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EDITORS: Zorana Nikitovic, Sladjana Vujicic, Ivan Piljan

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THEMATIC PROCEEDINGS

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DETERMINATION OF THE RELATIVE IMPORTANCE OF FACTORS INFLUENCING THE E-LEARNING CONTENT QUALITY

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ABSTRACT

E-learning courses have become quite popular nowadays. A very important question is whether the content quality of such a course is on the satisfying level. In this paper, the relative importance of the factors that affect on the e-learning content quality is determined by using the PIvot Pairwise RElative Criteria Importance Assessment – PIPRECIA method. The determination of the influential factors is based on the literature examination and five experts are involved in the assessment process. The main goal is to emphasize the usability of the PIPRECIA method in the group decision-making environment as well as to points out the most important factors on which the quality of the e-learning content depends.

Keywords: MCDM, PIPRECIA method, group decision-making, e-learning, content, quality

1 INTRODUCTION

The development of information technologies and the Internet bring change in the way of learning. The previous determinant of learning considers that the student and teacher must be present and make direct contact. Information technologies have changed that and make learning more available to interested groups. Now, the student could start studying a lesson any time on his computer or smartphone. The traditional face-to-face learning has transformed in the new form that is conducted in the virtual classroom and completely fulfils the motto “anytime, anywhere and anyone“ [1].

Besides e-learning become very attractive to the students, the success of some online course and effectiveness of learning does not depend only on the Internet and used technologies. This process is affected by many factors that determine the quality of an online course [2]. Assessment of the e-learning effectiveness is a very delicate issue that requires a careful analysis of every aspect important for consumers as well as for suppliers of such a service. Until now, many research studies have been conducted with a goal of systematization of the factors important for the e-learning effectiveness evaluation [3]. Course content represents one of the determinants that certainly have a serious impact on the effectiveness of e-learning.

Incorporating a course content in an e-learning format is a very complicated task and many factors influence it. Many standards are predicted for the content evaluation but every criterion is connected to a certain field [4]. Also, different authors proposed different sets of criteria for the assessment of the e-learning content quality as well as different evaluation methods [5]-[10]. The proposed models differentiate the learner's or developer's point of view. Also, in some cases, the quality of content represents one of the perspectives that determine the overall quality of an e-learning platform. But, in this case, we give full attention to the content quality because it represents the base for the educational process.

The primary goal of this paper is to determine the relative importance of the factors that affect the quality of e-learning content. The set of factors are determined based on the literature observation and five respondents are involved in the assessment procedure. PIPRECIA method proposed by Stanujkic et al. is used for the determination of the relative importance of the considered factors [11]. The paper is organized as follows. In Section 2, we explain the PIPRECIA method. Section 3 is inclusive of the case study which is followed by a Conclusion.

2 THE PIPRECIA METHOD

Stanujkic et al. introduced the PIPRECIA method [11] which relies on the previously proposed SWARA method [12]. This method retains all the good features of the SWARA method and the main improvement relative to it represents its convenience for applying in the group decision-making environment. The utilization of the proposed method in group decision-making could be demonstrated through the following series of steps.

Step 1. Form a group of respondents that will be included in the decision-making process.

Step 2. Select the evaluation criteria which pre-sorting in descending order is not mandatory as is the case with SWARA method.

Step 3. Each of the involved respondents determines the relative importance of the evaluation criteria s_j^r, starting from the second criterion, as follows:

$$s_j^r = \begin{Bmatrix} >1 & when & C_j \succ C_{j-1} \\ 1 & when & C_j = C_{j-1} \\ <1 & when & C_j \prec C_{j-1} \end{Bmatrix}. \quad (1)$$

Step 4. The relative weight for each respondent is calculated by using the Eqs. (2)-(4), respectively as follows:

$$k_j^r = \begin{Bmatrix} 1 & j=1 \\ 2-s_j^r & j>1 \end{Bmatrix}, \quad (2)$$

$$q_j^r = \begin{Bmatrix} 1 & j=1 \\ \dfrac{q_{j-1}^r}{k_j^r} & j>1 \end{Bmatrix}, \quad (3)$$

$$w_j^r = \frac{q_j^r}{\sum_{k=1}^{n} q_j^r}, \quad (4)$$

where k_j^r is coefficient, q_j^r denotes the recalculated weight and $w^r{}_j$ represents the weight of the criterion *j*, respectively, defined according to the certain respondent *r*.

Step 5. The group relative weights of the evaluation criteria could be calculated in the following way:

$$w_j^* = \left(\prod_{r=1}^{R} w_j^r \right)^{1/R}, \quad (5)$$

$$w_j = \frac{w_j^*}{\sum_{j=1}^{n} w_j^*}, \quad (6)$$

where $w^*{}_j$ is the geometric mean of the weights of the criterion *j* obtained by *R* respondents.

3 A CASE STUDY

The given set of factors and sub-factors that are submitted to further analysis are retrieved from the paper of Al-Alwani with certain modifications [13]. From the initial list of factors is omitted the factor "*Main criteria*" because it is concretely pointed to the Kingdom of Saudi Arabia. The proposed list of the evaluation factors and sub-factors are presented in Table 1.

Table 1. Evaluation factors and sub-factors

	Factors		Sub-factors
C_1	Level of content	C_{11}	Content is suitable for the grade level
		C_{12}	Content is appropriate to the characteristics of learners
		C_{13}	The content is relevant, appropriate and clear
		C_{14}	The content is arranged in a clear, logical and orderly manner
		C_{15}	Content is free of language and grammatical errors
		C_{16}	Content uses relevant examples and cases
		C_{17}	Content is covering technical details
		C_{18}	Content raises students' interest by linking what they learn to their environment and everyday life
		C_{19}	The relevance of goals and information
		C_{110}	Good definitions of technical terms
		C_{111}	Proper use of acronyms
C_2	Presentation methods	C_{21}	Simplicity and clarity of the used text
		C_{22}	Readability of the used font
		C_{23}	Appropriate format of paragraphing on screen
		C_{24}	Choice of media concerning content
		C_{25}	Possibility of the undoing of incorrect choices and entries
		C_{26}	Display of time required to view media
		C_{27}	Ease of navigation and control tools
		C_{28}	Availability of lists' information
		C_{29}	Clarity of the selection from the lists
		C_{210}	All embedded materials are easily accessible
		C_{211}	Utilization of links to external websites
C_3	Teaching methods	C_{31}	Appropriate teaching methods used
		C_{32}	Validity, accuracy, and modernization of information
		C_{33}	An appropriate level of cotrolling the target group
		C_{34}	Possibility to review of pre-displayed parts
		C_{35}	Possibility of optional access to information and ideas
		C_{36}	Clarity of amendment of incorrect choices when answering
		C_{37}	Possibility of offering appropriate entries
		C_{38}	Asked questions are answered appropriately
		C_{39}	Appropriate assessment of learner's level
		C_{310}	Assessment linked to the lesson's specific objectives
		C_{311}	Appropriate evaluation at the end of each stage
C_4	User-friendly interface	C_{41}	Availability of directions and instructions on the screen
		C_{42}	Ease of use of the home page
		C_{43}	Attractive view of information on the home page
		C_{44}	Harmoniously designed screens
		C_{45}	Stability of interfaces
		C_{46}	Direct return to the previously visited material
		C_{47}	Possibility of exit and return to the same location while taking a lesson
		C_{48}	Variety of assessment tools
		C_{49}	Possibility of requesting to display the correct answer or solution to the problem at hand
		C_{410}	More than one attempt allowed
		C_{411}	Simplicity and un-crowded display screen
		C_{412}	Accessibility by smartphones
		C_{413}	Interactive descriptions of all learning activities, including the learning objectives
C_5	Technical information	C_{51}	Operating requirements clearly stated
		C_{52}	User-guide includes a list of available options
		C_{53}	Suitable to work with an operating system (Windows, Linux)
		C_{54}	Ease of installation
		C_{55}	Ease of un-installation
		C_{56}	Clarity of update time and time needed during the update process
		C_{57}	Availability of technical support or online help
		C_{58}	Information about limitations
C_6	Multimedia control	C_{61}	Viewable audio-readings to help the learner to pronounce the technical terms
		C_{62}	Sound control
		C_{63}	Clarity of all images and graphs
		C_{64}	Control of audio or video clips, forward, backward and stop
		C_{65}	Adjustment with final display process
		C_{66}	Optimized size for multimedia contents

As Table 1 shows, six factors involve a significant number of sub-factors. By using Eqs. (1)-(4) the relative importance of the factors and sub-factors for each of five decision-makers (hereinafter referred to as DM) is determined. Fig. 1 represents the relative importance of factors for each DM.

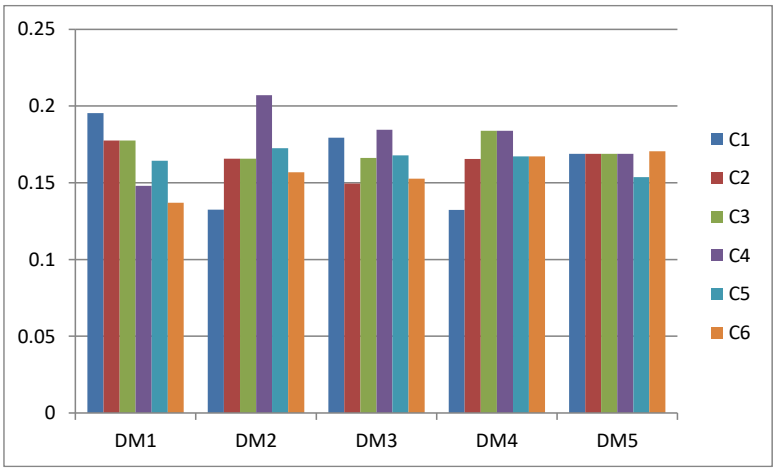

Fig. 1. Relative weights of the factors

According to the DM_1 the highest relative importance has the factor C_1 – *Level of content*. For the DM_2 the most important is factor C_4 – *User-friendly interface* as well as for DM_3. DM_4 gives the priority to the factors C_3 - *Teaching methods* and C_4 – *User-friendly interface*, while according to the DM_5 only factor C_5 - *Technical information* has slightly lower relative importance.

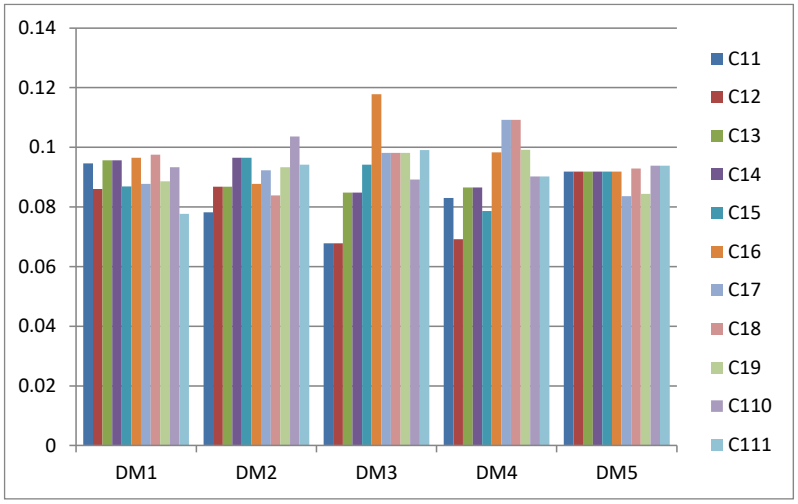

Fig. 2. Sub-factors from the group "Level of content"

Fig. 2 shows the estimation of the relative significance of the sub-factors form the group "*Level of content*". As we can see, DM_1 and DM_5 give relatively equable importance to all sub-factors. DM_2 considered sub-factor C_{110} – *Good definitions of technical terms* as most important, while the DM_3 gives the significant priority to the sub-factor C_{16} - *Content uses relevant examples and cases.* According to the DM_4 sub-factors C_{17} – *Content is covering technical details* and C_{18} - *Content raises students' interest by linking what they learn to their environment and everyday life* are equally important.

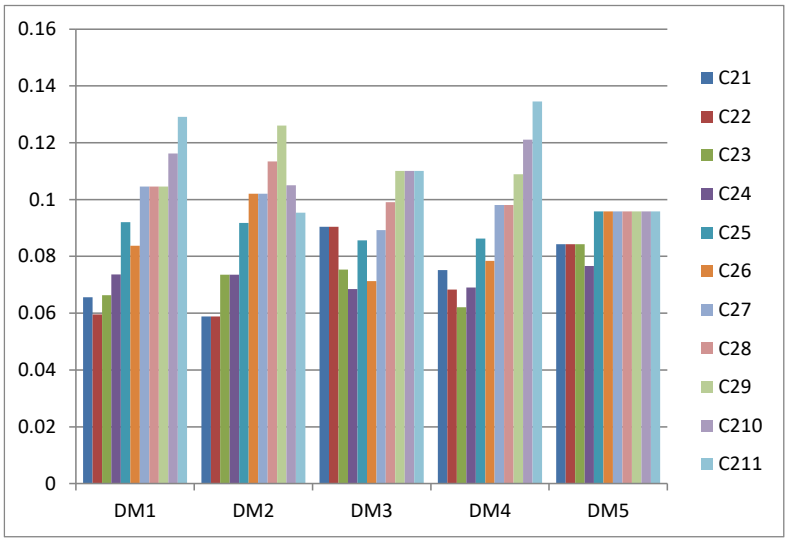

Fig. 3. Sub-factors from the group "Presentation methods"

The sub-factor from the group "*Presentation methods*" that has the greatest relative importance according to the DM_1 and DM_4 is sub-factor C_{211} - *Utilization of links to external websites*. DM_2 gives the priority to the sub-factor C_{29} - *Clarity of the selection from the lists*, while the DM_3 sees three sub-factors as most influential form this group and they are: C_{29} - *Clarity of the selection from the lists*, C_{210} - *All embedded materials are easily accessible* and C_{211} - *Utilization of links to external websites*. DM_5 still gives the mainly equal importance to all considered sub-factors.

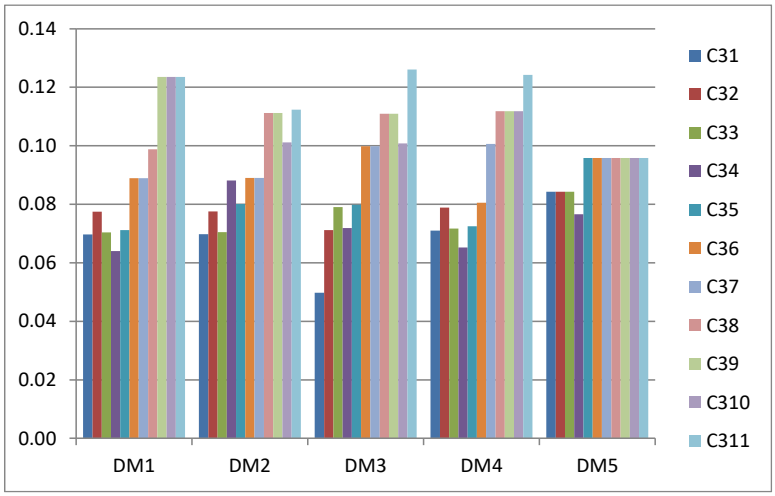

Fig. 4. Sub-factors from the group "Teaching methods"

In the case of the sub-factors from the group "*Teaching methods*", the DMs determine the sub-factor C_{311} - *Appropriate evaluation at the end of each stage* as the most important. Besides, the sub-factors C_{38} - *Asked questions are answered appropriately*, C_{39} - *Appropriate assessment of learner's level*, C_{310} - *Assessment linked to the lesson's specific objectives* step out as the most influential sub-factors from the considered group (Fig. 4).

Fig. 5 shows the results connected to the relative importance of the sub-factors from the group "*User-friendly interface*". According to the DM_1 the highest relative importance has the sub-factor C_{412} – *Accessibility by smartphones* which is followed by sub-factors C_{49} – *Possibility of requesting to display the correct answer or solution to the problem at hand* and C_{410} - *More than one attempt allowed*. DM_2 gives priority to the sub-factor C_{413} - *Interactive descriptions of all learning activities*, *including the learning objectives*, while the DM_3 considers the sub-factors C_{410}, C_{411}, and C_{412} as the most influential. Sub-factor C_{413} is the most important according to the DM_4. In the end, the DM_5 is moderate in his standpoint and literary divide the given sub-factors in the three groups where the sub-factors from C_{49} to C_{413} has relatively higher priority relative to the rest.

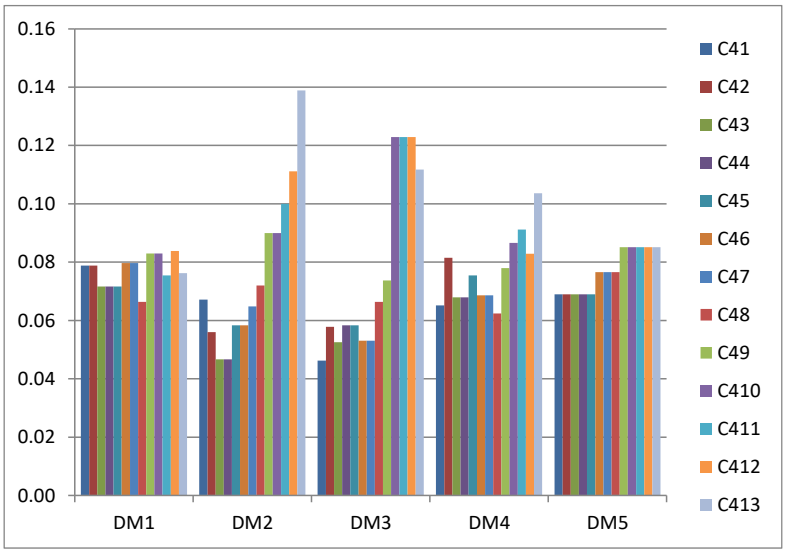

Fig. 5. Sub-factors from the group "User-friendly interface"

As in previous observations, in the case of the sub-factors from the group "*Technical information*", DM_1 and DM_5 again have the least oscillations of the relative significance. DM_2, DM_3, and DM_4 consider the sub-factor C_{53} - *Suitable to work with an operating system (Windows, Linux)*, C_{52} - *User-guide includes a list of available options*, C_{57} - *Availability of technical support or online help* and C_{58} - *Information about limitations* as the most influential, respectively (Fig. 6).

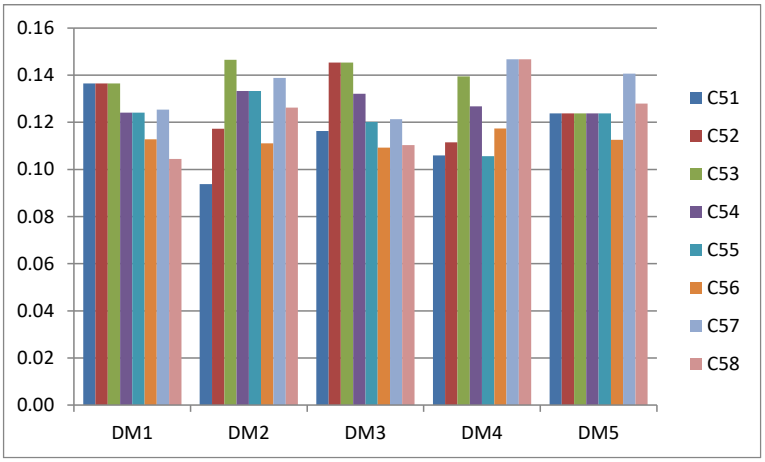

Fig. 6. Sub-factors from the group "Technical information"

Relative to the group "*Multimedia control*" the DMs mainly give the equal relative importance to all of them and from case to case each of the six sub-factors takes the first place (Fig. 7).

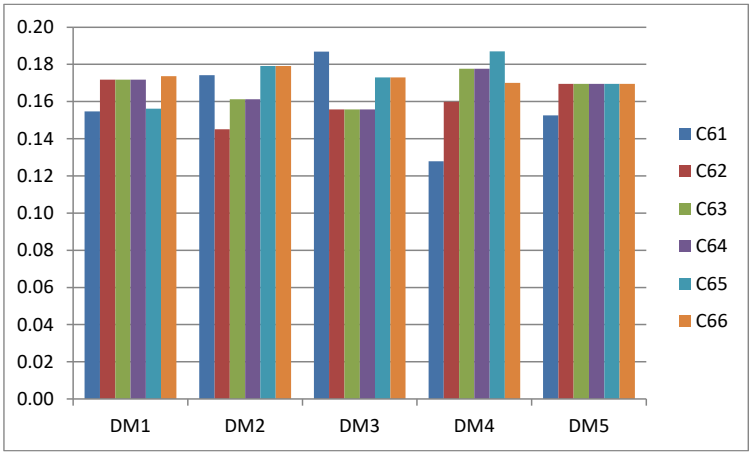

Fig. 7. Sub-factors from the group "Multimedia control"

Fig. 8 presents the global importance of the sub-factors determined by multiplying the local weights of the factors and sub-factors.

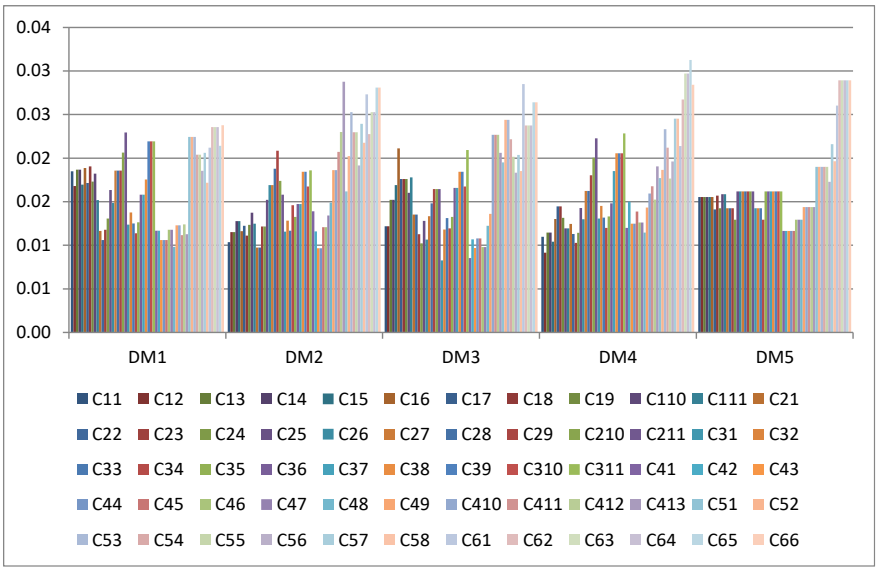

Fig. 8. Global importance of sub-factors for each DM

Finally, the overall global importance of the considered sub-factors is determined by using the Eqs. (5) and (6). The obtained results are presented in Fig. 9.

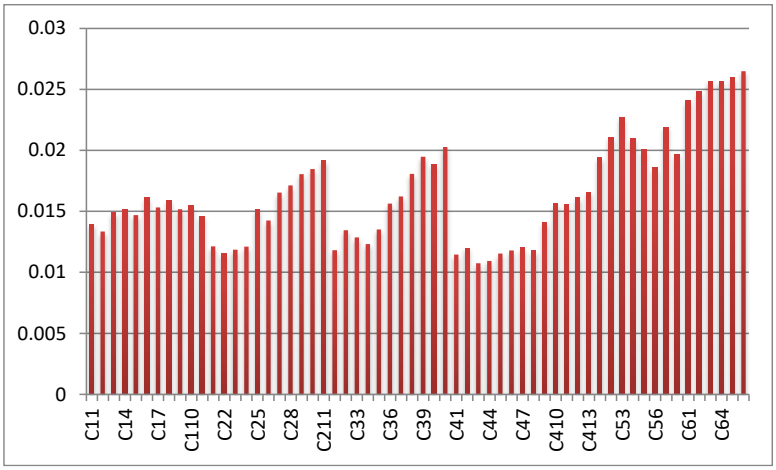

Fig. 9. Overall global importance of sub-factors

The obtained result shows that the highest relative importance has the sub-factors from the group "*Multimedia control*". The reason for this kind of result could be the smallest number of sub-factors that were under assessment which results in higher weights. When we look at the gained results separately, for each group, the results are as follows. The most important sub-factor from the group "*Level of content*" is sub-factor C_{16} - *Content uses relevant examples and cases*. The sub-factor C_{211} - *Utilization of links to external websites* has the highest relative importance in the group "*Presentation methods*", while in the group "*Teaching methods*" the most influential sub-factor is C_{311} - *Appropriate evaluation at the end of each stage*. The sub-factor with the greatest relative importance from the group "*User-friendly interface*" is C_{413} - *Interactive descriptions of all learning activities, including the learning objectives* and the most important sub-factor from the group "*Technical information*" is the sub-factor C_{53} - *Suitable to work with an operating system (Windows, Linux)*. At last, the sub-factor C_{66} - *Optimized size for multimedia contents* is the most significant sub-factor from the group "*Multimedia control*".

4 CONCLUSION

The main aim of this paper is to emphasize the importance of determining the key factors and sub-factors that influence the e-learning content quality. The list of factors, that are slightly adjusted, is adopted from the paper of Al-Alwani [13]. Five DMs were involved in the assessment procedure of the given list of factors and sub-factors which is performed by using PIPRECIA method. The crucial reason for applying the mentioned method relies on the fact that it is convenient for applying in the group decision-making environment. Besides, its procedure is very simple and understanding and obtained results are reliable and objective. The proposed method could be used for the content quality assessment from the learner's as well as from the developer's point of view.

The main deficiency of this paper reflects through neglecting of the uncertainty and vagueness. By introducing the fuzzy, grey or neutrosophic numbers this shortage will be overcome. Additionally, by involving the greater number of DMs, the results will be more realistic. Besides, by involving the students and teachers in the evaluation process the more precise knowledge about the main determinants of the e-learning content quality will be obtained.

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