# Investigation of multi-factor effect on e-learning: a student's perspective

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ABSTRACT: The existing literature does not yet cover the essential differences of e-teaching or e-learning, but has focused on discussions of learning effectiveness. Consequently, the essential differences between viewpoints and the recognition of teaching and learning may cause disagreements when judging the levels of importance of any influential elements during the design of systems related to e-learning and the development of teaching materials. This study adopted the multi-theme decision making trial and evaluation laboratory to list all the elements that might influence teaching and learning. This enabled discussion on the levels of importance of the different elements involved in e-learning, following which global concepts were used to discuss the interaction among all the important elements to confirm those crucial elements that would actually influence e-learning in practical teaching. The study showed that learners emphasised that the crucial element influencing e-teaching was the quality of the teaching materials. Finally, the study carried out further discussion and proposed suggestions.

## INTRODUCTION

In 1991, the National Science Foundation of the USA removed the application limitations of the Internet, thus causing a boom in Web sites. E-learning emerged in such an environment. Since then, e-learning has developed for over 20 years. However, there is still disagreement on the definition of e-learning and the words and phrases used to describe it. For example, Alshibly et al believed that e-learning was a learning style, whereby the delivery and obtaining of learning content were completed by networks (including the Internet, intranet and extranet) and electronic media [1]. Meanwhile, McIntosh emphasised that e-learning used Web sites as communication platforms to enable learners to retrieve and use learning resources and tools, such as program content, teacher assistance, discussion board, the function of file sharing, etc, anytime, anywhere [2]. Compared to the above scholars' ideas on e-learning, the American Society for Training and Development (ASTD) holds the opinion that e-learning should break the limitations of the Internet, and emphasises that learners should choose e-media (including the Internet, enterprise networks, computers, satellite radio, audio tapes, videos, interactive television, discs, etc) by themselves to undertake active learning. In other words, teaching and learning styles that derive from the convenience of e-technology are now generally referred to as e-learning. However, on teaching sites, teaching and learning are two different units. They usually have different thinking axes and focuses. However, there is very little in the literature that discusses the different focuses of teachers and learners or the mutual influences or functioning situations of different elements during e-teaching in order to achieve planned teaching objectives. However, this topic is urgent and important for enhancing the learning effectiveness of e-learning.

There is also a considerable amount of research emphasising that learning should, once again, be student-oriented. However, with respect to such opinions, there are still many disputes about what elements have a significant influence on the effectiveness of e-learning [2]. Consequently, with respect to the attributes of the elements of different dimensions, this study adopted the multi-theme decision making trial and evaluation laboratory to re-examine the importance of the thrust and pull elements of e-learning, and explored which type was more important. Meanwhile, the study determined the interactions among the different elements to master and verify the influencing level of each element on e-learning. In order to obtain the above two major research contributions, this study firstly discussed the important literature through a literature review, and used the results as a research framework and reference for the items of the questionnaire. Following the literature review, the study developed the questionnaires and conducted questionnaire investigations then analysed the data collected. Finally, the study proposed the conclusions, management implications, research limitations, and suggestions.

## LITERATURE REVIEW

E-learning is directly influenced by information and communication technology, and a high-quality e-learning system is an effective way to attract learners to specific e-learning [3]. Convenient access and good response speeds are important

reasons for learners to choose e-learning [3][4]. Another element that directly influences a learner's choice of e-learning in order to acquire knowledge and skills is that the learner finds the e-learning helpful and that the system is easy to use [4][5]. When learners find an effective e-learning method that can meet their specific requirements, they will be willing to accept and use it [4]. This is an important element for learners when choosing an e-learning system.

This study summarised related research by domestic and foreign scholars, and used factor analysis to filter the influencing elements regarding learners' choices of e-learning. The study divided these elements into nine indices of two dimensions (shown in Table 1).

The first dimension included the quality of the systems: the design of the system interfaces [1][4], the reliability of the systems [6-8], the response speed of the systems [4][7][8], and their safety [1][6][8], all of which were important elements of this study. The second dimension explored the quality of the teaching materials: the richness of the teaching materials [5][9], their correctness [9], the presentation quality [5][9], the content quality [5][9], and the interactivity of the teaching materials [5], all of which were also important elements of this study.

The literature to date has concluded there are many kinds of elements that influence e-learning and that various studies have made certain contributions to e-learning. By contrast, this study expected to clarify which of these important elements were more effective in influencing Taiwanese learners' choices when taking part in e-learning, which was also the contribution made by this study. Meanwhile, this study further explored the interactions among these elements and the levels of mutual influence.

METHODOLOGY

In order to achieve the above mentioned study objectives, this study developed suitable tools based on the results of the literature review, confirmed the study objects, carried out the data collection and analysis, discriminated the interactions among the different elements and verified the levels of influence that each element had on e-learning.

Research Tools

This study conducted a literature review, and based on the reviewed material, included certain items into the questionnaire for the pre-test. After that, this study invited experts to confirm the adequacy of the items, before developing a DEMATEL questionnaire. Finally, based on the questionnaire, this study discussed the levels of direct/indirect influence of the different elements on e-learning, and the relationships among them. Briefly, the questionnaire for the pre-test was in the form of a common five-point Likert scale, and the formal questionnaire was in the form of a DEMATEL questionnaire. The development processes are as follows.

*The design and completion of the questionnaires:* based on the results of the literature review and exploratory factor analysis, this study identified the possible elements that could influence e-learning, and used them as the items for the pre-test questionnaire. In addition, in order to obtain effective and representative data, this study invited experts to discuss the appropriateness and conceptual definitions of these elements, and removed any inapplicable elements. The first page of the questionnaire clearly explained the implication of each element. Then, the study adopted purposive sampling to select 200 respondents from two technological universities in Taiwan's central region for the pre-test, using the analysis results of the pre-test to confirm the correctness and effectiveness of the formal questionnaire.

*Establishing the reliability and validity of the formal questionnaire:* after completing the formal questionnaire, five experts with experience in the production of e-learning teaching materials were invited to complete the questionnaire. They discussed the appropriateness of the item content, and added and removed several items to finally complete the DEMATEL questionnaire for the formal test. The items of the questionnaire are in the form of comparisons between any two elements. Respondents were asked to estimate the level of influence of one element on the other elements (from level 0 to level 3). 0 represents *no influence*, 1 represents *slight influence*, 2 represents *certain influence*, and 3 represents *significant influence*.

Respondents and Implementation

The respondents to the formal test were sampled from junior colleges in Taiwan which provided e-learning. Based on the distribution of these colleges in the north, centre and south of Taiwan, the study adopted stratified random sampling to select six junior colleges in the north, three in the central region and three in the South, in proportion. The study gave out 480 copies of the questionnaire, 40 copies for each college, and collected 408 effective copies. The effective return rate was 85.00%. In order to avoid analysis differences between the different regions, the study carried out single-factor variability analysis on respondents from the north, central region and the south. The analysis results show that there were no significant differences in the recognition of the items of the questionnaire among the three regions (F = 0.799, p = 0.663 > 0.05). Consequently, the results of this study have good external validity.

This study collected 408 questionnaires from the three regions in proportion and, then, used Excel 2013 to carry out the data analysis. The study calculated the matrices of the direct/indirect relationships between the influencing elements and

e-learning and, finally, drew the causal diagrams, transferring the direct/indirect relationship matrices into columns and rows for calculation, and using $D + R$ and $D - R$ as coordinate positions for the drawing. Making $t_{ij}(i,j = 1,2,...,n)$ as elements of T, and using $D_j$ and $R_j$ and  to represent the sum of columns and the sum of rows, respectively.

$D_j$ represents the sum of the influences of element $i$ on other elements, including direct and indirect influences. $R_j$ represents the sum of the influences on element $j$ by other elements. $(D + R)$ is called prominence, which is the sum of $D_k$ and $R_k$, indicating the importance of this element among all elements that influence e-learning. $(D - R)$ is called relation, which is the difference between $D_k$ and $R_k$. When $(D_k - R_k)$ is positive, the element tends to be a reason type, and when $(D_k - R_k)$ is negative, the element tends to be an influencing type. In other words, the positive or negative value of the element indicates which role it plays during e-learning decision making, either influencing other elements or being influenced by other elements. The causal diagram takes $(D_k + R_k, D_k - R_k)$ as an ordered pair, $(D + R)$ as the horizontal axis and $(D - R)$ as the vertical axis. The causal diagram can simplify complex causal relationships into a visible structure, which is easy to understand, and directly shows the levels of mutual influence among the various elements and the interacting situations. With the assistance of the causal diagram, decision makers can rapidly make a proper decision depending on the influencing or influenced attribute of the element [10].

CONCLUSIONS AND IMPLICATIONS

Conclusions

A larger value of D+R (prominent value) indicates that the evaluated element (item) plays a more important role during the entire assessment process of whether to undertake e-learning. Namely, this element may directly influence a learner's willingness to take part in e-learning. Considering the convenience of management practice, this study selected elements whose values of D+R were larger than the mean value (7.0048), and obtained a total of five elements for evaluation. The levels of importance are in the following order: *C8. the content quality of the teaching materials*; *C5. the richness of the e-learning teaching materials*; *C7. the presentation quality of the teaching materials*; *C6. the correctness of the e-learning teaching materials*; and *C9. the interactivity of the teaching materials* (shown in Table 1).

In other words, the elements having a significant influence belong to the *content quality of the teaching materials*. Consequently, efforts should be made to ensure a high level of the content quality of the teaching materials of e-learning in order to attract learners. On the other hand, *C4. the safety of systems*; *C6. the correctness of the e-learning teaching materials*; and *C3. the response speed of the systems* do not have much influence on e-learning (shown in Table 1). It means that during the promotion of e-learning in Taiwan, learners are generally satisfied with the safety and response speed of e-learning systems [1][5][10].

Table 1: Aggregation of the overall influencing relationships of e-learning.

| Sum of column (D) | | Sum of row (R) | | D + R | | D - R | |
|---|---|---|---|---|---|---|---|
| Items | Value | Items | Value | Items | Value | Items | Value |
| C1 | 4.1818 | C4 | 4.4465 | C8 | 7.4523* | C1 | 1.6128 |
| C9 | 4.0254 | C6 | 4.3852 | C5 | 7.2937* | C9 | 0.9828 |
| C7 | 3.601 | C8 | 4.0967 | C7 | 7.2289* | C2 | 0.0138 |
| C5 | 3.5793 | C5 | 3.7144 | C6 | 7.1691* | C7 | -0.0268 |
| C8 | 3.3555 | C7 | 3.6278 | C9 | 7.0680* | C5 | -0.1351 |
| C2 | 3.2581 | C3 | 3.4767 | C4 | 6.9822 | C3 | -0.3578 |
| C3 | 3.119 | C2 | 3.2443 | C1 | 6.7508 | C8 | -0.7412 |
| C6 | 2.7839 | C9 | 3.0426 | C3 | 6.5957 | C6 | -1.6013 |
| C4 | 2.5356 | C1 | 2.569 | C2 | 6.5023 | C4 | -1.9109 |

Note：*represents mean value larger than overall average value 7.0048

In columns and rows, the sum of the columns minus the sum of the rows produces the value of D - R (relation). A larger positive value for D - R (relation) indicates that the evaluated element has more significant influencing ability on learners' willingness to undertake e-learning, while a larger negative value for D - R (relation) indicates that the evaluated element has less influence on learners' willingness to take part in e-learning, which means the element is mainly influenced by other elements. Taking the values of D - R in Table 1 as an example, *C1. the design of the system interfaces* and *C9. the interactivity of the teaching materials*, etc, in sequence, are the top three elements that have a more significant influence on other elements, while *C4. the safety of systems* and *C6. the correctness of e-learning teaching materials* are elements that can be easily influenced by other elements. These study results are sufficient to explain the previous discoveries on system safety and correctness of e-learning teaching materials. In other words, organisations promoting e-learning should consider these two elements as must-have elements for quality requirements. Although

these two elements are not significant during learners' decision-making regarding e-learning, if these two elements are missing, learners may not consider e-learning as a necessary option [10].

Based on the mutual relationships between the evaluated elements, the researchers drew a relationship diagram of the different kinds of thrust and the important elements that influence e-learning (refer to Figure 1 for details). The visual diagram clearly presents the interactions among the elements, and their levels of influence on learners' willingness to undertake e-learning. According to the diagram, elements that are closer to the right have a more significant influence on the choice of e-learning, and elements located in the upper part of the coordinates influence the elements in the lower part.
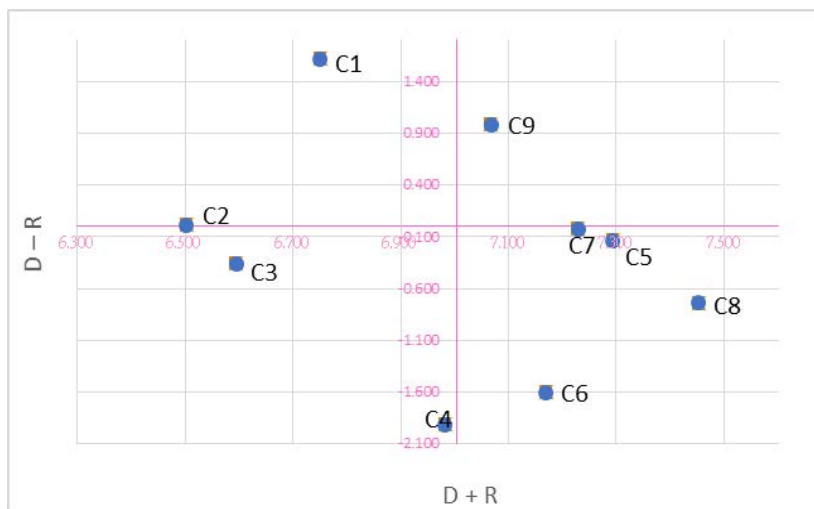


Figure 1: Relationship diagram of thrust and the important influencing elements on e-learning.

Implications and Limitations

The results of this study indicate that, in order to effectively promote e-learning, providers should first construct a good system interface, encouraging learners to feel that it is convenient and easy to use. This study discovered several implications for management practice:

1. Establishing an e-learning system, which is suitable for learners and easy to use is the most important foundation when promoting e-learning;
2. Connecting e-learning to an individual's promotion or salary increase is more effective than policy requirements or encouragement from supervisors because the former can enable the individual to more directly recognise the importance of e-learning;
3. Enable learners to have a high-quality e-learning experience each time, which will help to increase learners' willingness to undertake e-learning. In other words, e-learning is influenced by learners' internal recognition mechanism when learning knowledge or skills. If learners find that they can actually learn something, their willingness to take part in e-learning will be enhanced. This discovery conforms to the idea of Fusilier and Durlabhji [9];
4. the effective implementation of e-learning in junior colleges in Taiwan depends on learners' initial perceptions of its usefulness, i.e. learners find e-learning easy to use, and receive good feedback during their e-learning. Meanwhile, good quality teaching materials are very important.

To summarise, the e-learning systems of junior colleges nowadays are good and stable. As a result, in order to effectively promote e-learning, an effective strategy for junior colleges would be to take the quality of the teaching materials as the foundation, and enable learners to obtain the results they expect.

The study results show that among those elements that influence learners' decisions to undertake e-learning or not, self-regulated learning is the crucial core. However, neither domestic nor foreign literature has yet reached agreement on the connotation and definition of self-regulated learning. For example, some research emphasises the layer of motivation [5], some emphasise the self-efficacy of learners [2], and some focus on the cognitive competence of learners [5].

There is also some research that values how teachers guide students when undertaking independent learning [5][9]. This concept is often mentioned in the same breath as self-directed learning, self-instruction, active learning, self-planned learning, self-managed learning and self-monitored learning, which causes confusion over the applicability of the definitions and connotations. The definition confusion over this concept may influence the applicability of the subsequent deductions of this study.

In addition, as e-learning defined by this study is centred on students, the investigations and deductions were conducted from the viewpoint of learners. Consequently, it is suggested that subsequent studies could further clarify the definitions

and applicability of ideas surrounding e-learning and e-teaching, and regenerate operational definitions to enhance the external validity of the study.

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