MOOCs in Smart Education: Comparative Study by Applying AHP and COPRAS Method

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Abstract—The current educational system radically changed during the last years and continues to grow. The Smart education is now a typical feature of education issue from a new information and communication technologies and of the introduction of these new technologies in the institutional learning. The introduction of these technologies in education has been associated with a rise evolution of people's quality of life by improving teaching and learning. MOOCs, are some of the recent technologies, which have been introduced recently in the higher education sector. This article focuses on the level of intelligence introduced into the online teaching and learning process. Different MOOCs will be presented, compared and analyzed according to a comparative study of multicriteria analysis by applying decision analysis methods; Analytical Hierarchy Process (AHP) and Complex Proportional Assessment Method (COPRAS) to show the importance of MOOC platforms and their impact in smart education.

Keywords—Mooc, smart education, e-learning, COPRAS method, AHP, multiple criteria, COVID-19

1 Introduction

The new changes in information and communication technologies are a fact that is reflected in society. One example is the Internet, which is involved in most of our daily actions. The educational field is aware of this, especially in the present day; due to the COVID-19 crisis, it has become the main means of developing teaching and learning processes. This develops at all stages of education, especially in the academic context [1] [2] [3] [4] [5]. In this educational context, various techno-didactic tools offered by the Internet are effective for the educational development of students. These tools allow students to improve their creativity and critical thinking [4] [6] [7] [8] [9].

One of the developments recently led to new concepts and projects "Massive Open Online Courses (MOOC)" in 2008 [10].

The aim of this project is that anyone with an Internet connection can easily and freely participate in the courses offered all over the world. Recently, the demand for

MOOCs is growing, requiring rapid knowledge gathering and lifelong learning. Therefore, new methods must be considered to meet the needs of the learners.

Moreover, the unprecedented COVID-19 pandemic has also played a catalytic role in the education system, whose digital transformation is struggling to spread widely [11]. This health crisis poses many challenges around the world, but for higher education institutions, they were accelerated their digital transformation.

Since a large number of open online courses have recently been introduced as a modern learning method, the field of MOOC research is still in its infancy and the literature available for the analysis of MOOC platforms is relatively limited [12].

The aim of this analysis is to identify the main characteristics of this type of learning by comparing the most commonly used Massive Open Online Course platforms according to the analysis criteria they provide, and to consider that they will generate the interests of all parties, not only universities, but also those who cause commercial interests. There are opportunities to explore in this area. This is one of the main reasons why start-ups like Coursera are starting to cooperate with world-famous universities; other universities have decided to offer their courses online through platforms like edX, and even big universities are considering MOOC methods in the higher education sector [13].

2 Related work

Nowadays, the rapid evolution of information and communication technologies, has led to the emergence of new opportunities in many fields, including in the fields of education and vocational training.

In addition, the serious health crisis that we have been experiencing since March 2020 has considerably accelerated the digital switchover all over the world. There is no doubt that the spirit of innovation and the deployment of digital technologies have contributed to strengthening collaboration between public and private agents to ensure the continuity of the services offered to their users (citizens and organizations).

Therefore, a new need is emerging in online education: Platforms that host different courses around the world, free or paid, often with educational video content, provided by prestigious universities, instructors or even experienced users. This is the reason why some researchers have conducted comparative studies and analyzes for the recognition of current MOOCs platforms.

A study was carried out [14] "A Comparative Analysis of MOOC (Massive Open Online Course) Platforms" brought together the main aspects that characterize a MOOC platform, the study was based on four platforms: Coursera, Udemy, Udacity and EdX, in order to draw up a comparison between them, based on the data collected for each. For each type of functionality, the study highlighted the advantages and shortcomings of the platforms and the suitability for a lifetime user profile.

An exploratory research titled "Massive Open Online Courses (MOOCs): A Comparative Analysis of the Main Platforms" [15] investigated the main characteristics of

the most popular MOOC platforms today, Coursera and EdX. The platforms were compared from both a technical and user perspective and each detailed feature was rated based on its strengths and weaknesses.

A different comparative study on the usability results of the three MOOC platforms (EdX, Coursera and Udacity) [16] showed that the user task success rate was rather high (> = 90%) for these evaluated platforms. In addition, no significant difference between platforms was found on the success of user tasks.

3 Moocs in smart education

The 21st century has witnessed many innovations in the information and communication technology (ICT) sector, especially in education, which [17] called "a lot of great new digital things in education over the years". By "big things" we are referring to innovations made in the field of education, in particular the use of Moocs to improve distance learning [18].

The purpose of Moocs in Education is to support the efforts of teachers and largely take over the time consuming tasks of teachers such as keeping accurate records and scoring scripts during exams etc. Innovations in Moocs technology that are responsible for the emergence of intelligent systems lessons in school and education systems have given most researchers plenty of reasons to start questioning the role and place that Moocs have should really play in the education sector today. It is from this premise that this article seeks to study and critically analyze different Moocs and its direct impact on the field of education in order to assess and compare its effects and implications on classrooms today, on online education platforms and on human development in general [19].

Figure 1 shows the development of the major MOOCs between 2010 and 2021, but since the beginning of this century, there has been an evolution towards a smaller form does it attest to the failure of the Moocs to find a viable economic model, a lasting form? On the contrary, the variations of this type of platform show that there is not just one model, and perpetually question the ways of learning and teaching.

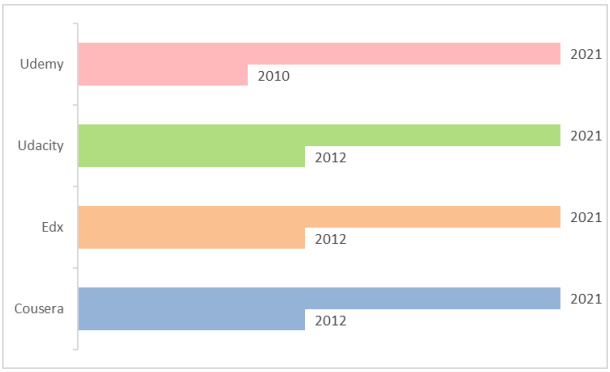

Fig. 1. Timeline of development of major MOOCs

While they are increasingly integrated into training, MOOCs remain a still developing and evolving form of education [20]. In addition, it is perhaps this experimental nature that constitutes their greatest wealth: by constantly adapting to the needs of structures and learners, the Moocs constantly question education in the Internet age [21].

The most important prospect here is the interoperability and compliance between the different MOOCs platforms, which has given the most famous universities to take the initiative to choose one of these different systems, including this point of view. However, we decided to focus our study on; Udemy, Udacity, Edx, Coursera are MOOCs systems as shown in Table 1.

Table 1. List of Moocs systems

Moocs	Founded Year
Udemy	2010
Udacity	2011
Edx	2012
Coursera	2012

A brief description of each of them is presented below.

Udemy. Udemy created in 2010, is arguably a platform that offers the most courses. Udemy currently has over 80,000 courses. Generally, the courses that are offered on the site are offered by professionals and experts from all over the world. The lessons are partly free, but the paid mode is also included [22].

Udacity. Udacity is a for-profit MOOC platform that focuses on career development through technical and professional online courses. The subjects cover six areas of study, which include data science, cloud computing, autonomous systems, and artificial intelligence. Students can also take programming and development courses [23].

Edx. Edx Launched in 2012, it has nearly 5 million participants in 2015. The edX platform offers university-level courses. The courses are offered in 6 different languages, notably French. It is mainly funded by Harvard University and MIT (Massachusetts Institute Technology). More than fifty universities, associations and various organizations regularly post courses there [24].

Coursera. Coursera is an American platform founded in 2012 and currently has more than 25 million users. In 2017, more than 2,000 MOOC courses in several languages were presented there. The platform hosts prestigious American universities such as Stanford, Duke, Berklee, but also works in collaboration with French universities such as Paris Tech Bridge School, Higher Normal School, Hec Paris, Sciences Po and many others ... [25].

4 Choosing the weight criteria using the Ahp method

4.1 Selecting evaluation criteria

Based on the research and efforts carried out on studies concerning smart education platforms [26] [27] [28] [29] [30] [31] and the EduTools WCET (Western Cooperative

for Educational Telecommunications) [32] site which lists more than 50 MOOCs and LMS systems, which made a comparison of 47 criteria and characteristics of these systems. The criteria were selected in order to know the weaknesses and the problems localized at the level of the MOOCs platforms and to solve them. We define 10 possible analysis criteria, which we will use in the multicriteria study to ensure better analysis and optimization, and these criteria are as follows:

- **Location-Aware (C1):** In intelligent learning, real-time localization is an important data that systems need to adapt the content and the situation to the learner; this feature allows teachers to monitor the position of learners in real time for a specified period during a lesson.
- **Context sensitive (C2):** Explore different business scenarios and information; this feature allows you to discover the different types of activities and training adapted to the needs and specific situations of learners, respecting as much as possible the learning profiles and the micro-context scenario of the course.
- **Socially-Aware (C3):** The use of social media has become essential in the daily life of modern man. However, for this indispensable tool to achieve its objectives, it is important to take the time to fully understand their nature and role in social awareness to detect social relationships.
- **Interoperability (C4):** A smart system can only be effective if standards-based interoperability can be guaranteed for the different resources, services and open platforms.
- **Seamless Connection (C5):** Seamlessly switch connection between multiple devices and provide continuous service when a device connects.
- **Adaptability (C6):** Pushing learning resources according to access, preference and demand.
- **Ubiquitous (C7):** predicting learner demands until clearly expressed, providing visual and transparent access to learning resources and services.
- **Whole Record (C8):** Recording learning path data to mine and analyze in depth, then providing reasonable assessment, suggestions and pushing on-demand service.
- **Natural Interaction (C9):** Transferring the senses of multimodal interaction, including position and facial expression recognition.
- **High Engagement (C10):** Immersion in multidirectional interactive learning experiences in technology-enriched environments.

4.2 AHP methodology

The AHP method is a method suitable for multicriteria decision problems, that is to say comprising several solutions satisfying a set of criteria. The method's approach is to simplify the problem by breaking it down into a hierarchical system. Thomas Saaty [33] is the originator of this method and created it in the 1970s. We call alternatives the solutions of the decision-making problem, criteria the parameters on which the alternatives are evaluated, sub-criteria the parameters belonging to a criterion and on which the alternatives are evaluated and evaluator the person who will do the evaluations [34].

We speak of a 2-level problem when it admits sub-criteria; conversely, it is a level one problem. Analytical hierarchy process (AHP) consists of following steps:

Define decision criteria in the form of a hierarchy of objectives. AHP uses a normalized comparison scale for the relative importance shown in Table 2, for the pair-wise comparison, the comparisons made in the indices using "Criteria 1-9 Proportion".

Table 2. Pairwise comparison scale of attributes

Intensity of importance	Definition
1	Equal importance (no preference)
2	Intermediate between 1 and 3
3	Moderately more important
4	Intermediate between 3 and 5
5	Strongly more important
6	Intermediate between 5 and 7
7	Very strongly important
8	Intermediate between 7 and 9
9	Extremely strongly more important
1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9	Reciprocals of 2, 3, 4, 5, 6, 7, 8, and 9

- If they are equally important, then to take 1;
- If the former is slightly important than the latter then the former taking 3 and the latter taking 1 / 3;
- If the former is strongly important than the latter then the former taking 5 and the latter taking 1 / 5;
- If the former is very strongly important than the latter then the former taking 7 and the latter taking 1 / 7;
- If the former is extremely important than the latter then the former taking 9 and the latter taking 1 / 9;
- Between their values are for 2, 4, 6, 8.

Development of judgment matrices A by pairwise comparisons

$$A = \{a_{ij}\} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & a_{n3} & \cdots & a_{nn} \end{bmatrix} \quad (1)$$

After a judgment matrix, a priority vector to weight the elements of the matrix is calculated

$$W_i = \frac{\sqrt[n]{\prod_{j=1}^{n} a_{ij}}}{\sum_{i=1}^{n} \sqrt[n]{\prod_{j=1}^{1} a_{ij}}} \; (\mathrm{i}, \mathrm{j} = 1, 2, \ldots, \mathrm{n}) \quad (2)$$

After the generation of priority vector, inconsistency in pair-wise comparison may occur due to subjective human judgment error. Therefore, it is important to

check the consistency in response through a consistency index (CI) by using the following equation.

$$CI = (\lambda_{max} - n)/(n - 1) \quad (3)$$

After the generation of priority vector, inconsistency in pair-wise comparison may occur due to subjective human judgment error. Therefore, it is important to check the consistency in response through a consistency index (CI) by using the following equation.

$$CR = CI/RCI \quad (4)$$

Table 3. Random consistensy index

Matrix Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.51

When the CR<0.10, we think the judging matrix has satisfying consistency. Otherwise, the comparison matrices are not consistent; we should adjust the elements in the matrixes and carry out a consistency test until they are consistent.

In our study, we found as a result of consistency (CR) received CR=0,08 which is less than 0,1, thus that the comparison is consistent.

We can calculate the weights of the hierarchical structure for the evaluation of MOOCs on smart education by the AHP method. The exact weights of the criteria are obtained and which are indicated in Table 4:

Table 4. Results from judgment matrices of criteria

Criteria	**Weight**
Location-Aware	0,208
Socially-Aware	0,162
Accessibility	0,118
Interoperability	0,101
Seamless Connection	0,100
Adaptability	0,078
Ubiquitous	0,070
Whole record	0,065
Natural Interaction	0,051
High Engagement	0,046

5 Selecting of the best MOOCs applying the COPRAS method

5.1 COPRAS (complex proportional assessment) method

In 1994, Zavadskas and Kaklauskas presented the COPRAS method, which is a reference ranking method for ranking different alternatives (Zavadskas et al.) [35]. The COPRAS method considers the performance of the alternatives with respect to different criteria. This method selects the best decision considering both the ideal-best and the ideal-worst solutions. Steps to rank alternatives by the COPRAS method are as follows:

For The normalized decision-making matrix R is constructed. For normalization in COPRAS method the following formula is used:

$$R = r_{ij} = \frac{a_{ij}}{\sum_{i=1}^{m} a_{ij}} \tag{5}$$

Where a_{ij} is the performance of the i-th alternative with respect to the j-th criterion r_{ijis} its normalized value, and m is number of alternatives.

Forming of the weighted normalized decision matrix $V = \left[v_{ij}\right]_{mxn}$ Weighted normalized value v_{ij} is calculated using the formula:

$$v_{ij} = w_j . r_{ij} \ , i = 1, \dots, m \ ; \ j = 1, \dots, n \tag{6}$$

Where w_j represents the weight/importance of the j-th criteria/attributes, and $\sum_{j=1}^{n} w_j = 1$.

For The normalized decision-making matrix R is constructed. For normalization in COPRAS method the following formula is used:

$$P_i = \sum_{j=1}^{n} v_{ij} \mid j \in j^{max} , i = 1, \dots, m \tag{7}$$

$$R_i = \sum_{j=1}^{n} v_{ij} \mid j \in j^{min} , i = 1, \dots, m \tag{8}$$

Where: j^{max} represents a set of revenue criteria/attributes, and j^{min} a set of expenditure criteria/attributes.

Calculation of the relative importance (weight) of each alternative. The relative importance (weight) Qi of i-th alternative is calculated as follows:

$$Q_i = P_i + \frac{\min R_i \sum_{i=1}^{m} R_i}{R_i \sum_{i=1}^{m} \frac{\min R_i}{R_i}} \tag{9}$$

Formula (9) can also be written in simplified form as follows:

$$Q_i = P_i + \frac{\sum_{i=1}^{m} R_i}{R_i \sum_{i=1}^{m} \frac{1}{R_i}} \tag{10}$$

Calculation of the relative importance (weight) of each alternative. The relative importance (weight) Qi of i-th alternative is calculated as follows:

$$A^* = \{A_i \mid \max Q_i\} \tag{11}$$

5.2 The choice of the best MOOC by applying the COPRAS method

Table 5. The given decision matrix

Weight	**0,208**	**0,162**	**0,118**	**0,101**	**0,1**	**0,078**	**0,07**	**0,065**	**0,051**	**0,046**
Opt	**Min**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Max**
Criteria	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
Alt										
A1	12	12,5	1,15	18	12	12,5	1,15	8	9	3,1
A2	9,9	10,5	3	2	10,9	2	2,2	11	18	5,3
A3	13,5	18,5	3	22	15,5	18,5	1,3	23	14,3	6,7
A4	6,5	8	1	14	8,5	7	2	13	2	1,45
SUM	41,9	49,5	8,15	56	46,9	40	6,65	55	43,3	16,55

5.3 For a given decision matrix

The procedure consisting of selecting the most acceptable solution using the method of COPRAS will be presented by applying the following steps:

Formation of normalized decision matrix

$$R = \begin{bmatrix} 0{,}286 & 0{,}253 & 0{,}141 & 0{,}321 & 0256 & 0{,}313 & 0{,}173 & 0{,}145 & 0.208 & 0{,}187 \\ 0{,}236 & 0{,}212 & 0368 & 0{,}036 & 0{,}232 & 0{,}050 & 0{,}331 & 0{,}200 & 0{,}416 & 0{,}320 \\ 0{,}322 & 0{,}374 & 0{,}368 & 0{,}393 & 0{,}330 & 0{,}463 & 0{,}195 & 0{,}418 & 0{,}330 & 0{,}405 \\ 0{,}155 & 0{,}162 & 0{,}123 & 0{,}250 & 0{,}181 & 0{,}175 & 0{,}301 & 0{,}236 & 0{,}046 & 0{,}088 \end{bmatrix} \quad (12)$$

$$R = \begin{bmatrix} 0{,}412 & 0{,}500 & 0{,}400 & 0{,}154 & 0{,}600 & 0{,}125 \\ 0{,}176 & 0{,}188 & 0{,}133 & 0{,}231 & 0{,}200 & 0{,}125 \\ 0{,}176 & 0{,}063 & 0{,}067 & 0{,}308 & 0{,}067 & 0{,}375 \\ 0{,}176 & 0{,}125 & 0{,}200 & 0{,}077 & 0{,}067 & 0{,}250 \\ 0{,}059 & 0{,}125 & 0{,}200 & 0{,}231 & 0{,}067 & 0{,}125 \end{bmatrix} \quad (13)$$

Forming weighted normalized decision matrix

$$W = \begin{bmatrix} 0{,}208 & 0{,}162 & 0{,}118 & 0{,}101 & 0{,}100 & 0{,}078 & 0{,}070 & 0{,}065 & 0{,}051 & 0{,}046 \end{bmatrix} \quad (14)$$

$$R = \begin{bmatrix} 0{,}286 & 0{,}253 & 0{,}141 & 0{,}321 & 0256 & 0{,}313 & 0{,}173 & 0{,}145 & 0.208 & 0{,}187 \\ 0{,}236 & 0{,}212 & 0368 & 0{,}036 & 0{,}232 & 0{,}050 & 0{,}331 & 0{,}200 & 0{,}416 & 0{,}320 \\ 0{,}322 & 0{,}374 & 0{,}368 & 0{,}393 & 0{,}330 & 0{,}463 & 0{,}195 & 0{,}418 & 0{,}330 & 0{,}405 \\ 0{,}155 & 0{,}162 & 0{,}123 & 0{,}250 & 0{,}181 & 0{,}175 & 0{,}301 & 0{,}236 & 0{,}046 & 0{,}088 \end{bmatrix} \quad (15)$$

$$V = W * R \quad (16)$$

$$V = \begin{bmatrix} 0{,}060 & 0{,}041 & 0{,}017 & 0{,}032 & 0{,}026 & 0{,}024 & 0{,}012 & 0{,}009 & 0{,}011 & 0{,}009 \\ 0{,}049 & 0{,}034 & 0{,}043 & 0{,}004 & 0{,}023 & 0{,}004 & 0{,}023 & 0{,}013 & 0{,}021 & 0{,}015 \\ 0{,}067 & 0{,}061 & 0{,}043 & 0{,}040 & 0{,}033 & 0{,}036 & 0{,}014 & 0{,}027 & 0{,}017 & 0{,}019 \\ 0{,}032 & 0{,}026 & 0{,}014 & 0{,}025 & 0{,}018 & 0{,}014 & 0{,}021 & 0{,}015 & 0{,}002 & 0{,}004 \end{bmatrix} \quad (17)$$

Determining the value of P and R

$$P = \begin{bmatrix} 0{,}145 \\ 0{,}101 \\ 0{,}210 \\ 0{,}120 \end{bmatrix} \quad (18)$$

$$R = \begin{bmatrix} 0{,}076 \\ 0{,}093 \\ 0{,}110 \\ 0{,}047 \end{bmatrix} \quad (19)$$

Calculate the resulting performance of each MOOCs and choosing the most appropriate one

$$Q_i = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \end{matrix} \begin{bmatrix} 1{,}539 \\ 1{,}249 \\ 1{,}172 \\ 2{,}393 \end{bmatrix} \begin{matrix} 2 \\ 3 \\ 4 \\ 1 \end{matrix} \quad (20)$$

Calculate based on the values of Qi the most acceptable MOOCs. Figure 2 shows the distribution of the four curves representing the final results of performance of each MOOCs compared with the criteria for comparison. The best performance score is Q = 2,393. We can express that none of these MOOCs could reach the perfect score according to this comparative study.

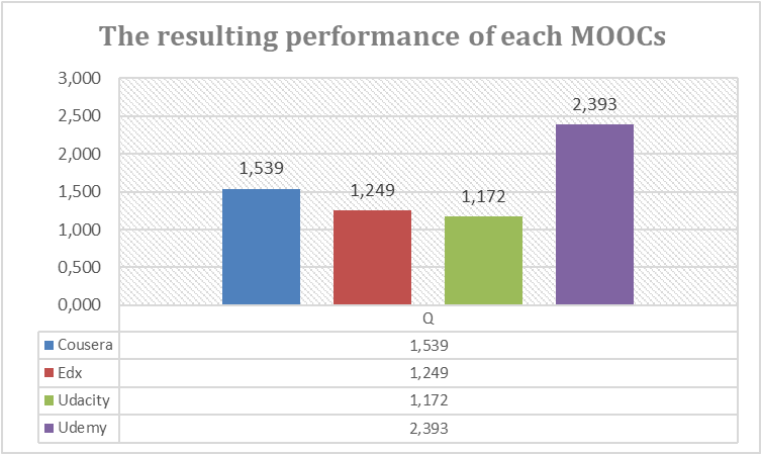

Fig. 2. The resulting performance of each MOOCs

Obtained results of the study indicates that the overall score of the MOOCs platforms is higher compared to other e-learning MOOCs with a score of Q = 2,393, is the correct choice in the existing conditions and it always have the best score on all of the selected criteria., Coursera with a score of Q = 1,539, the other learning moocs come last, respectively, follows them; Edx with a score of Q=1,249, Udacity of Q=1,172 that is the lowest.

6 Conclusion

The new changes in information and communication technologies are a fact that is reflected in society, it has been quickly advanced and we will be obliged to use it, as well to dispose it in the education sector. Recently, the Moocs systems were held among the ranks of development and evolution technology. This study also gives a great contribution for professionals and researchers to help them to choose the best existing systems in smart education according to their needs and criteria that are most important to them.

The proposed methodology on AHP basic method to determine the weights of the criteria and COPRAS method that will help in the selection of Moocs in Smart Education. Methodologies may include a number of objective criteria and offer simpler and more consistent in the selection of Moocs. It can be applied to the performance evaluation of other types of Moocs. Moreover, the choice of Moocs can be based on different criteria, not only in what we have used in our work. we have seen that these Moocs systems are still in development and in perspective, Since the perspectives are directly linked to smart education evolution in the new technologies area, any evolution can be envisaged in a smart education and the way to use this Moocs. In future work, we will propose a new approach to improve the realiability and performance of moocs in smart education through recent technologies such as IoT [36], Big Data [37], Virtual Reality [38], Semantic Web [39], Gamification [40] …

7 References

[1] Baer, W. S. (1998). Will the internet transform higher education?. Santa Monica, CA: Rand.

[2] Shumakova, S. Y., Shugaeva, E. A., Orlova, I. K., Lakhtin, A. Y., Sadekova, S. R., & Vakulenko, A. N. (2020). Distance education of students: a study of social and psychological opportunities and limitations. Laplage em Revista, 6(Extra-C), 282-291. https://doi.org/10.24115/S2446-622020206Extra-C653p.282-291

[3] Datu, J. A. D., Yang, W., Valdez, J. P. M., & Chu, S. K. W. (2018). Is facebook involvement associated with academic engagement among Filipino university students? A cross-sectional study. Computers & Education, 125, 246-253. https://doi.org/10.1016/j.compedu.2018.06.010

[4] Segura-Robles, A., Moreno-Guerrero, A. J., Parra-González, M. E., & López-Belmonte, J. (2020). Review of research trends in learning and the internet in higher education. Social Sciences, 9(6), 101. https://doi.org/10.3390/socsci9060101

[5] Moorthy, K., Yee, T. T., T'ing, L. C., & Kumaran, V. V. (2019). Habit and hedonic motivation are the strongest influences in mobile learning behaviours among higher education students in Malaysia. Australasian Journal of Educational Technology, 35(4). https://doi.org/10.14742/ajet.4432

[6] Eggers, F., Lovelace, K. J., & Kraft, F. (2017). Fostering creativity through critical thinking: The case of business start- up simulations. Creativity and Innovation Management, 26(3), 266-276. https://doi.org/10.1111/caim.12225

[7] Segura-Robles, A., Moreno-Guerrero, A. J., Parra-González, M. E., & López-Belmonte, J. (2020). Review of research trends in learning and the internet in higher education. Social Sciences, 9(6), 101. https://doi.org/10.3390/socsci9060101

[8] Kurt, E., Ovalı, İ. E., Gülaçtı, U., Canpolat, S., Kafadar, H., Lok, U., ... & Yücetaş, Ş. C. (2021). Psychosocial status and attitudes of healthcare workers amid the COVID-19 pandemic. https://doi.org/10.21203/rs.3.rs-40091/v2

[9] Nazar, H., Rathbone, A., & Husband, A. (2021). The development of undergraduate pharmacy students as reflective thinkers for the evolving field of pharmacy. International Journal of Pharmacy Practice, 29(3), 271-276. https://doi.org/10.1093/ijpp/riab005

[10] Liu, M., Zha, S., & He, W. (2019). Digital transformation challenges: A case study regarding the MOOC development and operations at higher education institutions in china. TechTrends, 63(5), 621-630. https://doi.org/10.1007/s11528-019-00409-y

[11] Huang, R. H., Liu, D. J., Guo, J., Yang, J. F., Zhao, J. H., Wei, X. F., ... & Chang, T. W. (2020). Guidance on flexible learning during campus closures: Ensuring course quality of higher education in COVID-19 outbreak. Beijing: Smart Learning Institute of Beijing Normal University.

[12] Chen, C. C., Lee, C. H., & Hsiao, K. L. (2018). Comparing the determinants of non-MOOC and MOOC continuance intention in Taiwan: Effects of interactivity and openness. Library Hi Tech. https://doi.org/10.1108/LHT-11-2016-0129

[13] Miah, S. J., Miah, M., & Shen, J. (2020). Editorial note: Learning management systems and big data technologies for higher education. Education and Information Technologies, 25(2), 725-730. https://doi.org/10.1007/s10639-020-10129-z

[14] Conache, M., Dima, R., & Mutu, A. (2016). A comparative analysis of MOOC (Massive Open Online Course) platforms. Informatica Economica, 20(2). https://doi.org/10.12948/issn14531305/20.2.2016.01

[15] Funieru, L. M., & LĂZĂROIU, F. (2016). Massive Open Online Courses (MOOCs): A Comparative Analysis of the Main Platforms. Informatica Economica, 20(2). https://doi.org/10.12948/issn14531305/20.2.2016.04

[16] Tsironis, A., Katsanos, C., & Xenos, M. (2016, April). Comparative usability evaluation of three popular MOOC platforms. In 2016 IEEE Global Engineering Education Conference (EDUCON) (pp. 608-612). IEEE. https://doi.org/10.1109/EDUCON.2016.7474613

[17] Ikedinachi, A. P., Misra, S., Assibong, P. A., Olu-Owolabi, E. F., Maskeliūnas, R., & Damasevicius, R. (2019). Artificial intelligence, smart classrooms and online education in the 21st century: Implications for human development. Journal of Cases on Information Technology (JCIT), 21(3), 66-79. https://doi.org/10.4018/JCIT.2019070105

[18] Castaño-Muñoz, J., & Rodrigues, M. (2021). Open to MOOCs? Evidence of their impact on labour market outcomes. Computers & Education, 104289. https://doi.org/10.1016/j.compedu.2021.104289

[19] Vargo, D., Zhu, L., Benwell, B., & Yan, Z. (2021). Digital technology use during COVID-19 pandemic: A rapid review. Human Behavior and Emerging Technologies, 3(1), 13-24. https://doi.org/10.1002/hbe2.242

[20] Jing, Z., & Tian, L. M. (2021, April). Research on Blended Teaching of" Electronic Technology and Application" Course Based on MOOC. In 2021 2nd International Conference on

Big Data and Informatization Education (ICBDIE) (pp. 617-620). IEEE. https://doi.org/10.1109/ICBDIE52740.2021.00146
[21] Zhu, M. (2021). Enhancing MOOC learners' skills for self-directed learning. Distance Education, 1-20. https://doi.org/10.1080/01587919.2021.1956302
[22] Nurhudatiana, A., & Caesarion, A. S. (2020, February). Exploring User Experience of Massive Open Online Courses (MOOCs) A Case Study of Millennial Learners in Jakarta, Indonesia. In Proceedings of the 2020 9th International Conference on Educational and Information Technology (pp. 44-49). https://doi.org/10.1145/3383923.3383968
[23] Bakar, N. F. A., Yusof, A. F., Iahad, N. A., & Ahmad, N. (2018, August). The implementation of gamification in massive open online courses (MOOC) platform. In International Conference on User Science and Engineering (pp. 183-193). Springer, Singapore. https://doi.org/10.1007/978-981-13-1628-9_17
[24] Khalil, M., & Belokrys, G. (2020). OXALIC: an Open edX Advanced Learning Analytics Tool. In 2020 IEEE Learning With MOOCS (LWMOOCS) (pp. 185-190). IEEE. https://doi.org/10.1109/LWMOOCS50143.2020.9234322
[25] Acquatella, F., Fernandez, V., & Houy, T. (2019). The Coursera Case as the Prefiguration of the Ongoing Changes on the MOOC Platforms. In Advanced Web Applications and Progressing E-Learning 2.0 Technologies in Higher Education (pp. 20-34). IGI Global. https://doi.org/10.4018/978-1-5225-7435-4.ch002
[26] Alshurideh, M. T., Kurdi, B. A., AlHamad, A. Q., Salloum, S. A., Alkurdi, S., Dehghan, A., ... & Masa'deh, R. E. (2021, June). Factors affecting the use of smart mobile examination platforms by universities' postgraduate students during the COVID 19 pandemic: an empirical study. In Informatics (Vol. 8, No. 2, p. 32). Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/informatics8020032
[27] Abdulla, M. A., & Esmaeel, A. M. (2019). Providing information through smart platforms: an applied study on academic libraries in Saudi universities. Journal of Education, Society and Behavioural Science, 1-24. https://doi.org/10.9734/jesbs/2019/v30i430134
[28] Chi, Y., Qin, Y., Song, R., & Xu, H. (2018). Knowledge graph in smart education: A case study of entrepreneurship scientific publication management. Sustainability, 10(4), 995. https://doi.org/10.3390/su10040995
[29] El Emrani, S., El Merzouqi, A., & Khaldi, M. (2019). Massive online open courses platforms: analysis and comparative study of some pedagogical and technical characteristics. International Journal of Smart Education and Urban Society (IJSEUS), 10(1), 25-36. https://doi.org/10.4018/IJSEUS.2019010103
[30] Bakhouyi, A., Dehbi, R., Talea, M., & Batouta, Z. I. (2016). Selection of commercial and open source LMS: Multi-criteria analysis and advanced comparative study. International Journal of Applied Engineering Research, 11(7), 4980-4989.
[31] Bakhouyi, A., Dehbi, R., & Talea, M. (2016). Multiple Criteria Comparative Evaluation on the Interoperability of LMS by Applying COPRAS Method. FTC 2016-Future Technologies Conference 2016. https://doi.org/10.1109/FTC.2016.7821635
[32] EduTools–WCET. Website at http://www.wcet.wiche.edu
[33] Saaty, T. L. (1988). What is the analytic hierarchy process?. In Mathematical models for decision support (pp. 109-121). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-83555-1_5
[34] Golden, B. L., Wasil, E. A., & Harker, P. T. (1989). The analytic hierarchy process. Applications and Studies, Berlin, Heidelberg, 2. https://doi.org/10.1007/978-3-642-50244-6
[35] Zavadskas, E. K., Kaklauskas, A., & Sarka, V. (1994). The new method of multicriteria complex proportional assessment of projects. Technological and Economic Development of Economy.

[36] Yang, Y., & Yu, K. (2016). Construction of Distance Education Classroom in Architecture Specialty Based on Internet of Things Technology. International Journal of Emerging Technologies in Learning, 11(5). https://doi.org/10.3991/ijet.v11i05.5695

[37] Huda, M., Maseleno, A., Atmotiyoso, P., Siregar, M., Ahmad, R., Jasmi, K., & Muhamad, N. (2018). Big data emerging technology: insights into innovative environment for online learning resources. International Journal of Emerging Technologies in Learning (iJET), 13(1), 23-36. https://doi.org/10.3991/ijet.v13i01.6990

[38] Ji, Y. (2021). Use of Virtual Reality Technology in Animation Course Teaching. International Journal of Emerging Technologies in Learning (iJET), 16(17), 191-208. https://doi.org/10.3991/ijet.v16i17.25337

[39] Bakhouyi, A., Dehbi, R., Banane, M., & Talea, M. (2019, July). A semantic web solution for enhancing the interoperability of e-learning systems by using next generation of SCORM specifications. In International Conference on Advanced Intelligent Systems for Sustainable Development (pp. 56-67). Springer, Cham. https://doi.org/10.1007/978-3-030-36653-7_5

[40] Liu, Z. Y., Shaikh, Z., & Gazizova, F. (2020). Using the concept of game-based learning in education. International Journal of Emerging Technologies in Learning (iJET), 15(14), 53-64. https://doi.org/10.3991/ijet.v15i14.14675

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