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Fuzzy Delphi method in education: A mapping

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Abstract. The Fuzzy Delphi method offers many benefits, including the ability to obtain expert opinion, build consensus, determine the suitability of implementing instructional interventions, forecast trends, and interact with research subjects without being limited by time and space. However, overall understanding of state-of-art in the Fuzzy Delphi Method is still needed. Therefore, this article aims to classify, identify scientific publications, and conduct thematic analyses of the current literature in the Fuzzy Delphi Method to create a broad and detailed understanding, especially in education. The results of this mapping are expected to contribute to researchers and practitioners in determining the gap of the research focus and the next type of research on Fuzzy Delphi Analysis. The research method was carried out by systematic mapping studies (SMS) to study scientific publications Fuzzy Delphi Method in education produced from time to time, the focus of research and the most researched types of paper, and research methods that have been applied. The SMS procedure follows practical guidelines and data mapping using the SCOPUS electronic database library. Based on the results of the SMS on research in the Fuzzy Delphi Method in the field of education it is known that the methods used to determine interactive animation are appropriately applied as learning media, selecting prospective students and determining majors in Vocational High Schools, identifying elements of competencies needed by industry.

1. Introduction

This article aims to classify, identify scientific publications, and conduct a thematic investigation of the current literature in the Fuzzy Delphi Method to create an extensive and detailed understanding, especially in education. This systematic mapping study is to form the background of further research and gain deeper insight into the study of the Fuzzy Delphi Method in the field of education. In the search, researchers used an electronic database to find articles that discussed Fuzzy Delphi Methods. SMS study is the right method as a literature study approach because it is supported by articles from searches in Scopus electronic database [1]. The main questions (Research Questions) in this study include how the focus of research (research focuses) on the topic that has been studied? The results of this study provide a comprehensive research approach on the Fuzzy Delphi Method (FDM) as well as implications and guidelines for academics and other practitioners.

2. Research method

This study uses a systematic mapping study (SMS) which is a secondary study. SMS is rooted in a study literature review (SLR) introduced in medical research [2]. The application of SLR is to identify, evaluate, and interpret all available and relevant literature related to research questions or domains of



interest [3]. The most common reasons for conducting an SLR are: first, summarize the available evidence on the topic; Second, to identify gaps in current research and provide suggestions for future investigations; And third, to provide a background for positioning new research activities [4].

SMS is applied to describe the types of research activities that have been carried out in this study. SMS describes research at a high level and maps research from investigating detailed research questions [5]. In other words, SMS can be considered as a method to get a general picture of a particular area of research [6], because, SMS research explores information in detail [7].

3. Results and discussion

Based on the results of the SMS on research in the field of Fuzzy Delphi Method/ FDM in education known that the method is used for determine interactive animation is appropriately applied as a learning medium, selecting prospective students and determining majors in Vocational High Schools, identify elements of technical skills needed by students of electrical engineering who will make them marketable today to face complexity in choosing the best effective teaching among lecturers, determine the elements of e-Portfolio in the learning process for the context of art and design, it be useful for educational technology researchers and to get expert consensus on writing relevant items that incorporate their integrated science process skills competency indicators.

Every new school year, the school conducts acceptance and selection of new students through several tests. Application of Decision Support Systems to select prospective Vocational students can save time and facilitate the committee in determining class majors, as well as providing accurate and accurate majors information to students. The method used in implementing this Decision Support System is the fuzzy method.

Examined the characteristics of corresponding interactive animation to be awakened as a learning medium for homeschooling children using the Fuzzy Delphi approach [8]. The approach to homeschooling childhood learning with the help of interactive animation is not only able to facilitate the learning process but also increase the motivation of homeschooling children. As many as 15 experts in homeschooling and educational technology in the field of childhood education have been chosen to analyze the fuzziness of expert consensus. Study results show that appropriate interactive animation is applied as a learning medium for homeschooling children.

It has led another methodology that applies Fuzzy Delphi technique in Simple Additive Weighting (SAW) is proposed to be utilized in the Maintenance Strategy Selection Problem (MSSP). This methodology depends on a portrayal of the significance of objectives and every procedure capacities to fulfill every upkeep objectives with fluffy numbers. Fluffy Delphi technique is connected for the appraisal of the significance of every objective and capacity of every upkeep system, thinking about the master's supposition. This technique considers both unmistakable and immaterial objectives managing the choice issue. Fluffy Delphi technique produces a L-R fluffy number that estimates data about the idea of assessments all the more sufficiently. Yager positioning strategy is utilized in changing fluffy numbers in the determination issue. At last, through a heuristic calculation, the fundamental strides of the proposed strategy are exhibited. The MSSP must be considered as a fundamental administration issue as a result of its valuable jobs underway and fabricating. The exactness in the determination of a productive support system for hardware depends on deciding the correct upkeep objectives in the basic leadership process. The principle issue in the basic leadership process is that there are a few objectives which are immaterial. To manage the correct choice in the choice of the best support system, in this paper, the fluffy Delphi technique is connected. Yager positioning strategy is utilized to exchange the consequence of fluffy Delphi technique to fresh qualities. Ideally, this methodology can help leaders in the choice of the most productive upkeep procedure. Additionally research can be centered around applying fluffy Delphi technique to AHP to gauge the immaterial criteria managing the choice of the best upkeep system [9].

Mindful advancement of a country calls for learned and talented human capital. To be sure, human capital assumes a major job in the arranging procedure and the usage of national advancement. To accomplish this, one technique is to improve the abilities of people, consequently additionally upgrading their attractiveness to guarantee the accessibility of an adaptable, actually gifted and productive

workforce. To create and satisfy the prerequisite for a gifted workforce, the instruction conveyance framework and pragmatic preparing of future alumni ought to wind up more receptive to the necessities of the activity showcase, or, in other words gainful and adapted towards worldwide rivalry. This investigation intends to recognize the components of the specialized aptitudes required by electrical designing understudies that would make them attractive today. A sum of 21 specialists were chosen to dissect the fluffiness accord of specialists. Every single gathered datum were investigated utilizing the Fuzzy Delphi Method. The outcomes demonstrate 16 of the 23 components meet the conditions, the edge esteem (Moonstruck) is under 0.2 and the level of the master amass is over 75%. This demonstrates, in view of the accord of the specialists, the components of specialized abilities are required by electrical building understudies for acing specialized aptitudes.

The discoveries unmistakably show that there are 16 components of specialized abilities that are required by electrical building understudies dependent on the accord of master feeling. Inspiration is the essential component and the primary selection of specialists. This examination has empowered the distinguishing proof of the parts of the specialized abilities of understudies of electrical building. This data will enable instructors to get ready exercises or projects that are reasonable for understudies to ace specialized aptitudes successfully and productively with an eye towards addressing the requirements of the business. This examination additionally gives a reasonable picture to establishments of higher discovering that are required to get ready specialized or psychomotor areas for instructing and learning assignments that are particular to the requests of the electrical designing industry [10].

Data and input from industry can help in the arrangement of a model or system of components of specialized abilities for understudies through supporting archives, for example, handbooks to be utilized as a kind of perspective. This will encourage learning and educating extraordinarily. Input from the service on the measures and the components that need enhancement will likewise create electrical building understudies who are prepared to have their spot in the business, along these lines diminishing the joblessness rate among *alumni*.

Studied to provide a transparent user requirement for developing learning apps for Down syndrome children by using Fuzzy Delphi Method (FDM) method in User Centered Design (UCD) process. Methods/ Statistical Analysis: UCD is an approach that supports the entire development process with user-centered activities, to create applications which are easy to use and are of added value to the intended users. While, the FDM is a technique to obtain the approval of experts in determining the item or sub-item in a study carried out. The targeted user in this study is students with Down syndrome. Findings: The first stage utilizes FDM to obtain the characteristics of the user, learning method and structure of learning technology that suit with the user in designing the application. The empirical study shows the list of user requirement that can be used in developing the learning application. It is also used to obtain information about the extent to which the needs of technology in support of teaching and learning. Application/ Improvements: The findings of this study are expected capable of contributing to the needs of a researcher and programmer to understand the basis of the basic learning needs of students with Down syndrome [10].

After the defuzzification score analysis was conducted, the researchers found that DS students are able to communicate well with the people around them even if they are physically unable to speak properly due to their short tongue. Also, DS students are also easy to follow routines well if given effective instruction. This clearly shows that DS students they are capable to follow the learning procedure even if they are categorized either as they are learning difficulties. The argument of this study is in line with the argument Stoel-Gammon [11] and Kasari, et al. [12], which they state that students with DS are able to learn how to read, write, and do simple arithmetic tasks after they have received proper education and good care.

For the second finding is a good factor for building an application with DS students for learning session is have a strong attraction with the image element and soft sounds. The image or photos used should also be clearly visible and can be touched well. This element consists of the ability to develop good learning apps for DS students which it's developing according to their needs. This was reinforced by the findings in the learning method section which it's provides the characteristics of learning that are

required by DS students. These elements are essential for the DS student to learn better with the use of learning technology. Based on the discussions and findings of the study, clearly shows that DS students were able to learn as other students. With learning technology which was built according to their requirements and needs precisely able to give help and motivate them to continue to seek better learning. The findings of this study are expected capable of contributing to the needs of a researcher and programmer to understand the basis of the basic learning needs of students with Down syndrome.

Tarmudi et al. have been seen that the prerequisite for state funded colleges to quantify compelling educating among their speakers is an expanding worry as of late [13]. Since the colleges for the most part decide the vast majority of the criteria, therefore this paper turn out with that viable instructing ought to be surveyed through understudies' points of view. The examination centers around how a fluffy methodology can assess the distinguished measure utilizing fluffy Delphi technique (FDM). The criteria weights and successful instructing appraisals are gathered through a seven-point semantic before changing over into fluffy triangular numbers (TFNs). At that point, the strategy is furnished with three levels of certainty to offer more elective choices dependent on leaders (DMs) last judgment. An experimental precedent was utilized to exhibit the appropriateness of the proposed technique. The outcomes demonstrate that the strategy has an incredible potential to manage the multifaceted nature of picking the best compelling educating among the teachers. It offers a flexible judgment, clear in strategies and the proposed strategy can encourage the colleges' DMs to use the proposed methodology for speakers' appraisal purposes.

In this paper, we have adjusted the FDM by adding the choice grid devices to manage the criteria and sub-criteria along the assessment procedure. Likewise, the TFNs have been used to assess the significance of each characteristic, and the strategy gives the 3 level of certainty dependent on phonetic factors, individually. By embedding these instruments, it is seen that the way is the most basic, simple and extensive concerning the assessment procedure and system. Next, this FDM technique has a special favorable position as in it gives the reevaluate ventures to check purposes (see stage 2) if DMs feel that something has needed as well as lost of data along the assessment procedure. Furnished with a level of certainty is another preferred standpoint of this proposed technique which is once in a while investigated by the customary way. At last, our next exertion in this examination is to play out an affectability investigation (SA) in the examination procedure to guarantee the proposed alteration strategy is sufficiently hearty as regard to any little unsettling influence in information parameters. This exertion is left to the following exploration subject soon.

Intuitive liveliness learning is another way to deal with natural instruction in Malaysia. This learning strategy is a synergistic learning configuration utilizing innovation dependent on the earth to improved information among understudies. Fluffy Delphi investigation was led on 15 instructors from different foundations master specialized and professional training to get an accord of specialists on the future intelligent activity for learning in Malaysia utilizing 5 builds. Discoveries demonstrated that the intuitive movements are appropriate to be connected for future natural training in Malaysia. Discoveries demonstrated that the intelligent movements are reasonable to be connected for future ecological training in Malaysia. Facebook as media for learning and e-learning for intelligent movement.

Abd Rahman et al. introduces the Fuzzy Delphi method results obtained in the study on determining e-Portfolio elements in the learning process for art and design context. This technique dependent on qualified specialists that guarantee the legitimacy of the gathered data. Specifically, the affirmation of components depends on specialists' sentiment and agreement. The agreement review built dependent on the rising topics the specialists raised from the led meet. For this reason around 23 specialists in instructional innovation engaged with the meeting and reactions the study. As result, the Fuzzy Delphi will decipher the basic leadership made by specialists dependent on need as a rule to the prescribed procedures and component of executing e-Portfolio as a methodological apparatus [14].

As instructive innovation experts and scientists take part in research in the field, a wide cluster of research strategies are accessible to them. One such strategy is the Delphi Technique. Utilization of the Delphi Technique offers numerous advantages, including the capacity to get a specialist sentiment, construct accord, decide the reasonableness of the use of instructional intercessions, conjecture inclines,

and interface with research subjects without being constrained by time and space. While the cause and early utilization of the Delphi Technique were in the business setting, it has been utilized in different situations throughout the years, including instructive settings. The different inherent characteristics of the strategy could be gainful to the field of instructive innovation. This article inspects the Delphi Technique, its advantages, and how it could profit instructive innovation scientists.

The Delphi methodology is designed to both obtain and identify areas of consensus and divergence of opinion. The Delphi methodology is a practical approach in cases that involve a problem for which the use of analytical techniques cannot be easily applied, but which can gain from subjective judgment. The Delphi Technique can be useful when investigating problems with multiple issues and which requires the judgments of expert panelists. This research approach is based on the notion that the collective viewpoints of expert panelists can yield better results than the limited view of an individual. It can be a beneficial tool in the field of educational technology.

This article has discussed the Delphi Technique, the process involved in its use, and the ways it has been used in various disciplines. The provided examples of Delphi use in different fields and organizations did not exhaust the possibilities in the use of the Delphi Technique. Researchers in the field of educational technology could apply the Delphi Technique creatively in other areas. The methods and attributes of the Delphi present an alternative methodology for educational technology researchers and graduate students who might be interested in conducting research studies. With developments in information technology, innovations in teaching and learning processes, and changes in the field of educational technology, the Delphi Technique could be used in studies that will help to identify new directions for the field, competencies, roles and responsibilities, best practices, changes in the area, technology applications, leadership and policy issues, and more, in an effort to continue to improve practices in the field.

Obtained expert consensus on the writing of relevant items which allied their competency indicators of integrated science process skills. There are five develops of joined science process aptitudes, to be specific detailing speculations, characterizing operationally, recognizing and controlling factors, deciphering information, and testing. Check is finished by 13 specialists in the field of science training utilizing organized survey intending to approve the things markers to pick up reaction about shape one understudy's capacity on coordinated science process abilities. This finding shows that every one of the things were acknowledged to coordinate the pointers of ISPS regarding content approval. Fluffy Delphi is a perfect strategy in acquiring specialist's endorsement. The survey is a simple apparatus to be administrated upon numerous masters which are scarcely to meet because of different limitations. Every one of the things markers intended for the ISPS instrument accomplished all underlined condition utilizing FDM by the specialists' watcher. There are numerous methods to survey master audit for substance approval, however this investigation applies FDM. Presently, the instrument is prepared to be spread to the respondents and enter the following phase of develop approval. At long last, the rule approval will happen. Every one of these stages finish the instrument improvement process. For one which began with substance approval by FDM [13].

4. Conclusion

Based on the results of the SMS on research in the field of education, the Fuzzy Delphi Method can be used to determine the interactive animation appropriately applied as a learning media. In addition, it is used to select prospective students and determine majors in Vocational High Schools, identifying elements of competencies needed by the industry.

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