

# A multidimensional model of Google Classroom usability in use during the Covid19 pandemic

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## ABSTRACT

The pandemic generated by the coronavirus COVID19 changed people's lives and had major consequences on education. Because of lockdown restrictions, the online teaching and learning platform became the educational working space for teachers and students and usability has increased in importance. The objective of this research is to develop and test a multidimensional model of usability in use as perceived by university students using the Google Classroom platform. The multidimensional model has three dimensions: effectiveness in use, efficiency in use, and satisfaction in use. The results show that satisfaction in use is the most important dimension.

## Keywords

Online learning, pandemic, COVID19, Google Classroom, quality in use, satisfaction.

## ACM Classification

D.2.2: Design tools and techniques. H5.2 User interfaces.

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## INTRODUCTION

The pandemic generated by the coronavirus COVID19 changed people's lives and had major consequences on education. Lockdown restrictions determined a shift from face-to-face education to distance education. After more than two years, extant literature shows a mix of positive and negative feelings experienced by Romanian university students, from comfort, safety, time, and money savings [15, 18] to lack of motivation, boredom, stress, and fatigue [3, 8, 18].

Online education challenged universities to ensure teaching and learning platforms. This changed the way teachers and students work. Although most universities already had an LMS (learning management system), this has been mainly used for the distribution of additional learning content and assignments. The shift to exclusive online education makes the online platform the main working space for teachers and students and brings in front usability, quality in use, and technology acceptance issues.

In the ISO 25010 [11] standard, quality in use has three components: usability in use, flexibility in use, and safety. Usability in use has been defined through effectiveness in

use, efficiency in use, satisfaction in use, and usability in-use compliance.

Google Classroom is an educational platform widely used in universities. Classes that are specified for specific disciplines include students, professors, assignments, learning materials, and a timeline that summarizes the resources, announcements, and other messages. Interactions are live or via announcements, comments on posts/assignments, or even using the integrated Gmail. The live interaction used for classes and laboratories can be made using google meet which is a service associated with google classroom and allows live presentations and screen sharing. Extant literature shows that Google Classroom proved to be an effective educational technology during the pandemic [1, 2, 5, 19]

The purpose of this research was to develop and test a multidimensional model of usability in use. The model has been tested on a sample of 155 university students using the Google Classroom platform. The model is featuring three dimensions: effectiveness in use, efficiency in use, and satisfaction in use. The next section presents the theoretical background and conceptualization. Then the model testing results are presented and discussed.

## BACKGROUND AND CONCEPTUALIZATION

### Related work

Albashtawi & Al Bataineh [1] analyzed the perceived effectiveness of using Google Classroom by Jordanian students. They found that after using Google Classroom students' reading and writing performance in the English language increased. Another finding was the positive attitude as regards the perceived usefulness, ease of use, and ease of access.

Gupta & Pathania [9] presented a study that aimed to assess the impact of the Google Classroom Platform at the teacher education level. In their study, they used the Web-Based Learning Environment Inventory and Google Classroom Evaluation Survey. They found it to be an effective medium of learning and students felt that learning through Google classroom was not boring and it was not a waste of time.

Pal & Patra [17] tested a technology acceptance model (TAM) featuring the task-technology fit model (TTF) as an antecedent of the perceived ease of use and perceived usefulness. The proposed task-technology fit construct has two antecedents: technology characteristics and individual

characteristics. Their results showed a higher influence of TTF on perceived ease of use.

Jakkaew & Hemrungrote [12] used the unified theory of acceptance and use of technology (UTAUT2) model to explore the factors that determine the deployment of Google Classroom in an introductory course to information technology. They found that performance expectancy, effort expectancy, and social influence determine students' behavioral intention; moreover, facilitating conditions and behavioral intentions determine students' use of Google Classroom.

Another relevant paper published by Francom et. al. [7] compared Google classroom with Brightspace using a survey instrument based on the Technology Acceptance Model. Both LMSs were implemented in blended learning situations as a support for online activities that occurred in conjunction with face-to-face course activities. Their findings indicate a general preference for the Brightspace LMS for its productivity tools and attitude toward usage and usability

**Research model**

In Figure 1, the proposed research model of usability in use is presented which has been conceptualized as a global factor having three facets: effectiveness in use, efficiency in use, and satisfaction in use.

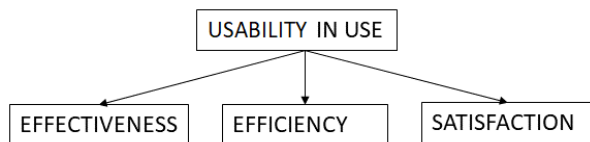


Figure 1. The research model

The effectiveness (EFN) is related to the completeness and accuracy with which university students are achieving their learning goals. Efficiency (EFC) refers to the effort and time needed to perform learning tasks. Satisfaction (SAT) refers to the degree of accomplishment of learning tasks and the results obtained. The operationalization of usability in use facets is adapted from the definitions of effectiveness, efficiency, and satisfaction in the ISO standard [11].

The operationalization of the latent variables is presented in Table 1.

Table 1. Variables used in the study

Item	Statement
EFN1	Using Google Classroom I can complete my learning tasks
EFN2	Using Google Classroom I can accurately complete my work
EFC1	I am able to complete my work quickly using Google Classroom
EFC2	I am able to efficiently complete my work using Google Classroom
EFC3	Using the online learning platform I can easier complete my work
SAT1	I am satisfied with the perceived achievement of my learning goals
SAT2	I am satisfied with the results I got using the online learning platform

**EMPIRICAL STUDY**

**Method and sample**

Following the recommendations from the literature [4, 13], the empirical validation has been done in a two-step approach: testing the inter-correlated first-order factors model and then the second-order factor model.

The model was analyzed with Lisrel 9.3 for Windows [16], using the maximum likelihood estimation method. The analysis has been done in a two-step approach: testing the measurement model (relationships between construct and indicators) for construct validity and then the structural model (relationships between constructs) for model fit and hypotheses checking.

The following criteria have been used to assess the validity of the measurement model [6, 10]: unidimensionality of factors, scale reliability by examining the convergent validity through composite reliability (CR) and average variance extracted (AVE), discriminant validity through comparison of the square root of AVE and the correlations between constructs, and fit of the model with the data.

Based on the recommendations from the literature [6], the following goodness-of-fit indices were used to assess the model fit: chi-square ( $\chi^2$ ), normed chi-square ( $\chi^2/df$ ), comparative fit index (CFI), goodness-of-fit index (GFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA).

Google Classroom launched in august 2014 and became widely used at the University of Craiova in 2020, once with the pandemic lockdown. The study is relevant for this specific situation in which students had at least a full year of study using the platform and part of them had also a semester of face-to-face education.

A questionnaire has been administrated in the first and second semesters of the year 2021/2022 to students from the University of Craiova. Students have been asked to answer some general questions such as demographics (age, gender) and enrollment (university, faculty, year of study), then to evaluate items on a 5-points Likert scale.

The students who attended the questionnaire were enrolled at the Faculty of Automation, Computers, and Electronics attending computers in Romanian and English language. The group was composed of students enrolled in the second and third years of Bachelor's studies as well as in Master's studies.

We need to mention that the students from the second year of study have attended only online studies using google classroom and the ones from the third year of study attended only one semester of face-to-face education.

A total of 168 questionnaires have been received out of which 13 have been eliminated for incomplete data thus resulting in a working sample of 155 observations (110 male students and 45 female students).

**3-factor model**

The 3-factor model testing indicated a good fit with the data:  $\chi^2=23.46$ ,  $DF=11$ ,  $p=0.01$ ,  $\chi^2/DF=2.133$ ,  $CFI=0.989$ ,  $GFI=0.961$ ,  $SRMR= 0.0185$ ,  $RMSEA=0.085$ .

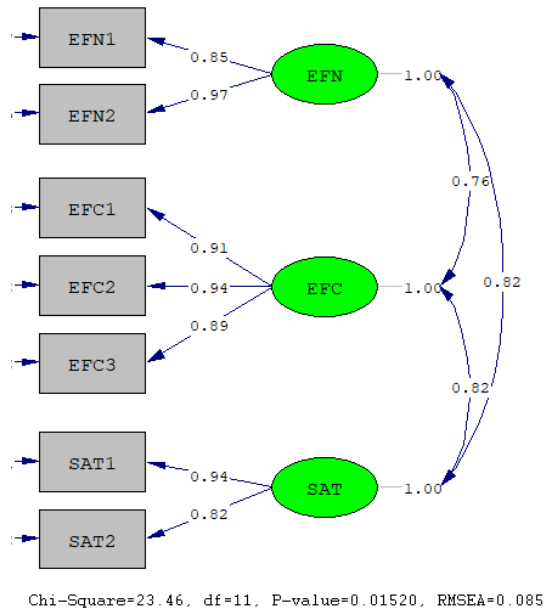


Figure 2. Three-factor model (N=155)

The descriptive statistics, composite reliability (CR), average variance extracted (AVE), and factor loadings are presented in Table 2. All constructs have a very good convergent validity since CR and AVE are much over the thresholds of 0.7 and 0.5 [10].

Table 2. Descriptives, convergent validity, and factor loadings (N=155)

Factor	CR	AVE	Item	M	SD	Loadings
EFN	0.908	0.832	EFN1	4.25	1.08	0.85
			EFN2	4.14	1.11	0.97
EFC	0.938	0.835	EFC1	3.77	1.19	0.91
			EFC2	3.90	1.19	0.94
			EFC3	3.80	1.21	0.89
SAT	0.875	0.778	SAT1	4.21	0.99	0.94
			SAT2	4.25	0.96	0.82

All observed scores are over the neutral value of 3.00, which shows a positive perception of each dimension. Effectiveness and satisfaction items have been scored over 4.00. The highest-rated items refer to completing the learning tasks and achievement of learning goals.

Based on the recommendations of Fornel and Larker [6], the discriminant validity has been assessed by comparing the correlations between constructs with the square root of AVE, in Table 3. Since the square root of AVE is greater than inter-factor correlations the discriminant validity is good.

Table 3 Discriminant validity (N=155)

	QC	QE	SAT
QC	<b>0.912</b>		
QE	0.765	<b>0.914</b>	
SAT	0.815	0.824	<b>0.882</b>

Note: The bold diagonal numbers represent the square root of AVE

**Second-order factor model**

The second-order factor model estimation results are presented in Figure 3. The goodness of fit indices (GOF) indicate a good fit of the model with the data:  $\chi^2=23.46$ , DF=11,  $p=0.001$ ,  $\chi^2/DF=2.133$ , CFI=0.988, GFI=0.961, SRMR= 0.022, RMSEA=0.085

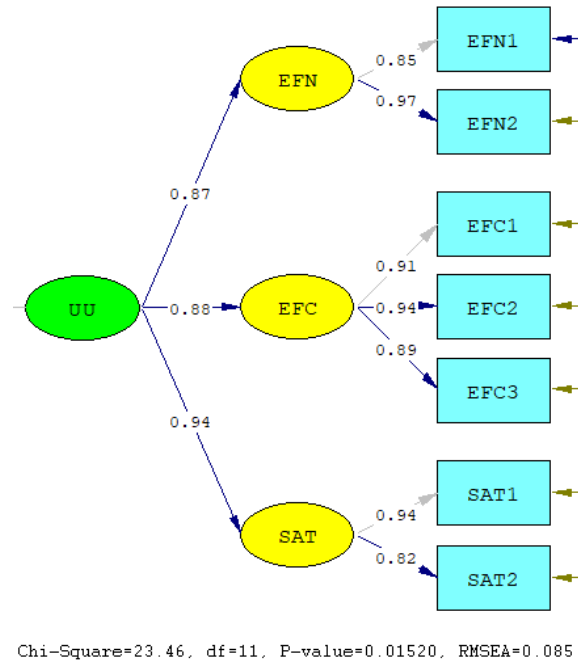


Figure 3. Second-order factor model (N=155)

The model explains 75.7% variance in perceived effectiveness, 77.4% in perceived efficacy, and 87.9% in perceived satisfaction.

**Discussion**

This study contributes with an empirically validated model measuring the usability in use of the Google Classroom platform. Usability in use has been conceptualized as a second-order factor that manifests on three dimensions: effectiveness, efficiency, and satisfaction.

The model testing results show that students have a high perception of the usability in use. Students appreciated the effectiveness and were satisfied with the accomplishment of their learning goals. The correlation between satisfaction in use and the other two dimensions is very high.

The results are similar to other studies targeting the effectiveness of Google Classroom and its acceptance by university students during the pandemic [1, 5].

The quality in use perspective enables a complementary view on usability issues by taking a closer look at the effectiveness, efficiency, and satisfaction with which university students are accomplishing their learning goals. As Lew et al. [14] mentioned, quality in use is a key driver for web application evaluation.

This exploratory study has inherent limitations. The sample is relatively small and from only one university. Two

dimensions are measured with only two indicators. Future research will extend the measurement scales.

### CONCLUSION AND FUTURE WORK

Under the restrictions imposed by the pandemic, teaching and learning platforms are the pre-condition for continuity in education which makes usability an important issue. This work brings a complementary view by shedding light on the factors that are measuring the usability in use.

There are several research directions for future work. First, the measurement scales will be extended, and the model will be tested again on a larger sample. Second, a study of technology acceptance of Google Classroom will be carried on. A third research direction is a comparative analysis with other platforms (Moodle, Microsoft Teams) as regards the usability in use and technology acceptance.

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