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Teaching the Metaverse:
Applying TPACK to a Multidisciplinary First Year Seminar Course Design

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Abstract

This paper explores the course design and implementation of a first-year discovery seminar on "Living in the Metaverse" offered at a business university. Integrated with standardized college-readiness topics, the course combines hands-on activities with collaborative assignments and class discussions to present a multidisciplinary exploration of the metaverse from business, technology, and societal perspectives. The authors describe how they utilized the TPACK (Technology, Pedagogy and Content Knowledge) model in designing the course, and how this model can be applied when considering how to incorporate new technologies into courses. To assess the effectiveness of this approach, the authors surveyed students in three sections of the course taught during two consecutive semesters to determine their attitude toward relevant technologies and the course topics. We found that hands-on activities with virtual reality headsets helped make metaverse concepts easier to grasp, while students still had concerns about widespread use of the metaverse, including privacy and security.

Teaching the Metaverse: Applying TPACK to a Multidisciplinary First Year Seminar Course Design

Mark Frydenberg, David J. Yates and Andre Noonan

1. INTRODUCTION

This paper describes the design of a first-year discovery seminar (FDS) course at a business university where the instructors chose as its theme, "Living in the Metaverse." The FDS course at many universities provides an extended orientation for incoming students to adapt to their new college surroundings, meet their peers, and learn about research by exploring complex problems from a multidisciplinary perspective (Reid et al., 2014; Rust & Korstange, 2018)**.** This combination of academic-skill building (critical thinking, information literacy, working across differences, problem solving, learning how to learn, intellectual curiosity, and academic integrity) within the context of a larger open-ended question provides a compelling model for exploration and learning and can have a positive impact on student success.

Each incoming student enrolls in an FDS course during the fall semester (the exception being transfer students and those who need to repeat the course.) The university offers more than 50 sections of FDS each fall, collectively, these are taught by more than 40 different instructors. One-third of the FDS course content is standard material, common across all sections: campus resources, time management, academic expectations, information literacy, unconscious bias, doing research, writing a research paper. The other two-thirds of the course content can be any "wicked problem" or open-ended issue that each instructor selects for their section. The authors chose to explore the metaverse as the open-ended "challenge" in their sections, and designed the course to be *about the metaverse*, presenting an overview of the topic from a multidisciplinary perspective, focusing on its connections to business, society, and technological development.

At its most basic level, a metaverse is a three-dimensional space in which users interact using virtual reality and with other users represented as avatars. Many metaverses exist: decentralized virtual spaces, or worlds, such as Meta Horizon Worlds, Roblox, Decentraland, and the Sandbox, where people gather synchronously online to conduct business meetings, play video games, attend social events, purchase real estate, and visit destinations they may not be able to get to in real life. Many metaverses have their own digital economies. Avatars or digital twins form a person's online identity in and across metaverses (Kshetri, 2022). As metaverse technologies evolve, a goal is to link individuals' avatars and digital assets so that users can operate consistently across multiple metaverses. Some consider the metaverse as the next iteration or future of the internet (Ramesh et al., 2022), a Web3 application that brings value to the user generated content that characterizes Web 2.0 (Suderman, 2022).

The following questions guided this study:

- When designing a multidisciplinary course intended to introduce a new technology, what pedagogical approaches and technology tools can instructors utilize to make course concepts relevant and accessible to students?

- How can student attitudes and concerns be measured to ascertain their learning and engagement with the topic?

This paper is organized as follows: the next section describes the goals of the course from a multidisciplinary perspective. The subsequent sections analyze the course design using the TPACK (Technology, Pedagogy, and Content Knowledge) framework (Niess, 2011), mapping learning goals and assignments to its various components. The final sections of this paper present the authors' methodology to develop a survey instrument and share findings related to the student experience during the course. The paper ends with a discussion of lessons learned and other considerations while designing and teaching the course.

2. THE METAVERSE FROM A MULTIDISCIPLINARY PERSPECTIVE

Because the metaverse has connections to business, society, and technology development, the instructors chose to teach "Living in the Metaverse" from a multidisciplinary perspective. To that end, the instructors posed more complicated questions to motivate in-class discussion. For example:

- What new benefits does the metaverse offer for engaging in business and social interactions, and what is required to do so? What risks might come with these benefits?

- How does the metaverse allow us to blend physical and digital experiences? How do we represent ourselves and interact with others similarly or differently in physical and virtual worlds?

- How has the development of mobile devices, wearable computing, augmented and virtual reality, wireless internet, digital currencies, and advanced communication networks converged to create a new frontier where interacting in activities of daily life, from learning to business to social, are possible?

To choose supporting material, instructional content, and teaching methods, we were guided by learning objectives specific to the metaverse. Furthermore, by stating what we wanted the students to accomplish, we were better able to understand whether students had gained the appropriate knowledge and skills by the end of the course. The learning objectives we used appear in Appendix A.

To support these learning objectives, the course included several hands-on opportunities to explore metaverses both in a browser and wearing VR (Virtual Reality) headsets. Students attended events in online virtual communities, created avatars, designed their own virtual worlds and interactive games, and investigated features of established metaverse spaces. This approach included connecting student experiences to theory. This connection was especially of interest to FDS program administrators who wanted students to appreciate both principles and practices within the scope of the course. The expansive nature of the learning objectives encouraged students to select a diverse array of topics within the realm of the metaverse for their research papers, including fast fashion, technology addiction, community governance, decentralization of authority, and the impact of the metaverse in developing countries.

The cadence of the course content included a somewhat gentle beginning and end. Most of the learning resources during the first three weeks were introductory in nature and appeared in the popular press and online video sites, e.g. (CNET, 2022; Hill, 2022). Such resources illustrated the relevance of the metaverse and were written (and produced) in a way that is accessible to first-year students. During the last two weeks, the students learned about personal identity and avatars (Szita, 2022; Trinity College, 2022) and how meetings are hosted in the metaverse (Chodor, 2022). Appendix A presents the structure and sequencing of the Spring 2023 course. Appendix D shares selected readings from the course that represent course topics including business, cultural, social, and technological perspectives on the metaverse.

The perspective of the private sector was well articulated by metaverse reports from Forrester (Truog et al., 2022), Gartner (Furlonger et al., 2022), Ernst & Young (Morini Bianzino, 2022), McKinsey & Company (2022), and others. These business-focused resources were balanced by reports focused on education (Korinek, 2023) and benefits and risks to society (J. Anderson & Rainie, 2022). Taken together, these resources provided examples of in-depth analysis of the subject matter and helped catalyze deliberative discourse among the students and exposed them to multiple perspectives from which they could draw upon when considering topics for their research papers.

Section 3 discusses the pedagogical model behind our multidisciplinary course design. Section 4 proceeds to describe the course assignments that support the learning objectives described in Appendix A.

3. AN ANALYSIS OF THE METAVERSE COURSE DESIGN USING THE TPACK FRAMEWORK

Technological Pedagogical and Content Knowledge (TPACK) is a conceptual framework to describe the knowledge base for the effective integration of technology in teaching (Mishra & Koehler, 2006). This model extends the work of Gudmundsdottir and Shulman (1987) by introducing the use of technology to enhance and support student learning. As an educational framework for course design, TPACK describes the knowledge that teachers need to successfully integrate Technology (T), Pedagogy (P), and Content (C) knowledge about a topic in the classroom. The TPACK framework requires instructors to make pedagogical decisions as to the best ways to introduce digital technologies in their courses to teach content knowledge. Figure 1 shows the interplay and relationships between these elements. The region at the intersection of technology, pedagogy, and content represents a full understanding for teaching with technology. TPACK provides a framework for using technology to teach concepts to enhance the learning experience. (Mishra & Koehler, 2006; Niess, 2011; *TPACK.ORG*, 2018).
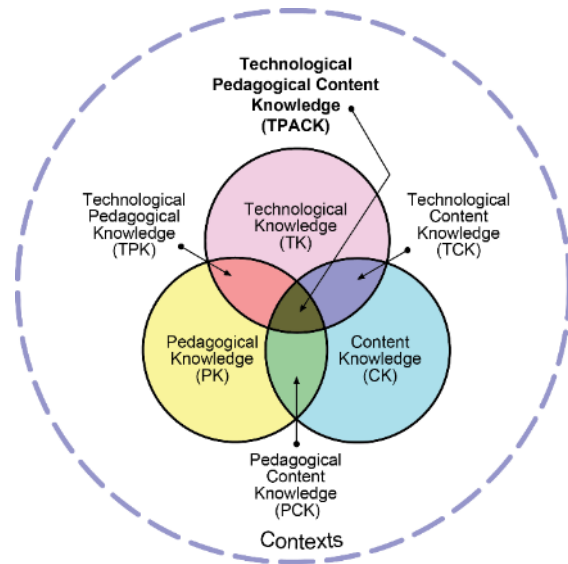
Figure 1: TPACK model; image courtesy of (*TPACK.ORG*, 2018).

Underlying truly meaningful and deeply skilled teaching with technology, TPACK is different from knowledge of all three concepts individually. Instead, TPACK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones" (Koehler & Mishra, 2009).

The authors considered this model as part of the course design for their FDS seminar on living in the metaverse. The instructors considered various pedagogies, processes, and practices necessary to make this content relevant to student learners. One technique used frequently was to create an online slide deck using Office 365 to which students could work in groups to add content.

By doing so, different groups could explore more deeply distinct parts of a complex article or reading, and develop their understanding with each other, and then share it with the class (Al-Samarraie & Saeed, 2018). When evaluating technology tools for the course, the instructors considered a suite of collaboration tools to incorporate. The instructors also explored scenarios for incorporating virtual reality headsets, applications, and toolkits for students to experience and create their own immersive virtual spaces.

4. COURSE ASSIGNMENTS

In addition to several extended orientation and study skills assignments often found in first-year seminar courses and common to all FDS sections at the university, approximately two-thirds of coursework was based on the section's wicked problem, living in the metaverse.

Appendix B describes the various metaverse-related assignments. The hands-on assignments progressed in difficulty from visiting existing metaverses (i.e., Decentraland) using a browser, to visiting a metaverse using VR headsets for an immersive experience, to creating one's own original interactive metaverse experience. Headsets were available for use in the technology learning lab (the CIS Sandbox) at Bentley University (Frydenberg, 2013). Each of these assignments required students to apply their technology knowledge and their content knowledge of the metaverse to complete.

TPACK Component	Description	Pedagogy to Meet Learning Objectives
CK	Knowledge about subject matter to be learned or taught	Provide background and materials for students to understand metaverse subject areas and topics
PK	Methods, processes, and practices of teaching, including learning and assessment	Create open ended assignments for students that foster curiosity and discovery
TK	Technology knowledge needed to use hardware/software	Design activities for students to effectively use VR equipment and metaverse software applications for experiential learning
PCK	Representing content and adopting pedagogical strategies to make topics more understandable to learners	Read and discuss in-depth articles with partners, think/pair/share, etc.
TCK	Using technology to represent/research and create content in different ways without consideration of pedagogy	Gather external readings from Forrester, Gartner, Forbes, popular blogs and websites, and videos from YouTube to support classroom learning
TPK	Using technologies to enable teaching approaches without consideration of subject matter	Assign students to develop collaborative slide presentations to divide and conquer complex journal articles; assign students in-class topic presentations
TPACK	Using technologies to teach and encourage knowledge creation of specific subject content	Enable students to become co-creators of immersive experiences using Roblox (fall) and Frame VR (spring), and meet in those spaces with VR headsets or via a browser

Table 1: TPACK components in the metaverse course design.

As shown in Table 1, assignments combined content knowledge (CK), technology knowledge (TK), and employed pedagogical methods for structured or experiential learning (TPACK) to give students opportunities to interact with the metaverse in various ways.

Table 2 maps several course elements to their corresponding TPACK components. The variety of assignments and activities were intended to engage and motivate students to analyze the metaverse from a variety of perspectives.

Content Assignments

Students also presented a topic in class using a Pecha Kucha/Ignite style lightning talk format (Courtney Klentzin et al., 2010). Frequently during class, students worked in small groups to study different parts of a longer article and add a few slides summarizing their key takeaways. This pedagogical approach made longer or more complex articles more manageable for students and allowed the entire class to learn from and share with each other.

TPACK Component	Assignments and Activities
CK	Research Paper, Key Takeaways from Readings
PK	Reflections on Experiential Learning Activities
TK	AltspaceVR/Meta Horizon Worlds
PCK	Ignite Presentation, The Great Debate
TCK	Decentraland, In-Class Collaboration & PowerPoint Presentations
TPK	Creating Avatars
TPACK	Roblox/Frame VR

Table 2: Mapping TPACK components to course assignments and activities.

The Decentraland assignment, given in both semesters, was an effective way for students to apply their content knowledge as they applied what they learned from the readings to what they saw/experienced in Decentraland. See Figure 2

for a sample slide/explanation from a student's assignment.
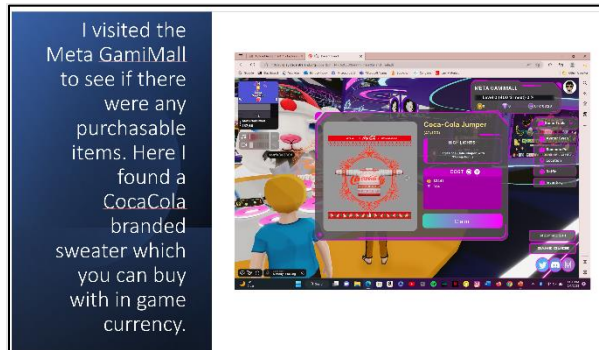
Figure 2: Exploring Decentraland.

During both semesters, students were assigned weekly assigned readings for which they prepared summaries or responses to discussion questions.

During the spring semester, the second time that the course was offered to one section, the instructor replaced short presentations of student research papers during the final exam period with a debate on the topic "Metaverse: Hope or Nope"? Students were preassigned roles in one of two "rounds" of the debate. Each round lasted 30 minutes, and consisted of a team "in favor", a team "against", and questioners. Students submitted prior to the start of the debate, a document containing at most two pages showing how they prepared for their role in the debate, with arguments and talking points for questions they anticipated. Using classroom debate as a pedagogical tool has a long tradition in the humanities (Musselman, 2004) and social sciences (Abernathy & Forestal, 2021) but has also been adopted in business courses (Rao, 2010).

The debate format got students engaged and involved in lively discussions with each other. Rather than giving an essay final exam based on the readings, having the students submit their arguments and talking points ahead of time required them to make up the questions and forced them to synthesize what they thought were the most salient points and take-aways from the course. Students naturally called out their peers whose positions were not argued as well as they could have been.

Experiential Assignments – Exploring Online Virtual Communities with VR

Students used VR headsets to explore online virtual communities. In Fall 2022 they explored the AltspaceVR metaverse, and in Spring 2023, the Meta Horizon Worlds metaverse. (AltspaceVR

was discontinued in early 2023, necessitating the switch to a different online virtual community.) For many students this was their first experience with a VR headset, and they needed some guidance from lab tutors on how to use the hand controllers to navigate and explore their virtual spaces. In the fall, this assignment was given later in the semester; in the spring, it was earlier, so that students could better appreciate readings about immersive technologies and spaces having experienced them themselves. (See Figure 3.)

Figure 3: Students explore virtual words wearing VR headsets.

During the final two-hour class session of the fall semester, and during a snow-day in the spring semester, students met in a virtual learning space, designed as a digital twin of the university's technology learning center, as shown in Figure 4. The goal was to explore the feasibility of meeting in immersive learning environments. Before the class, students added slides to a common PowerPoint Online slide deck. The instructor showed the slide deck on one of the floor-to-ceiling displays, as students maneuvered their avatars around the virtual space to see it. They joined their classmates in this virtual environment to present their work in real time. Students then reflected on their experiences learning in this type of space. "By combining virtual reality learning with physical learning, an educational social space can be constructed where students are able to interact and socialize with peers while learning" (Cui et al., 2023).
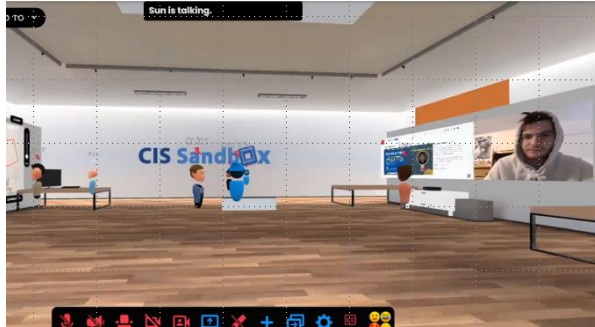
Figure 4: Students as avatars meet in a virtual environment.

Content Creation Assignments: Building a Metaverse

Students in the Fall sections completed tutorials using Roblox Studio, a development environment to create three-dimensional models and worlds that integrate with the Roblox metaverse. "Roblox is the world's largest multiplayer game community in which players can create a sandbox game online, and its platform includes virtual worlds, leisure communities, and self-built content" (Han et al., 2023). The platform contains virtual worlds and games built by its users, and the instructors originally felt that since many students were familiar with Roblox as a game playing platform, being able to create their own games would be an empowering experience.

The tutorials provided instructions to create VR games or other simple immersive experiences, as shown in Figure 5. While no original coding was involved except for possibly copying a line or two of code provided into a specified screen as shown in the instructions, and most elements of the scene or game were controlled by setting properties, the instructors found that many students had difficulty following these steps or making simple enhancements to add a billboard or sign with their name on it. Roblox Studio may be a better fit for students studying computer science as it introduces computer programming concepts (Hoffman et al., 2022; Malva et al., 2020).

Given the difficulty that many students had with following the instructions in the Roblox tutorials in the fall, during the spring semester, the instructor replaced that assignment with a new exercise to create an immersive scene using the Frame VR platform. Frame VR is a tool for creating immersive spaces where users can gather in real time for meetings, collaboration, and other events (Hwang et al., 2023).

Figure 5: Virtual world created in Roblox Studio, personalized with a student's name on the road sign.

Frame VR turned out to be a useful tool for business students to use because of its simple drag and drop interface and extensive templates and asset libraries. No coding is involved; Frame VR integrates with avatars created using the popular ReadyPlayer.Me platform, allowing students to take their digital identities with them; they can explore their worlds easily in a browser on laptops or mobile devices or visit them wearing VR headsets. As such it is becoming popular in many educational settings (Lee & Hwang, 2022; Wallace, 2022).

Students worked in groups of three to design a scene representing an element of popular culture. Figure 6 shows one group's scene from Seattle Grace Memorial Hospital, the setting of the popular Grey's Anatomy series. Users can explore the scene by visiting it in a browser and navigating with the keyboard, or in VR using a headset.

Students found this assignment allowed them to be more creative. After watching a few tutorials online and with no set instructions to follow, they were able to design immersive scenes and place themselves (as avatars) within those scenes to explore with their team members. Scenes ranged from popular movies and TV shows to museum-like exhibits showcasing favorite musical performers. As an alternative to demonstrating their understanding by writing a paper about metaverse features and benefits, students created their own immersive spaces, and in an accompanying video tour, discuss how they applied the metaverse design principles studied in class (Truog et al., 2022) to their work.

Figure 6: A Frame VR metaverse depicts a scene from Grey's Anatomy, with an avatar of Dr. Grey.

5. METHODOLOGY

This study, conducted with surveys and student interviews administered at the end of the Fall 2022 and during Spring 2023 semesters, involved students enrolled in three sections of FDS. (See Appendix C.) These sections were taught by two different instructors who followed the same schedule, assignments, topics, and readings during the fall semester. The instructor teaching the course in the spring for a second time adapted the course based on lessons learned from the fall student experience. Students enrolled during the fall semester were all incoming college students and, in the spring, most were transfer students. Most had not chosen a major, and all were acclimating to their new university. The university assigned students randomly to their FDS sections, with no opportunity for them to select (or avoid) a section based on its topic. Students learned that they would be studying aspects of the metaverse during the first class session.

The authors first set out to learn what student perceptions were toward the metaverse and the multidisciplinary approach to the course in which they learned about it. To gather data around these issues, the authors conducted online surveys using Qualtrics (see Appendix C) at the start and end of each semester, reviewed student work, and conducted interviews with some students in each class. The survey was identical in both semesters, and therefore the results were combined.

The authors administered pre- and post-course surveys to 78 students in three synchronized

sections of FDS, taught by two different instructors during two semesters. Of these, 53 students provided valid survey responses. Two were under 18 years of age, so their responses were not included. The remaining students from each section were between 18 and 21 years old.

6. RESULTS

Figure 7 compares students' pre- and post-course learning about specific topics set out in the course learning objectives. Each "before" value comes from the pre-course survey, and each "after" value comes from the corresponding question in the post-course survey. By assigning numeric values 1 through 5 to each of the values on a 5-point Likert scale (no nothing about, heard of, have some understanding, have good understanding, have excellent understanding), multiplying the number of responses for each scale item by its corresponding numeric value and adding the results, we obtain a numeric value representing the overall understanding level for each topic across all sections.
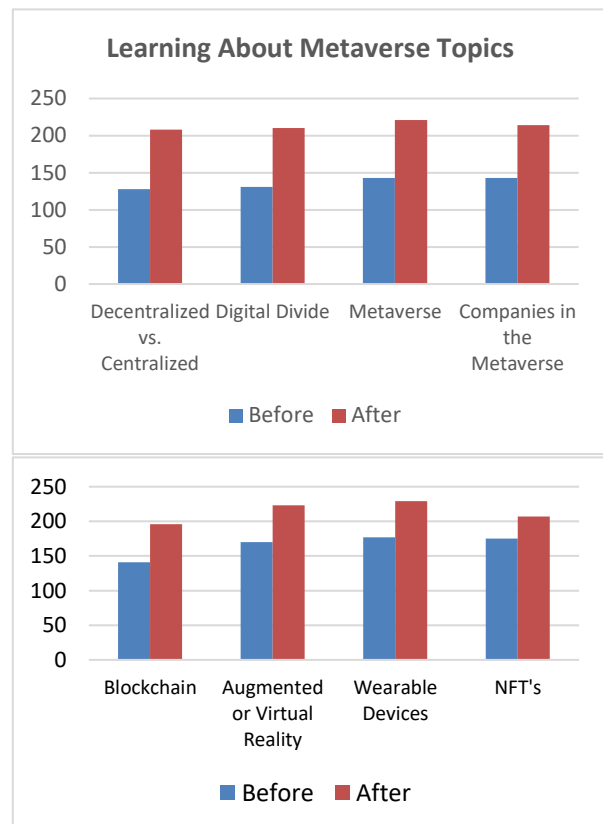
Figure 7: Pre- and post-course familiarity with important concepts.

In each case, as expected, students had greater familiarity with several course topics at the end of the course when compared to their knowledge

about these topics coming in. Students were most familiar with augmented and virtual reality, headsets, and NFTs (non-fungible tokens) prior to the start of the course, so those items saw the smallest increase in student learning. Less familiar topics, such as decentralization and the digital divide, saw the greatest increase in student learning.

Favorite Metaverse Topics

To ascertain students' perceptions toward learning about the metaverse, the survey posed an open-ended question, "What was your favorite aspect of the course?". A simple word cloud analysis, where more frequently appearing words in their responses appear in a larger font than those which were less frequently cited, is shown in Figure 8, to get a general sense of their preferred topics and activities. Common stop-words were removed, and similar words (crypto and cryptocurrency, for example, were combined, for the sake of clarity.

Figure 8: Favorite metaverse topics.

Crypto, business, real estate, and NFTs were the most frequently cited favorite topics in the course. The course covered aspects of the digital economy's significance within the metaverse, and the role of cryptocurrencies in transactions, virtual commerce, and digital assets. Business-related responses suggested student interest in exploring entrepreneurial opportunities and innovative businesses within the metaverse.

Favorite Course Activities

Figure 9 shows the most popular words that emerged when students considered their favorite activities in the course.
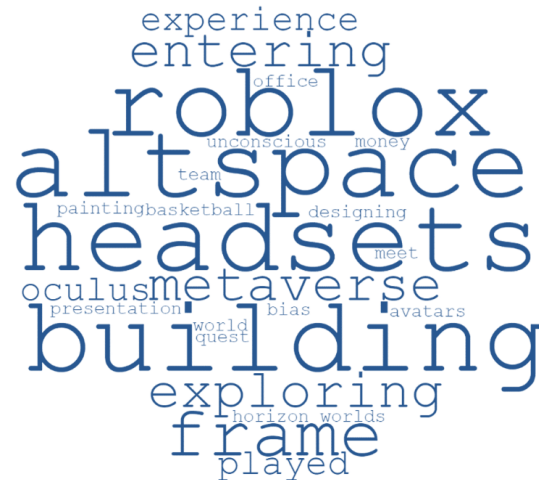
Figure 9: Favorite course activities.

The most popular activity among the students was using VR headsets to experience immersive environments. Specifically, they mentioned Roblox and Frame and "building" as most popular, demonstrating their interest in becoming co-creators of original metaverse environments. Also of note is that assignments on meeting in VR worlds and communities had strikingly different popularities. The number of students who mentioned AltspaceVR as a favorite activity in the fall far exceeded the number who mentioned the Meta Horizon Worlds activity in the spring, despite the hype associated with Facebook's immersive environment at the time this was assigned. (While the assignments were similar, visiting virtual communities in Meta Horizon Worlds replaced visiting AltspaceVR virtual communities after that platform was discontinued in early 2023.)

Students found building their own virtual worlds and meeting in them to be exciting, although they also found completing Roblox tutorials to be incredibly challenging. In response, the instructor replaced Roblox the following semester with a new assignment using Frame VR.

Metaverse Attitudes and Concerns

Tables 3 and 4 show student concerns and attitudes toward the metaverse, based on data from the post-course survey. The survey posed questions about specific course topics and their concerns or attitudes toward them. Each item received 53 responses. Results are presented in reverse sorted order by mean score, to highlight the items of greatest concern or relevance to students.

Concern	Mean	Std Dev	Vari-ance
Privacy	3.98	0.84	0.70
Security	3.89	0.92	0.86
Being hacked	3.79	0.90	0.81
Lack of regulation	3.74	0.95	0.91
Lack of norms	3.48	0.97	0.94
Cost of technology to participate	3.43	1.06	1.11
Why anyone would participate in the first place	2.92	1.00	0.99

Table 3: Concerns about the metaverse.

As shown in Table 3, students were most concerned about privacy, security, and being hacked. These findings, especially those related to concerns about privacy and security of online information, are consistent with Gen Z attitudes assessed by the Pew Research Center (M. Anderson et al., 2022).

Based on survey responses, students recognized the opportunities for new metaverse technologies to grow and develop over time as well as a desire to continue using them to explore new realms. Students were also optimistic about opportunities for businesses to break ground and innovate in virtual markets.

The data in Table 4 suggest that that students mostly agree regarding the potential impact and opportunities associated with the metaverse. However, there is some variation in opinions, particularly regarding the long-term sustainability and widespread adoption of the metaverse.

7. DISCUSSION

Lessons Learned

While many students showed interest in learning about the metaverse, many had a challenging time identifying with it as a tangible experience because they had not used VR headsets previously, or because their only prior experience with VR was in a gaming context and hence, they could not identify with its business and social applications. During the fall semester, the first assignment to use VR headsets began during week six, which was far too late. During the spring semester, the first VR headset assignment was given during week two. Conducting the first VR headset activity earlier in the semester enabled more students to have a common experience around the technology whose applications to the metaverse they were beginning to study and made these concepts more concrete.

Attitude or Perception	Mean	Std Dev	Variance
I worry about the societal impacts of the metaverse	3.87	0.85	0.72
The metaverse will accelerate the use of digital assets	3.85	0.60	0.35
The metaverse is exciting and offers the opportunity to be creative in a virtual world	3.79	0.84	0.71
The metaverse will revolutionize businesses creating a "creator economy"	3.72	0.86	0.73
Accessing the metaverse is easy	3.62	0.99	0.99
The metaverse will be the next social platform for businesses	3.57	0.81	0.66
The metaverse is a place aimed at younger people	3.57	0.84	0.70
A true metaverse won't be achieved within the next ten years	3.51	0.92	0.85
The metaverse is the next incarnation of the internet	3.49	0.94	0.89
Virtual environments can offer a sense of place and connection to physical environments	3.42	0.96	0.92
The metaverse is inclusive to all	3.21	1.00	0.99
The metaverse is a fad whose popularity will diminish within the next five to ten years	2.98	0.86	0.74
The metaverse will not materialize or catch on	2.85	0.96	0.92

Table 4: Attitudes toward the metaverse.

The TPACK model worked well, even for a course with content that is changing and evolving. TPACK aligns the content that is taught with techniques and technologies that can be used to support or enhance student learning.

The most helpful information from our post-course survey (see Appendix C) gave us feedback on favorite topics, favorite readings, and advice for instructors that teach this course in the future. Although some of these findings are summarized in figures 8 and 9, we present a more detailed analysis here.

Most of the favorite topics in the course integrated learning a technology and applying it in the metaverse. From a TCK perspective, students were most interested in marketing, advertising, fashion, digital retail, and digital real estate. The most popular technology elements of the course (TK) were blockchain, NFTs, and cryptocurrency. The favorite aspects of the course that integrated metaverse content, technology, and pedagogy (TPACK) were understanding digital asset markets (Zainab et al., 2022), leveraging Web 3 technologies (Bobier et al., 2022), learning the platforms themselves (e.g., AltspaceVR, Roblox, and Decentraland), and building digital experiences using these platforms (see Section 4).

Students provided a variety of feedback when asked about their favorite reading. The clear favorite was chapters selected from Snow Crash (Stephenson, 2003). Outside of these chapters (CK), readings that integrated two or more disciplines (CPK and TPACK) were most popular. Examples include the concerns and risks of unconscious bias and lack of diversity, equity, and inclusion in the metaverse (Morini Bianzino, 2022; Zallio & Clarkson, 2022). Some of the foundational readings (TCK and TPACK) were also popular with some students, most notably those that presented design principles (Chaturvedi et al., 2011; Truog et al., 2022) and discussed privacy, security, and ethics (Hackl, 2020; Pooyandeh et al., 2022; Wang et al., 2022). Other favorite areas of interest included metaverse economics (Du et al., 2023; Korinek, 2023; McKinsey & Company, 2022), workplace culture (Purdy, 2022), and commerce in the metaverse (Bratu & Săbău, 2022; Shen et al., 2021).

Because of the timeliness of this topic when it was initially offered (three months before the launch of ChatGPT), administrators saw this course an engaging way to introduce a current technology trend with wide business and societal implications

to students. The course design balanced theoretical content, reflective teaching methods, and VR experiential learning, and was therefore well-received.

Two dominant themes emerged when we asked students to suggest ways to improve the course. A considerable number of students thought more hands-on activities would improve the course. Many students also felt disoriented by the mix of material focused on extended orientation and academic skills (both common across all sections of FDS), and the metaverse topic of the sections in which they were enrolled.

Limitations and Future Work

Because applications, use cases, and technology development surrounding the metaverse continue to evolve, this course needs to evolve with these trends to remain relevant. Metaverse platforms come and go, as we have witnessed, and some are easier to use than others. While the premise of assignments might stay the same in future iterations of the course, their implementation would need to be re-examined to incorporate currently available technologies and environments.

The authors would also identify readings selected specifically to explore some of the student concerns as articulated in Table 3 in the context of existing course topics (security, privacy, and safety, the digital divide, societal impact of the metaverse). Increased discussion of these topics could inform the attitudes of future students toward the metaverse, as presented in Table 4.

8. CONCLUSION

This paper described the use of the TPACK framework (Mishra & Koehler, 2006; Niess, 2011) to integrate technology, pedagogy, and conceptual knowledge into a first-year discovery seminar course on "Living in the Metaverse." The instructors incorporated several pedagogical approaches, including collaborative work, discussions, and hands-on activities with VR headsets, designed to enrich student learning about the metaverse in a classroom environment that promoted inquiry, thoughtful conversations, experiential learning, and deliberative discourse. Surveys on student attitudes toward the metaverse showed both interest in its promise and concerns about its consequences.

Applying the TPACK framework, identifying multidisciplinary perspectives, and considering various attitudes to the topic allowed students to develop a greater understanding of the

metaverse and its applications to areas of their own interest. This approach to course design can serve as a model for instructors designing future courses which include learning about and experimenting with new technologies.

9. REFERENCES

Abernathy, C., & Forestal, J. (2021). The use of debates in political science courses. *Journal of Political Science Education*, *17*(3), 343–355. https://doi.org/10.1080/15512169.2019.1656082

Al-Samarraie, H., & Saeed, N. (2018). A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment. *Computers & Education*, *124*, 77–91. https://doi.org/10.1016/j.compedu.2018.05.016

Anderson, J., & Rainie, L. (2022, June 30). The Metaverse in 2040. *Pew Research Center: Internet, Science & Tech*.

Anderson, M., Vogel, E., Perrin, A., & Rainie, L. (2022, November 16). Connection, Creativity and Drama: Teen Life on Social Media in 2022. *Pew Research Center: Internet, Science & Tech*.

Bobier, J.-F., Merey, T., Robnett, S., Grebe, M., Feng, J., Rehberg, B., Woolsey, K., & Hazan, J. (2022). The Corporate Hitchhiker's Guide to the Metaverse. *Boston Consulting Group*.

Bratu, S., & Sabău, R. I. (2022). Digital commerce in the immersive metaverse environment: Cognitive analytics management, real-time purchasing data, and seamless connected shopping experiences. *Linguistic and Philosophical Investigations*, *21*, 170–186. https://doi.org/10.22381/lpi21202211

Chaturvedi, A. R., Dolk, D. R., & Drnevich, P. L. (2011). Design Principles for Virtual Worlds. *MIS Quarterly*, *35*(3), 673–684. https://doi.org/10.2307/23042803

Chodor, B. (2022, January 13). Meetings in the Metaverse: Is This The Future Of Events And Conferences? *Forbes*.

CNET. (2022). *Explaining the Metaverse: Everything You Need to Know About Future of the Internet*. https://www.youtube.com/watch?v=7DEVfUk2zCk

Courtney Klentzin, J., Bounds Paladino, E., Johnston, B., & Devine, C. (2010). Pecha Kucha: Using "lightning talk" in university instruction. *Reference Services Review*, *38*(1), 158–167. https://doi.org/10.1108/00907321011020798.

Crews, T. B., Wilkinson, K., & Neill, J. K. (2015). *Principles for good practice in undergraduate education: Effective online course design to assist students' success*. *Journal of Online Learning and Teaching, 11*(1), 87-103.

Cui, L., Zhu, C., Hare, R., & Tang, Y. (2023). MetaEdu: A new framework for future education, Discover Artificial Intelligence, 3, Art. 10. https://doi.org/10.1007/s44163-023-00053-9

Du, H., Ma, B., Niyato, D., Kang, J., Xiong, Z., & Yang, Z. (2023). Rethinking quality of experience for metaverse services: A consumer-based economics perspective. *IEEE Network*. https://doi.org/10.1109/MNET.131.2200503

Frydenberg, M. (2013). Creating a collaborative learning community in the CIS Sandbox. *Interactive Technology and Smart Education*, *10*(1), 49–62. https://doi.org/10.1108/17415651311326446

Furlonger, D., Uzureau, C., & Kandaswamy, R. (2022). *Quick Answer: How to Increase Customer Engagement and Drive Revenue in the Metaverse*. Gartner.

Gudmundsdottir, S., & Shulman, L. (1987). Pedagogical Content Knowledge in Social Studies. *Scandinavian Journal of Educational Research*, *31*(2), 59–70. https://doi.org/10.1080/0031383870310201

Hackl, C. (2020, August 2). Now Is the Time to Talk about Ethics and Privacy in the Metaverse. *Forbes*.

Han, J., Liu, G., & Gao, Y. (2023). Learners in the Metaverse: A Systematic Review on the Use of Roblox in Learning. *Education Sciences*, *13*(3), Art. 296, https://doi.org/10.3390/educsci13030296.

Hedrick, E., Harper, M., Oliver, E., & Hatch, D. (2022). Teaching & Learning in Virtual Reality: Metaverse Classroom Exploration. *2022 Intermountain Engineering, Technology and Computing (IETC)*, 1–5, https://doi.org/10.1109/IETC54973.2022.9796765.

Hill, K. (2022, October 7). This is Life in the Metaverse. *New York Times*.

Hoffman, D. L., Leong, P., Ka'aloa, R. P. H., & Paek, S. (2022). Teachers' Perspectives on Culturally-Relevant Computing: Principles and Processes. *TechTrends*, *66*(3), 423–435, https://doi.org/10.1007/s11528-022-00733-w.

Hwang, Y., Shin, D., & Lee, H. (2023). Students' Perception on Immersive Learning Through 2D and 3D Metaverse Platforms. *Educational Technology Research and Development*, 1–22, https://doi.org/10.1007/s11423-023-10238-9.

Iacono, S., & Vercelli, G. (2023). How to Prepare High-Level Massive Online Open Courses for the Metaverse: Tools and Needs. *Engineering Proceedings*, *38*(1), Art. 2. https://doi.org/10.3390/engproc2023038002

Koehler, M., & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Korinek, A. (2023). *Metaverse Economics Part 1: Creating Value in the Metaverse*. Brookings Institution.

Kshetri, N. (2022). A Typology of Metaverses. *Computer*, *55*(12), 150–155. https://doi.org/10.1109/MC.2022.3204978

Lee, H., & Hwang, Y. (2022). Technology-Enhanced Education through VR-Making and Metaverse-Linking to Foster Teacher Readiness and Sustainable Learning. *Sustainability*, *14*(8), Art. 4786. https://doi.org/10.3390/su14084786

Malva, L., Hooshyar, D., Yang, Y., & Pedaste, M. (2020). Engaging Estonian primary school children in computational thinking through adaptive educational games: A qualitative study. *IEEE 20th International Conference on Advanced Learning Technologies (ICALT)*, 188–190. https://doi.org/10.1109/ICALT49669.2020.00061

McKinsey & Company. (2022). *Value creation in the metaverse: The real business of the virtual world*. McKinsey & Company.

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Morini Bianzino, N. (2022). *How will the metaverse change our behavior as it reshapes experiences?* Ernst & Young.

Musselman, E. G. (2004). Using Structured Debate to Achieve Autonomous Student Discussion. *The History Teacher*, *37*(3), 335–349. https://doi.org/10.2307/1555673

Niess, M. L. (2011). Investigating TPACK: Knowledge Growth in Teaching with Technology. *Journal of Educational Computing Research*, *44*(3), 299–317. https://doi.org/10.2190/EC.44.3.c

Pooyandeh, M., Han, K.-J., & Sohn, I. (2022). Cybersecurity in the AI-Based metaverse: A survey. *Applied Sciences*, *12*(24), Art. 12993, https://www.mdpi.com/2076-3417/12/24/12993.

Purdy, M. (2022, April 5). How the metaverse could change work. *Harvard Business Review*.

Ramesh, U. V., Harini, A., Divya Gowri, Ch. S., Durga, K. V., Druvitha, P., & Kumar, K. S. (2022). Metaverse: Future of the Internet. *International Journal of Research Publication and Reviews*, *3*(2), 93–97.

Rao, P. (2010). Debates as a Pedagogical Learning Technique: Empirical Research with Business Students. *Multicultural Education & Technology Journal*, *4*(4), 234–250. https://doi.org/10.1108/17504971011087531

Reid, K. M., Reynolds, R. E., & Perkins-Auman, P. G. (2014). College First-Year Seminars: What are We Doing, What Should We Be Doing? *Journal of College Student Retention: Research, Theory & Practice*, *16*(1), 73–93. https://doi.org/10.2190/CS.16.1.d

Rust, D. Z., & Korstange, R. (2018). Prioritizing Reflection and Integrative Learning in First-Year Seminar Courses. *Journal of College Orientation, Transition, and Retention*, *25*(2), Art. 5. https://doi.org/10.24926/jcotr.v25i2.2121

Shen, B., Tan, W., Guo, J., Zhao, L., & Qin, P. (2021). How to promote user purchase in metaverse? A systematic literature review on consumer behavior research and virtual commerce application design. *Applied Sciences*, *11*(23), Art. 11087. https://doi.org/10.3390/app112311087

Stephenson, N. (2003). *Snow Crash*. Spectra.

Suderman, P. (2022, July). The Metaverse Is Already Here. *Reason*, *54*(3), 46–53.

Szita, K. (2022). A Virtual Safe Space? An Approach of Intersectionality and Social Identity to Behavior in Virtual Environments. *Journal of Digital Social Research*, *4*(3), Art. 91. https://doi.org/10.33621/jdsr.v4i3.91

TPACK.ORG. (2018, March 28). TPACK.ORG. http://matt-koehler.com/tpack2/

Trinity College. (2022, September 19). *Who do you think you are? What does your avatar say about you?* https://phys.org/news/2022-09-avatar.html

Truog, D., Jacobs, I., Ask, J., Proulx, M., Do, T., & Neuburg, S. (2022). *Designing The Metaverse: Ten Principles For Envisioning XR Experiences Now In Preparation for the Metaverse*. Forrester Research.

Wallace, P. (2022). Supporting Cultural Understanding of Indonesia Through Virtual Reality and Immersive Media*.* In T. Bastiaens (Ed.), *EdMedia + Innovate Learning Summit,* 779–783.

Wang, Y., Su, Z., Zhang, N., Xing, R., Liu, D., Luan, T. H., & Shen, X. (2022). A survey on metaverse: Fundamentals, security, and privacy. *IEEE Communications Surveys & Tutorials*, *25*(1), 319–352. https://doi.org/10.48550/arXiv.2203.02662

Zainab, H. E., Bawany, N. Z., Imran, J., & Rehman, W. (2022). Virtual dimension—A primer to metaverse. *IT Professional*, *24*(6), 27–33. https://doi.org/10.1109/MITP.2022.3203820

Zallio, M., & Clarkson, P. J. (2022). Designing the metaverse: A study on inclusion, diversity, equity, accessibility and safety for digital immersive environments. *Telematics and Informatics*, *75*, Art. 101909. https://doi.org/10.1016/j.tele.2022.101909

Zyda, M. (2023). The Metaverse University. *Computer*, *56*(1), 150–156. https://doi.ieeecomputersociety.org/10.1109/MC.2022.3218389

APPENDIX A
Learning Objectives and Course Schedule for Spring 2023

Learning Objectives for "Living in the Metaverse"

- Identify key companies and innovators whose work is shaping the metaverse.
- Describe the technologies needed for the continued development of the metaverse.
- Create digital artefacts (avatars, virtual spaces) to be used when exploring an immersive environment.
- Implications for Business, Individuals, and Society.
- Define characteristics of the metaverse, and their applications and implications for social and business interactions.
- Explain how companies in various industries might do business in the metaverse, and what that looks like in a virtual world.
- Evaluate the future of the metaverse from a socio-economic perspective, including risks.
- Compare the metaverse of today and tomorrow with its origins in popular culture.
- Reflect on being a consumer or a citizen in an immersive, virtual experience and compare that with a similar in-person experience.

High-level Structure and Sequencing of the Spring 2023 First-Year Discovery (FDS) Seminar

Advanced topics were introduced after the first three weeks of the course following the structure of a survey course (Crews et al., 2015). Instruction on technology topics often included demonstrations and hands-on activities during class time to prepare students to complete their assignments. For example, students explored design principles, practices, and ethics during week four (Truog et al., 2022). Ethics was a recurring theme in the course, especially as it relates to privacy and psychological safety (Ayub, Yazdani & Kanwal, 2022; Hackl, 2020). Students explored different business opportunities in the metaverse, e.g., value creation (McKinsey & Company, 2022), customer engagement (Furlonger et al., 2022), and the future of work (Purdy, 2022).

Detailed Structure and Sequencing of the FDS Seminar

BENTLEY UNIVERSITY FIRST-YEAR DISCOVERY SEMINAR
SPRING 2023 SCHEDULE

FDS 100 SECTION 2 | Tuesday/Thursday | 3:30 – 4:50 PM | Class Location

Ⓜ = FDS Module   📄 = Research Paper   ✏️ = Reflection (common to all sections of FDS)
🥽 = Metaverse (our section's topic)

This schedule is tentative. Any changes to themes or assignments will be updated here. Watch for Ⓜ Module assignment due dates on Blackboard.

Week	Dates	Theme	Assignment
1	Jan 24, 26	Introductions Ⓜ 1 Campus Resources 🥽 1: What is the Metaverse?	🥽 1 – Decentraland Assigned Jan 26
2	Jan 31, Feb 2	Ⓜ 2 Time Management 🥽 2: Definitions 🥽 3: Technology Foundations	✏ All About Me Worksheet Due
3	Feb 7, 9	Ⓜ 3 Academic Expectations Presentation Skills 🥽 4: Virtual Communities and the Future of Work	🥽 1 – Decentraland Due Feb 7 ✏ Reflection #1 Due Feb 9 🥽 2 – Horizon Worlds Assigned Feb 9
4	Feb 14, 16	Ⓜ 4 Information Literacy, Critical Thinking, Library Search 📄 1 Select a Research Paper Topic 🥽 4: Virtual Communities and the Future of Work, continued 🥽 5: Design Principles, Privacy, and Ethics	
5	Feb 21, 23	Ⓜ 5 Unconscious Bias (Tue) Ⓜ Unconscious Bias Slides Group Work (Thu) 🥽 6: Frame VR Introduction 📄 2 Get Started with Research Zotero, Annotated Bibliography	📄 Research Paper Topic Proposal Due 🥽 2 – Horizon Worlds Due Feb 21 Ⓜ 5 Unconscious Bias Group Conversation
6	Feb 28, Mar 2	Ⓜ 6 Academic Integrity Ⓜ 7 Diversity, Equity & Inclusion (DEI) 🥽 7: DEI in the Metaverse 📄 3 Form a Thesis Statement 📄 4 Create an Outline	🥽 3 – Frame VR Assigned Feb 28
7	Mar 7, 9	Ⓜ 5 Unconscious Bias Debrief 🥽 8: Frame VR Workshop (Tue) 📄 5 Research Paper workshop	Ⓜ 5 Unconscious Bias Reflection Due FRIDAY Mar 10
	Mar 14,16	Spring Break	
8	Mar 21, 23	Ⓜ 8 Academic Advising I 🥽 3/21 Guest Speaker: VR in Health Care	Ⓜ **Academic Advising** ✏ Reflection #2 Due Mar 23

Week	Dates	Theme	Assignment
		🥽 9: Privacy, Security, and Ethics	📄 Annotated Bibliography for Research Paper Due
9	**Mar 28, 30**	Ⓜ 9 Peer Collaboration & Academic Advising II 📄 6 Editing your Research Paper workshop	**🥽 3 – Frame VR Project Due Tue Mar 28** 📄 Research Paper Thesis and Outline Due -- TUESDAY Mar 28 for review; THURDSAY to submit
10	**Apr 4, 6**	📄 7 Peer Review 1 🥽 10: Snow Crash & Predicting the Future 🥽 Visit to VR Research Lab	🥽 Readings from VR Lab 📄 Peer Review 1 Comments Due
11	**Apr 11, 13**	🥽 11: Social Concerns, including Tech Addiction 📄 8 Peer Review 2 📄 9 Write your Research Paper abstract 🥽 12: Business Applications	🥽 VR Lab Visit Report Due 📄 Peer Review 2 Comments Due
12	**Apr 18, 20**	📄 10 Quiet time to Read/Write – Plan to finish Research Paper 🥽 13: Metaverse and Personal Identity, Avatars	🥽 How to Make an Avatar 📄 **Final Research Paper Due Thu Apr 20**
13	**Apr 25, 27**	🥽 14: Meetings in the Metaverse 🥽 Make your RPM avatar and visit a virtual world with your avatar	✏ Final Reflection (#3) Due Thu Apr 27 🥽 Completed Avatar Due
FINAL	**Wed May 3, Final Exam Block (11:30 AM)**	🥽 The Great Debate, Metaverse: Hope or Nope?	📄 Research Paper in Four Slides Due before Final Exam Block

APPENDIX B
Metaverse/VR Assignment Summaries

Weekly Readings

Students submitted three bullet point "takeaways" or wrote short reactions on a discussion board to demonstrate that they read at least some of the assigned weekly readings.

In Class Presentation (Individual, Fall 2022 and Spring 2023)

An Ignite-style presentation uses a PowerPoint deck with 20 slides, each of which advances automatically after 15 seconds. That gives you five minutes to present a topic by telling a story about it. Don't put too many words on your slides since you won't be able to read them so quickly. Instead, use automatically playing videos and images to be the backdrop of your story. Practice so that your presentation is smooth!

You will sign up to give an Ignite presentation one week during the semester in which you present an article of your choice related to the readings for a given week. You may perform additional research to find related material to add to your presentation. Two or three students will give presentations during most weeks of the semester. Your classmates will evaluate your presentation based on content, delivery, and appearance of the slides, and their evaluations will contribute to your grade on this assignment. You will also receive feedback from your classmates (shared anonymously) about your presentation.

Explore Decentraland (Fall 2022 and Spring 2023)

Read the articles and watch the videos from weeks 1 and 2 that talk about features and characteristics of the metaverse. Decentraland (https://decentraland.org/) is an evolving metaverse created by members of the community, that you can explore in a web-browser. It was opened to the public in February 2020 and is overseen by the nonprofit Decentraland Foundation.

Visit https://decentraland.org and click Open in Browser. Click on play as guest. Create your avatar. Dismiss the message about the graphics card if it appears.

Complete the "tour" / tutorial so you learn how to navigate the metaverse with keyboard commands (W/A/S/D to move around and using the mouse to look around or set your view.)

Explore the Decentraland metaverse. Open a PowerPoint presentation. Take five screenshots, showing elements of the metaverse that you encountered. Place each screenshot on its own slide. Write a caption of at least two sentences about each screenshot and describe how it is an example of an idea or concept that you learned about in the readings or videos for weeks 1 and 2. (In PowerPoint, use Insert -> Screenshot to take a screenshot and insert it on a slide.)

Create a title slide containing your name as a new slide in your presentation. Submit your presentation.

Explore AltspaceVR (Fall 2022)
Explore Meta Horizon Worlds (Spring 2023)

After completing the assigned readings about virtual communities visit the lab to explore Altspace/Meta Horizon Worlds using Oculus 2 VR headsets. Then write a short report about your experience; be sure to respond to each of the questions below.

Create an avatar. Screenshot your avatar. Write a paragraph about how you designed the avatar, and what it says about you.

Select a metaverse event or activity to visit with your partners.
- What did you do? Who else was there? Describe your experience.
- How "real" or immersive is it? What do you see?

- How could you interact with the environment?
- How can you interact with other people/avatars in the environment?
- What other elements (audio, video, images) were available?
- How do you navigate around? Where can you go?
- What can you do in this virtual world that you can't do in the physical world?
- Do you feel present in this space? Or isolated? Or something else?

Include a photo of yourself wearing the headset with the event behind you on the big screen.

Roblox Metaverse (Group Assignment, Fall 2022)

Working with a partner of your choice, design a VR Scene or game using Roblox Studio. You will follow a tutorial and add a feature of your choice as you design, build, evaluate, test, and share your virtual world.

Follow these steps to build your game:

- Select one of the Build it Play it Tutorials from Roblox Studio and follow the instructions to complete it. See https://create.roblox.com/docs/education/landing-pages/build-it-play-it .
- Add a block or a sign to your game that contains your first name somewhere in the scene.
- Based on your own discovery after playing with Roblox, or after searching online for ideas, make a change to your game design so that the game has a different appearance, storyline, background, or other features.

Follow these steps to play your game:

- Play your game and test it. Make sure it works! Create a screen recording of no more than 30 seconds as you play your game, and upload it to the Flip website.
- Share your game to Roblox, get a link, and post the link on the class discussion board.

Write a discussion post in which you and your partner answer these questions together:

- What features did you add to the game? ii. Which element(s) from the Designing the Metaverse article that we read in class last week does your project incorporate?
- Write an individual discussion post in which you answer these questions (separate from your partner, each of you should respond individually).
- What was most enjoyable and most challenging as you completed this project?
- What did you learn about the process of designing a virtual world by completing this project?

Frame VR Assignment (Group Assignment, Spring 2023)

In this assignment you will work with your assigned partners to design a 3D interactive metaverse using Frame VR (https://framevr.io) by recreating a scene from your favorite book/movie/TV show or a favorite place you like to visit (restaurant, famous building, etc.) in virtual reality, Create an account on Frame VR for your team.

Your virtual world should include:

- 5-10 Digital Assets either imported either from Frame VR's asset library or from your computer.
- At least three photos or images
- At least one text file or document,
- At least one video clip
- At least one collaboration tool (white board, screen sharing, basketball, etc.)

Create your own avatar in ReadyPlayer.me that you can use in Frame VR when you visit it with your team. Visit your World with your partners in a browser and with the VR headsets.

Team Submission: Create a screen recording (from visiting in a browser) of approximately 5 minutes where you and your partners explore your world, talk about the contributions that each of you made to

it, and show some of its features. What metaverse design principles based on the readings did you implement? Walk around and see how it feels to be closer or further from others. Post your video to Flip.

Individual Submission: Write a short report (one page) describing the scene you are trying to recreate, your contributions to the Frame VR metaverse (and the design principles, based on the readings, for which your contribution is an example). Include a screenshot of your avatar created in ReadyPlayer.Me, when exploring your metaverse.

Research Paper (Individual Assignment, Fall 2022 and Spring 2023)

Write a research paper (8 to 10 pages) exploring a topic related to our class "wicked problem" (Living in the Metaverse). Your paper will be due in stages, and will consist of these deliverables:
- Select a topic. Review with a partner to determine that the scope is not too broad or too narrow.
- Create an annotated bibliography of at least ten sources, from at least two scholarly, two trade, and two popular media publications.
- Create a thesis statement that you wish to explore.
- Create an outline of your paper.
- Complete a peer review with a partner of your thesis statement and outline.
- Create a first draft and a peer review with a partner. Complete the peer review form.
- Complete a second draft and peer review if time permits. Comment on improvement since first draft in the peer review form.
- Submit your paper.

The Great Debate (Spring Semester during Final Exam Period)

We will hold a debate during final exam period, The topic: Metaverse: Hope or Nope? You will be assigned to one of two groups, each of which will debate for 30 minutes during the final exam period. Within each group, you will be assigned one of three roles: a team arguing in favor of the future potential of the metaverse ("hope"), a team against it ("nope"), and questioners. You will submit prior to the start of the debate, a Word document containing at most two pages of your preparation for the debate. If you are a questioner, don't just ask a question such as "How can people engage in the metaverse if headsets are uncomfortable?", but instead, provide a story around each question. For example,

> Studies have shown that technology addiction is a growing concern, with the average person spending more than 5 hours per day using mobile devices. This can lead to various negative effects such as anxiety, depression, and poor sleep quality. Given the potential negative impact of technology addiction on individuals, what are the long-term implications for the viability of the metaverse as a technology platform? How else might people engage in the metaverse to ensure its long-term success?

If you are a respondent, create four detailed talking points that you can use to take a stand and respond to issues you think may come up when arguing for or against the future potential of the metaverse. This will help you to argue your assigned position.

You might read different articles from earlier in the semester, or review articles from your research paper. You will be graded on your participation, the quality of the questions and responses you give, and your written preparation, which must be submitted before the start of class.

APPENDIX C
Pre- and Post-Course Student Survey Questions

Pre-Course Survey for First-Year Discovery (FDS) Seminar, Living in the Metaverse

[introduction, consent, age, and gender not shown]

	Not at all	Slightly	Moderately	Very	Extremely
Would you describe yourself as entrepreneurial?					
Are you an early adopter of technology?					
Are you technology savvy?					
Are you socially well connected in your (offline) life?					
Are you socially well connected online?					

In this course we will explore metaverses through the lens of business opportunities, social concerns, and technological innovations. List two business opportunities that are possible in the metaverse.

In this course we will explore metaverses through the lens of business opportunities, social concerns, and technological innovations. List two social concerns that arise because of the impact of the metaverse.

In this course we will explore metaverses through the lens of business opportunities, social concerns, and technological innovations. List two technological innovations that enable interaction in the metaverse.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I follow news about the metaverse / metaverses out of curiosity.					
I can go to places using a metaverse that I can't go in real life.					
I can't wait to try a metaverse.					
I think that metaverse experiences are (or will be) exciting for me.					
I want to try a metaverse because it is an interesting technology trend.					
I think that using the metaverse / metaverses is a good idea for society.					
I believe that using the metaverse / metaverses will be helpful to me.					

Select all the statements below that you believe are True or Mostly True
- ☐ In ten years, people will live and co-exist mainly in the metaverse.
- ☐ The metaverse will become a part of our everyday life in the next ten years.
- ☐ The metaverse can cause harm to society.
- ☐ I am concerned about privacy in the metaverse.
- ☐ Some activities in the metaverse should be age-restricted.
- ☐ Some activities in the metaverse should be censored or disallowed.
- ☐ Extended use of the metaverse can cause health problems.

Select all reasons below that express why you would likely join a metaverse.
- ☐ Work possibilities
- ☐ Art and live entertainment
- ☐ Money and investing
- ☐ Education

- □   Socializing and online dating
- □   Gaming
- □   Adult entertainment

How would you rate your current understanding of the following topics?

	Not familiar with	Heard of it	Have some understanding	Good understanding	Excellent understanding
Avatars					
Multi-player games					
3-D Worlds					
Augmented reality					
Virtual reality					
Wearable devices					
Internet of Things					
Blockchains					
Cryptocurrencies					
Non-fungible tokens (NFTs)					
The Metaverse / metaverses					
The digital divide					
Internet addiction					

For each response that is not "I never heard of it," display the corresponding question:
- ➢   Briefly describe, define, or give an example of an avatar.
- ➢   Briefly describe, define, or give an example of a multiplayer game.
- ➢   Briefly describe, define, or give an example of a 3-D world.
- ➢   Briefly describe, define, or give an example of augmented reality.
- ➢   Briefly describe, define, or give an example of virtual reality.
- ➢   Briefly describe, define, or give an example of a metaverse.
- ➢   Briefly describe, define, or give an example of the digital divide.
- ➢   Briefly describe, define, or give an example of internet addiction.

What would you most like to learn about the metaverse this semester?
Do you have any additional comments, questions, or concerns?

Post-Course Survey for FDS, Living in the Metaverse

[introduction, consent, age, and gender not shown]

	Not at all	Slightly	Moderately	Very	Extremely
Are you an early adopter of technology?					
Are you technology savvy?					

In this course we explored metaverses through the lens of business opportunities, social concerns, and technological innovations. List two important business opportunities that are (or will be) enabled by the metaverse.

In this course we explored metaverses through the lens of business opportunities, social concerns, and technological innovations. List two social concerns that are (or will) arise because of the metaverse.

In this course we explored metaverses through the lens of business opportunities, social concerns, and technological innovations. List two technological innovations that are (or will) enable interaction in the metaverse.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I believe that the metaverse is an interesting technology trend.					
I think that using the metaverse /metaverses is a good idea for society.					
I believe that using the metaverse / metaverses will be helpful to me.					

What was your favorite topic during the course?
What was your favorite reading during the course?
What was your favorite hands-on activity in class, in the technology lab, or out of class?

What was your least favorite topic during the course?
What was your least favorite reading during the course?
What was your least favorite hands-on activity in class, in the technology lab, or out of class?

AFTER this course ...

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I would like to explore virtual reality more with headsets					
I could see myself purchasing NFTs					
I could see myself attending a concert, sporting event, or other event in the metaverse					
I could see myself involved in a virtual community					
I could see myself doing business with companies in the metaverse					
I feel prepared to follow topics about the metaverse that are in the news					

AFTER this course, when I consider participating in the metaverse, I am concerned about ...

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Privacy					
Security					
Being hacked					
Lack of norms					
Lack of regulation					
Cost of technology to participate					
Why would anyone participate in the metaverse in the first place?					

AFTER learning about the metaverse in this course, I believe that ...

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Accessing the metaverse is easy					
Virtual environments can offer a sense of place and connection to physical environments					
The metaverse will revolutionize businesses creating a 'creator economy'					
The metaverse will be the next social platform for businesses					

The metaverse is the next incarnation of the internet					
The metaverse will not materialize or catch on					
I worry about the societal impacts of the metaverse					
The metaverse is a place aimed at younger people					
The metaverse will accelerate the use of digital assets					
The metaverse is exciting and offers the opportunity to be creative in a virtual world					
The metaverse is inclusive to all					
The metaverse is a fad whose popularity will diminish within the next five to ten years					
A true metaverse won't be achieved within the next ten years					

BEFORE this course, how would you describe your knowledge of ...

	Never heard of it	Heard of it	Have some understanding	Good understanding	Excellent understanding
The metaverse					
Companies in the metaverse					
Decentralized vs. centralized					
Digital divide					
Augmented or virtual reality					
Wearable devices					
NFTs					
Blockchain					

AFTER this course, how would you describe your knowledge of ...

	Never heard of it	Heard of it	Have some understanding	Good understanding	Excellent understanding
The metaverse					
Companies in the metaverse					
Decentralized vs. centralized					
Digital divide					
Augmented or virtual reality					
Wearable devices					
NFTs					
Blockchain					

AFTER this course, how would you describe your knowledge of each of the learning objectives ...

	Never heard of it	Heard of it	Have some understanding	Good understanding	Excellent understanding
Companies and innovators whose work is shaping the metaverse					
Technologies needed for the continued development of the metaverse					
How to create avatars and virtual spaces to be used when exploring the metaverse					
Implications of the metaverse for businesses					

Implications of the metaverse for individuals					
Implications of the metaverse for society					
Origins of the metaverse in popular culture					
Characteristics of the metaverse					
How companies in various industries do business in the metaverse					

What would you suggest that your instructors do differently to improve the FDS "Living in the Metaverse" course when we teach it again?

Do you have any additional comments, questions, or concerns?

APPENDIX D – SELECTED READINGS

▶ = video 📖 = reading

🥽 1. What is the Metaverse?

▶ CNET. (2022). **Explaining the Metaverse: Everything You Need to Know About Future of the Internet,** https://www.youtube.com/watch?v=7DEVfUk2zCk

📖 Leslie, J. (2022). **The Roblox Metaverse: What is it, and why is it so Popular Amongst Gen Z?**. Fanbytes blog, https://fanbytes.co.uk/the-roblox-metaverse .

📖 Ravenscraft, E. (2022). **What Is the Metaverse, Exactly?** Wired, https://www.wired.com/story/what-is-the-metaverse .

🥽 2 – Definitions

▶ Jung, B. (2022). TEDx, How the Metaverse Will Change the World | Brian Jung | TEDxRockville

📖 Resnick, M. et al. (2022). **Building a Digital Future: The Metaverse**. Gartner, https://www.gartner.com/document/4015962 . Log in to the library website or access the PDF here.

📖 Lovich, D. (2022). **What Is the Metaverse and Why Should You Care?** Forbes, https://www.forbes.com/sites/deborahlovich/2022/05/11/what-is-the-metaverse-and-why-should-you-care/ .

🥽 3 - Technology Foundations
📖 ▶ Marr, B. (2022) **The Important Difference Between Web3 And The Metaverse** https://www.forbes.com/sites/bernardmarr/2022/02/22/the-important-difference-between-web3-and-the-metaverse

🥽 4 – Virtual Communities and the Future of Work

📖 Purdy, M. (2022). **How the Metaverse Could Change Work**. Harvard Business Review, https://hbr.org/2022/04/how-the-metaverse-could-change-work.

📖 **Meta Pursues Teen Users as Horizon Metaverse App Struggles to Grow** **(Wall Street Journal).** You will need to create a free account to read this. Get your FREE subscription here: https://libguides.bentley.edu/news/wsj

📖 This is Life in the Metaverse (New York Times)

🥽 5 – Design Principles
📖 Truog, D. et al. (2022). **Designing The Metaverse**. Forrester, https://www.forrester.com/report/designing-the-metaverse/RES177430.

🥽 6 – Roblox / FrameVR Introduction

(No recommended readings)

🥽 7 – Diversity, Equity, and Inclusion

📖 Williams, M. (2022, February). **Building the Metaverse with Diversity and Inclusion from the Start**. https://about.fb.com/news/2022/02/building-the-metaverse-with-diversity-and-inclusion-from-the-start.

📖 Lu, J. (2022, June). **Metaverse platforms face diversity, equity and inclusion challenges. Here's how to address them**. World Economic Forum blog, https://www.weforum.org/agenda/2022/06/metaverse-platforms-face-diversity-equity-and-inclusion-challenges-heres-how-to-address-them/.

🚌 **8 – Frame VR Workshop**
(No recommended readings – hands-on session)

🚌 **9 – Privacy, Security, and Ethics**

📖 PwC (2022). **Metaverse security: Emerging scams and phishing risks**
https://www.pwc.com/us/en/tech-effect/cybersecurity/emerging-scams-and-phishing-risks-in-the-metaverse.html

📖 Hackl, C. (2020). **Now Is the Time to Talk About Ethics and Privacy in The Metaverse**. Forbes, https://www.forbes.com/sites/cathyhackl/2020/08/02/now-is-the-time-to-talk-about-ethics--privacy-in-the-metaverse/.

🚌 **10 – Snow Crash, Predicting the Future**

📖Stephenson, N. (2003). **Snow Crash.** (Selected chapters, to be provided). https://www.google.com/books/edition/Snow_Crash/RMd3GpIFxcUC

📖 Robinson, J. (2017). **The Sci-Fi Guru Who Predicted Google Earth Explains Silicon Valley's Latest Obsession**. Vanity Fair, https://www.vanityfair.com/news/2017/06/neal-stephenson-metaverse-snow-crash-silicon-valley-virtual-reality .

🚌 **11 – Social Concerns: Injustice, Social Good, and Technology Addiction**

📖 Bojic, L. **Metaverse through the prism of power and addiction: what will happen when the virtual world becomes more attractive than reality?**. Eur J Futures Res 10, 22 (2022). https://doi.org/10.1186/s40309-022-00208-4

📖 Floridi, L. (2022). **Metaverse: A Matter of Experience**. *Philosophy & Technology,* https://doi.org/10.1007/s13347-022-00568-6 .

🚌 **12 – Business Implications**

📖 (Read only pp. 7-8 and 53-56) McKinsey & Company. (2022). **Value creation in the metaverse: The real business of the virtual world**. https://www.mckinsey.com/~/media/mckinsey/business%20functions/marketing%20and%20sales/our%20insights/value%20creation%20in%20the%20metaverse/Value-creation-in-the-metaverse.pdf.

📖 Furlonger, D. Uzureau, C. & Kandaswamy, R. (2022). **How to Increase Customer Engagement and Drive Revenue in the Metaverse**. Gartner, https://www.gartner.com/document/4011155.

📖 Wang, R. (2022, July/August). **Prepare for the Age of The Metaverse Economy**. Customer Relationship Management, https://www.destinationcrm.com/Articles/Columns-Departments/Customer-Experience/Prepare-for-the-Age-of-the-Metaverse-Economy-153752.aspx

🥽 13 – Metaverse and Personal Identity

☐ Digital identity in the Metaverse will be represented by avatars with utility
https://cointelegraph.com/news/digital-identity-in-the-metaverse-will-be-represented-by-avatars-with-utility

☐ Metaverse Avatar Guide; Embody Yourself in the Metaverse https://metamandrill.com/metaverse-avatar/

🥽 14 – Meetings in The Metaverse

☐ Meetings In The Metaverse: Is This The Future Of Events And Conferences?
https://www.forbes.com/sites/forbescommunicationscouncil/2022/01/13/meetings-in-the-metaverse-is-this-the-future-of-events-and-conferences/