results of the study presented useful information in understanding the relationshipsamong TAM, TPACK and online education satisfaction in EFL context and they may be starting point to test those relationships in other context, but these results are out of question to globally generalize to all EFL teaching contexts since the sample consisted of only Turkish EFL faculty members. For more comprehensive depiction, studies with participants from different countries and fields can be carried out. Additionally, the researchers focused on examining the relationships among TAM, TPACK and online education satisfaction of instructors only. Accordingly, the relationship among these variables can be investigated in order to make comparisons in terms of both instructors and students.Also, this study aimed to examine only relationship with certain variables thus, further studies could also specify cause-effect relationships. Moreover, other methodologies can be triangulated to also provide a qualitative perspective of the related components using interviews, discussion groups and observations allowing a deeper understanding as well as interventional studies. Likewise, there is a need to examinemore about information and communication technologies (ICT) in EFL education related to the various types of higher education (e.g., online teaching/ courses, blended learning,e-learning, distance education,webinars and interactive tutorials, etc.).

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