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-RESEARCH ARTICLE-

PROSPECTS OF METAVERSE TECHNOLOGY IN HOME ECONOMICS EDUCATION: EXAMINING THE FUTURE IN THE CONTEXT OF DIGITAL LEARNING

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─Abstract─

This study aimed to investigate the perspectives of experts and specialists in the fields of educational technology and home economics within educational institutions regarding the integration of Metaverse technology in education, specifically focusing on the teaching of home economics in the context of digital learning. Employing a prospective approach, the Delphi method was utilized to gather experts' opinions and predictions. Additionally, a descriptive survey-analytical approach was applied for systematic data collection, classification, analysis, and interpretation. In-depth interviews and questionnaires were employed to elicit insights into the potential future utilization of metaverse technology in teaching home economics. The findings underscored the importance of augmenting knowledge about metaverse technology, its application areas, and its associated positive and negative effects. Crucial prerequisites for successful implementation included institutional support, the preparation of qualified personnel, and strategic planning. Challenges identified encompassed insufficient infrastructure, the imperative for continuous modernization, and the scarcity of skilled human resources. The research emphasized collaborative efforts between administration and faculty members, ultimately concluding that the premature implementation of metaverse technology in teaching home economics is hindered by the absence of a robust electronic environment with fully equipped educational facilities.

Keywords: Metaverse Technology, Digital Learning, Home Economics

INTRODUCTION

The domain of education has undergone substantial influence arising from the widespread use and reliance on information technology, evident in academic activities

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within and beyond the confines of the classroom, as well as in the administrative functions within educational institutions. Additionally, exigent situations such as the COVID-19 pandemic, conflicts, and natural disasters such as floods and snowstorms, have necessitated the adoption of assistive technology by teachers, parents, and students, underscoring its advantages in the educational sphere (Muhammad et al. 2023). The incorporation of technology into the educational milieu confers myriad benefits. It elevates student engagement and motivation through the provision of interactive and multimedia-enriched learning experiences. Digital tools and platforms afford avenues for personalized and adaptive learning, accommodating the diverse needs and preferences of individual students. Furthermore, technology fosters collaboration and communication among students and educators, transcending geographical constraints and fostering global connections (Timotheou et al., 2023).

Furthermore, Baiden (2019) underscored the importance of incorporating gamification to facilitate participatory and collaborative learning, thereby revolutionizing and improving education through innovative pedagogical approaches. The gamification model promoted heightened interaction between students and educators, and the study concluded that gamification offers a promising outlook for contemporary teaching methodologies. As indicated by Al-Alawi and Al-Tawazni (2023), metaverse technology holds the potential to afford individuals an immersive three-dimensional encounter facilitated by virtual reality technology. This immersive engagement enables individuals to partake in virtual adventures and scenarios closely mirroring tangible reality. The metaverse, in essence, offers a glimpse into a prospective future where individuals enjoy the liberty to reside and work in any geographical location and temporal setting. Given the ongoing advancements in metaverse technologies and their remarkable capacity to convincingly simulate sensory and cognitive experiences, the digital metaverse environment is poised to seamlessly integrate into and become an indiscernible component of actual life (Zaatar & al-Din, 2022).

The principal objective of the present research is to scrutinize the viewpoints and expertise of authorities and specialists in the realms of educational technology and home economics within academic institutions concerning the integration of metaverse technology in education, with particular attention to its application in teaching home economics, given the ubiquity of digital learning. In pursuit of this overarching aim, the study endeavours to interrogate the subsequent primary question:

What future prospects exist for the incorporation of metaverse technology in education, encompassing broader applications and, more specifically, its implications within the domain of home economics, within the framework of digital education?

To delve deeper into the primary inquiry, the subsequent sub-questions have been formulated:

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1. What is the extent of comprehension within the research cohort concerning metaverse technology, encompassing its application domains and the consequential positive and negative ramifications inherent in its integration within the educational landscape, spanning both general education and the domain of home economics, within the realm of digital education?
2. What are the essential prerequisites essential for the efficacious integration of metaverse technology into educational settings, taking into account both general education and the particular domain of home economics, within the paradigm of digital education?
3. What are the foremost challenges that emerge during the implementation of metaverse technology in educational settings, spanning both general education and the domain of home economics, within the context of digital education?
4. What future-oriented visions and perspectives exist for the utilization of metaverse technology in education, both broadly and with specific emphasis on the field of home economics, considering the advancements in digital learning?

LITERATURE REVIEW

Numerous studies emphasize the importance of augmenting and progressing home economics education, along with the necessity to diversify its instructional methodologies to conform to contemporary demands and technological progressions. For example, Chenglong et al. (2019) carried out a study that accentuates the significance of cultivating home economics applications by employing a mixed development mode and effecting modifications to the application infrastructure. Metaverse technology, fundamentally, embodies a convergence of the actual information realm and the virtual domain, symbolizing a paradigm shift in technological progress.

Metaverse technology constitutes a modern technological solution with substantial potential to enhance home economics education. Through the establishment of interactive and engaging learning environments, this technology fosters student involvement and provides practical tools that can notably augment their comprehension of home economics concepts. The advent of metaverse technology can be ascribed to notable progressions in digitalization and communication evident in the contemporary era. Initially predominantly employed in the media sector, the metaverse has progressively broadened its purview to encompass diverse domains and everyday activities (Al & Mohamed Karam Kamal Al, 2022). Moreover, the widespread integration of the metaverse into social networking platforms has metamorphosed it from a conceptual notion into a tangible actuality, emphasizing its pragmatic implementations (Al-Zuhairi, 2022).

The Metaverse stands as a noteworthy endeavour that surpasses conventional boundaries, symbolizing the prospective evolution of the Internet. It establishes a

enduring linkage between the tangible realm and the virtual sphere in three dimensions. Within this immersive milieu, participants, depicted as avatars, partake in communication, shopping, as well as an array of entertainment and educational pursuits (Zidane & Al-Suwaidi, 2022). In light of the ramifications of the Metaverse for the future, it is positioned to overhaul every facet of human endeavour, with a particular emphasis on education in the era of digital learning. This metamorphosis is anticipated to instigate a fundamental shift in the structure and essence of education. Capitalizing on the opportunities that ensue in sectors such as commerce, education, and training mandates a paradigm shift in educational systems, promoting digital literacy, endorsing innovation, and nurturing creativity (Bahi El-Din, 2022). Hence, it is imperative for educational authorities to embrace this paradigm shift and embark on digital transformation initiatives to cater to the evolving requirements of learners in the future.

The Concept of Metaverse Technology

Metaverse technology, as defined by experts, constitutes an amalgamation of virtual realms wherein users interact with one another through personalized avatars. These interactions transcend beyond the realm of gaming and entertainment, encompassing a diverse array of activities spanning various industries (Zhang et al., 2022). As articulated by Kim (2022), the metaverse is delineated as a digital domain integrating virtual reality and augmented reality technologies, facilitating user interaction within a virtual environment. Augmented reality (AR) incorporates digital elements and sensory experiences into the actual world, thereby enriching the overall user experience. This amalgamation of the physical and digital domains enables users to submerge themselves in the content, fostering a heightened level of engagement with the metaverse.

The application of metaverse technology in education carries considerable significance, serving as a portal to the future of learning. This pioneering approach to digital education, characterized by project-based learning and problem-solving, presents manifold advantages and opportunities. Academics like Zhang et al. (2022) have underscored various advantages of metaverse technology, including the enhancement of educational content, the establishment of a novel educational realm, facilitation of cultural exchange and communication, as well as the improvement of access to quality education and remedial opportunities. Furthermore, Al-Alawi and Al-Tawazni (2023) elucidated the educational prerequisites for metaverse technology, encompassing Virtual Reality (VR) Technologies, Augmented Reality (AR) Technologies, Mixed Reality (XR) Technologies, as well as Virtual Reality and Augmented Reality Glasses, alongside Education and Communication Platforms.

Challenges in Implementing Metaverse Technology

The incorporation of metaverse technology introduces specific challenges that warrant meticulous consideration, as emphasized by Bahi El-Din (2022). These

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challenges encompass Implications for Morality and Human Factors, Data Privacy and Information Security, Elevated Costs, as well as the imperative of Standardization and Collaboration. In conjunction with the previously mentioned challenges, Brik (2022) identifies supplementary impediments in the implementation of metaverse technology, encompassing Consumer Addiction, Social Alienation, and Heightened Concerns regarding Misinformation. Polona et al. (2022) underscore various apprehensions linked with metaverse technology, including its Effects on Health, Influence on Social Norms, Impact on Educational Infrastructure and Content Production, as well as its Implications for Children. Digital learning denotes an educational methodology integrating technology to augment the learning experience. It spans a diverse array of practices and strategies, encompassing adaptive learning, gamification, blended learning, classroom technologies, electronic textbooks, learning analytics, mobile learning, personalized learning, online learning (or e-learning), open educational resources (OERs), technology-enhanced teaching and learning, virtual reality, and augmented reality (Schriever et al., 2020). Through effective technology integration, digital learning broadens opportunities for engaging and interactive education. Adaptive learning employs personalized algorithms to customize instruction based on individual student needs, while gamification integrates game elements to motivate and engage learners. Blended learning combines conventional classroom instruction with online components, fostering a flexible and dynamic learning environment. Classroom technologies, like interactive whiteboards and digital devices, facilitate interactive and collaborative learning experiences. Electronic textbooks provide multimedia content and interactive features, enhancing the accessibility and interactivity of educational materials. Learning analytics utilizes data to gain insights into student performance and inform instructional decision-making (Bucchiarone, 2022).

The importance of digital education resides in its capacity to establish an integrated educational system that harnesses information technology and interactive communication on computers for knowledge delivery, fostering learner participation in knowledge production, and facilitating the dissemination and distribution of knowledge. Multiple studies, such as those conducted by Lahoudik (2020) and Al-Dabaa (2021), underscore the significance of digital learning. Moreover, digital learning presents myriad advantages that enhance the educational experience. Through the establishment of an interactive environment utilizing computer applications, it facilitates seamless communication between educators and learners, providing access to information from diverse sources at any time and location. Several investigations, such as those conducted by Al-Rashed (2018), Al-Shammari (2019), and Khalfawi and Darfouf (2022), have delved into the benefits of digital learning.

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METHODOLOGY

Type of Research

This research falls within the realm of exploratory Futures Studies or Future Research, a methodology applied when the field is nascent or when information is scarce. The study specifically examines the prospective trajectory of home economics education within the framework of digital learning and metaverse technology.

Research Methodology

The present investigation utilized the subsequent methodologies:

- Prospective Approach using the Delphi Method: The Delphi method constitutes a systematic approach for forecasting the future by soliciting opinions from a meticulously chosen group of experts possessing substantial expertise in the research domain. Employing the Delphi method, this study endeavoured to project the future trajectory of home economics education concerning digital learning and metaverse technology, with the objective of discerning consensus among experts regarding potential future scenarios.

- Descriptive Survey-Analytical Approach: This study employed a descriptive survey-analytical approach. The principal aim of this methodology was to gather data on metaverse technology, encompassing its applications and consequential impacts. Furthermore, it sought to pinpoint challenges linked to its implementation, collect expert opinions and insights concerning the prospective utilization of metaverse technology in teaching home economics within the digital education framework. The acquired data was subsequently categorized, analysed, and interpreted to furnish a comprehensive and precise depiction of the phenomenon under scrutiny, encompassing both quantitative and qualitative dimensions.

Study Population and Sample

The research population for this study encompasses academic and professional experts specializing in educational technology and home economics. This cohort includes individuals such as education professors specializing in educational technology, faculty members, supervisors in home economics, and home economics teachers. With a diverse spectrum of knowledge and experience in their respective domains, these experts are well-positioned to offer valuable insights into the research topic. From this population, a sample of 123 participants was purposively selected to partake in the present research investigation. The sample was purposively selected to guarantee representation from diverse roles, encompassing department heads, faculty members, supervisors, and teachers, thereby encompassing a comprehensive spectrum of perspectives. The participants exhibited varying years of experience, reflecting a

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diverse array of expertise and insights within the field. A detailed depiction of the characteristics of the research sample is presented in Table 1.

Table 1: Characteristics of the Research Sample

Variables	Variable elements	Frequency	Percentage	Total
Age	From 25 years old and less than 35 years old	50	41%	123
	From 35 years old and less than 45 years old	48	39.1%	
	From 45 years old and less than 55 years old	17	13.9%	
	55 years old and above	8	6%	
Academic qualification	Ph.D	15	12%	123
	Master	31	25%	
	Higher Diploma	29	24%	
	Bachelor's	48	39%	
Job title	faculty members, lecturer and Lab supervisor	41	33%	123
	supervisors	15	12%	
	teachers	67	54%	
Experience	less than one year	21	17%	123
	From 1 year to less than 5 years	22	18%	
	From 5 years to less than 10 years	46	37%	
	From 10 years to less than 15 years	23	19%	
	From 15 years and over	11	9%	

Analysis of Table 1 discloses that a substantial proportion of the research sample, amounting to 80.1%, falls within the age range of 25 to 45 years old. Additionally, a majority of the participants possess either bachelor's or master's degrees, constituting 39% and 25% of the sample, respectively. Concerning professional roles, teachers constitute the largest percentage within the research sample at 54%, while faculty members, lecturers, and lab supervisors each account for 33% of the sample. In terms of job experience, the highest percentage, 56%, pertains to participants with more than 5 to 15 years of experience. These results denote a noteworthy level of expertise within a substantial portion of the research sample. The findings suggest that the sample predominantly comprises individuals in the early to mid-stages of their careers, exhibiting a robust educational background and diverse professional roles. A significant majority of participants possess substantial job experience, offering valuable insights and perspectives for the research study.

Study Tools

The research utilized the following methods as tools for data collection and analysis:

In-depth Interviews

In-depth interviews served as a qualitative research method for data collection on the

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research topic. Open-ended questions were directed to participants within the research sample, with the objective of exploring their perspectives and insights concerning the future of home economics education in the context of digital learning and metaverse technology. These interviews were conducted both in-person and remotely through electronic applications, allowing for flexibility and accessibility. The primary indicators and key discussion points were meticulously documented during these interviews. Additionally, a questionnaire, developed using the Delphi method, was utilized to enhance the comprehension of experts' opinions and perceptions regarding the future of home economics education in relation to digital learning and metaverse technology. The interview questions encompassed various aspects, including:

- The participants' viewpoints on the prospective applications and ramifications of metaverse technology as an alternative to physical reality.
- A scrutiny of the merits and demerits associated with the integration of technology in education, particularly within the domain of home economics.
- Identification of domains wherein technology can be adeptly employed within the educational context.
- Exploration of the requirements for implementing technology in education, with a specific focus on home economics.
- Examination of the challenges that educational institutions may encounter when adopting this technology.
- Perspectives and foresights of participants concerning the future integration of this technology in education broadly and, more specifically, in the domain of home economics.

Expert Opinion Questionnaire on the Future of Home Economics Education in the Context of Digital Learning and Metaverse Technology

The objective of this questionnaire is to evaluate the perspectives of experts regarding the future trajectory of home economics education in the context of digital learning and metaverse technology. The dimensions of the questionnaire were delineated through an exhaustive examination of the research literature and prior studies, encompassing works by Abdel-Al (2022), Brik (2022). The preliminary iteration of the questionnaire comprised two segments:

Demographic Information

This section gathers data on the characteristics of the participants in the research sample, including age, academic qualifications, job titles, and years of experience.

Questionnaire Sections

This section encompasses 41 items categorized into four principal dimensions:

a. Degree of Knowledge of Metaverse Technology and Its Application Areas: This

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dimension comprises fourteen items specifically crafted to assess the research participants' proficiency in understanding metaverse technology, its application domains, as well as the merits and demerits associated with its utilization.

b. Requirements for Employing Metaverse Technology: This dimension encompasses seven items aimed at evaluating the perspectives of the research cohort concerning the adequacy of essential prerequisites for the integration of metaverse technology in the instructional context of home economics.

Challenges of Applying Metaverse Technology in Teaching Home Economics: This dimension encompasses ten items designed to evaluate the diverse challenges encountered in the implementation of metaverse technology within the educational domain, specifically within the realm of home economics instruction. These challenges encompass economic, technological, professional, ethical, and institutional dimensions.

c. Future Vision of Employing Metaverse Technology in Teaching Home Economics: This dimension comprises ten items devised to gauge the formulation of a prospective vision for harnessing metaverse technology within the educational sphere, specifically focusing on the pedagogical domain of home economics.

d. The participants' responses to the questionnaire items are assessed using a five-point scale, spanning from "strongly agree" to "strongly disagree."

Through this extensive questionnaire, the study aims to collect expert opinions on the future of home economics education, specifically focusing on the integration of digital learning and metaverse technology. The gathered responses will provide valuable insights, fostering a nuanced understanding of experts' perspectives and contributing to the advancement of knowledge in the field.

Questionnaire Validity

The questionnaire's validity was evaluated through the following methodologies:

First, to ensure questionnaire validity, it was reviewed by a panel of nine experienced specialists. Their expertise assessed its clarity, appropriateness for research objectives, and alignment with dimensions. The panel's feedback led to refinements enhancing the questionnaire's overall validity. This process involved revising specific items in accordance with expert recommendations, restructuring and clarifying items for improved lucidity, and eliminating redundant or deemed unnecessary content. Additionally, Content Validity Ratio (CVR) calculations were performed for each questionnaire item. CVR values, ranging from 87% to 100%, indicated substantial expert consensus on the relevance and necessity of individual items. The comprehensive questionnaire demonstrated an overall CVR of 91%, reflecting a significant degree of precision and alignment with ideal standards.

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Second step involved evaluating construct validity, which gauges the internal consistency of the questionnaire in capturing experts' perspectives on the future of home economics education in the context of digital learning and metaverse technology. This assessment utilized correlation coefficients between item scores and their respective dimensions. Correlation coefficient values for questionnaire items ranged between 0.42 and 0.85. Significantly, all coefficients were statistically significant at the 0.05 level, affirming a robust and meaningful association between the items and their respective dimensions. These findings are detailed in Table 2.

Table 2: Internal Consistency Validity of the Expert Opinion Perception Questionnaire on the Future of Home Economics Education in the Context of Digital Learning and Metaverse Technology

Dimension	Item	Corr. coeff.	Dimension	Item	Corr. coeff.	Dimension	Item	Corr. coeff.	Dimension	Item	Corr. coeff.
Degree of Knowledge of Metaverse Technology and Its Application Areas	1	0.48	Requirements for Employing Metaverse Technology	15	0.55	Challenges of Applying Metaverse Technology	22	0.77	Future Vision of Employing Metaverse Technology in Teaching Home Economics	32	0.46
	2	0.59		16	0.48		23	0.60		33	0.54
	3	0.48		17	0.76		24	0.55		34	0.74
	4	0.69		18	0.83		25	0.45		35	0.58
	5	0.55		19	0.57		26	0.67		36	0.76
	6	0.76		20	0.78		27	0.77		37	0.50
	7	0.61		21	0.83		28	0.56		38	0.55
	8	0.58					29	0.42		39	0.66
	9	0.54					30	0.82		40	0.82
	10	0.56					31	0.70		41	0.60
	11	0.70									
	12	0.56									
	13	0.62									
	14	0.58									

Table 3 displays the correlation coefficient values between the scores of individual dimensions and the overall questionnaire score.

Table 3: Correlation Coefficient Values between Dimension Scores and Total Questionnaire Score

Dimension	correlation coefficient
Degree of Knowledge of Metaverse Technology and Its Application Areas	0.85
Requirements for Employing Metaverse Technology	0.82
Challenges of Applying Metaverse Technology	0.87
Future Vision of Employing Metaverse Technology in Teaching Home Economics	0.91

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Thirdly, construct validity was evaluated through Rasch model analysis, chosen for its effectiveness in providing a robust assessment. The Rasch model offers an objective framework for psychological and educational measurement, ensuring a comprehensive and unbiased evaluation of construct validity. Its application enhances the objectivity and reliability of measuring latent traits in psychological and educational assessments.

The questionnaire's validity underwent scrutiny through Rasch Model (RM) analysis, considering criteria such as dimensionality, item polarity, item fit, and calibration scales to assess psychometric properties. Dimensionality is vital to affirm that the questionnaire measures a singular dimension unidirectionally, contributing significantly to content and construct validity. In RM analysis, satisfactory dimensionality is indicated by measures explaining over 40% of raw variance and the unexplained variance in the first contrast being ≤ 15% (AlAli, 2020). In this analysis, the measured values explained 43.9% of the raw variance, signifying a substantial portion accounted for. Additionally, the unexplained variance in the first contrast was 7.1%, indicating a well-aligned dimensionality with the Rasch Model and a good fit. Item polarity, assessed through point measure correlation (PTMEA Corr.), was employed to evaluate the consistency of items in aligning with the measured constructs, serving as an initial indicator of construct validity. This analysis parallels factor analysis in assessing the relationship between items in measuring the intended constructs. In this analysis, the point measure correlation (PTMEA) value is expected to fall within the range of +0.2 to +1 (AlAli & Saleh, 2022). All items in the questionnaire demonstrated positive values exceeding 0.20, indicating that each item consistently aligns in parallel, effectively contributing to the measurement of underlying constructs. In accordance with AlAli and Al-Barakat (2022), fit mean-square (MNSQ) serves as an indicator of the congruence between the anticipated Rasch score and the observed score for each item. Infit, which gauges the fitting degree of an item or an individual, involves the transformation of residuals into infit mean square, representing the disparity between predicted and observed values for easier interpretation. For the scrutiny of these construct items, it is advisable that the MNSQ infit analysis value falls within the range of 0.5 to 1.5, while the PTMEA value should be positive and within the range of +0.2 to +1. The analysis results demonstrate that all items adhere to the stipulated criteria, implying their suitability for subsequent statistical analyses and inferential processes. These findings validate the alignment of the items with the Rasch model, instilling confidence in their efficacy to accurately measure the investigated constructs.

Fourth, Instrument reliability was evaluated through a reliability analysis, adhering to Rasch Model (RM) criteria where a reliability threshold exceeding 0.50 is conventionally accepted. Furthermore, a separation value surpassing 2 is deemed acceptable. Person separation reliability, a metric in RM analysis, assesses the instrument's capacity to discriminate among individuals at different levels of the measured concept (AlAli, 2020). In RM analysis, the reliability of items is akin to Cronbach's alpha (CA), an index of internal consistency that

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gauges the scale's reliability by computing variance among all conceivable item pairs. The analysis results revealed elevated person reliability at 0.89, coupled with a person separation value of 3.31. Additionally, the item reliability registered at 0.86, with an item separation value of 2.83. These outcomes signify commendable reliability for both person and item measurements within the questionnaire.

3. RESULTS

To investigate the initial research question assessing the research sample's knowledge of metaverse technology, its application domains, and the ensuing positive and negative effects in educational contexts, diverse statistical metrics were utilized. The responses to each questionnaire item were subjected to calculations of arithmetic means, standard deviations, and ranks. The resulting statistical measures, as detailed in Table 4, offer a thorough depiction of the research sample's proficiency concerning metaverse technology and its application domains.

Table 4. The Means, Standard Deviation, and Rank

No.	Item	Mean	Std. Deviation	Rank
1	The metaverse refers to a digital environment that facilitates interactive engagements between individuals, regardless of their physical location	3.5	1.33	High
2	Metaverse technology exhibits a range of variations across different forms and virtual environments.	3.4	1.34	High
3	Metaverse technology is used to produce digital Storytelling	2.2	1.34	Low
4	Metaverse technology empowers individuals with the ability to possess and own virtual assets that mirror their real-world counterparts.	2.7	1.24	Medium
5	The metaverse establishes a virtual environment that serves as an alternative to the physical reality experienced by individuals.	1.8	1.73	Low
6	The metaverse facilitates the simulation of virtual reality	1.8	1.73	Low
7	The metaverse functions as a medium for delivering information in a dynamic and tangible manner.	2.2	1.24	Low
8	The metaverse operates through a variety of modalities and formats to present educational content.	3.6	1.98	High
9	The metaverse embodies a comprehensive sense of presence in three dimensions (3D) through the utilization of virtual reality (VR) or augmented reality (AR) glasses	1.7	1.00	Low
10	In the creation of content using 3D designs, live and realistic effects are employed	2.1	0.98	Low
11	Metaverse technology is susceptible to various forms of illicit activities	2.2	1.00	Low
12	Metaverse technology has a profound impact on the learner's perception and understanding of the physical environment.	1.7	1.00	Low
13	Metaverse technology has the potential to disrupt direct communication between individuals in physical spaces.	3.5	1.33	High
14	In various facets of life, the significance of the human element is diminishing as a result of metaverse technology's influence.	3.4	1.39	High
	Overall average	2.56	1.33	Low

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Table 4 delineates the arithmetic means and standard deviations of the study sample's responses pertaining to their knowledge level concerning metaverse technology and its application domains. The comprehensive mean estimate for the knowledge degree was modest, registering at 2.56, accompanied by a standard deviation of 1.33. Notably, the arithmetic mean for items 9 and 12, which address the metaverse's representation in three dimensions through virtual or augmented reality glasses and its impact on learners' perception, was 1.7, with a standard deviation of 1.00, indicating a relatively low assessment. Likewise, the arithmetic mean for the two items addressing the metaverse's capacity to create a virtual environment as a substitute for physical reality and its capability to simulate virtual reality was 1.8, accompanied by a standard deviation of 1.73, signifying a notably low assessment. These results imply a deficiency in the research sample's understanding of metaverse technology, its application domains, and the associated positive and negative implications.

To investigate the second research question centred on the fundamental prerequisites for integrating metaverse technology into digital learning, the researchers calculated arithmetic means, standard deviations, and estimates derived from the research sample's responses to each questionnaire item. The outcomes of this analysis, as delineated in Table 5, furnish valuable insights into the primary requirements essential for the efficacious incorporation of metaverse technology within the framework of digital learning.

Table 5: Analysis of Arithmetic Means, Standard Deviations, and Rank Estimates for the Sample's Response on the Dimension of Requirements for Employing Metaverse Technology

No.	Item	Mean	Std. Deviation	Rank
1	Educating individuals about the optimal use of metaverse technology	3.1	1.43	High
2	Providing an appropriate infrastructure of electronic equipment to employ metaverse technology	2.9	1.43	Medium
3	A conscientious management with a focus on strategic planning is essential to maximize the potential benefits derived from metaverse technology.	3.5	1.26	High
4	Offering comprehensive institutional support and allocating an adequate budget in employing the implementation of metaverse technology.	3.9	1.17	High
5	Ensuring the availability of well-equipped laboratories for the practical application of metaverse technology.	3.8	1.19	High
6	Providing training programs to develop skilled human resources capable of effectively utilizing metaverse technology.	3.9	1.17	High
7	Supplying information resources, including brochures, books, and virtual encyclopaedias, that are compatible with metaverse technology.	3.5	1.21	High
	Overall average	3.5	1.27	High

Table 5 delineates the arithmetic means and standard deviations derived from the research

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sample's responses concerning the prerequisites for the integration of metaverse technology in education, specifically within the domain of home economics. The overall average assessment was notably high, registering at 3.5, accompanied by a standard deviation of 1.27. In particular, the arithmetic mean for items 4 and 6, pertaining to the provision of integrated institutional support, allocation of a suitable budget for metaverse technology implementation, and training of personnel to cultivate qualified expertise in handling this technology, was 3.9, with a standard deviation of 1.17, indicating a significantly favourable rating. This underscores the imperative for educational institutions to provide support and allocate sufficient budgets for the integration of metaverse technology in education, specifically within the realm of home economics. It also emphasizes the crucial role of training staff members to adeptly leverage this contemporary technology. Likewise, item 5, addressing the provision of well-equipped laboratories for the application of metaverse technology, garnered an arithmetic mean of 3.8, accompanied by a standard deviation of 1.19, denoting a markedly favourable assessment. Moreover, item 3, addressing the existence of purposeful management with a focus on strategic planning to optimize the benefits of metaverse technology, yielded an arithmetic mean of 3.5, with a standard deviation of 1.26, indicating a favourable assessment. This underscores the criticality of adopting a management strategy that strategically plans the utilization of metaverse technology to achieve optimal objectives. Subsequent items, while maintaining high arithmetic averages, further underscore the importance of furnishing essential prerequisites to proficiently integrate metaverse technology in education.

Table 6: Analysis of Arithmetic Means, Standard Deviations, and Rank Estimates for the Sample's Response on the Dimension of Challenges of Applying Metaverse Technology

No.	Item	Mean	Std. Deviation	Rank
1	The absence of adequately skilled human resources capable of effectively managing metaverse technology.	3.8	1.13	High
2	Insufficient budgetary allocation to meet the substantial financial requirements associated with operating advanced metaverse technology.	3.7	1.24	High
3	Limited information awareness regarding the utilization of metaverse technologies.	3.8	1.07	High
4	Inadequate maintenance and insufficient monitoring of the performance of metaverse technology within laboratory settings.	3.7	1.24	High
5	The absence of essential software and applications required to effectively utilize metaverse technology.	3.6	1.13	High
6	The presence of a weak infrastructure to support the operation of metaverse technology in educational settings	4.0	1.06	High
7	Metaverse technology applications need continuous updating and development	3.9	1.13	High
8	Ensuring ethical considerations are taken into account to create a safe user experience while utilizing metaverse technology.	3.5	1.24	High
9	The limited availability of Arabic language-supported applications, considering it is a modern technology.	3.7	1.24	High
10	The absence of guaranteed information security and data confidentiality when employing metaverse technology.	3.6	1.24	High
	Overall average	3.7	1.17	High

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To address the third research question, investigating the noteworthy challenges linked to the integration of metaverse technology in educational institutions within the digital learning context, the researchers calculated arithmetic means, standard deviations, and rank estimates derived from the research sample's responses to each questionnaire item. The outcomes of this analysis, as elucidated in Table 6, offer valuable insights into the primary obstacles and complexities encountered in the deployment of metaverse technology.

Table 6 delineates the arithmetic means and standard deviations derived from the research sample's responses concerning the challenges encountered in the integration of metaverse technology in education, specifically within the domain of home economics. The overall average assessment was notably high at 3.7, accompanied by a standard deviation of 1.17. Among the identified challenges, the inadequacy of the infrastructure necessary for the operation of metaverse technology in education emerged as a prominent obstacle. Item 6, addressing the deficiency in infrastructure, garnered an arithmetic mean of 4.00, with a standard deviation of 1.06, indicating a markedly high rating. Furthermore, the continual updating and development of metaverse technology applications were underscored as pivotal requisites for its effective implementation in education. Item 7, concerning the imperative for continuous updating and development, yielded an arithmetic mean of 3.9, accompanied by a standard deviation of 1.13, signalling a high assessment. Similarly, items 1 and 3, addressing the deficiency in qualified human resources adept at handling metaverse technology and the lack of information awareness regarding its usage, obtained means of 3.8 and standard deviations of 1.07, both indicative of elevated ratings. These challenges underscore the significance of rectifying human resource qualifications and augmenting information awareness for the efficacious implementation of metaverse technology in education. The remaining items in the table maintain a sequential pattern, all receiving high ratings. This accentuates the imperative of addressing these challenges for the successful integration of metaverse technology in education, including the domain of home economics.

To investigate the fourth research question, which delves into future visions for integrating metaverse technology in education, specifically within the domain of home economics in the context of digital learning, the researchers computed arithmetic means and standard deviations based on the research sample's responses to each questionnaire item. These computations aimed to discern the foremost future visions for the application of metaverse technology. The outcomes of this analysis are detailed in Table 7, offering valuable insights into the primary aspirations and potential trajectories for the utilization of metaverse technology in education, encompassing the field of home economics.

Table 7 presents the mean values and standard deviations derived from the study sample's responses concerning their perceptions of future visions for the integration of metaverse technology in the instruction of home economics. The overall mean assessment received a designation of "high," with a percentage of 3.9 and a standard deviation of 1.1. The research outcomes underscore several noteworthy future visions.

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Primarily, there is a pronounced emphasis on collaborative endeavours between administration and faculty members, coupled with the cultivation of technological competencies among teachers and learners. This emphasis is distinctly evident in items 4 and 9 (mandating cooperative efforts between management and members and organizing workshops to introduce metaverse technology to teachers and learners), both yielding a mean score of 4.08 and a standard deviation of 1.2, indicative of a significantly elevated rating.

Table 7: Analysis of Arithmetic Means, Standard Deviations, and Rank Estimates for the Sample's Response on the Dimension of Future Visions for Employing Metaverse Technology in Teaching Home Economics

No.	Item	Mean	Std. Deviation	Rank
1	Leveraging the experiences of countries that have previously implemented metaverse technology	3.6	1.24	High
2	The timing is not yet suitable for the implementation of metaverse technology in the context of teaching home economics.	3.8	1.24	High
3	Metaverse technology has the potential to enhance practical aspects of academic courses by providing accessible information sources through virtual reality.	3.5	1.09	High
4	Achieving effective learning and teaching processes through the use of technology necessitates a collaborative endeavour between the administration and faculty members.	3.9	1.13	High
5	Staying abreast of emerging global trends in technology for effectively incorporating technology in the realm of home economics.	3.3	1.13	High
6	Metaverse technology presents a valuable, cutting-edge, engaging, and versatile approach to content delivery.	3.5	1.13	High
7	Developing robust mechanisms and controls to ensure the preservation of privacy and property rights.	3.4	1.32	High
8	Formulating effective operational mechanisms and strategies to handle metaverse technology.	3.2	1.32	High
9	Organizing workshops aimed at familiarizing educators and learners with metaverse technology.	3.9	1.13	High
10	Creating a robust digital environment within educational facilities.	3.7	1.13	High
	Overall average	3.6	1.19	High

Furthermore, the research participants indicated a prevailing sentiment that the implementation of metaverse technology in the teaching of home economics is premature, as evidenced by item 2 (deeming it too early to apply metaverse technology in teaching home economics), which garnered a mean score of 4.07 and a standard deviation of 1.2, signifying a markedly elevated rating. Additionally, item 10 (advocating for the establishment of a robust electronic environment in educational settings) emerged as another prospective vision for the integration of metaverse technology, attaining a mean score of 4.04 and a standard deviation of 1.1, reflecting a high assessment. Furthermore, one of the envisioned future trajectories involves drawing upon the experiences of other nations in implementing technology, as

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elucidated in item 1 (benefiting from the experiences of preceding countries in utilizing metaverse technology), which received a mean score of 4.02 and a standard deviation of 1.2, also indicative of a significantly high rating. The remaining items consistently garnered elevated ratings, underscoring the importance of aspiring towards these future visions to proficiently incorporate metaverse technology in education, specifically in the domain of teaching home economics.

DISCUSSION

The findings emphasize the imperative of augmenting societal knowledge concerning metaverse technology to facilitate its effective utilization and integration into the educational paradigm. This necessitates a comprehensive understanding of its applications in education, specifically within the domain of home economics, along with a nuanced comprehension of the potential advantages and disadvantages associated with its implementation. These results resonate with prior research, such as the investigation by Ning et al. (2023), delving into the principal domains of metaverse application and the attendant challenges. Correspondingly, Al and Mohamed Karam Kamal Al (2022) explores the metaverse as an intermediary realm between reality and envisioned future developments. Moreover, AlAli (2023) underscores the significance of heightened awareness and knowledge regarding the metaverse and its concomitant modern technologies, encompassing Blockchain, digital codes, symbols, and others, particularly within the Arab region.

The results underscore the crucial requirement for effective utilization of metaverse technology, emphasizing the need for comprehensive support from educational institutions. This support includes financial and moral backing, coupled with the allocation of suitable budgets to facilitate technology implementation. Additionally, training educators and staff members is essential to equip them with the requisite skills for utilizing educational technological innovations, adapting to evolving times and technological advancements, and proficiently leveraging metaverse technology. These findings align with prior studies that highlight the importance of offering both material and moral support. Ning et al. (2023) underscores technology as an emerging domain requiring the provision of technical, spatial, and social capabilities for effective utilization. Likewise, Lee et al. (2021) offer a comprehensive exploration of the metaverse concept, detailing enabling technologies for the transition from the current Internet to the metaverse world. These technologies encompass extended reality, human-computer interaction, artificial intelligence, IoT and robotics, edge and cloud computing, and future mobile networks. The study delves into user-centric factors within the metaverse ecosystem, including avatars, content creation, the virtual economy, social acceptance, security and privacy, trust, and accountability. Additionally, Han et al. (2022) propose a dynamic framework for resource allocation synchronized with metaverse and Internet of Things services and data.

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The findings emphasize that a primary challenge impeding the integration of metaverse technology in education is the insufficient infrastructure within educational institutions. These results are consistent with prior research emphasizing the significance of establishing robust infrastructure to facilitate the optimal use of metaverse technology, accounting for associated costs. For example, Xu et al. (2022) propose a framework designed to attain near-perfect social welfare while halving information exchange costs compared to baseline costs. Another identified challenge is the lack of information awareness, necessitating heightened efforts to raise awareness and equip individuals with the requisite knowledge and skills for effective engagement with technology. This finding is corroborated by Han (2020), underscoring the importance of teachers being cognizant of their students' learning processes and guiding them through the immersive metaverse encountered in teaching. The demand for continuous updating poses a significant challenge in metaverse technology application, complicating its implementation. This observation is substantiated by Lee et al. (2021), who stress the need for ongoing technological advancements and propose a specific research agenda for metaverse development. Similarly, Ning et al. (2023) offer insights into the current state of metaverse development, its technical framework, social aspects, temporality, hyper spatiality, and discuss initial application areas of the metaverse, along with potential challenges and issues. Additionally, the scarcity of human resources emerges as a hindrance, as discussed by Han (2020) in their proposition of a dynamic framework for resource allocation to synchronize the metaverse with Internet of Things services and data. Lin et al. (2022) also scrutinize the challenges of implementing technology in education, with a significant concern being the inadequacy of qualified human resources proficient in handling technology.

The findings highlight a crucial future vision for employing metaverse technology in education, centring on a transformative shift in the educational landscape. Experts envision a future marked by increased flexibility in education, facilitating heightened interaction with educational content. This vision underscores the significance of collaborative endeavours to integrate technology into educational institutions and emphasizes the imperative for decision-makers to endorse the implementation of interactive applications in education. These perspectives align with the insights presented in the study by AlAli and Saleh (2022), which underscores the imperative of collective engagement in harnessing the potential of metaverse technology in education. The findings underscore that expert envision a transformative future for the education sector through the integration of metaverse technology, recognizing its potential impact on this pivotal domain. This vision anticipates a flexible educational environment conducive to interactive engagement with educational content. Realizing this vision necessitates concerted efforts to integrate technology within educational institutions, with decision-makers actively endorsing the implementation of interactive applications in education. AlAli and Al-Barakat (2022) emphasizes the essentiality of collective collaboration in leveraging the potential of metaverse technology in education.

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Additionally, there is an urgent need to enhance the skills of teachers and learners in effectively navigating metaverse technology. Ning et al. (2023) supports this idea by highlighting that metaverse technology, as a new domain, requires the provision of various technical, spatial, and social possibilities. However, it is essential to recognize that the widespread implementation of metaverse technology in education, including the field of home economics, is still in its early stages. The study by Inceoglu and Ciloglugil (2022) aligns with this perspective, indicating that the techniques and structures required for the effective implementation of this technology are not yet mature. Consequently, it is essential to identify suitable strategies for integrating the metaverse into education and thoroughly assess its impact on a broader scale, allowing for the maturation of metaverse infrastructure. Establishing a robust digital environment is imperative to efficiently activate and utilize metaverse technology in education, including the field of home economics. This idea is supported by the study conducted by Duan et al. (2021), which proposes a comprehensive three-dimensional metaverse environment encompassing infrastructure, interaction, ecosystem, a detailed timeline, and specific features. Additionally, there is a significant need to leverage the experiences of countries that have already implemented metaverse technology in education, particularly in the context of home economics. Several studies offer systematic plans to activate and utilize metaverse technology in education. For instance, Duan et al. (2021) and Han et al. (2022) provide valuable insights into the potential of digital twins of real-world entities within the metaverse, facilitating the provision of virtual services.

By capitalizing on insights derived from prior experiences and implementing a meticulously crafted digital environment, educational institutions can adeptly exploit the potential of metaverse technology to enrich learning experiences, notably within the domain of home economics.

RECOMMENDATIONS AND FUTURE DIRECTIONS

The current research yields several recommendations for the effective integration of metaverse technology in education and scientific research. Primarily, it is imperative to address impediments and challenges hindering the adoption of metaverse technology in these domains. Secondly, the implementation of workshops and training courses is advised to equip individuals with the necessary skills for proficiently utilizing metaverse technology in educational settings. Additionally, a collaborative effort between experts in educational technology and the field of home economics is essential to formulate a coherent operational plan. Allocating resources and meeting requirements, as dictated by research findings, for the seamless integration of metaverse technology into home economics education is crucial. The establishment of a robust electronic infrastructure capable of supporting the effective implementation of metaverse technology is deemed imperative. Furthermore, the incorporation of the metaverse into courses addressing digital transformation is recommended, recognizing

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it as an emerging reality that warrants attention. Through the implementation of these recommendations, barriers can be surmounted, educational practices can be elevated, and the full potential of metaverse technology in education and research can be realized.

The current research suggests: First, undertaking additional studies to further comprehend the significance of metaverse technology in education, specifically in the context of teaching home economics. Second, proposing a study to enhance the competencies of faculty members in metaverse technology. Lastly, presenting a vision for incorporating metaverse technology into digital learning. These recommendations offer valuable directions for the ongoing exploration and implementation of metaverse technology in education.

IMPLICATIONS

This exploratory study contributes to the knowledge base of home economics education by investigating the prospective applications of metaverse technology as an emerging instructional tool. It broadens the comprehension of potential advancements in the field and constitutes a valuable addition to existing research literature. The study introduces and delves into the concept of metaverse technology, elucidating its plausible integration within educational institutions. By illuminating this innovative technology, the research enhances educators' and policymakers' understanding of its capabilities and benefits in the realm of teaching home economics. Incorporating a diverse array of expert perspectives and viewpoints in the field of digital education, the research seeks a comprehensive analysis of metaverse technology's potential implications and applications. This inclusion of expert insights bolsters the credibility and robustness of the research findings. The study holds significance in aiding educational institutions in staying abreast of the latest technological developments and augmenting their capacities. By exploring the potential utilization of metaverse technology in teaching home economics within the digital education landscape, the study provides a forward-looking perspective. This vision empowers educational institutions to envision the possibilities and opportunities presented by metaverse technology, thereby facilitating informed decision-making and strategic planning for its integration into home economics education.

LIMITATIONS OF THE STUDY

The study acknowledges several limitations that warrant consideration. Firstly, the sample size was constrained to 123 participants, encompassing teaching staff, support personnel, expert mentors, teachers, and specialists in educational technology and home economics. This limited sample size poses potential challenges to the generalizability of the findings. Secondly, the research was specifically undertaken during the second semester of the academic year 2022/2023, which may introduce temporal constraints on the relevance of the results. Lastly, the interpretation of the research findings was circumscribed by the constraints imposed by the size and composition of the sample employed. It is imperative to bear in mind these limitations when assessing the

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applicability and significance of the study's outcomes.

Author Contributions

All authors have sufficiently contributed to the study and agreed with the results and conclusions.

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Informed Consent Statement

Informed consent was obtained from all individual participants included in the study.

Data Availability Statement

Data supporting the findings and conclusions are available upon request from the corresponding author.

Conflicts of Interest

No conflict of interest is declared by authors.

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