Exploring the Influences of Metaverse on Education Based on the Neutrosophic Appraiser Model

Sara Fawaz AL-baker[1] , Ibrahim elhenawy[1], Mona Mohamed[2,*]

[1]Faculty of Computers and Informatics, Zagazig University, Zagazig 44519, Egypt;

[2]Higher Technological Institute, 10th of Ramadan City 44629, Egypt;

Emails: s.fawaz23@fci.zu.edu.eg; ielhenawy@zu.edu.eg; mona.fouad@hti.edu.eg

Abstract

The growth of information technology over the course of human history has resulted in an update to traditional schooling. The Metaverse is an innovative concept for social work that incorporates many different types of technology. These technologies include big data, interactivity, artificial intelligence (AI), game design, internet computing, the Internet of Things (IoTs), and blockchain. It is reasonable to anticipate that the utilization of Metaverse will contribute to the advancement of educational practices. However, the structures of the Metaverse in educational settings are not yet developed to the point where they are ready for use. When it comes to schooling and the Metaverse, there are a lot of questions that need answering. Considering this, the purpose of this research is to provide a comprehensive analysis of the use of Metaverse in educational settings. This article provides an in-depth study of the use of the Metaverse in education, with a particular emphasis on contemporary technology, obstacles, and possibilities, as well as potential future paths. First, we provide a concise introduction to the use of the Metaverse in education, as well as an explanation of the rationale for including it. After that, we look at a few crucial aspects of the Metaverse's use in the educational sector, such as the individual's capacity to create their own personalized learning and teaching environments. The next step is appraising determined alternatives and criteria which related to utilize metaverse in education environment. Hence, entropy is supported with SingleValue Neutrosophic Sets (SVNSs) to analyze and valuation of criteria's weights. Then Combined Compromise Solution (CoCoSo) is utilized under authority of SVNSs to rank alternatives related to deploying metaverse in educations. The results demonstrated that alternative 1 is the optimal otherwise alternative 3 is worst.

Keywords: Metaverse; Education; Internet of Things; Artificial intelligence; Technological businesses; SingleValue Neutrosophic Sets (SVNSs); Combined Compromise Solution (CoCoSo).

1. Introduction

The idea of a Metaverse was initially conceived in 1992, but it wasn't until the release of Ready Player One that it gained widespread popularity [1]. The physical world and the virtual realm known as the Metaverse are inextricably linked. Its goal is to create a digitalized environment that is made up of many forms of digital media. The coexistence of the real and the virtual worlds is illustrative of the fact that the virtual world can influence the actual world via everyday life and the workings of the economy. To put it another way, he or she will have a less difficult time locating themselves in the Metaverse than they would in the real world. In other words, the actual world and virtual reality are not two separate universes but rather interactions according to the Metaverse, which we detailed in prior articles. In a broader sense, the Metaverse may also be seen as a universe in which activities associated with everyday living and commercial endeavours are synchronized. Some businesses and organizations have already begun experimenting with using Metaverse for a variety of purposes, including the education and training of employees and students, as well as for entertainment purposes. The Metaverse is now making its way into

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

the present world in a very slow manner. To fully benefit from the Metaverse, it is required and crucial to first understand it and then use it to its greatest potential [2].

Word of mouth has been one of the most effective forms of communication for the transmission of information throughout the whole of human history. Homer's Epics, Classics of Poetry, and other such works were passed down from generation to generation by word of mouth since there was no other trustworthy means of transmitting knowledge at the time. These accounts of survival are characterized by being straightforward, significant, emotionally engaging, and straightforward to recall. However, throughout the process of dissemination, information distortion will unavoidably occur; thus, the listener must give full play to his or her imagination to comprehend the narrative. The investigation of new areas of knowledge by a vast number of individuals is severely limited because of this instance. In subsequent years, the invention of paper gave humans the ability to freely record almost anything. Writing down messages on paper is not only more convenient than relaying information verbally, but it also ensures that the information will be preserved for a longer period. More crucially, the author can use as many words as necessary to properly depict the situation, which may result in a reduction in the degree to which information entropy is increased. Over the course of the last several decades, the globe has entered the internet age and seen significant development as a result. People are no longer content with gaining knowledge through reading alone. People's perceptual experiences are enriched because of newly developed technologies such as 4G, streaming media, and Bluetooth. On the computer or even on a mobile phone, we may see images or movies in high resolution and without jerkiness. We can get an easy understanding of what is taking place on the other side of the planet thanks to the technology made available by the internet. The only thing that separates us from the rest of the world is a network cable. The advent of the Metaverse in modern times has ushered in a new age for education, one that features decentralized classrooms and immersive learning environments. The prefix "meta" is derived from the Greek words for "first," "beginning," "important," and "consummation." On the one hand, it denotes a fresh start, but on the other, when seen from the angle of exhaustiveness, its meaning already encompasses not only the worlds of the past and the virtual present but also the worlds of the actual present and the potential future. On a more fundamental level, it encompasses a wide range of up-and-coming technologies, including big data, virtual reality (VR), augmented reality (AR), mixed reality (MR), blockchain, digital twin, AI, and many more [3]. In a nutshell, it is a massive integration of humans, virtual worlds, and the actual world across several dimensions of time and space.

Even though it's become a popular catchphrase, most people still have no idea what the Metaverse is. Is the use of the Metaverse in educational settings a boon or a bane? What new capabilities or ideas are brought into being because of the merging of education and the Metaverse? Will this lead to more friction and complicate an already difficult situation? The answers to these questions have not been provided.

The following is a list of the contributions that this article makes.

- We provide more explanation of the features that are shared by traditional education, the Metaverse, and the merger of the two. In this section, we discuss the ways in which education, with the assistance of the Metaverse, will usher in the new age. In addition to this topic, we address the role that the new educational paradigm will have in the expansion of the Metaverse.
- We provide a comprehensive analysis of cutting-edge industry case studies (from both businesses and educational institutions) for the purpose of intelligent education and skill development.
- Based on our comprehensive study, we highlight several important obstacles and future directions, and we also provide some ideas for how the Metaverse might be used in future educational endeavours.

2. Ways to Change the Metaverse for Education

The Metaverse is a vast infrastructure that has many of the emerging digital qualities of the future. The environment of the Metaverse offers a lot of advantages, such as the capacity to engage with other people, authenticity, and mobility. As a consequence of this, the new educational system requires attention in order to keep its accessibility and ensure its continued existence [4]. We examine seven ways in which the Metaverse may positively affect education and outline some of the methods in which the Metaverse can be used in the education business as shown in Figure 1.

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

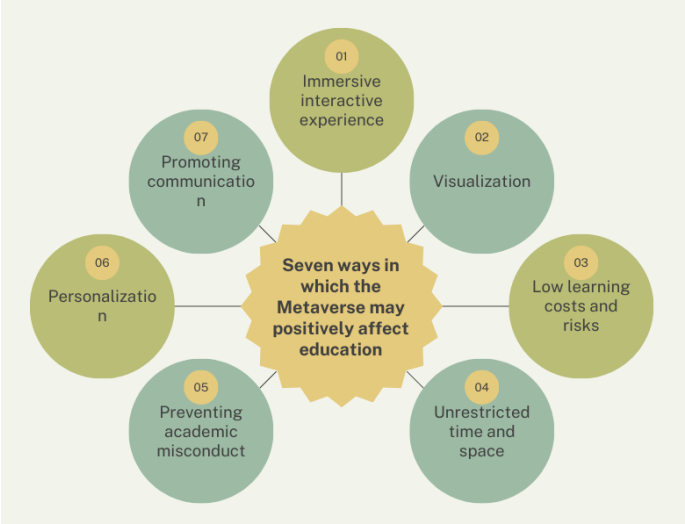

Figure 1: Seven ways in which the Metaverse may positively affect education.

- The constraints of traditional web-based education are overcome through Metaverse education, which is a component of Web 2.0. Learners will have a better time in a teaching class, and as a result, they will retain more information when the session is held in an atmosphere that simulates real-world experiences.
- According to digital technology, the Metaverse may assist students in seeing things that were previously difficult for them to see in the actual world, such as biological cells in a microscopic perspective. This was previously impossible for students to perceive. In addition to that, it has the capability of simulating ideal circumstances in physics, which helps to concretize abstract ideas like Einstein's theory of relativity.
- Experiments are a required component of the curriculum for several subjects, including Chemistry and Physics. On the other hand, each of these tests may be replicated virtually by using digitization, which is an element of education in the Metaverse. This might reduce the number of resources needed. In a similar vein, if learners train during high-risk experiments (for example, with combustible and explosive chemical ingredients or air crash simulation exercises), the operational risk of the learner will be reduced.
- The use of the Metaverse for educational purposes may circumvent the constraints of time. For instance, by recreating historical events and experiencing them first-hand, teachers may save their pupils the trouble of having to visualize them for themselves or learn about them through books or media. On the other hand, it eliminates the need for geographical constraints. Students who reside in temperate zones, for example, are interested in learning about the ecology of tropical regions that are located closer to the equator. Students will be able to accomplish this goal via the usage of the Metaverse if digital models of tropical environments have been developed.
- Using blockchain technology, Metaverse investigates allegations of academic dishonesty. For instance, blockchain imposes the need that each information production, release, and flow be recorded in a time ledger in accordance with the timestamp. This function may be used for the protection of intellectual property, which will allow for the publishing, distribution, and dissemination of scholarly works to be readily tracked and overseen. In addition, the performance of smart contracts is contingent upon the parties to the contract fulfilling their respective commitments. In this system, the submission of a manuscript by an author may cause a new block to be formed, and the information on the transaction will be disseminated and kept in the block that is at the same level. To a certain extent, academic dishonesty, such as numerous submissions and multiple releases, may be avoided thanks to this scenario, which guarantees the one-of-a-kind nature of the author's submitting behaviour.
- Learners may construct customized avatars according to their tastes using digital twin generators or simulators, exactly like the students at Metahkust. This will help learners feel more secure and interested in the learning process. In addition, once users have consented to the education system having access to their personal data, the education system is able to develop instructional material and arrange courses within legal constraints.
- The present iteration of the online classroom is plagued by insufficient opportunities for meaningful engagement and conversation. Learners are unable to resist distraction, and instructors

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

are unable to achieve the desired teaching impact based on the learners' responses (such as facial expressions and body movements) in the allotted amount of time. The Metaverse gives educators the ability to construct virtual rooms for use in conducting in-class discussions and gatherings. Learners can simultaneously form study rooms in which they are free to study, work together on projects, and freely interact with one another. It seems as if everyone can see one another, effortlessly transfer files, and engage in gaming activities. These elements contribute to the development of stronger ties between instructors and students.

3. Problem Discription

This study exhibits and discuss the recent crises to which the world has been exposed. For instance Covid 19 in [5] which compelled people to live in an environment where they don't interact with each other face to face. That means the virtual world has absorbed actual world pursuits. As [6] demonstrated that An increased desire for a more sophisticated virtual environment has resulted from humankind's quest to push the limits of the real world. Hence, moder technologies as metaverse has drawn more and more attention where [7]described metaverse as 3 dimensional digital area where the borders between the actual and virtual worlds have fallen.

This study is leveraging the capabilities of metaverse to bolster the education sector. In the sector of education, the improvement process is depicted into set of points. These points consider in tis study as alternatives (Alts) which have been appraised through set of criteria.

Hence, we constructed intelligent decision-making model (IDMM) to appraising these alternatives based on determined criteria. This model depending on uncertainty Single Value Neutrosophic Sets (SVNSs) to support MCDM techniques in appraising process to guarantee an impartial decision free from bias and suspicion.

4. Proposed Methodology

This section exhibits the appraising process for Alts and indicators of employing metaverse in education. This process has been illustrated through several steps in light of leveraging SVNSs to support entropy technique of MCDM where [8] emphasized the importance of SVNSs to more effectively handle expert opinions that include uncertainties and discrepancies with decision makers' (DMS') comprehension of the alternatives and indicators.

Here, there are several dimensions are mentioned in this process as following:

4.1 First dimension: Clarification of alternatives

Herein we exploit prior studies as [9] for showcasing the different roles of metaverse in education and we embodied metaverse's roles of the metaverse in set of Alts as following:

Alt $_1$: Incorporating metaverse as intelligent tutor or lecturer: As an alternative, the system will support or mimic instructions for students, helping them and offering guidance to others whenever needed.

Alt $_2$: Incorporating metaverse as intelligent student or learner: learners interact with tutors with the intention of learning and seeking advice from experienced tutor.

Alt $_3$: Providing societal milieu: according to this alternative the students are interacting with each other for exchanging knowledge and information.

Alt $_4$: utilizing metaverse environment as behavioral analyst: Learning activities and interactive content can be retained in the metaverse. The stored activities and interactive are analyzing through leveraging AI techniques as machine learning (ML).

4.2 Second dimension: Formulation of impactful criteria

Considering the appraising of Alts, the important aspects in this process are determining the influenced criteria where Alts have been appraised according to the influenced criteria.

in this study, we determine the influenced criteria (Cr) as following:

Cr$_1$: Granting users more control over their privacy: Malicious malware compromises user information. Therefore, it's critical to realize that Metaverse technology may help create a more secure system.

Cr$_2$: Exploiting innovative technologies: leveraging technologies such as AI, ML and analytical techniques for optimizing and achieving proactiveness through responding quickly to damaging assaults.

Cr 3: Education based on unrestricted time and location: Traditionally, students and teachers meet in person in the classroom at a set time that corresponds to the curriculum and timetable, or students can only join courses when a teacher starts a meeting on the video conferencing platform. Otherwise in the metaverse, individuals may learn almost anywhere free from the limitations of time and place.

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

Cr_4: Stability of communication: applying technologies as 5G or 6G to make the metaverse maintain consistency, stability, and low latency.

Cr 5: Interaction to gain insight: In the conventional method, students communicate with actual professors and classmates in a physical classroom or via a video conferencing platform. Whilst Learners may collaborate with two types of instructors and peers: intelligent Non-Player Character NPC teachers and peers, and avatar teachers and peers.

4.3 Third dimension: Figuring out criteria's weights.

This dimension entails the techniques which are used for analyzing the determined criteria for valuing its weights. This study is employing entropy as one of MCDM techniques based on conducted survey for recent studies as [10]. This method is responsible for obtaining criteria's weights and working under SVNSs' oversight through the following steps:

Step 1: Various SVN decision matrices are constructed based on decision makers' (DMs) rate for determined criteria. We followed authors of [10] through utilizing SVN scale during rating process for criteria by DMS.

Step 2: SVN decision matrices are converted to crisp decision matrices with assistance of Eq.(1).

$$s(\mathrm{Cr_{ij}}) = \frac{(2+\alpha-\beta-\theta)}{3} \quad (1)$$

Where α, β, θ refers to truth, false, and indeterminacy respectively.

Step 2: Eq. (2) has responsibility for aggregating crisp matrices into single matrix.

$$\mathrm{Sing\_mat_{ij}} = \frac{(\sum_{j=1}^{N} \mathrm{Cr_{ij}})}{N} \quad (2)$$

Where $\mathrm{Cr_{ij}}$ refers to value of criterion in matrix, N refers to number of decision makers.

Step3: Single matrix $\mathrm{Sing\_mat_{ij}}$ is normalized through utilizing Eq.(3) to generate normalized matrix $\mathrm{Q_{ij}}$

$$\mathrm{Q_{ij}} = \frac{q_{ij}}{\sum_{j=1}^{m} q_{ij}} \quad (3)$$

Where $\sum_{j=1}^{m} q_{ij}$ indicates sum of each criterion in aggregated matrix per column.

Step 4: The following Eq.s contributes to computed entropy.

$$\mathrm{En_{j=-h\sum_{i=1}^{m} Q_{ij}}} \ln \mathrm{Q_{ij}} \quad (4)$$

where,

$$\mathrm{h} = \frac{1}{\ln(S)} \quad (5)$$

S refers to number of alternatives

Step 5: According to Eq. (6), weight vectors become easy to obtain.

$$\mathrm{w_{j=}} \frac{1-\mathrm{En_j}}{\sum_{j=1}^{n}(1-\mathrm{En_j})} \quad (6)$$

4.4 Fourth dimension: Ranking the alternatives (Alts)

The objective of this dimension is prioritizing candidates of Alts and rank these candidates. Thus, the ranking operation is robust motivator for exploiting MCDM ranker techniques where CoCoSo technique plays this role toward ranking Alts. This technique avoids uncertainty and DMs bias through leveraging SVNSs as branch of neutrosophic uncertainty theory to treat with ambiguity and unclarified situations. Hence, the motivation of this dimension is appraising and ranking Alts by combining SVNSs with CoCoSo. This motivation is achieving through deploying set of steps as following:

Step 6: We are leveraging the single matrix which is generated in step 2 of third dimension. After that Eq.s (7) and (8) are applied to normalize single matrix.

$$\mathrm{Norm_{ij}} = \frac{q_{ij}-\min(q_{ij})}{\max(q_{ij})-\min(q_{ij})}, \text{ for beneficial criteria} \quad (7)$$

$$\mathrm{Norm_{ij}} = \frac{\max(q_{ij})-q_{ij}}{\max(q_{ij})-\min(q_{ij})}, \text{ for non-beneficial criteria} \quad (8)$$

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

Step 7: Sum of weighted matrix is generated based on Eq. (9).

$$S_i = \sum_{j=1}^{n} w_j \, Norm_{ij} \quad (9)$$

Step 8: Eq. (10) is deploying for calculating power of weighted matrix.

$$P_j = \sum_{j=1}^{n} \left(Norm_{ij}\right)^{w_j} \quad (10)$$

Step 9: In this technique. It is important to estimate three different appraisal score for candidates of Alts through following Eq.s.

$$K_{ia=\frac{S_i+P_i}{\sum_{i=1}^{m} S_i+P_i}} \quad (11)$$

$$K_{ib} = \frac{S_i}{min_i S_i} + \frac{P_i}{min_i P_i} \quad (12)$$

$$K_{ic} = \frac{\lambda S_i+(1-\lambda)P_i}{\lambda max_i S_i+(1-\lambda)max_i P_i} \;, 0 \leq \lambda \quad (13)$$

Step 10: Ultimately, the final rank is calculated via Eq. (14).

$$K_{i=}(K_{ia} * K_{ib} * K_{ic})^{1/3} + \frac{1}{3}(K_{ia} + K_{ib} + K_{ic}) \quad (14)$$

5. Case Study

The use of the Metaverse in various educational settings is something that excites us. The Metaverse has already shown that it has a great deal of promise, and there are even several organizations working on securing funding for educational programs that are based on the Metaverse.

Many technological businesses have lately begun to take an interest in the concept of Metaverse schooling. Roblox, as a key representation of the Metaverse area, has several distinct benefits regarding the teaching of the Metaverse. On the one hand, it offers players the opportunity to participate in group activities and have meaningful conversations with other students. On the other hand, it gives users the ability to design anything they want, which significantly boosts the amount of information included in educational situations. Roblox made an announcement in November 2021 stating that the company intends to produce three educational video games and contribute more than ten million dollars in non-profit organizations. On the other hand, the gaming business is not the only one that stands to gain from the Metaverse.

A growing number of people are beginning to see the value in incorporating elements of the Metaverse into educational settings as the subject of the Metaverse continues to gain popularity. To verify these hypotheses, a number of educational institutions have started experimenting with Metaverse education. By participating in immersive experiences, each of these programs intends to strengthen students' academic memories and increase the effectiveness of instruction.

In this section we are applying our constructed IDMM. Hence, our model is employing in educational enterprise which aims to learn and communication between participants anywhere and anytime. The appraising process is conducting through deploying several steps for utilized techniques toward achieve the mentioned four dimensions.

5.1 Identification and clarification Process

Step 1: In our study four DMs are volunteering to rating Alts and determined criteria through filling questionnaire.

Step 2: The results of the questionnaire are illustrated as SVN decision matrices and convert to crisp matrices according to Eq. (1) after that Eq. (2) is applied to aggregate crisp matrices into single matrix as listed in Table 1.

5.2 Calculation Criteria's weights

Step 3: Table 2 represents the normalization for matrix is listed in Table 1 through employing Eq.(3).

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

Step 4: entropy (En_j) is computed through utilizing Eq.s (4),(5) to generate Table 3 and vector weight's criteria are produced in Figure 2. We noticed from this Figure that Cr_1 is the highest criterion with highest value of weight followed by Cr_5 while Cr_2 is least one.

Table 1: An aggregated single matrix

	Cr_1	Cr_2	Cr_3	Cr_4	Cr_5
Alt_1	0.5375	0.3875	0.758333333	0.5	0.5
Alt_2	0.4625	0.5375	0.345833333	0.404166667	0.666666667
Alt_3	0.2625	0.6	0.479166667	0.2125	0.3
Alt_4	0.145833333	0.345833333	0.520833333	0.4625	0.858333333

Table 2: Normailzed single matrix

	Cr_1	Cr_2	Cr_3	Cr_4	Cr_5
Alt_1	0.381656805	0.207126949	0.36039604	0.316622691	0.215053763
Alt_2	0.328402367	0.287305122	0.164356436	0.255936675	0.286738351
Alt_3	0.186390533	0.320712695	0.227722772	0.134564644	0.129032258
Alt_4	0.103550296	0.184855234	0.247524752	0.292875989	0.369175627

Table 3: Entropy matrix

	Cr_1	Cr_2	Cr_3	Cr_4	Cr_5
Alt_1	-0.367624616	-0.326105514	-0.367802806	-0.364130173	-0.330509079
Alt_2	-0.36568119	-0.358329961	-0.296781345	-0.348796958	-0.35818929
Alt_3	-0.313119537	-0.364717552	-0.336944603	-0.269897729	-0.264218431
Alt_4	-0.234820782	-0.31206933	-0.345605122	-0.359653473	-0.36787716
$\sum_{i=1}^{m} Q_{ij}$	-1.281246125	-1.361222356	-1.347133876	-1.342478333	-1.320793961
En_j	0.924226892	0.981917747	0.971755021	0.968396745	0.952754724

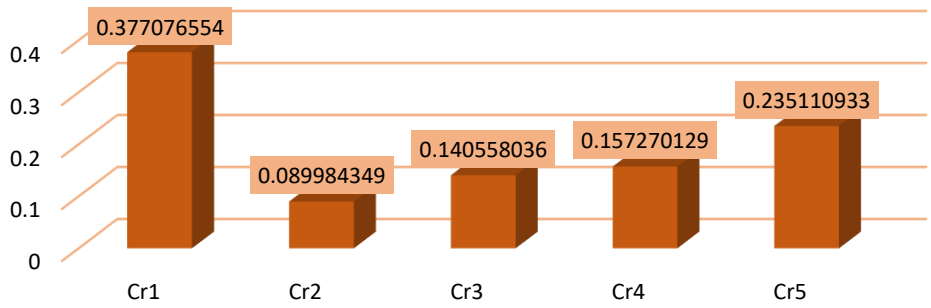

Figure 2: Criteria's weights based on entropy-SVNSs

5.3 Ranking the alternatives

Step 5: we normalize again an aggregated single matrix but through CoCoSo under authority of SVNSs via Eq.(7) and take into consideration determined criteria fall into beneficial category. Table 4 is generated from normalizing matrix in Table 1.

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

Step 6: Leveraging the normalized decision matrix and Eq. (9) to produce Sum of weighted matrix.
Step 7: We calculated the power of sum weighted matrix according to Eq.(10) and results are showcased in Table 6.

Step 8: The different appraisal scores for candidates of Alts are calculated through Eq.(11),(12),(13).

Hence, Table 7 is collected the different scores.

Step 9: Finally, the final rank for candidates Alts. Based on Eq.(14) and this rank illustrated in Figure 3. This Figure demonstrated that Alt_1 is optimal and best whilst Alt_3 is worst. We noticed that ranking of Figure 3 is agreed with and like ranking in Table 7.

Table 4: Normalized decision matrix

	Cr_1	**Cr_2**	**Cr_3**	**Cr_4**	**Cr_5**
Alt_1	1	0.163934426	1	1	0.358208955
Alt_2	0.808510638	0.754098361	0	0.666666667	0.656716418
Alt 3	0.29787234	1	0.323232323	0	0
Alt_4	0	0	0.424242424	0.869565217	1

Table 5. weighted decision matrix

	Cr_1	**Cr_2**	**Cr_3**	**Cr_4**	**Cr_5**
Alt_1	0.377076554	0.014751533	0.140558036	0.157270129	0.084218842
Alt_2	0.304870405	0.06785705	0	0.104846752	0.154401209
Alt 3	0.112320676	0.089984349	0.0454329	0	0
Alt_4	0	0	0.059630682	0.136756634	0.235110933

Table 6: Power weighted decision matrix

	Cr_1	**Cr_2**	**Cr_3**	**Cr_4**	**Cr_5**
Alt_1	1	0.849831072	1	1	0.785547774
Alt_2	0.922976102	0.974923274	0	0.938223064	0.905865128
Alt 3	0.633386951	1	0.853214763	0	0
Alt_4	0	0	0.88645801	0.97825943	1

Table 7: Different scores for alternatives

	K_{ia}	K_{ib}	K_{ic}	Rank
Alt_1	0.342059684	4.987907198	0.583474848	1
Alt_2	0.276592006	4.055843781	0.471802104	2
Alt 3	0.172908753	2	0.294942412	4
Alt_4	0.208439557	2.89381413	0.355549762	3

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

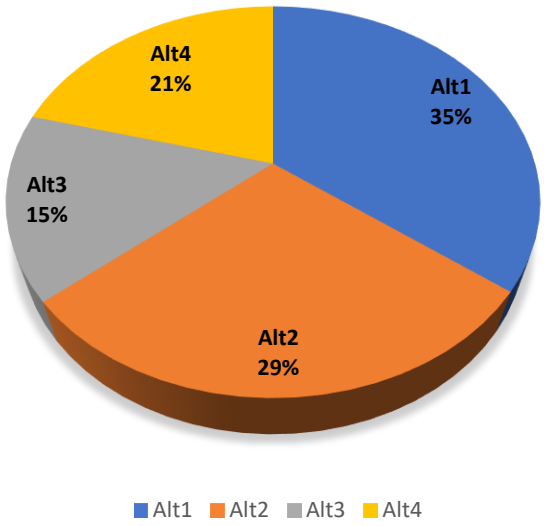

Figure 3: Ranking of alternatives based on CoCoSo- SVNSs

6. Difficulties and Issues

Actually, there is a humongous quantity of stuff that is connected to be discussed. As a result, we have compiled a list of the most pressing problems to fix, which are as follows: privacy threats, inclusivity, the adoption of technology, addiction, and governance difficulties, as presented in Figure 4.

6.1 Technical Specification and Execution

- Immersive interactive technology: The development of the Metaverse is dependent on the implementation of immersive interactive technologies, the most important of which are VR, AR, and MR. Extended reality (XR), in particular, is the umbrella term for all three of these technological advancements [11].
- AI is a crucial technology that can make Metaverse education more successful. This can be accomplished via the creation of virtual teaching assistants, the processing of language for students from a variety of places, and the evaluation of learning outcomes. For educational AI systems, three fundamental difficulties need to be addressed: how to develop virtual teaching assistants that are acceptable for the learners themselves; how to accomplish barrier-free communication between persons speaking various languages; and how to fairly assess the learning results of students. In addition, the ethical regulation of artificial intelligence decision-making in the Metaverse and the prevention of abusive use of AI in the Metaverse are also significant challenges that cannot be ignored.
- A digital twin is primarily used in the Metaverse for the purpose of digitizing physical items from the actual world into the virtual world in real-time. Some of the studies that are conducted within the realm of Metaverse schooling call for a high level of precision and place stringent demands on the accuracy and real-time performance of digital twins. This implies that digital twins must be able to detect faults and implement appropriate solutions. When developing digital twin models using real-time data, one of the most significant challenges posed by digital twins is maintaining the confidentiality and integrity of user data.
- The present computational speed of blockchain may not be sufficient to satisfy the requirements of large data processing when an increasing number of students want to get their education in the Metaverse. Scalability, which refers to the processing capabilities of the blockchain network, is the primary factor that decides whether education can be conducted via the blockchain. On the other hand, as scalability is enhanced, the number of blockchain nodes that participate in the operation will rise, which in turn will raise the likelihood of a split occurring in the blockchain.

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

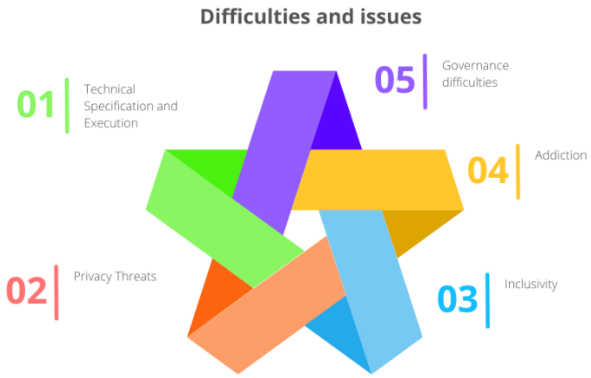

Figure 4: Difficulties and issues.

6.2 Privacy Threats

With the introduction of the Metaverse, it seems inevitable that individuals will use the internet for longer periods of time than they have in the past. The corporations that operate in the Metaverse will eventually acquire vast volumes of personally identifiable information from users to get a profound comprehension of the user's thought processes and patterns of behaviour. There is no shadow of a doubt that the data gathered will be unique in every way. Because of this, these businesses are forced to fulfil recognized standards for the protection of personal data and guarantee that programs are always in place to satisfy any additional needs.

6.3 Inclusivity

Both schooling and the Metaverse were developed with the intention of drawing more people into their respective realms. Because of this, it is essential to establish a virtual environment that is welcoming to all participants and that takes into consideration the diverse needs of as many of them as is feasible.

6.4 Addiction

Learners are exposed to a plethora of visual and audio stimuli throughout the XR experience, which may increase the amount of mental effort required of them. However, the use of immersive gaming technology is unavoidable in the Metaverse educational system. As a result, one of the most critical challenges that educators have while working with the Metaverse is figuring out how to design a game that provides educational benefits to players without making them dependent on the experience. In the end, education of the Metaverse needs to be seen as more of a tool than a magic bullet. Some educational material that can be taught well without the assistance of a virtual environment, known as the Metaverse, will not only help students learn more effectively but will also help them steer clear of addiction.

6.5 Governance difficulties

It should pay greater attention to community governance than to other aspects of the Metaverse since the moral level of learners varies widely. As a result, it is essential to disseminate and continuously work to improve community norms of behaviour to forestall ethical conflicts.

7. Conclusion

The purpose of this study was to present an overview of the intersection between education and the Metaverse. Numerous studies and real-world applications have shown that integrating Metaverse technologies is a workable strategy for achieving relative parity in terms of educational possibilities. Emerging technologies eliminate several obstacles, such as cost, time, and space, and as a result, they provide solutions to problems that are difficult to handle in the actual world. The typical classroom setting does not allow for the same level of excellent visualization that is available in Metaverse. Because of the quick pace at which technology is advancing, further research efforts are required to enhance the unique education model with different technologies. These technologies include immersive interactive technology (such as VR, AR, and MR), network computing, artificial intelligence, digital twins, and blockchain. Moreover, there is a need for more research efforts. Since this is a novel educational setting, we focused on new educator evaluation standards, governance systems, and study-level testing methodologies. At this point in time, while the Metaverse is still in the process of being developed, we can see that education and the Metaverse are both contributing to each other's success. More talent is required, particularly in the early phases of development for the current iteration of the Metaverse. Talents for the Metaverse may be

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

continually developed, cultivated, and transported via the use of education. Because of this, we believe that education and the Metaverse are intrinsically connected with one another. How will the use of the Metaverse in education progress in the years to come, and what possible adjustments will the field of education need from the Metaverse? After some more time has passed, we will be able to look ahead to the future of education during the period of the Metaverse.

7.1 Theoretical Contribution

Despite it is acknowledged that the metaverse represents the next evolution of social interaction, Discussions about the many uses of the metaverse are rare. Hence, this study realized this issue and attempts to treat this issue through showcasing the importance of metaverse and other technologies in education sector. As a result of the importance of metaverse, it applied in many applications for computer gaming and social networks around the world. Due to the ability of metaverse for emerging various technologies as Digital Twin (DT), VR, internet of things (IoTs), holography…etc.

Hence, this study discussed the roles of metaverse in education and treat with these roles as alternatives. Then, we examine the importance of these alternatives through analysing set of criteria which related to metaverse's alternatives.

Moreover, we constructed IDMM for performing this role, which analysing, and valuation determined criteria toward estimating most effective and optimal alternative related to metaverse.

Herein, we applied this model where there are four alternatives are appraising based on five criteria for real educational enterprise. So, model's steps are deployed, and four DMs are contributed to appraise alternatives. the results of steps included the following:

- Through applying entropy based on uncertainty SVNSs for analyzing criteria's weights, the findings demonstrated that Cr1 is optimal with highest weight otherwise Cr2 with least value of weight and Figure 2 considers greatest evidence.
- CoCoSo merged with SVNSs toward determining optimal and effective Alts through ranking these, Alts.
- The combined techniques ranking alternatives according to various of appraising scores as $Alt_1 > Alt_2 > Alt_4 > Alt_3$ as in Figure 3.

Funding: "This research received no external funding."

Conflicts of Interest: "The authors declare no conflict of interest."

References

[1] Y. K. Dwivedi *et al.*, "Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy," *Int. J. Inf. Manage.*, vol. 66, p. 102542, 2022, doi: https://doi.org/10.1016/j.ijinfomgt.2022.102542.

[2] L. Chang *et al.*, "6G-Enabled Edge AI for Metaverse: Challenges, Methods, and Future Research Directions," *J. Commun. Inf. Networks*, vol. 7, no. 2, pp. 107–121, 2022, doi: 10.23919/JCIN.2022.9815195.

[3] Z. Allam, A. Sharifi, S. E. Bibri, D. S. Jones, and J. Krogstie, "The Metaverse as a Virtual Form of Smart Cities: Opportunities and Challenges for Environmental, Economic, and Social Sustainability in Urban Futures," *Smart Cities*, vol. 5, no. 3. pp. 771–801, 2022. doi: 10.3390/smartcities5030040.

[4] J.-E. Yu, "Exploration of Educational Possibilities by Four Metaverse Types in Physical Education," *Technologies*, vol. 10, no. 5. 2022. doi: 10.3390/technologies10050104.

[5] X. Zhang, Y. Chen, L. Hu, and Y. Wang, "The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics," *Front. Psychol.*, vol. 13, no. October, pp. 1–18, 2022, doi: 10.3389/fpsyg.2022.1016300.

[6] S. Suzuki *et al.*, "Virtual Experiments in Metaverse and their Applications to Collaborative Projects: The framework and its significance," *Procedia Comput. Sci.*, vol. 176, pp. 2125–2132, 2020.

[7] G.-J. Hwang and S.-Y. Chien, "Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective," *Comput. Educ. Artif. Intell.*, vol. 3, p. 100082, 2022.

[8] M. Deveci, N. Erdogan, U. Cali, J. Stekli, and S. Zhong, "Type-2 neutrosophic number based multi-attributive border approximation area comparison (MABAC) approach for offshore wind farm site selection in USA," *Eng. Appl. Artif. Intell.*, vol. 103, no. May, p. 104311, 2021, doi: 10.1016/j.engappai.2021.104311.

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023

[9] G. J. Hwang and S. Y. Chien, "Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective," *Comput. Educ. Artif. Intell.*, vol. 3, no. April, p. 100082, 2022, doi: 10.1016/j.caeai.2022.100082.
[10] G. S. Hussein, "ADM : Appraiser Decision Model for Empowering Industry 5 . 0- Driven Manufacturers toward Sustainability and Optimization : A Case Study," vol. 11, 2023.
[11] M. Trunfio and S. Rossi, "Advances in Metaverse Investigation: Streams of Research and Future Agenda," *Virtual Worlds*, vol. 1, no. 2. pp. 103–129, 2022. doi: 10.3390/virtualworlds1020007.

Doi: https://doi.org/10.54216/IJNS.230112
Received: May 23, 2023 Revised: August 18, 2023 Accepted: November 16, 2023