

## Evaluating the effectiveness of factors affecting the development of virtual education in the COVID-19 era based on SCORM model (Case Study: Ferdowsi University of Mashhad)

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### Abstract

*This study evaluates the effectiveness of factors affecting the development of virtual education in the era of COVID-19 based on SCORM model from the viewpoint of students at Ferdowsi University of Mashhad. SCORM includes six dimensions that provide a comprehensive picture of the implementation process of a web-based learning management system. This research is a descriptive survey in terms of practical purpose and in terms of the data collection method. The statistical population of this research includes all postgraduate students in 2019. According to Morgan's table, the sample size is 370 people. The data collection tool is a researcher-made questionnaire, and the validity and reliability of the questionnaire are confirmed. The stratified random sampling method is used to distribute the questionnaires. One-sample t-test and "SPSS" software are used to test the research hypotheses. The results of the research showed that in the era of COVID-19 pandemic, virtual education has been effective and at a higher than average level in all six dimensions of SCORM standard (Accessibility, Consistency, Financial facilities, Durability, ability to run, reusability) and every six hypotheses are confirmed. Based on this, it is concluded that the virtual education programs planned at the Ferdowsi University of Mashhad are on the right path and can be strengthened and developed by receiving periodic feedback. Also, considering the successful performance of virtual education in the pandemic, in the future, this technology can be used as an effective supplement in educational and research activities in the university.*

**Keywords:** Virtual education, Effectiveness, COVID-19 era, SCORM standard

Manuscript was received on 10/03/2022, revised on 11/15/2022 and accepted for publication on 12/11/2022.

### 1. Introduction

In January 2020, the global issue, i.e., Covid-19, spread from Wuhan, China to different countries of the world and became a serious threat to human societies [1]. Due to the high transferability and invisibility of this problem, all activities in different parts of the country, especially universities and educational centers, face a big [2]. Overcoming this challenge which caused the closure of universities and educational institutions, depends on the optimal use of modern educational technologies. Due to the ever-increasing expansion of educational methods and many advances in the field of information and communication technology, electronic education is one of the best strategies in the era of COVID-19 pandemic in the field of education. Various terms such as; Computer-based education, CD-based education, online education, virtual education, web-based education, Internet education and other terms

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are considered to define the set of education provided to the learner through computer, multimedia and Internet agents under the title of virtual learning. Virtual education is one of the new generations of distance education that uses electronic tools to facilitate people's access to education at different times and places. [3]

Some authors like; King et.al., defined e-learning as only learning through the Internet [4]. But it can be said that the word "electronic" includes other technological tools such as computers and CDs in addition to the Internet. Electronic learning (e-learning) is the use of electronic systems such as computers, multimedia disks, websites, electronic publications and virtual newsletters etc. The goals of utilizing e-learning are training more effective and easier, reducing traffic and saving more time and fund [5].

E-learning means using new information and communication technologies to provide education in the digital world and in browser-based systems [6]. The purpose of e-learning in educational centers is to hold, manage and properly organize the education steps, inspect and control the quantity and quality of courses, save time and money, remove time and place limitations, share data, and make the education process student-oriented and reuse educational contents. The Internet can be a very suitable environment for the implementation of the best virtual and electronic education systems in universities and educational centers.

Hence, different universities are able to easily use these technologies in COVID-19 pandemic era. But due to the lack of necessary infrastructure and facilities for designing and implementing a suitable virtual education system, they may face serious challenges at the beginning. If universities are successful in using virtual education correctly and effectively, this strategy can be one of the best educational supplements and academic progress for users and learners. Implementation of e-learning in a non-standard way does not bring comprehensive educational effectiveness, but the effective factors for realizing the effectiveness of e-learning goals should be determined based on a comprehensive and standard model. Achieving important and basic factors in e-learning requires the definition and extraction of e-learning standards. These standards are actually an organized set of rules that make the education infrastructure work in an integrated manner. General standards include Flash, Html, PowerPoint, Pdf and Doc formats. SCORM and AICC are examples of professional content production standards, which are preferred by most content producers.

The most widely used standard for producing educational content and modern and affordable educational software is the SCORM standard, which was developed for e-learning by the ADL group. SCORM stands for "Sharable Content Object Reference Model". It is an innovative standard based on XML, and its main use is to coordinate and organize educational modules that can work together in an educational system. Standardization through SCORM provides a suitable model for e-learning systems. SCORM standard creates the necessary infrastructure for users in a way that each user can create their own models of educational content and systems based on it. One of the reasons for SCORM importance and utilization is that the user can control the educational content and web-based applications. Another reason for using educational standards such as SCORM in e-learning is that it makes education simpler and more specific and creates an attractive environment for educational members, for this reason, specific formats and standards such as SCORM are used to determine these paths. These standards are actually a unified set of rules that make the infrastructure of education work in a unified way everywhere. E-learning standards apply common rules to e-learning technology. The rules specify how to produce the online training course and the training in a way that works in harmony with each other. The rules provide a common language for e-learning courses and learning management systems to share

information or exchange ideas with each other and also allow different e-learning systems to work in an integrated manner [7]. Authors in [8] introduced compliance with standards as a criterion for desirable e-learning programs. In the process of e-learning, standards have been discussed as a very important category for a long time, so institutions such as IEEE, AICC, etc., have made many efforts to standardize the debates in the field of e-learning and education. One of the standards that has received much attention in recent years is the SCORM standard. According to the providers of this standard, the purpose of structure and organization of learning is covered in all SCORM details [9]. SCORM standard is an idea taken from the IMS standard.

SCORM describes a framework in full detail in which educational content, technology, and presenter systems can communicate with each other, making ability of management, running, and reusing [9].

In fact, SCORM is the interface between content and learning management system [10]. The learning content developed in SCORM is a collection that does not exist in any educational management system [11].

Complete comprehension of the factors influencing the effectiveness of e-learning is necessary to avoid mistakes and improve methods. Many researchers consider the necessity of determining and defining the quality standards of e-learning in order to determine the level of effectiveness. The meaning of effectiveness is actually scrutinizing the effectiveness of the measures taken to achieve predetermined goals.

In [10], SCORM is considered due to the ability to display web-based content. SCORM includes sections that provide a comprehensive picture of the implementation process of the web-based learning management system. In fact, SCORM is an interface between the content and the learning management system [10].

SCORM is created based on six key criteria as follows.

1- Accessibility: SCORM creates content that is accessible in remote locations. Accessibility is the level and degree of ease of access, something with which you can reach and access a certain level from any path and location.

2- Consistency: SCORM standard has the ability to adapt to the needs of learners. The designed educational structure that specifies different teaching methods and the situations in which these methods are used. Procedures can be divided into simple methods and finally used according to the situation and need. This requires a more accurate analysis of the relationship between educational objects and learning models, routes and prerequisites.

3- Financial Facilities: SCORM model reduces the prices and transfers the learning content in a shorter period of time in order to have economic justification.

4- Durability: Durability means that the educational content does not need to be re-designed and re-programmed. SCORM model can be easily changed with the change of content and methods and can be used for a longer period of time. In other words, we will not have to change the system by changing the content and methods. Learning content needs to be designed, configured, planned and finally evaluated for retention.

5- Ability to run and collaborate: Standard learning content is developed in a situation with a set of tools and can be used at other times with a set of different tools, SCORM fulfills this requirement. This model can be used as a common language to allow collaboration between different types of hardware, operating systems, browsers and educational management systems.

٦ -Reusability: SCORM makes it possible to use a part of educational content in several texts or applications. In other words, it is easy to use the resources prepared in different educational systems for different purposes and courses several times [12].

Therefore, despite the excitement, possibilities and attractions that the utilization of virtual education brings, using it without analyzing whether the held virtual courses have the necessary effectiveness or not may cause the failure of these courses. Considering that measuring the effectiveness of held courses is one of the most necessary things that must be done in any organization, and this need is doubled in the university as an organization that has its own demand for research. Evaluating the effectiveness of university e-learning courses in COVID-19 pandemic based on SCORM model helps decision makers to scientifically identify the factors affecting the effectiveness of virtual education courses and choose appropriate strategies to improve the quality and achieve the goals of e-learning.

Therefore, the main question of the research is to what extent virtual education based on SCORM model has been effective in COVID-19 pandemic from the viewpoint of graduate students at Ferdowsi University of Mashhad?

This review can provide background information necessary to understand the weaknesses and strengths of technology from the users' viewpoint and introduces scientifically and methodically a reliable foundation for planning and improving the quality of virtual education in accordance with global standards.

## 2. Background research

In this part of the study, the results of domestic and international researches that have been done in relation to the subject of this research is mentioned. In Iran, from the second half of 2010 onwards, attention was paid to virtual education in various universities to provide educational courses [13]. The results of some domestic and international researches that have been conducted in relation to the subject of this research are as follows. Measuring the effectiveness of e-learning, SCORM standard criteria is the most comprehensive model, and many large companies in the world use this model to design and develop virtual education [14] in [15] university of Shiraz virtual education was examined, the criteria of this research are: communication and interaction, flexibility and adaptability, student justification, facilities and technical support, educational support, assessment strategies, feedback, online teaching strategies and guidance. The results of the research showed that the students rated the quality of the criteria of content, flexibility and adaptability, technical support, evaluation strategies and online guidance as unsuitable, and the quality of the communication and interaction, students' justification, educational support, feedback and teaching strategies were evaluated at an average level. In [16] Golzari et al evaluated the quality of electronic education, human factors, infrastructure, support, cultural, legal, economic and political factors, international cooperation, management and leadership. Abdoli and MohammadHasani in [17] found that the most important evaluation components of e-learning include usability, quality of content and information, accessibility, communication, interaction and user interface, management and control capability, technical system and services and support. Wu and Lin concluded that some factors such as human resources, operational capabilities, service process, information requirements, management system, curriculum development, course materials, educational design, educational process, tracking,

educational media, educational support, technology and evaluation play a role in the effectiveness of e-learning [18]. In [19], Masoumi and Fazelian evaluated the technical quality of the electronic content of the virtual university of Shiraz based on SCORM standards. The results showed that, according to the students, the implementation of SCORM standard was evaluated as above average and at a suitable level.

In [20], Agbehi et al evaluated virtual education courses of Khajeh Nasir Tousi University of Technology from the viewpoint of students and professors according to SCORM standard, and the results showed that from the viewpoint of professors and students, the content of virtual education and educational management system is appropriate. In [21], the authors assessed the efficiency of e-learning courses in Tarbiat Modares University from the users' viewpoint, the results of the research statistically indicated that the users of the e-learning system have good access to the system; They benefit from support, tests, evaluations, resources, and appropriate lesson presentation and exercises and assignments, electronic content and user interface are not at a suitable level.

In [22], Kazemi concluded that the quality of the content provided in the e-learning courses. The quality of electronic content from the students' viewpoint of Mashhad University of Medical Sciences is at a desirable level.

Khodabakhshi et al. recognized the quality criteria of electronic education in higher agricultural education in five separate dimensions implementation design, teacher, infrastructure-support and financial, policymaking, and evaluation management [23].

In [24] the authors introduced the effectiveness of electronic education, including educational factors, technology, interface design, management, human and organizational resource support and evaluation.

Chao et al. indicated that factors affecting the success of e-learning include support and financial facilities, organizational resources, course development, teaching and learning, course structure, students, assessment and evaluation [25].]. Ibrahim believes that three factors of management, finance and support, and learning goals should be emphasized in e-learning [26].

According to researches, it can be concluded that using a comprehensive and standard model to measure the performance of e-learning is an inevitable necessity, and on the other hand, the use of a comprehensive standard model will gain the trust of applicants and clients, the satisfaction of industry owners, the possibility of reuse of production content, non-exclusivity of products, the possibility of joint design of resources and materials and other such cases.

Results of domestic and international researches have helped to improve the methods of providing virtual education. Most researches in this field have been carried out without considering a comprehensive and standard model to examine the various aspects of the quality of virtual education. Therefore, in this study, SCORM is used to measure the effectiveness of e-learning. There are few researches that consider all the main dimensions affecting the effectiveness of e-learning. The aim of this research is to introduce the latest

model and implement a coherent framework to meet all-around requirements, reduce anxiety, gain the trust of learners, satisfy administrators and teachers and make content reusable non-exclusive, easily and affordably accessible and collaboratively designed. This study provides more coherent and structured knowledge to those interested in this subject.

### 3. Research method

This is an applied study, and its method is a descriptive survey. Descriptive research can be effective in understanding the current situation and decision-making. The survey method can provide suitable solutions to improve practical solutions, and the questionnaire is the easiest way to obtain these data. In this research, library and internet methods are used to collect secondary information, and a researcher-made questionnaire (based on SCORM scale) is used to collect data and field information. In this research, descriptive statistics indicators are used to describe the questionnaire data. Student's t-test and SPSS statistical software are used to test the research hypotheses. This research started in 2019 and was carried out at Ferdowsi University of Mashhad in 2014.

#### Research questions and hypotheses:

The main question of this research is to what extent the development of virtual education based on the SCORM model has been effective in the COVID-19 pandemic era from the viewpoint of graduate students at the Ferdowsi University of Mashhad. This research includes one main hypothesis and six sub-hypotheses presented in Table 1.

**Table 1 - Research hypotheses**

| Sub-hypotheses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The main hypothesis                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>۱. Virtual education was effective in terms of accessibility.</li> <li>۲. Virtual training was effective in terms of consistency</li> <li>۳. The development of virtual education was effective in terms of financial facilities.</li> <li>۴. Virtual education was effective in terms of durability.</li> <li>۵. Virtual training was effective in terms of implementation ability.</li> <li>۶. Virtual training was effective in terms of reusability.</li> </ol> | <p>Virtual education in the era of COVID-19 pandemic based on the SCORM model was effective from the students' viewpoint.</p> |

#### Statistical population and statistical sample size

Statistical population of this research is all postgraduate students at the Ferdowsi University of Mashhad, with a number of is 9000 in 2019. Since the number of members of this statistical population was limited, the method of calculating the sample size was used in the case of a limited population. The sample size was determined using the following formula

$$n = \frac{N \cdot z_{\frac{\alpha}{2}}^2 \cdot p \cdot q}{e^2 (N - 1) + z_{\frac{\alpha}{2}}^2 \cdot p \cdot q} \approx 370$$

In this formula: N is the size of the population. The population size in this research is 9000 people (total postgraduate students at the Ferdowsi University of Mashhad).

$\alpha$  - is the level of error, which is assumed to be 5% in this research.

P - is the probability of items that answer the questions about the desired variable.

Z - is the probability of standard normal distribution, which is taken according to the error level (5%) from the relevant table, which is calculated as 1.96 in this research.

e - is the acceptable error value in parameter estimation, which is considered 0.07 in this research

According to the calculations, the sample size is 370 people  $n_i = \frac{N_i}{N} . n$ .

### Sampling method:

In this research, a stratified random sampling method was used. In this way, first, the population was divided into different strata according to the types of faculties, and then the questionnaires were distributed randomly among students in 10 faculties (with postgraduate students). In order to distribute the questionnaires according to the simple random stratified sampling method, first, the samples must be allocated to each of the strata (faculties) by using allocation proportional to the size of the different strata. Therefore, the following formula is used  $n_i = \frac{N_i}{N} . n$ : where  $N_i$  the population size of each class, i.e., the number,  $n_i$  is the sample size of the class. Therefore, the sample size estimation table in each of the strata is in the form of Table 2:

**Table 2- Stratified sampling according to size**

| Sample size | Population size | University faculties                 | Row |
|-------------|-----------------|--------------------------------------|-----|
| 43          | 1050            | Literature                           | 1   |
| 17          | 430             | theology                             | 2   |
| 12          | 301             | Physical Education                   | 3   |
| 7           | 140             | veterinary medicine                  | 4   |
| 38          | 947             | Science                              | 5   |
| 25          | 598             | Economic and Administrative sciences | 6   |
| 22          | 520             | Mathematics                          | 7   |
| 33          | 803             | Educational Science                  | 8   |
| 67          | 1627            | agriculture                          | 9   |
| 106         | 2584            | Engineering                          | 10  |
| 370         | 9000            | Total                                |     |

### Variables

In this research, the main variable is the SCORM standard, which includes dimensions, accessibility, consistency, financial facilities, durability, implementation ability, and reusability.

### Validity and reliability of the questionnaire:

Validity means that the content of the questionnaire with its questions accurately measures the variables and the subject under study. In this research, the validity of the questionnaires has been achieved through content. To determine the validity of the questionnaire according to the opinion of professors and experts, Standard SCORM was used, and the validity of the questionnaire was confirmed.

Also, the reliability of the questionnaire interpreted as validity and accuracy, which means that if a measurement criterion used to measure a variable and attribute is applied in similar conditions in another time and place, similar results will be obtained [27].

To test the reliability of the questionnaire, Cronbach's alpha coefficient method was used. According to the calculations done to determine the reliability of the questionnaire, first, through a pre-test, the questionnaires were distributed among a random sample, and then with SPSS, the Cronbach's alpha coefficient of the SCORM questionnaire was calculated and confirmed as 0.92. The questionnaire has six criteria and 42 questions, explained in Table 3.

**Table 3- The six dimensions of SCORM standard and related questions**

| Reusability | ability to perform | Durability | financial facilities | Consistency | accessibility | Dimension         |
|-------------|--------------------|------------|----------------------|-------------|---------------|-------------------|
| 37-42       | 30-36              | 24-29      | 17-23                | 8-16        | 1-7           | Related questions |

Determining the effectiveness criterion (theoretical average)

To determine the effectiveness of virtual education, the average score of the 5-Point Likert Scale was used, and this theoretical average is equal to 3. The difference between theoretical average and operational average indicates the effectiveness level of each of the SCORM standard dimensions.

### Operational definition of questionnaire options

In order to make it easier to express the results of the questionnaires, as mentioned, the questions were scored based on the Likert scale in 5 points. The very high option with a score of 5 means that the effectiveness in the relevant field of activity is at a very good level (desirably effective). The high option means that the effectiveness in the relevant field of activity is at a reasonable level. The medium option means that its effectiveness is at an acceptable level, which is the theoretical average of the Likert scale points. Low and very low options mean the effectiveness is unacceptable and should be improved immediately.



### Grading method

Options of the 5-Point Likert Scale are "very low, low, medium, much and very much" grading of each option is explained in Table 4.

Table 4- Questionnaire grading method

| very much | Much | medium | Low | very Low | option |
|-----------|------|--------|-----|----------|--------|
| 5         | 4    | 3      | 2   | 1        | Grade  |

Based on this, the conceptual model of the research is in the form of Fig. 1.

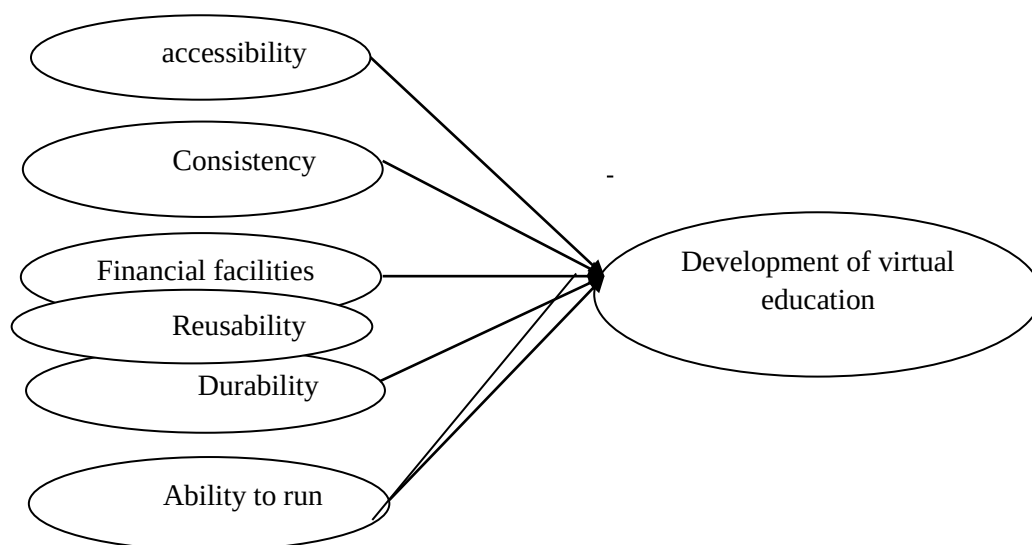


Fig. 1. conceptual model of the research

### Statistical analysis and hypothesis test results

Data analysis was done in the descriptive statistics section (mean, standard deviation, minimum and maximum) and in the inferential statistics section (one-variable t-test) with statistical analysis software SPSS version 20. Also, based on the results obtained from the Kolmogorov-Smirnov test (Table 5), because the obtained sig values in all 6 variables are greater than 0.05; Therefore, with 95% confidence level, the condition of equality of variances is established, and the normality of data distribution is confirmed. The likelihood ratio test can be used in structural equation modeling.

Table 5- Kolmogorov-Smirnov test results

| Result       | Significance level | Z statistic | Variables            |                                  |
|--------------|--------------------|-------------|----------------------|----------------------------------|
| It is normal | 0/139              | 1/105       | accessibility        | SCORM<br>SCORM standard criteria |
| It is normal | 0/069              | 1/297       | Consistency          |                                  |
| It is normal | 0/096              | 1/271       | financial facilities |                                  |
| It is normal | 0/077              | 1/247       | Durability           |                                  |
| It is normal | 0/112              | 1/101       | ability to perform   |                                  |
| It is normal | 0/232              | 1/138       | Reusability          |                                  |

The descriptive indices of the research variables from the viewpoint of students in Table 6 show that the mean and standard deviation of the standard SCORM dimensions, including access to educational content, consistency, financial facilities, durability, ability to implement, and reusability of virtual education content, are at a desirable level.

Table 6: Descriptive indicators of research variables from viewpoints of students

| variable             | The number | Practical average | Theoretical average | Standard deviation | score       |             |
|----------------------|------------|-------------------|---------------------|--------------------|-------------|-------------|
|                      |            |                   |                     |                    | Lower limit | Upper limit |
| SCORM Standard       | 370        | 4.12              | 3                   | 0/72               | 3           | 5           |
| Accessibility        | 370        | 3.82              | 3                   | 0,78               | 2           | 4           |
| Consistency          | 370        | 3.45              | 3                   | 0/85               | 3           | 4           |
| Financial Facilities | 370        | 3.82              | 3                   | 0/88               | 1           | 5           |
| Durability           | 370        | 4.10              | 3                   | 0/90               | 2           | 5           |
| Ability to run       | 370        | 3.85              | 3                   | 0/93               | 3           | 5           |
| Reusability          | 370        | 3.75              | 3                   | 0/89               | 3           | 4           |

Considering that the current research includes one main hypothesis and six sub-hypotheses, the univariate t-test is used to test the hypotheses in the inferential statistics section. The test results are given in Table 7.

Table 7. The results of the univariate t-test related to the SCORM standard and its dimensions

| Main variable and dimensions   | Average | T statistic Test value | Theoretical average | Degrees of freedom | Significance level | Difference of averages |
|--------------------------------|---------|------------------------|---------------------|--------------------|--------------------|------------------------|
| main variable (SCORM standard) | 4.12    | 14.50                  | 3                   | 180                | 0/000              | 0.78                   |
| accessibility                  | 3.82    | 13.47                  | 3                   | 185                | 0/000              | 1.200                  |
| Consistency                    | 3.45    | ۱۴,۳۲۳                 | 3                   | 181                | 0/000              | 1.55                   |
| financial facilities           | 3.80    | 12.800                 | 3                   | 186                | 0/000              | 1.20                   |
| Durability                     | 4.10    | 13.400                 | 3                   | 180                | 0/000              | 0.90                   |

|                |      |       |   |     |       |      |
|----------------|------|-------|---|-----|-------|------|
| ability to run | 3.85 | 15.30 | 3 | 182 | 0/000 | 1.15 |
| Reusability    | 3.75 | 14.22 | 3 | 186 | 0/000 | 1.25 |

**The sub-hypothesis of the main hypothesis 1:** Virtual education based on the SCORM model was effective from the viewpoint of students.

In this hypothesis, considering that the level of significance obtained from the main variable, i.e., SCORM standard, is equal to zero ( $p > 0.000$ ) and this value is smaller than 0.05, so it can be concluded that there is a relationship between the obtained mean and the theoretical mean of the SCORM standard variable. The obtained value is significant, and since the obtained mean (4.12) is higher than the theoretical average (3), it can be concluded that the effectiveness of the SCORM standard is above average from the viewpoint of students.

**Sub-hypothesis 1-1 test:** Virtual education was effective in terms of accessibility from the students' viewpoint. Considering that the significance level obtained ( $p > 0.00$ ) related to the dimension of accessibility is smaller than 0.05, so it is concluded that there is a significant relationship between the average obtained from the degree of accessibility to virtual education and the theoretical average and since the obtained average (3.82) is higher than the theoretical average (3), it can be concluded that the effectiveness of accessibility to virtual education from the students' viewpoint is above average.

**The second hypothesis (1-2):** virtual education is effective in terms of consistency from the students' viewpoint.

Considering that the significance level obtained ( $p > 0.00$ ) related to the consistency dimension is smaller than 0.05, it is concluded that there is a significant relationship between the average obtained from the degree of accessibility to virtual education and the theoretical average, and since the average obtained (3.45) is more than the theoretical average (3), it can be concluded that the effectiveness of virtual education consistency from the students' viewpoint is above average.

**The third hypothesis (1-3):** Virtual education is effective in terms of financial facilities from the students' viewpoint.

Considering that the significance level obtained related to the dimension of financial facilities ( $p > 0.00$ ) is less than 0.05, it is concluded that there is a significant relationship between the average obtained from the amount of dimension of financial facilities for virtual education and the theoretical average and since the average is 3.80.

It can be concluded that the effectiveness of financial facilities for virtual education is higher than the average level from the students' viewpoint.

**The fourth hypothesis (1-4):** virtual education is effective in terms of durability from the students' view point.

Considering that the significance level obtained for the durability dimension ( $p > 0.00$ ) is less than 0.05, it is concluded that there is a significant relationship between the average obtained for the durability of virtual training and the theoretical average, since the average obtained

(4.10) is more than the theoretical average (3), it can be concluded, the effectiveness of durability for virtual education from the students' viewpoint is above average.

**The fifth hypothesis (1-5):** virtual education is effective in terms of the ability to run from the students' viewpoint.

Considering that the significance level obtained for the dimension of ability to run ( $p > 0.00$ ) is smaller than 0.05, it is concluded that there is a significant relationship between the average obtained from the amount of ability to run of virtual training and the theoretical average, and since the average the obtained result (3.85) is more than the theoretical average (3), it can be concluded that the effectiveness of virtual education ability to run from the students' viewpoint is higher than the average.

**The sixth hypothesis (1-6):** virtual education is effective in terms of reusability from the students' viewpoint.

Considering that the significance level obtained for the dimension of reusability ( $p > 0.00$ ) is less than 0.05, it is concluded that there is a significant relationship between the average obtained from the amount of virtual education reusability and the theoretical average since the obtained average (3.75) is higher than the theoretical average (3), it can be concluded that the effectiveness of the dimension of reusability in virtual education from students' viewpoint is above average. The research shows that using a comprehensive standard model is one of the most important tools needed to evaluate the quality and effectiveness of e-learning. It will increase the trust of students and clients, the satisfaction of managers, will cause non-exclusivity of content, and collaborative design of educational content.

#### 4. Conclusion

The main goal of this research is to evaluate the effectiveness of the factors affecting the development of virtual education in COVID-19 pandemic era based on SCORM model from the viewpoint of the students at the Ferdowsi University of Mashhad in order to provide solutions for the successful utilization of this system. The results confirmed that all the hypotheses and the mentioned factors have an effect on the development of virtual education in the university, and the least to most effective factors are, respectively, durability, ability to run, accessibility, financial facilities, and reusability.

It is concluded that SCORM standard is suitable in order to prevent deviation and avoid failure in providing effective e-learning services. SCORM consists of strategic factors to maintain the quality of educational content, increase the trust of clients and integrate virtual education in parallel in universities and other sources of science production. Evaluation of effectiveness actually means checking the degree of achievement to predetermined goals.

The findings of this research about the main hypothesis showed that virtual education in COVID-19 pandemic era based on the SCORM model was above the average level from the students' viewpoint. This finding is in line with the results in [15] and [22].

In fact, SCORM standard creates a basic model for users based on which anyone can create models of educational content. SCORM is considered a reference model for evaluating the effectiveness of a set of independent characteristics. [7]

Based on the findings of the research related the main hypothesis, it is suggested that faculty members be taught how to standardize electronic content based on the SCORM model. The cooperation of professors and students in the production of electronic content will reduce costs. Regarding the sub-hypothesis (1-1): The findings of the research showed that the effectiveness of the accessibility of e-learning content courses from the viewpoint of students based on SCORM standard is high; This finding is in line with the results in [22] & [21].

The availability of e-learning content also provides opportunities for working people to study. Accessibility allows every student to study according to their own conditions and at the appropriate time. The higher level of users' access to electronic content, the more credibility and effectiveness are evaluated for that content, and as the standard educational content expands on a wider scale through reliable Internet systems, the amount of citation of that content increases, and as a result, it becomes more effective and validates.

Therefore, it is suggested to consider software updates, server maintenance and technical services. The level of accessibility should be evaluated and reviewed. In order for those interested to access standard scientific content, it is suggested that the Ferdowsi University of Mashhad provide free access to electronic content for the public.

Regarding the sub-hypothesis (1-2): The findings of this research showed that the degree of effectiveness of the Consistency dimension of e-learning content courses from the viewpoint of students based on SCORM standard is higher than the average. This finding is in line with the results of [22]& [21]. that evaluated the degree of consistency at a high level. Consistency is one of the essential components of e-learning because it leads to effective content learning and material retrieval.

Consistency can be considered as designing and predicting suitable methods of virtual education to meet the needs of users and achieve educational goals through improving the level of knowledge, skills and attitudes of students. The adaptability dimension is actually the prediction and design of effective methods of virtual education for better and easy learning. In this dimension, there are important elements such as goals and advanced educational methods, effective content, and the possibility of retrieving and evaluating the content, which is important in the realization and desirability of the Consistency dimension. In relation to the second hypothesis, it is suggested that the educational content planners keep the content up to date. Act with the standards in such a way that the services provided are competitive with other universities and meet the educational needs of the users.

In relation to the second sub-hypothesis, it is suggested that the indicators of the electronic educational system and content offered by the university should be reviewed, evaluated, revised and updated by all users, including students, professors and staff.

The test of the third sub-hypothesis (1-3) showed that virtual education in the conditions of Corona based on the SCORM standard has been effective in terms of financial facilities. This result is in line with the research results of [18] &[23] &[24]& [25] &[26] aligned. The financial facilities in SCORM reduce the prices and transfer the learning content to the user in a shorter period of time. Then the financial facilities reduce many of the usual costs in the face-to-face learning system, and this is one of its most important advantages. In the dimension of financial facilities, some methods will be designed which have benefits like reducing the time and cost of students' commuting, expanding and creating the opportunity to learn for everyone, and compensation for mistakes made, various low-cost student services, ease of access to many educational resources.

The dimension of financial facilities is to assure users that they will be able to receive the best online and offline electronic content services at the lowest cost, and by investing in infrastructure and resources, it provides security to users for performing their duties and assignments. There are regular online supports to guide users.

Regarding the third sub-hypothesis, it is suggested to improve and strengthen the infrastructures of the financial facilities, which lead to reducing the time and cost of commuting and providing low-cost services. University facilities for students should be improved. Students should be assured that their tuition payments will be spent on improving resources and services.

The test of the fourth sub-hypothesis (1-4) showed that virtual education in COVID-19 pandemic era based on the SCOREM standard was above the effective level of durability. This result is in line with the research results of [20] & [22]. The durability dimension is the fourth component of the SCOREM standard which means planning and organizing educational content and materials in a way that causes effective learning.

In other words, the durability dimension organized the content of the system to make it durable. In relation to the fourth sub-hypothesis, it is suggested to pay attention to the design of lessons presented to motivate the learners. In this regard, the variety of graphic items, coloring, course materials arrangement, and the design of suitable software according to users' requirements and modern technology are identified as important items. Considering that the logical structure of knowledge is one of the effective factors in choosing the type of content organization, it is suggested that the type of content organization conforms to the logical structure of knowledge. In the dimension of durability, users are given the opportunity to use course content to strengthen a specific skill many times and even permanently during the academic years, so this type of learning is effective. In the dimension of durability, while sustaining the previous content, an arrangement should be made so that the content is the basis for the cultivation and development of the next scientific abilities of the users.

In the testing of the fifth hypothesis, it was found that virtual education is more effective than the average in terms of the ability to run. This result is not in line with the research results of [15]. At the beginning of the virtual education activity in Iran, the virtual education design and ability to run faced challenges, but gradually it has been developed with additional efforts. The main goal of this dimension is to encourage and direct learners to do attractive and continuous educational activities by creating advanced and efficient technology and software and through designing and creating complex cultural environments and using evaluation and feedback. They have a positive effect on the effective and motivational learning process of learners. The ability to run is one of the important infrastructures of learning assessment because it is a process for identifying the current and future needs of learners and how to achieve these abilities required by users. The ability to run can have positive effects on students' learning and participation. In relation to the fifth sub-hypothesis, it is suggested that the software related to the presentation of courses should be applicable, and more advanced facilities should be used to hold seminars and training sessions. Learning content in various formats (graphics, video audio and etc.) and classes should be provided without jamming. Software updates should be done automatically.

The test of the sixth sub-hypothesis showed that virtual training in COVID-19 pandemic era is more effective than average based on SCORM standard in terms of reusability. The result is in line with the results of the research. Reusability is a part of educational content that can be used in several applications or texts, and standard prepared resources can easily be used multiple times in different educational systems for different purposes and courses.

Reusability describes a detailed framework in which learning content, technology, and presenter systems can communicate with each other, resulting in manageability, reusability [22] reusability improves the learning ability of learners. If the learners do not learn some parts of a course correctly, they can review those parts at any time. Using the dimension of reusability, the training content can be fully described so that the existence of such is possible

to easily find specific educational content and deliver it to the requesting person at the appointed time. In relation to the sixth sub-hypothesis, it is proposed that reusability is defined for any part of the educational content of any type, from the smallest unit of data to a complete lesson. Reusability in this way allows each level of content to be easily searched and reused. The four applications of reusability are classification, clustering, reusing, and dynamic structures. Each of the above features saves money and time and increases human efficiency.

In the end, according to the results, in the conditions of the spread of the Coronavirus, virtual education has been more effective than the average in all six dimensions of the SCORM standard, so it can be concluded that the virtual education programs planned in the Ferdowsi University of Mashhad are on the way It is correct. These programs can be strengthened and developed by obtaining periodic feedback according to the successful performance of virtual education in COVID-19 pandemic era, and this technology can be used in the future as an effective supplement in the educational and research activities of the university. Like any other research, it has faced limitations such as the lack of competent experts in the field of the research topic and the lack of related research.

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