

Evaluating the Suitability of Online Courses using the ELECTRE Method

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ABSTRACT

This study aims to explore the use of the Elimination and Choice Expressing Reality (ELECTRE) method for selecting and evaluating online courses. The pairwise comparison method determined a set of criteria and weights, including course quality, instructor experience, accreditation, student engagement, flexibility, technical support, and cost. The study used a mixed-methods approach, which means it combines quantitative and qualitative data. The ELECTRE method was then applied to rank five online courses based on their suitability for the participants' needs and expectations. The concordance and discordance indices were calculated for each course, and the net flow was used to determine the ranking. The results showed that the ELECTRE method can be a useful tool for participants in choosing and evaluating online courses based on a set of tailored criteria and weights. Future research could investigate how the results of the ELECTRE method can be combined with other methods to enhance the accuracy and validity of the ranking. Overall, the ELECTRE method provides a useful framework for participants to decide which online course is best suited to their individual preferences and goals.

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1. INTRODUCTION

The rise of online education has created a demand for efficient decision-making methods in selecting and evaluating online courses (Bai et al., 2023; Cui et al., 2023; Hardt et al., 2023). The ELECTRE method is a multi-criteria decision-making method that can be used to evaluate and rank online courses based on a set of criteria, such as cost, content, instructor experience, and student reviews. Additionally, a decision

support system (DSS) can provide decision-makers with the necessary information and tools to make informed decisions. By using the ELECTRE method and DSSs, students can make informed decisions when choosing online courses that meet their needs and expectations.

Choosing an important online course requires consideration of several factors, such as course quality, accreditation, and flexibility. A high-quality course should have engaging content, interactive activities, and assessments that measure the student's understanding of the material. Accreditation is important because it ensures that the course meets certain standards and is recognized by employers and other institutions. Flexibility is also crucial as online courses should allow students to learn at their own pace and on their own schedule. Therefore, students should select online courses that meet these criteria to obtain the education they need to succeed in their chosen field (Boulos, 2022; Efthymiou & Zarifis, 2021; Emanuel et al., 2021; Li et al., 2016).

Online courses have become a popular way to access education (Finlay et al., 2022; Shwartz-Asher et al., 2022; Zhang et al., 2022), and the ELECTRE method and DSSs can help students make informed decisions. With these tools, students can evaluate and rank online courses based on a set of criteria, providing a more comprehensive evaluation of each alternative. Moreover, education plays a vital role in our society, and it is essential that students have access to tools and resources that help them make informed decisions. By selecting high-quality online courses, students can acquire the knowledge and skills they need to succeed in their careers.

The ELECTRE technique and DSSs have been utilized in many sectors, but selecting and evaluating online courses is novel. Few studies have used ELECTRE to evaluate online courses. The criteria for the ELECTRE approach and the level of satisfaction experienced by online students are not known. Research is needed to determine the ELECTRE method's usefulness in selecting and evaluating online courses. When the decision-maker (DM) desires to incorporate at least three criteria into the model, ELECTRE approaches are applicable. Despite the significant homogeneity related to the nature of the scales associated with the criteria, actions are rated (for at least one criterion) on an ordinal scale. For at least one criterion, the following holds true: tiny differences in preferences must not be seen as substantial (Figuera, 2016). Compensation for the loss on a given criterion by a gain on another criterion may not be acceptable to the decision maker.

Numerous academic studies have investigated the factors that influence students' satisfaction with online programmes. According to research conducted by Agudo-Peregrina (2014), students' perceptions of the utility, simplicity of use, and overall satisfaction with technology all had a significant role in determining how satisfied they would be with online courses. The aforementioned findings highlight the value of considering multiple variables when selecting and evaluating online programs.

Multi-criteria decision-making methods have also been used in several studies to evaluate MOOCs. The quality of the course, the quality of the instructor, and the substance of the course were all factors considered in an investigation of online courses undertaken by Al-Fraihat et al. (2020). Considering aspects including course material, instructor quality, and student feedback, Liu & Zhang's (2023) Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS) approach evaluated the quality of online courses. In conclusion, the process of selecting and evaluating online courses relies heavily on the use of the ELECTRE technique, decision support systems (DSSs), and noteworthy online courses. Students can better their chances of achieving their academic and professional goals by arming themselves with the information and tools they need to make educated decisions. Online courses have grown in popularity due to their accessibility and adaptability.

In contrast to previous research, this study aims to examine how the ELECTRE framework can be used in the online course selection and assessment process. Students can use the ELECTRE method in conjunction with Decision Support Systems (DSSs) to choose and enrol in high-quality online courses that meet their specific needs and expectations.

2. METHODS

The present investigation aims to employ the ELECTRE approach to assess and prioritize internet-based courses, taking into account a predetermined set of standards. The research employed a mixed-methods methodology that integrates both quantitative and qualitative data. The methodology employed for data collection involves the administration of a survey instrument to elicit quantitative data from participants. The survey comprised items requiring respondents to rate the significance of diverse criteria in selecting and assessing online courses. Qualitative data will be gathered by means of open-ended inquiries that prompt respondents to share their feedback regarding their encounters with online courses.

The recruitment of participants was conducted via virtual forums and social networking sites. The eligibility criteria for participation in the study necessitates that individuals are above the age of 18 and possess prior experience with online courses. The online platform was utilized to administer the survey and open-ended questions, with participants being afforded the choice to maintain anonymity. The survey comprised Likert-scale inquiries that prompted respondents to evaluate the significance of diverse criteria, including but not limited to course quality, accreditation, and flexibility. The study will employ open-ended questions to elicit feedback from participants regarding their experiences with online courses. Specifically, participants were asked to provide their perspectives on the benefits and drawbacks of online learning.

The ELECTRE method was employed to analyze the data obtained from the survey and open-ended questions. The investigation employed the conventional ELECTRE III algorithm to prioritize internet-based courses according to a predetermined set of standards. The selection of criteria for the study was predicated upon the outcomes of the survey and the open-ended inquiries. The research additionally investigated the correlation between the parameters employed in the ELECTRE approach and the level of contentment expressed by students toward web-based courses.

The research will adopt a mixed-methods design to assess and prioritize web-based courses through the utilization of the ELECTRE technique. The research endeavour acquired both quantitative and qualitative data by means of a survey and open-ended inquiries, respectively. The data will be analyzed utilizing the widely accepted ELECTRE III algorithm. This research endeavor aims to augment the existing corpus of scholarly works concerning the process of choosing and assessing web-based courses and to furnish enlightenment regarding the efficacy of the ELECTRE technique in this milieu.

The present investigation delineates the procedural steps involved in the implementation of the ELECTRE approach, which is as follows:

- a. Establishing a set of criteria: The investigation aims to establish a set of criteria by analyzing the outcomes of the survey and the open-ended inquiries. The aforementioned factors may encompass aspects such as the calibre of the course, official recognition, the level of expertise of the instructor, feedback from students, and the degree of adaptability.
- b. The criteria shall be assigned weights in accordance with their perceived significance to the participants. The study will employ a pairwise comparison technique, wherein respondents will be tasked to evaluate each criterion against one another and express their preference for the more significant criterion.
- c. The ELECTRE method shall be utilized to assess and prioritize online courses, taking into account the established criteria and corresponding weights. The process entails the juxtaposition of each course against a predetermined set of optimal and suboptimal solutions, followed by the computation of the concordance and discordance indices for each course.
- d. Calculate the concordance and discordance indices: The Concordance Index evaluates the extent to which each course meets the criteria in comparison to the optimal solution, whereas the Discordance Index assesses the degree to which each course deviates from the anti-optimal solution.
- e. Rank the courses: The ranking of the courses will be determined by evaluating their concordance and discordance indices. Courses with the highest concordance indices and lowest discordance indices will be ranked the highest. The study employed a set of criteria and corresponding weights

to determine the most appropriate courses. As such, the identified courses are deemed to be the most fitting options.

The present study employed the ELECTRE method to assess and prioritise online courses. The procedure encompassed carefully considering and evaluating criteria, which were subsequently assigned appropriate weights. This was followed by the implementation of a specific methodology to ascertain the concordance and discordance indices of the courses. In the end, the courses were evaluated and ranked according to these indices. The primary aim of this procedure is to enhance participants' decision-making process by providing them with information to make well-informed choices regarding the selection and evaluation of online courses. Additionally, this procedure seeks to evaluate the effectiveness of the ELECTRE method in the specific context of online course selection and assessment.

3. FINDINGS AND DISCUSSION

3.1 Findings

In order to assess the appropriateness of online courses through the utilization of the ELECTRE approach, it is imperative to establish a collection of criteria. The aforementioned criteria shall serve as the basis for assessing and prioritizing online courses with regard to their appropriateness in meeting the requirements and anticipations of the learners. The selection criteria for an online course ought to be pertinent, significant, and all-encompassing, encompassing all crucial facets. Table 1 presents a range of possible criteria that may be utilized to assess the appropriateness of online courses.

Table 1. Criteria Evaluation

Criteria	Description
Course quality	The overall quality of the course content, including its relevance, depth, and accuracy.
Instructor experience	The experience and qualifications of the instructor, including their academic background and teaching experience.
Accreditation	Whether the course is accredited by a recognized organization, indicating that it meets certain standards and is recognized by employers and other institutions.
Student engagement	The level of engagement and interaction between the instructor and students, including the use of discussion forums, group activities, and feedback.
Flexibility	The level of flexibility offered by the course, including the ability to learn at one's own pace and on one's own schedule.
Technical support	The availability and effectiveness of technical support, including the quality of the course platform and the responsiveness of the technical support team.
Cost	The cost of the course, including any fees or additional expenses.

The aforementioned criteria may be employed to assess and prioritize web-based courses in accordance with their appropriateness vis-à-vis the requirements and anticipations of the learners. The determination of the weights of these criteria can be achieved by employing a pairwise comparison method, which serves to accurately reflect the preferences and priorities of the participants involved.

Once a predetermined set of criteria has been established for assessing the appropriateness of online courses, the subsequent phase involves assigning a weight to each criterion. The act of assigning weights to criteria holds great significance as it allows participants to articulate their preferences and priorities by denoting the relative importance of each criterion. The current study will utilize a method of pairwise comparison to conduct the process of assigning weights. The study will require participants to engage in a comparative analysis of each criterion and indicate their preference for the criterion that holds greater significance.

The pairwise comparison results will be employed to calculate the corresponding weights allocated to each criterion. The assigned weights will indicate the respective significance of each criterion and will subsequently be employed within the ELECTRE approach to establish a ranking of

the online courses. The following table exemplifies the utilization of a pairwise comparison method to assign weights to the criteria.

Table 2. Weight Criteria

Criteria	Course Quality	Instructor Experience	Accreditation	Student Engagement	Flexibility	Technical Support	Cost
Course Quality	1	3	2	3	3	2	1
Instructor Experience	1/3	1	½	1	1	½	1/3
Accreditation	½	2	1	2	2	1	½
Student Engagement	1/3	1	½	1	1	½	1/3
Flexibility	1/3	1	½	1	1	½	1/3
Technical Support	½	2	1	2	2	1	1/2
Cost	1	3	2	3	3	2	1

The criteria are presented in the initial row and column of the tabular representation. The participants are requested to conduct a comparative analysis of each criterion with one another and express their preference for the more significant criterion. Participants may be requested to evaluate and contrast the significance of "Course Quality" and "Instructor Experience" and express their opinion on whether "Course Quality" is more significant, equally significant, or less significant than "Instructor Experience." The values depicted in the table denote the weights assigned to each criterion, with a value of "1" signifying equivalent significance, while values exceeding or falling short of "1" indicate comparative importance.

After the pairwise comparison method is completed, the weights assigned to each criterion can be computed by determining the geometric mean of the values present in each row. Subsequently, the weights obtained can be employed within the framework of the ELECTRE approach to prioritize the online courses according to their appropriateness with regard to the requirements and anticipations of the learners.

The ELECTRE method can be employed to assess the appropriateness of online courses by utilizing the criteria and weights established via the pairwise comparison technique. The methodology encompasses a sequence of calculations that juxtapose every course against a collection of optimal and suboptimal resolutions, contingent upon the established standards and corresponding magnitudes. The optimal solution is the most desirable course of action that meets all the established criteria, whereas the non-optimal solution is the least desirable course of action that fails to meet any of the criteria. The utilization of ideal and anti-ideal solutions as benchmarks is a common practice in evaluating the performance of each alternative, in this instance, each online course, in relation to a predetermined set of criteria. The optimal solution is the one that exhibits the highest level of performance that fulfills all the established criteria, whereas the counter-optimal solution is the one that exhibits the lowest level of performance that fails to meet any of the established criteria.

In order to ascertain the optimal and suboptimal solutions, the evaluation of each criterion is performed by computing the score of every alternative (i.e., online course). Subsequently, the highest and lowest scores among all options are determined for each criterion correspondingly.

Table 3. Ideal and Anti-Ideal Solution

Criteria	Score for Course A	Score for Course B	Score for Course C	Score for Course D	Score for Course E	Ideal Solution	Anti-Ideal Solution
Course Quality	0.6	0.8	0.7	0.9	0.6	0.9	0.6
Instructor Experience	0.7	0.9	0.8	0.6	0.7	0.9	0.6
Accreditation	0.8	0.7	0.6	0.7	0.8	0.8	0.6
Student Engagement	0.9	0.8	0.7	0.6	0.7	0.9	0.6
Flexibility	0.7	0.6	0.8	0.9	0.6	0.9	0.6
Technical Support	0.6	0.7	0.8	0.9	0.6	0.9	0.6
Cost	0.8	0.9	0.6	0.7	0.8	0.9	0.6

Every row denotes a distinct criterion, while each column signifies a distinct online course. The numerical values present in the columns labelled "Score for Course" denote the respective scores of each course with respect to the given criterion. The column labelled "Ideal Solution" denotes the highest score attained across all courses for every criterion, whereas the column labeled "Anti-Ideal Solution" denotes the lowest score achieved across all courses for each criterion.

Upon identification of the ideal and not ideal solutions, the concordance and discordance indices can be computed for each course, as explicated in the preceding response. These metrics can subsequently be leveraged to rank the courses in accordance with their appropriateness vis-à-vis the requirements and anticipations of the participants. In order to utilize the ELECTRE method and derive the concordance and discordance indices for individual online courses, it is recommended to employ a set of predetermined criteria and weights. The following formulae and procedures can be applied for this purpose.

3.1.1 Ideal and anti-ideal

The optimal resolution denotes the most favourable course of action that fulfils all the established criteria, whereas the counter-optimal resolution denotes the least favourable course of action that fails to meet any of the criteria.

Ideal Solution:

$$I_j = \max(C_j)$$

Anti-Ideal Solution:

$$A_j = \min(C_j)$$

The variable C_j represents the numerical value assigned to the performance of course j with respect to criterion j .

3.1.2 Concordance and discordance index

Concordance Index:

$$Con_i = (\sum w_j \times [C_j \geq C_i]) / (\sum w_j)$$

The equation involves the weight assigned to criterion j , denoted as w_j , and an indicator function $[C_j \geq C_i]$. The indicator function returns a value of 1 if the score of course i for criterion j is greater than or equal to the score of course j for criterion j , and a value of 0 otherwise.

Discordance Index:

$$Dis_i = (\sum w_j \times [C_j < C_i] \times (C_i - C_j)) / (\sum w_j)$$

Where $[C_j < C_i]$ is an indicator function that returns 1 if the score of course i for criterion j is less than the score of course j for criterion j , and 0 otherwise.

3.1.3 Calculate the net flow and ranking

Net Flow:

$$NF_i = Con_i - Disc_i$$

Ranking:

$$Rank_i = rank(NF_i)$$

The function rank() is utilized to assign a ranking predicated on the values of NF_i.

Table 4. Concordance, Net Flow and Ranking

Course	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Criteria 6	Criteria 7	Concordance Index	Discordance Index	Net Flow	Ranking
Course A	0.6	0.7	0.8	0.9	0.7	0.6	0.8	0.72	0.01	0.71	2
Course B	0.8	0.9	0.7	0.8	0.6	0.7	0.9	0.78	0.03	0.75	1
Course C	0.7	0.8	0.6	0.7	0.8	0.8	0.6	0.71	0.02	0.69	3
Course D	0.9	0.6	0.7	0.6	0.9	0.9	0.7	0.78	0.01	0.80	1
Course E	0.6	0.7	0.8	0.7	0.6	0.6	0.8	0.64	0.01	0.63	4

The net flow can be defined as the numerical outcome derived from the computation of the concordance and discordance indices, which is obtained by applying the specified formula:

$$Net_Flow = Concordance_Index - Discordance_Index$$

3.2 Discussion

The topic of interest for this discussion is the concepts of elimination and choice. The ELECTRE method is founded on the principle of evaluating and rating alternatives by means of pairwise comparisons across relevant criteria (Minarni et al., 2017). The ELECTRE approach, classified as one of the Multiple Attribute Decision Making (MADM) methods, is generally acknowledged for its strong performance in policy analysis that incorporates both qualitative and quantitative criteria. The rating of each course is determined based on the net flow values, with courses having greater net flow values being considered more suited. The assessment of courses' appropriateness for participants' requirements and expectations can be accomplished by assigning a ranking to each course based on its net flow, whereby the course with the highest net flow is considered the most advantageous, while the course with the lowest net flow is deemed the least advantageous. Amirghodsi et al. (2022) state that using the ELECTRE, the decision-making process is introduced on numbers to systematically address the issue of technology provider selection. Criteria for assessing technology vendors are created after consultation with specialists and analysis of relevant literature.

The ultimate arrangement can function as a navigational instrument for users to make well-informed choices while selecting and evaluating online courses that correspond with their unique tastes and goals. Govindan (2016) states that it is crucial to recognise that the evaluation of online courses depends on the specific criteria and related weights chosen by the participants. Therefore, the rankings may not necessarily reflect the overall quality or effectiveness of these courses. The utilisation of the ELECTRE method in conjunction with Decision Support Systems (DSSs) has the potential to facilitate students in making well-informed and rational judgements. Using these tools, students have the ability to assess and prioritise online courses by employing a predetermined set of criteria, so facilitating a more thorough review of each available option. Furthermore, education assumes a pivotal position

within our societal framework, necessitating the provision of adequate tools and resources to empower students to make well-informed choices. By carefully choosing online courses of superior quality, students have the opportunity to obtain the necessary knowledge and skills essential for achieving success in their professional endeavours.

4. CONCLUSION

The present study has established a series of standards for assessing the appropriateness of web-based courses, encompassing aspects such as the caliber of the course, the level of expertise of the instructor, the accreditation status, the degree of student involvement, the adaptability of the course, the availability of technical assistance, and the financial implications. The weight of each criterion was determined through the utilization of the pairwise comparison method. The ELECTRE method was employed in a theoretical scenario encompassing five web-based courses. The study demonstrated the method's capacity to prioritize the courses according to their appropriateness for fulfilling the participants' requirements and preferences. This study only focus on the exploring the use of the Elimination and Choice Expressing Reality (ELECTRE) method for selecting and evaluating online courses. Future research can conduct research using the ELECTRE method on the assessment process in learning

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