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Critical Success Factors for Electronic Learning from the Perspectives of Faculty Members and Experts of Tehran University of Medical Sciences, Tehran, Iran, Using Delphi Method and Analytic Hierarchy Process

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Background: The present study aimed to investigate and rank the effective success factors for e-learning based on the perspectives of the faculty members, students, and technical specialists of Tehran University of Medical Sciences, Tehran, Iran.

Methods: This descriptive survey was conducted using the qualitative-quantitative method. At the first stage of the qualitative approach, 15 specialists in e-learning were selected from the Tehran University of Medical Sciences through the purposive sampling technique to discuss and confirm the effective factors in the e-learning success using the Delphi method and a questionnaire. Subsequently, these students categorized the effective factors in the success of e-learning based on their level of importance using a researcher-made paired comparison questionnaire and analytical hierarchy process. The reliability of the study tools was confirmed by showing a Cronbach's alpha coefficient of higher than 0.7, and their structural validity was confirmed using the confirmatory factor analysis.

Results: According to the results of the study, the management with the relative weight of 0.311 was found to be the most effective factor in determining the success of e-learning. This factor was followed by support services, teaching strategies, financial sources, technology infrastructure, and teacher-learner with relative weights of 0.236, 0.197, 0.124, 0.094, and 0.038, respectively.

Conclusion: As the findings of the current study indicated, the factors of management, support services, education strategies, financial sources, and technology infrastructure had the highest significance in e-learning, respectively, whereas the factor of teacher-learner had the lowest importance in this regard.

Keywords: Delphi method, E-learning, Analytic hierarchy process, Critical success factors

دراسة العوامل الأساسية لنجاح التعليم المجازي من وجهة نظر المتخصصين والطلاب في جامعة طهران للعلوم الطبية بالإستفادة من طريقة Delphi-AHP

خلاصة : التعليم المجازي { الإلكتروني } هو مجموعة واسعة من الطرق التعليمية التي تعتمد على تكنولوجيا المعلومات والبرامج التطبيقية، التي توفر بدورها إمكانية التعليم لكل الأفراد وفي أي زمان، ولهذا بدوره يساعد على إيجاد تغييرات مهمة في المجال العلمي والثقافي. الهدف من هذا التحقيق هو دراسة العوامل المؤثرة على نجاح التعليم المجازي بالإعتماد على آراء و وجهات نظر الطلاب و المتخصصين الفنيين العاملين في كلية التعليم المجازي في جامعة طهران للعلوم الطبية، وترتيب هذه العوامل على أساس أهميتها ودرجة تأثيرها على نجاح التعليم المجازي.

الطريقة : تمت إجراء هذه الدراسة بالطريقة (الكمية و النوعية) في المرحلة الأولى من القسم النوعي من الدراسة تم إختيار ١٥ عينة من المتخصصين في التعليم المجازي في الجامعة الطبية المذكورة وبطريقة دلفي تم التطرق والتركيز على العوامل المؤثرة في نجاح التعليم المجازي. في القسم الكمي من الدراسة على أساس طريقة كوكران تم إختيار ١٣٦ طالب من كلية التعليم المجازي في جامعة طهران للعلوم الطبية و بإستخدام مجموعة من الأسئلة المكتوبة و المقارنات الزوجية و طريقة التحليل المراتبية (AHP) تم التقرير حول ترتيب العوامل المهمة والمؤثرة على نجاح التعليم المجازي. تم تحليل وتفكيك و تأييد نتائج الدراسة بطريقة ألفا كرونباخ التي بلغت أكثر من ٠.٧.

النتائج : في النتائج النهائية حول ترتيب الأهمية في التأثير على فعالية التعليم المجازي تبين أن عامل الإدارة هو أهم عامل مع وزن نسبي يعادل ٠.٣١١. ويأتي ثانيا عامل الخدمات والدعم مع وزن نسبي يعادل ٠.٢٣٦ . ثم استراتيجية التعليم مع وزن نسبي يعادل ٠.١٩٧. ومن ثم المصادر المالية بوزن نسبي يعادل ٠.١٢٤. ومن ثم البنية التحتية الإستراتيجية بوزن نسبي يعادل ٠.٠٩٤. وأخيراً يأتي المعلم والمتعلم بوزن نسبي يعادل ٠.٠٣٨ .

الإستخلاص : حسب الترتيب : العوامل الإدارية، خدمات الدعم، إستراتيجية التعليم، المنابع المالية، البنى التحتية الإستراتيجية تحظى على الأهمية الكبرى في حين أن عامل المعلم والمتعلم يحظى على أهمية قليلة في مجال التعليم المجازي.

الكلمات المفتاحية : التعليم المجازي، التحليل على شكل سلسلة مع مراتب، طريقة

بررسی عوامل کلیدی موفقیت در آموزش از راه دور از دیدگاه متخصصان و دانشجویان با استفاده از روش Delphi-AHP در دانشگاه علوم پزشکی تهران

زمینه : آموزش الکترونیک به عنوان مجموعه ای وسیع از روش های آموزش مبتنی بر تکنولوژی اطلاعات و نرم افزار ها است که برای هر فرد در هر موقعیتی امکان یادگیری را در هر مکان و زمان فراهم می آورد. این مهم به وجود آورنده ی تغییرات مهم در توسعه فرهنگی و علمی است. هدف از این پژوهش صحه گذاری عوامل تأثیر گذار بر موفقیت آموزش از راه دور (آموزش الکترونیکی) با تکیه بر دیدگاه اعضاء هیات علمی، دانشجویان و متخصصین فنی دانشکده مجازی دانشگاه علوم پزشکی تهران و همچنین رتبه بندی این عوامل نسبت به یکدیگر از نظر اهمیت و درجه تأثیر گذاری بر موفقیت آموزش الکترونیکی بوده است.

روش : تحقیق از نوع توصیفی-پیمایشی و روش آن آمیخته (کمی-کیفی) بوده است. در مرحله ی اول از بخش کیفی ۱۵ نمونه بر اساس روش نمونه گیری هدفمند از متخصصان حیطه ی آموزش از راه دور دانشگاه علوم پزشکی و با روش دلفی به صحه گذاری عوامل موثر بر موفقیت آموزش الکترونیکی پرداختند. در بخش کمی بر اساس روش کوگران۱۳۶ نمونه از دانشجویان دانشکده مجازی دانشگاه علوم پزشکی تهران انتخاب و با به کارگیری پرسشنامه مقایسات زوجی و روش تحلیل سلسله مراتبی (AHP) به تصمیم گیری درباره ی رتبه بندی اهمیت عوامل موثر بر موفقیت در آموزش از راه دور پرداخته شد. در مرحله ی کیفی از پرسشنامه و در بخش کمی نیز از پرسشنامه ی محقق ساخته ی مقایسات زوجی استفاده شده است. پایایی ابزار با آلفای کرونباخ بالای ۰.۷ تایید و روایی سازه ای توسط تحلیل عامل تاییدی، مورد تایید قرار گرفت.

نتایج: نتایج نهایی اولویت بندی مؤلفه های مورد نظر حاکی از آن است که عامل مدیریتی با وزن نسبی ۰/۳۱۱ بیشترین اهمیت را در تعیین اثربخشی آموزش از راه دور دارد و بعد از آن به ترتیب عامل خدمات پشتیبانی با وزن نسبی ۰۰/۲۳۶ راهبرد آموزشی با وزن نسبی ۰/۱۹۷، منابع مالی با وزن نسبی ۰/۱۲۴، زیر ساخت فناوی با وزن نسبی ۰/۰۹۴ و یاددهنده و یادگیرنده با وزن نسبی ۰/۰۳۸ قرار دارند.

نتیجه گیری : عوامل مدیریت، خدمات پشتیبانی، راهبرد آموزشی، منابع مالی، زیرساخت فناوری به ترتیب بیشترین اهمیت و عامل یادهنده – یادگیرنده کمترین درجه ی اهمیت را در آموزش از راه دور به خود اختصاص داده است.

واژگان کلیدی: آموزش از راه دور، تحلیل سلسله مراتبی، روش دلفی، عوامل کلیدی موفقیت

تہران میڈیکل یونیورسٹی میں ماہرین اور طلباء الیکٹرانیک تعلیم کے فوائد۔ اس میں ڈیلفی اے ایچ پی روش اپنائي گئي تھی۔

بیک گراونڈ: الیکٹرانیک تعلیم انفارمیشن ٹکنالوجی سے تعلیم دینے کی بنیاد پر قائم ہے اور آپ اس وسیلے سے ہر فرد کو ہرجگہ تعلیم دے سکتے ہیں۔الیکٹرانیک روش تعلیم نے تعلیمی دنیا میں انقلاب برپا کردیا ہے۔اس تحقیق کا ھدف الیکٹرانیک تعلیم کے یا تعلیم از دور سے تعلیم کے مفید ہونے پر پاکید کرنا ہے۔اس تحقیق میں تہران کی میڈیکل یونیورسٹی کی ورچوئیل کالج کی اکیڈمیک کونسل کے ارکان، طلباء اور ماہرین نے حصہ لیا ہے۔ان کی نظر سے طلباء کی تعلیم میں بہتری الیکٹرانیک تعلیم کے اثرات کا جائزہ لیا گیا ہے۔

روش: یہ ایک توصیفی تحقیق ہے جس میں کمی اور کیفی دونون عناصر کو مد نظر رکھا گیا ہے پہلے مرحلے میں کیفیت یا کوالٹی کا جائزہ لیا گیا جس میں میڈیکل یونیورسٹی میں ورچوئیل ٹیچنگ کے پندرہ ماہرین اور اساتذہ نے شرکت کی، اس مرحلے میں ڈیلفی روش اختیار کی گئي تھی۔ اس کے بعد کمیت کے مرحلے میں ورچوئیل فیکلٹی کے بعض طلباء کو چنا گیا جنہوں نے زوج تقابلی سسٹم اور تین مرتبہ تجزیہ کے سسٹم اے ایچ پی سے کام لیتے ہوئے ورچوئیل ٹیچنگ پر اثر انداز عوامل کا جائزہ لیا اور اسکی افادیت کا پتہ لگایا۔

ڈیٹا کا تجربہ آلفا کرونباخ صفر اعشاریہ سات سے زیادہ کی رینج میں کیا گیا۔

نتیجے: مد نظر عناصر کا جائزہ لے کر یہ حتمی نتیجہ حاصل ہوا کہ ورچوئیل ٹیچنگ کے مینجمینٹ کا اس کی افادیت پر سب سے زیادہ اثر پڑتا ہے اور اس کے بعد ورچوئیل شعبے کو دی جانے والی خدمات اثر انداز ہوتی ہیں اور مالی ذرایع اور بجٹ کی فراہمی بھی نہایت اہمیت رکھتی ہے۔

سفارشات: مینجمینٹ، خدمات کی فراہمی، مالی ذرائع ٹکنالوجیکل بنیادی ڈھانچہ بنانے میں نہایت اہمیت کے حامل ہیں اس کے علاوہ ورچوئیل ٹیچر اور طلباً کی محنت بھی بنیادی اثرات کی حامل ہے۔

کلیدی الفاظ: دور سے تعلیم،ڈیلفی روش، کامیابی اور طلباء ۔

INTRODUCTION

The application of Information and Communication Technologies (ICT) in education, such as electronic learning (e-learning), is among the most important factors involved in the scientific and cultural development (1). Ideal e-learning is based on the correct and precise conceptualization of the major responsibilities and goals of institution, nature of students' demands, and curriculum requirements (2). E-learning is a kind of time and place independent learning using a large set of applicable software and IT-based methods (3).

This active and smart learning fills the educational gap by facilitating distance teaching/learning (4). The factors affecting the e-learning success were first studied by Pap in the United States who provided the foundation for other similar studies (5). In a study, the vital factors involved in e-learning success were classified into seven categories, including teacher characteristics, learner characteristics, IT quality, university support, content quality, participants' interaction, and application of knowledge management (6).

Truskolaska et al. (2015) demonstrated the Poland University student had a positive attitude toward e-learning and considered it an appealing alternative for conventional methods. However, most of the students expressed their concerns about technical problems that might occur in this type of education and unfulfillment of their expectations (7). In another study conducted in Singapore, human factors, technical competence of trainers and students, students' and trainers' attitudes toward online learning, cooperation, and IT infrastructures were reported as the success factors of e-learning (8).

Furthermore, Davoudi Mamghani stated most of the faculty members, authorities, and students believed that the factors associated with e-learning success were facilities like e-learning software, adequate hardware, digital library, enriched telecommunications, and manpower, cultural, leadership, managerial, and economic infrastructures (9). According to Rohayani, the recognition of this kind of education was one of the most important dimensions of achieving a successful e-learning in higher education (10).

Studies have shown that people's attitudes and skills are the most significant factors in the recognition of e-learning in higher education. Liaw and Huang indicated that the e-learning students' perceptions of useful educational content and interactive environment of this education affected the their satisfaction with e-learning courses (11). Stricker et al. concluded that team learning led to critical thinking, students' interaction, improved task and learning quality, and increased learners' dominance over the course content (12).

Striker et al., investigating e-learning through an efficient learning environment, reported that attitude toward perception, computer knowledge, motivation, learning style, accessible infrastructures, and gender distribution largely affected the successful establishment and implementation of e-learning (13). In a study conducted in Brazil, Testa reported five crucial factors for the success of e-learning programs, including the experience and knowledge of training team, learners' knowledge and behavioral features, learning style, ICT infrastructures, and unity and strategies of executive organizations (14).

Additionally, Sun et al. examined the factors affecting students' satisfaction with e-learning. They reported that teachers' attitude toward e-learning, quality and flexibility of educational content, students' evaluation of educational content usefulness, and diversity of student assessment methods were influential factors in e-learning (15). Margery evaluated the quality of online educational programs in the USA and identified flexibility, interaction, and cooperation as the major factors in online curriculum development (16).

Like other countries, Iran has been very responsive to the rapid development of technology and its implementation in higher education. Despite the fact that e-learning technology is welcomed

in Iran for its advantages in higher education system, its prerequisites and infrastructures has not been developed yet (16). Samadi et al. utilized a comparative approach to assess the critical success factors for e-learning in 17 countries, including Iran. They proposed learner, teacher, standards, educational policy, infrastructures, management, logistics, financial resources, educational design, and educational rules as critical determinants for e-learning success (2).

With this background in mind, we aimed to validate the factors affecting e-learning success from the perspectives of the faculty members, students, and experts of Virtual School of Tehran University of Medical Sciences, Tehran, Iran, using a Delphi-based method. Furthermore, analytic hierarchy process (AHP) was used to rank these factors in terms of their efficiency in e-learning success.

METHODS

The present study is categorized under applied and descriptive surveys in terms of goal and data collection procedure since it aims to rank the key factors affecting the success of e-learning. In addition, regarding the data collection technique, this study was a "mixed methods research" as we applied the qualitative and quantitative methods, respectively.

Evaluation of the available documents and studies related to research topic

After an in-depth review of the available documents and related literature, we obtained the model related to the key success factors for e-learning according to the local conditions of Iran.

Qualitative section: performing Delphi method by experts and specialists for the validation of available factors in research model

Research population in the qualitative section corresponded to a group of 15 experts and specialists in information technology (IT) (i.e., the specialists working in the field of education) working at the Tehran University of Medical Sciences, Tehran, Iran. These participants were selected through the purposive sampling technique since we were purposively looking for the IT experts and specialists who had the highest information about e-learning.

Data collection was carried out using the Delphi questionnaire, which contained 10 success factors for e-learning education,

extracted from a model proposed by Bazargan et al. In addition, the reliability of this questionnaire was estimated, rendering a Cronbach's alpha coefficient of 0.88. On the other hand, the content and structural validities of this instrument were confirmed by the approval of the respective professors and the use of the confirmatory factor analysis, showing a factor load of less than 0.5 for each item.

At the end of this stage, after an in-depth evaluation of the responses and collected data, a paired comparison questionnaire was designed based on the factors obtained from the experts to be used in the second stage of the qualitative section (i.e., Delphi method) and the quantitative part.

Quantitative section: factor ranking from the perspective of faculty members and students

To evaluate the students' perspective, the subjects were selected from 211 Master's students studying at the Virtual School of Tehran University of Medical Sciences. Based on the Cochran's sample size formula, the sample size was calculated as 136 participants, who were selected through the simple random sampling technique.

The quantitative data were collected using the researcher-made paired comparison questionnaire, which was designed based on six success factors for e-learning. After integrating the views of the faculty members and students, consensus was obtained regarding the success factors for e-learning and their ranking from the perspective of the faculty members and students.

Data collection

The first stage: evaluation of the literature and collection of effective success criteria for e-learning

After the evaluation of the literature and comparative assessment of the proposed models regarding the success of e-learning, the model offered by Samadi et al., which was based on the local considerations and requirements of Iran, was selected and used as the research model (6). The framework of this model was obtained using the knowledge and experiences of higher education experts, presenting 10 key factors for the evaluation of the level of e-learning success in the education system of Iran. These factors included learner (i.e., student), teacher (i.e., instructor), educational design, support services, technology infrastructure, education policies, management system, educational rules and regulations, financial sources, and standards.

The second stage: validation of the factors obtained from the first stage

In this section, the Delphi questionnaire containing 10 success key factors for e-learning, extracted from the model proposed by Samadi et al., was administered on 15 specialists and experts in e-learning working at the Tehran University of Medical Sciences (6). In the first phase of Delphi, a consensus of more than 85% was reached on the effectiveness of six factors. The factors with less than 50% consensus were rejected.

In the second stage, the two factors of learner and teacher were integrated. At the end of this phase, the effective success factors for e-learning were validated and confirmed according to the conditions and requirements. In total, six out of the ten proposed factors in the model were validated as key factors for the success of e-learning.

The fourth stage: factors affecting success from the students' perspective

The paired comparison questionnaires were distributed among the students. After the collection of the questionnaires, the data were analyzed to prioritize the success key factors for e-learning. In addition, the analytical hierarchy process (AHP) technique was applied to rank the success key factors for e-learning using the Expert Choice software.

RESULTS

The demographic characteristics of the subjects are displayed in Table 1.

Validation of factors by experts and specialists

After the implementation of the Delphi method, out of the ten success key factors extracted from the research model, six factors were confirmed to be effective in the success of the virtual courses of the Tehran University of Medical Sciences by the respective experts and specialists. These factors included educational strategies, management, technology infrastructures, support services, learner-teacher, and financial sources.

As indicated in Table 2, the Delphi members had more than 85% consensus over the success factors. On the other hand, the factors with the consensus of less than 50% were rejected. In addition, the integration of "learner and teacher" factors was proposed, which was reassessed in the second round of Delphi, leading to the consensus of the subjects.

Evaluation of the importance and ranking of effective factors from the faculty members' perspective

The data analysis was carried out based on the paired comparison questionnaire and AHP technique using the Expert Choice software. The factors of management,

Table 1. Demographic characteristics of the study population

	Gender		Mean age (years)	Education level
	Male	Female		
Faculty members	3	3	45	PhD
Students	64	72	36	General practitioner MSc
Experts and specialists	9	6	49	PhD

Table 2. Validation of the factors affecting the success of distance learning from the perspective of experts and specialists

Dimensions	Confirmed factors (N)	Rejected factors (N)	Percentage of consensus	Result of consensus
Management	15	0	100%	Component validation
Educational strategy	15	0	100%	Component validation
Financial sources	15	0	100%	Component validation
Learner and teacher	14	1	93%	Component validation
Support services	14	1	93%	Component validation
Technology infrastructure	15	0	100%	Component validation
Standards	7	8	47%	Component rejection
Rules and regulations	4	11	27%	Component rejection
Educational design	3	12	20%	Component rejection

Table 3. Ranking of success factors for e-learning from the students 'perspective

Rank	Factors	Mean rank
1	Management	3.86
2	Financial sources	3.66
3	Educational strategies	3.62
4	Learner-teacher	3.59
5	Support services	3.17
6	Technology infrastructure	3.11

Table 4. Integration of the opinions of faculty members and students

Components	Relative importance	Priority
Educational strategies	0.236	2
Financial sources	0.197	3
Support services	0.124	4
Learner-teacher	0.038	6
Management	0.311	1
Technology infrastructure	0.094	5

learner teacher, financial sources, technology infrastructure, and support services were regarded to have the highest importance in the success of e-learning, whereas educational policy received the lowest score in this regard.

Ranking of success factors for e-learning from the students' perspective

According to the results of the paired comparison questionnaire, the students ranked the importance of the factors affecting e-learning as indicated in Table 3. The data were analyzed based on the paired comparison questionnaire and AHP technique using the Expert Choice software.

Integration of obtained calculations and weights

We calculated the geometric mean of the opinions of the faculty members and the higher education students of the Virtual School of the Tehran University of Medical Sciences. Subsequently, these mean values were integrated with the final weights of the factors using the Choice Expert software (Table 4, Diagram 1). The results of the factor prioritization demonstrated that the management system with the relative weight of 0.311 had the highest importance in determining the model for effective e-learning. This factor was followed by educational policy, financial sources, support services, technology infrastructure, and learner-teacher with the relative weights of 0.236, 0.197, 0.124, 0.094, and 0.046, respectively.

DISCUSSION

According to the local and foreign studies, the modern education method, which is based on the use of new technological tools and lack of presence, has been significantly welcomed by the new generation. This attraction is due to the efficiency of this method in the improvement of educational level, involvement of students in educational activities, and enhancement of the learners' motivation caused by the elimination of personal limitations (i.e., time and location).

In total, it could be stated that IT has a remarkable ability to implement and affect teaching and learning activities in all higher education institutes. This field of science facilitates the provision of the facilities for designing new scientific environments, which was not possible in the past. Therefore, many Iranian universities are eager to implement e-learning courses using IT abilities in the form of e-learning.

One of the major goals of this study was to identify the factors affecting e-learning according to the perspective of the faculty members, students, and experts of the Virtual School of the Tehran University of Medical Sciences. Another study objective was to determine the ranking of these factors in terms of their level of effectiveness and significance in the success of e-learning.

The results related to the first priority (i.e., management) in

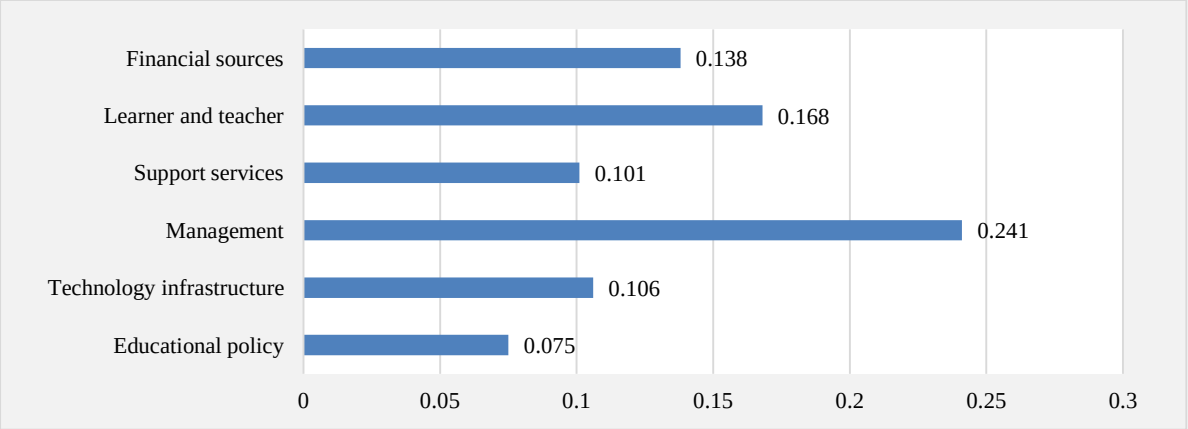

Diagram 1. Comparison of factors affecting electronic learning from the perspective of faculty members

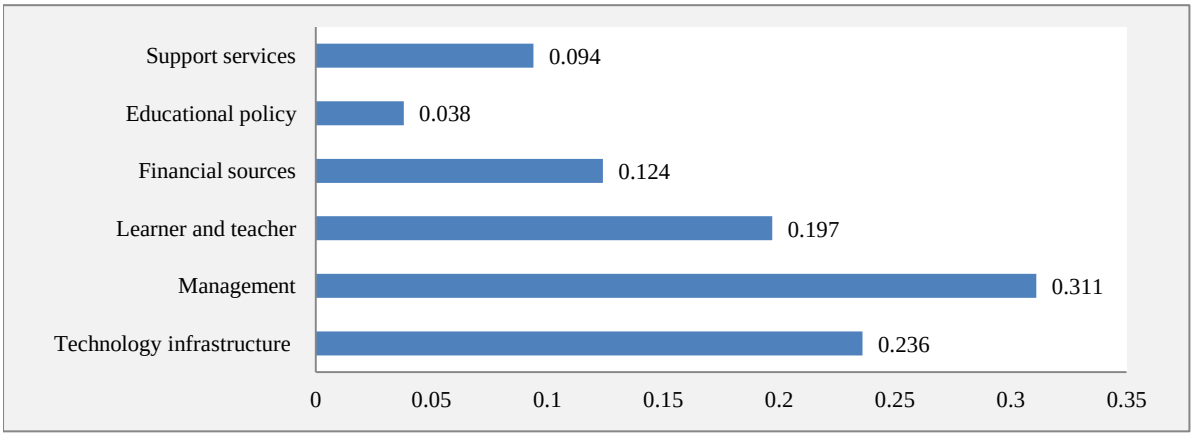

Diagram 2. Evaluation of the importance level of each factor

of management section is achieved by the improvement of the management ability in the administrative agencies of the organization. Therefore, the recruitment of expert and experienced managers, who are familiar with virtual environment, is a matter of fundamental important. The majority of the researchers have reported the presence of administrative and decision-making agents as the most important factor in improving the effectiveness of e-learning (17).

According to the results, the second important factor identified in the present study was support services, indicating that technical support is a significant factor in the effective implementation of e-learning. These findings are in line with the results obtained by McGarry (2003). Moreover, regular and coherent support services will motivate continuity in education. (9)

In line with a study carried out by MacMillan (2016), the third important factor for success in e-learning was found to be educational strategies. This factor determines the policy and philosophy of an educational course and is important in all planning stages (18). On the other hand, the fourth important factor was financial sources, which can challenge the successful implementation of e-learning. In this regard, Zehry et al. (2011) concluded that the most important factor was expense. They stated that this type of education provides an opportunity for the exchange of the individuals' experiences with minimum cost and time (19).

The implementation of e-learning mainly requires computer facilities. In addition, if there is a need for complicated software and programs in these courses, advanced computers must be provided, which demands high expenses. Moreover, the provision of IT facilities for a large number of learners imposes a considerable financial burden on the respective organizations.

Based on the results of the current study, financial source was one of the factors affecting the successful implementation of e-learning.

The fifth most important factor was IT infrastructure, highlighting the importance of further evaluation of information and communication technology in the educational institutes and universities. In accordance with our findings, Stricker et al. (2010) demonstrated that the

infrastructures played a significant role in the implementation and establishment of virtual education (12). in a study conducted in Brazil, Testa (2008) reported the technology infrastructure as a crucial factor for the success of e-learning programs (14).

The last factor that was important in the success of e-learning was learner-teacher. This factor was less prioritized, compared to other factors due to the nature of e-learning and the elimination of face-to-face interaction in this education method. Nevertheless, effective e-learning depends on the learning system of the learners and the coordination of the teaching methods with e-learning. Accordingly, some of the researchers have regarded the factor of learner-teacher as one of the most challenging factors for successful e-learning. Based on the results obtained by Liaw and Kheirandish (2013,2014), the interactive e-learning environment had an impact on students' satisfaction with e-learning courses (8 , 16).

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