EXPLORING THE QUALITY OF MULTI MODAL STUDENT DIALOGUE USING SOCIAL VIRTUAL REALITY TECHNOLOGY IN AN ONLINE COURSE

A Dissertation

presented to

the Faculty of the Graduate School

at The University of Missouri Columbia

in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

in Information Science and Learning Technologies

by

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May 2023

The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

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a candidate for the degree of doctor of philosophy, Information Science and Learning Technologies, and hereby certify that, in their opinion, it is worthy of acceptance.

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Dedication

I dedicate my dissertation to my family and friends. First and foremost my son Nicholas, who rode this train with me and never left my side. You are my shining light. I hope this journey has passed down the same values your grandparents gave to me. Two beloved souls, a special feeling of gratitude to my loving parents, and alumni, Jerry and Allene Meinke. They instilled the MIZ …ZOU spirit from a young age by bringing me to game days throughout my life. Most importantly they bestowed the value of lifelong learning and higher education and taught me the tenacity to never give up. My sister Elizabeth, who always encouraged me and knew just the right thing to say. A special thanks to Sandi and Sherman for their support in my parents' absence.

My dear friends Bonita, Tammy and Phillip for lending their ear and cheering me on. Nobody earns a dissertation solely alone. Finally, and most importantly thank you God for always walking side by side with me, in both my desperation and celebratory hours.

Acknowledgements

First and foremost I want to thank my amazing advisor, Dr. Isa Jahnke for her passion towards mentoring students and helping them become the best they can be. She believed in me, even when I had doubts. Her willingness to share honest feedback is an incredible learning tool and gift.

I would like to acknowledge Dr. Danielle Oprean for being my co-chair and assisting me in locating an online course to introduce Social VR and collect data. She is continuously innovative in teaching and research in which students reap the benefits.

I started this adventure with Dr. Howland as my advisor in the EdS program and here we are at the end of this journey. Everything I know about online instructional design and meaningful learning has been influenced through watching her model what she teaches. When I needed a qualitative guru, Dr. Tony Castro agreed to be on my committee. I continue to learn as I observe how he approaches qualitative methods.

Gratitude is also directed to the School of Information Sciences and Learning Technologies (SISLT) at the University of Missouri-Columbia for the teaching and research opportunities and willingness of faculty to involve students with their projects. I would also like to thank the students who participated in my research project. You rock! I learned so much from you.

This study would not be possible without Dr. Sara Hennessey and the Faculty of Education at the University of Cambridge, England. Their willingness to let me use and adapt the T-SEDA tool as well as allow me to spend a week at Cambridge learning about their work and sharing ideas with students remains a highlight in my life.

I also want to thank MU Extension (Wayne Prewitt) and UNH Extension (Michael

Young and Kendra Lewis), for allowing me professional development time to complete this dream of mine. I could not have achieved this without your support in the professional workplace.

Finally, I would be remiss if I did not mention my student cohort and fellow co-pilot, Devon Whetstone. We traveled this journey together and got to our destination. I thank you for all the support and late-night chats, but most of all the lifelong friendship and memories.

TABLE OF CONTENTS

List of Figures

List of Tables

Abstract

Online courses include the design for student interaction to support effective learning. Studies have shown that online discussion boards are a useful option to engage students. However, with new emerging digital technologies such as Virtual Reality (VR), the question remains to what extent or in what ways these immersive technologies can be used for synchronous online dialogue to get sufficient quality of student dialogue. Hence, the alignment of online synchronous discussion using Social VR combined with an instructional dialogic strategy conceptual framework was investigated to explore to what extent Social VR is as an effective support in learning design. The Instructional Dialogic Strategy (IDS) from dialogic theory has been used to study the three activities of articulation, collaboration/social negotiation and reflection. A qualitative case study was conducted within a sixteen-week online course for graduate students in 2022. More specifically, the Tech-SEDA (Scheme for Educational Dialogue Analysis) coding scheme was applied to measure the quality of student digital dialogue. Data shows that Social VR is an effective support within this learning design to provide quality dialogue for articulation, collaboration and social negotiation but lacks considerably in reflection, even when discussion board reflections were added to the assignments. Similar dialogic patterns emerged between two groups concluding that the learning design presented for framing the dialogic assignment using Socratic questioning techniques, exploratory talk and ground rules affect the dialogic outcomes for IDS activities, sub-categories and criteria. Following this learning design model promotes quality dialogue with Social VR as an effective support if all the components are included and adhered. Future research may study reflective learning with Social VR.

Keywords: social virtual reality, dialogue, online education, instructional dialogic strategy

Chapter 1: Introduction

I want to start by sharing my experience to illustrate the point of my research motivation. As a student, I have taken over 18 online courses, each using an average of three to five discussion boards as the main dialogic tool for student interaction and reflection. Speaking for myself, using discussion boards lost their luster and effectiveness after the first few courses. I found myself saving my personal introduction to cut and paste to each new course. My discussion posts became mechanical instead of thoughtful and reflective.

Literature says online higher education courses employ asynchronous discussion boards as a way for students to create cognitive and critical thinking skills as well as in-depth reflection (Andresen, 2009; Hew & Cheung, 2013). However, based on my own experience, I am questioning the *sole use* of discussion boards to fit this learning purpose. From a research perspective, I am interested in studying alternative options of collaborative technology tools that can provide quality dialogue such as Social Virtual Reality (VR). Online synchronous discussion using Social VR may allow students to engage in new ways and might be a useful substitute for online discussion boards, for example, Social VR may support students to discuss concepts, develop critical thinking skills and provide in-depth reflection.

That is why I want to investigate to what extent Social VR is an *effective support* that promotes synchronous student dialogue in asynchronous online course environments. Bird (2007) states, “Dialogue, meaning a process of inquiry, investigation and questioning, is a crucial element for online development of new concepts, knowledge construction and internalization of learning” (p.153). Vickers (2010) suggests IDS is fundamental and well suited for advanced dialogic learning, especially virtual worlds because it affords a structure for connecting to others through immersive experiences within the environment, thus

providing dialogic learning opportunities.

As illustrated in the literature review (read Chapter 2), over the last forty years, a strong body of research has focused on *classroom dialogue* between students and teachers in co-constructing student knowledge (Howe & Abedin, 2013) as an active learning strategy. Research has also been conducted on student discourse using discussion boards, but it is outdated in comparison to new digital technology or other emergent tools such as VR/AR/XR (mixed reality).

1.1 General Statement

A continuous growing knowledge economy comes with challenges to meet the needs of learners in the 21st century. According to the National Center for Educational Statistics (2018), there are almost 20 million post-secondary students enrolled in degree-seeking programs. Almost 7 million of these students were enrolled in any distance education course compared to 12.7 million who were not. Of these students who were enrolled in any distance education course, 3.7 million took at least one online course during their plan of study, with 3.3 million enrolled exclusively in distance education online programs. Higher education institutions are experiencing continued growth in student enrollments through online courses, certificate and degree offerings (NCES, 2018).

In the advent of emergent technologies such as wearables and VR/AR tools (Virtual Reality / Augmented Reality), there has been an influx of new methodologies for teaching and learning (Brown & Green, 2019). Still, a popular pedagogical tool in online learning is the use of discussion boards for engagement and creating social presence (Andresen, 2009; Hew & Cheung, 2013). Online communication web-based technology tools allow for collaborative learning environments that give students an opportunity to engage, interact and

construct knowledge (Kehrwald, 2010; So & Bush, 2008). Furthermore, Allen and Seaman (2013) states instructors are able to take advantage of technology to deliver course content to students with the aptitude to develop meaningful discourse. Hung et al. (2005) assert, dialogue in online learning environments draws on the 'distributed expertise' in the group, ensuring the learning task requires articulation, collaboration, social negotiation, and reflection. However, using discussion boards to engage students may not have the same learning benefit as it once had (AlJeraisy et al., 2015). There may be different reasons why discussion boards suffer, e.g., in one online course, there can be at least 3-5 discussion board assignments, which make it boring for the students. Furthermore, studies such as Askell-Williams and Lawson (2005) as well as Mann (2005), contend that student anxiety, lack of confidence and alienation in online discussions can be detrimental to the overall learning experience. This means that there is a need to explore other tools that may substitute discussion boards to some extent.

1.2 Statement of Problem

With the continued growth of online course enrollments, students expect to have a quality experience. Geiger et al. (2014) concluded students generally based the quality of their online learning experience on perceptions regarding active engagement, and So and Brush (2008) concluded collaborative learning through engagement was associated with social presence and online course satisfaction. Likewise, the "Go To" tool to meet engagement and social presence criteria has been discussion boards (Cho & Tobias, 2016). Even though discussion boards have been seen as effective in the past, there are students who view them as ineffective and burdensome, thus minimally participating (AlJeraisy et al., 2015; Hew et al., 2010; Fung, 2004; Khine et al., 2003).

Since Covid-19, other optional web-based tools were deployed such as Zoom, VoiceThread and Microsoft Teams. These 2D tools provide engagement, discussion, and collaborative learning in online course environments. Social VR, a 3D environment also allows for social presence. However, there is a gap in research as to if Social VR provides similar dialogic learning outcomes or the same quality when compared to other digital technology tools. Social VR is a promising candidate (new tool) to support dialogue in online courses.

1.3 Purpose of the Study

The purpose of this study is to understand to what extent Social VR is an effective support for fostering quality synchronous online student dialogue. To examine the use of Social VR – a virtual reality tool in which students meet as avatars in a virtual environment to discuss and engage – for supporting student dialogue, I will apply the concept of Instructional Dialogic Strategies (IDS). IDS are rooted in socio-cultural theory (SCT), characterized by Vygotsky (1978). SCT focusses on social interaction and culture in the development of higher-order thinking skills. Dialogical learning models emphasize social interaction through dialogue and conversation. Dabbagh (2007) states, dialogic models can assist learners in constructing knowledge through social interactions between conversational exchanges, which can foster a sense of community. Dabbagh and Bannan-Ritland (2005) assert asynchronous and synchronous web-based technologies such as discussion boards, virtual conferencing, and virtual worlds support conversational exchanges that promote skills in articulation, collaboration, social negotiation, and reflection (see Figure 1). In order for dialogic learning to occur, three activities must occur: articulation; collaboration and social negotiation; and reflection (Dabbagh & Bannan-Ritland, 2005; Dabbagh, et al., 2018; Hung,

et al, 2005; Rojas-Drummand et al., 2013). Within these three activities learners construct knowledge through dialogue and social interaction to promote meaningful dialogue. A visualization of this structure is presented in Figure 1.

Figure 1

Illustration of Dialogic Learning Strategies with Sub-Categories

Note. Dialogic Strategies follow three main activities of Articulation, Social Negotiation and Reflection, as defined by Dabbagh et al. (2018).

1.4 Theoretical Lens

Discussion in general and online discussion more specifically can be studied from different lenses. I chose to use "dialogue". Dialogue is the conceptual foundation that I applied in this study. Dialogue is "at the heart of the e-learning experience" (Littleton & Whitelock, 2004, p. 173) as Bakhtin (1986), a contemporary of Vygotsky, argued, "logic itself has no meaning; it is only the clash of different voices that gives meaning" (Dyke, et al., 2006, p. 9). Dialogue is a way to learn critical thinking skills (Wegerif, 2005). The dialogic approach is relevant for learning because students learn to take on perspectives of others in a dialogue (Ravenscroft, et al., 2007).

A *dialogic pedagogy* requires instructors and learners to actively engage in dialogue

to build on a set of ideas to construct shared knowledge and interpretations (Mercer et al., 2012; Hennessy, et al., 2017). In addition, further research (Johnson & Mercer, 2019; Rojas-Drummond et al., 2010) has indicated that dialogic pedagogy supports student "critical thinking and reasoning skills and self-regulated learning and yields evidence of subject learning gains" (Hennessy, et al., 2017, p. 147).

Dialogic pedagogy has its roots in social constructivism that is a theory in which people construct knowledge through interactions with others (Vygotsky, 1978). Students bring prior knowledge into a learning situation in which they must articulate, critique and re-evaluate their understanding (Vygotsky, 1978). Applying the lens of social constructivism, the learning process becomes collaborative and shifts from teacher-centered to learner-centered (Jonassen, 1994). Hernandez-Serrano et al., (2000) named virtual reality (VR) as one of the technologies that can support constructive learning. Social VR may be a useful tool for providing collaborative dialogue through interactions and negotiations.

Many research papers have been conducted on Social VR and Instructional Dialogue Strategies within separate contexts, including several systematic reviews over the past 40 years. Primarily, current research on Social VR has focused on social presence, avatars and other usability and design considerations. Researchers' have continually focused on student dialogue within the physical classroom for the past four decades. Digital dialogue for the online classroom has not received much attention when it comes to dialogic learning strategies. There is a gap in connecting both Social VR and Instructional Dialogic Strategies within the learning design as an effective support to promote student dialogue. Literature shows there is not sufficient knowledge using Social VR in online courses as a dialogic learning strategy. Hence, this study examines online student dialogue with Social VR. Social

VR has not been studied from the viewpoint of using Instructional Dialogic Strategies (read details in the Methodology chapter).

1.5 Research Questions

In this study, learning occurs through synchronous online discussions in the form of *dialogue* when students are socially collaborating to construct knowledge and engaged in knowledge creation (Moen et al., 2012; Stahl, et al., 2006). The conceptual framework of instructional dialogic strategies will be used to inform the study design and to collect data (Dabbagh & Bannan-Ritland, 2005; Dabbagh, et al., 2018; Hung, et al., 2005). The central research questions (RQ) are:

1. What is the quality of online student dialogue when using Social VR? (Applying the Tech-SEDA Coding Scheme; Appendix G)
2. What are additional factors that foster student dialogue with Social VR in online asynchronous courses?

Chapter 2: Literature Review

The first section of the literature review will look at existing studies in the field of discussion boards and Social VR (2.1). Following this section, the instructional design method, Instructional Dialogic Strategies, will be described to complete the conceptual framework (2.2).

2.1 Existing Studies

2.1.1 Existing Studies on Discussion Boards

Most learning management systems (LMS) in higher education provide some form of online discussion board as a pedagogical tool to engage students and create social presence (Andresen, 2009; Hew & Cheung, 2013). Researchers have established discussion in online classes enhances student learning and facilitates social interaction (An, et al., 2009; Andresen, 2009; Hew & Cheung, 2013; Hrastinski, 2008). Literature says, online higher education courses employ discussion boards as a way for students to create cognitive and critical thinking skills as well as in-depth reflection (Andresen, 2009; Hew & Cheung, 2013). Coole and Watts (2009) assert that instructors become *learning facilitators*, while they are not face to face, they are helping students engage in dialogue to grow and trust one another. Yim (2011) further acknowledges that while students are physically separated by time and place, a learning community can still be created to co-construct knowledge that can lead to academic achievement. Johnson (2016) further supports past studies by stating, “Acts of purposeful collaborative constructivism allow students to both construct knowledge within the online classroom community as well as retain that knowledge” (p. 1485).

Discussion boards can be a powerful tool for collaboration, motivation and reflection if well designed and executed. AlJeraisy et al., (2015) found that discussion boards could be

seen as both effective and ineffective. They can impact a students' sense of shared community and collaboration or the opposite, alienation. AlJeraisy et al., (2015) stated that those students who felt disengaged had more to do with how the discussion boards were managed rather than the discussion board itself.

Mooney et al. (2014) found that discussion boards can play a viable role in online learning using the suspense model and real-world applications. The suspense model paces the release of critical information as small groups of students engage in an online learning activity. In this study, students were placed in small groups and were asked to create a business plan for opening a restaurant as a legal partnership. As the week went on several real-world "surprises" were introduced such as a lawsuit filed against the business that the group had to respond to via discussion board discourse. Mooney et al. (2014) found that student's level of interaction and participation were greater in the suspense model versus the traditional discussion board thread. They also found that students preferred the suspense model because it capitalized on social presence in the learning community. Shattuck (2014) found that online students liken their social presence and interaction to course satisfaction and quality.

Discussion Board Challenges

Ferdig and Roehler (2004) found that the number of responses in an online discussion did not necessarily contribute to gaining new knowledge from the discussion. Likewise, Song and McNary (2011) found no correlation between number of posts and student academic success in the course. Dennen and Wieland (2007) also observed that online discussions can initially give a "false sense of actual conversation or dialogue" (p. 2). Meaning, that threaded responses do not automatically represent a discussion, even though they can certainly give

that impression. Asynchronous discussion threads may be nothing more than solitary comments over a period of time and not seen by all participants contributing to the thread (Dennen & Wieland, 2007; Nofsinger, 1999). Several studies found discussion boards were not seen as effective dialogue tools by some students but as irritating, burdensome, and unnecessary used only to accrue points towards a grade. (AlJeraisy et al., 2015; Hew et al., 2010; Fung, 2004; Khine et al., 2003; Rourke & Kanuka, 2007).

Cho and Tobias (2016) studied if discussion boards should be required in online courses. They used the Community of Inquiry instrument developed by Arbaugh et al. (2008). The instrument consists of 34 items that measures online learning in three distinct areas: a) teaching presence, b) social presence and c) cognitive presence. To compare student learning experiences three conditions were used: a) no discussion, b) discussion without instructor participation and c) discussion with active instructor participation. Cho and Tobias (2016) found that teaching presence and cognitive presence were not significantly different in any of the three conditions. They offer that one reason for this result is that students in a basic course can self-study and do not necessarily need instructor presence or to engage in knowledge construction with others. The results might be different if the course were higher level and went beyond basic concepts. They did find that social presence was significantly different among discussion conditions. Communication and group interconnection were higher in both discussion groups. They found along with other researchers that interaction with the instructor throughout the course seemed to be the most important influence for students' social presence in an online class (An, Shin, & Lim, 2009; Cho & Kim, 2013; Hew, Cheung, & Ng, 2010). Cho and Tobias note the following about cognitive presence:

> The results imply that without discussion boards and without heavy instructor involvement in discussion boards, students can still perform as well as other students in a condition that instructors heavily facilitate intellectual learning in this type of online course, which emphasized understanding basic concepts. (p. 134)

The researchers argue that not all online courses should include discussion boards as a mandatory "learning activity" and not all instructors need to actively participate in the discussion. Instead, insertion of discussion activities should coincide with 'teaching philosophy, course content, intended learning outcomes, and learner characteristics' (Cho and Tobias, 2016, p. 137).

Criteria Used for Measuring Discussion Boards

Past studies have measured discussion board activity using a multitude of measurements including multi-factor metrics, student participation, role of instructors, quantity of student posts, quality of discussion, and feedback among others. There are many factors that affect discussion board activity which makes it challenging to measure such as course design, instructional approach, and learner characteristics (Bliss and Lawrence, 2008; Cho and Tobias, 2016; Hou and Wu, 2011; Johnson 2015). Bliss and Lawrence (2008) developed a multi-factor metric which could characterize discussion board use in mathematics courses using the Communities of Inquiry model. They analyzed almost 12,000 posts over 335 math course discussion boards. Bliss and Lawrence (2008) determined whether a post is educationally valuable or less valuable by using the Educationally Valuable Talk (EVT) indicators. These include exploratory, invitational, argumentation, critical, heuristic, reflective or interpretive (Uzuner, 2007). ELVT (educationally less valuable talk) contains five indicators which include affective, judgmental, experiential, reproductional or

miscellaneous (Uzuner, 2007). Bliss and Lawrence's (2008) multi-metric tool quantifies student participation, quantity of posts, quality of posts, instructor presence, discussion board guidelines and presence of feedback. As a result, Bliss and Lawrence concluded that this study reinforces and strengthens past research which states that instructor presence, feedback and discussion board guidelines correlate with greater student participation, quality of posts and quantity of posts.

Hou and Wu (2011) studied a text-based IM (instant messaging) tool over 98 days to determine social knowledge construction in synchronous discussions based on topics postulated by the instructor. Social knowledge construction was measured by items in the coding scheme created by Gunawardena et al. (1997). The interesting finding was that the high-quality discussion teams outperformed the low-quality discussion teams in participation, coordination and knowledge construction but also had the most off-topic discussions that were irrelevant to the discussion question within their posts as well. Hou and Wu (2011) expressed that many studies have shown off-topic discussion threads in asynchronous discussions but in their study, they were more frequent in synchronous discussions and reflected sharing/comparing rather than co-constructing knowledge by negotiation of meaning. Hou and Wu (2011) contend:

> Social interactions are the critical bridge between academic discussions and task coordination. The high-quality teams showed more sequential correlation between the two dimensions of coordination and social interactions, whereas low-quality teams did not. These differences indicate a correlation between discussion quality and knowledge construction. (p. 1466)

In conclusion, discussion boards have many challenges in measuring quality and effectiveness because of the many variables that need to be considered. Different results occur in studies past and present depending on the criteria, measurement tools and methods used. Discussion boards have been seen as effective and ineffective based on the researchers' criteria. Discussion boards still have an important role to play in online student discourse and knowledge construction if taking into account course content, learning objectives, teaching philosophy and learner characteristics within the learning design strategy.

2.1.2 Existing Studies on Social VR

Freeman and Acena (2021) define Social Virtual Reality (Social VR) as "3D virtual spaces where multiple users can interact with one another through VR head-mounted displays and can be traced back to the concept of collaborative virtual environments (CVEs)" (p. 84). However, Social VR can be used without a VR head-mounted display in laptop mode or smartphone which makes it easier and more comfortable to use (Oyanagi et al., 2021). Social VR platforms vary broadly in their target users, functions and design choices. Li et al., (2019) describe Social VR as, "VR technology, where people are able to "meet" in a shared, immersive virtual environment and interact with virtual representations of each other. Such environments with multiple users are denoted as collaborate or Social VR" (p. 667). Furthermore, Li et al., (2021), view Social VR as an emerging medium for multiple users to join a (CVE) to support remote communication in an immersive way. Li et al., (2021) state, "The goal of social VR is not to replicate reality but to facilitate and extend existing communication channels in the physical world" (p.2).

Since Covid -19 remote work has skyrocketed and new methods of communication have been tested in many different settings. Guicet et al., (2021) explored the Social VR

platform Mozilla Hubs for residency recruitment during the Covid-19 pandemic. Guicet et al., (2021) wanted to provide perspective radiology residents with an alternative to Zoom. Traditionally, the pre-interview social is supposed to be low stress and a way in which resident applicants can see if the program is the right fit by socializing with residents and participating in an orientation. The medical doctors and faculty from the study by Guicet et al., (2021) wanted an alternative to Zoom for the pre-social event with student applicants because they felt it would make the process less of a formal interview and help current residents uphold the enthusiasm needed for the program through the remainder of the interview process. Wiederhold (2020) described Conventional Video Conferencing Software (CVCS) such as Zoom, linear and 'adynamic', citing users are hesitant to use it due to fatigue and off-screen distractions. Li et al., (2021) described CVCS as a means to "restrict users in front of screens with talking head experiences and limit physical activities that naturally arise from social interactions and spontaneous collaborations" (p. 2).

The team decided on using a Social VR platform that was accessible and low-cost such as Mozilla Hubs. They were able to create a private VR meeting space that included photographs of their radiology facilities, social events including a trivia session with clickable links of interest such as the residency website and social media profiles. 'A Day in the Life of a Radiologist' was created for those not able to attend in person shadowing rotations due to social distancing guidelines as well as visiting professors where able to participate in guided virtual tours. Mozilla Hubs also features "spatialized audio" which gives users the effect of sound in a physical environment depending on proximity to the audio source. Pre-resident candidates were able to have those important dialogues with residents and assess the residency program.

Guichet et al., (2021) quantified that 3% reported negative experiences with Mozilla Hubs versus 9% with CVCS. Most participants reported that using Mozilla Hubs over CVCS gave them better insight into residency culture, conversations felt more natural, and they were able to interact and become more familiar with the residents. Participants also stated that they were able to ask questions in Mozilla Hub that they did not feel comfortable asking in the CVCS socials. 72% of the applicants indicated that the Mozilla Hubs pre-social positively impacted their decision to strongly consider their residency program with 3% disagreeing. Gabrielson et al. (2020) asserted that using VR platforms may become the new normal in residency recruitment strategies.

Social VR has created several popular and inexpensive commercial platforms such as VRChat, RecRoom, and AltSpace. These have become more widespread in the past seven years supporting many conversational activities such as social networking, conferences, and meetings (Bleakley, 2020; Maloney, et al., 2021). Social VR relies on VR technology allowing people to socially network and interact in a multi-dimensional space without meeting each other in the physical world (Wang, 2020). However, VR technology and immersive worlds have a broader and extensive scholarly number of works. Hence, the research overlaps in some areas as well as supports newer research studies. Since Social VR is a VR technology both have shared benefits and challenges that have been studied.

Li et al. (2021) concluded that social VR is a contemporary medium for remote communication that supports social presence with rich non-verbal communications and provides immersive realistic interactions. Maloney et al. (2021) listed the following Social VR affordances gained in the last five years: full-body movements and gestures in real time, high-fidelity 3D immersive virtual spaces with 360-degree content, spatial and temporal

experiences, emotional presence similar to face-to-face interaction with a broad range of social activities via embodied social interactions and the ability to create and customize personal avatars.

Hew and Cheung (2010) examined empirical, peer-reviewed papers in electronic databases using the keyword virtual world. They returned 414 search results. Using the snowball method in selecting journal articles they cited and reviewed 15 empirical papers. Themes for virtual world research included spatial presence, experiential spaces, immersion and engagement communication spaces. This shows the most frequent types of research that has been conducted within VR and that dialogue quality has rarely been explored.

Bleakley (2020) reveals that Social VR has been studied in various contexts including communication affordances, perceptions of avatars, social dynamics and mechanics, and technical challenges for multi-party VR systems. However, a gap remains on how to design for dialogic VR experiences. Bleakley (2020) states, “There is yet to be a design framework in place to inform the design direction for conversations in VR. To achieve communicative immersion in VR, interaction design, behavioral science and HCI need to come together to create a design for Social VR applications” (p. 3).

Social VR Technology Benefits

Wang (2020) stated that Social VR brings three new characteristics compared with conventional social communication means: high immersion, diverse interactive modes and contextualized social content. High immersion in Social VR resembles offline social communication. Diverse interactive modes offer verbal and non-verbal communication that can be accessible through emojis and avatar gestures. Non-verbal communication such as emotion and gestures are significant in Social VR (Moustaga & Steed, 2018; Zibrek &

McDonnell, 2019). McVeigh-Schultz et al. (2019) noted non-verbal communications serve as stimulus for social interactions. Kerlaske and Wegerif (2017) define the term emoji as e (picture) and moji (letter/character). Similar to the word emotion, most people relate to the use of emoji in the form of digital communication for expressions of emotions. Furthermore, OED (2016) stated that emoji can cross language barriers. Emoji can play a similar role to facial expressions and gestures online, thus contributing to universal digital language development (Kerlaske & Wegerif, 2017). This type of interaction focuses on sharing experiences and information as contrasted to traditional IM software (Wang, 2020). The third characteristic (Wang, 2020) contextualized social content is created through 3D virtual scenes with interactive genres making it opportune and informal to socialize.

2.1.3 Existing Studies on Social Presence and Social VR

Studies show that Social VR supports social presence and the link between the two will be discussed in this section.

"Social presence refers to the subjective experience of being present with a "real" person and having access to his or her thoughts and emotions. Social presence refers to the "sense of being with another" (Biocca et al., 2003, p. 456). Social presence is considered an essential element of online learning (Garrison & Anderson, 2003) and Social VR (Li et al., 2019; Maloney, Freeman & Rob, 2021; McKerlich et al., 2011; Oh et al., 2018). Kehrwald (2010) outlines a continuum of social presence in 'degrees' in which a person is not simply present or absent but is present in 'degrees' with increasing involvement in their representation of self and their involvement with others in online environments. This case study found it is people (social presence) who make the system productive, not the technology. Presence and social presence in new immersive virtual environments and social

networking tools can help inform the design for online learning activities (Kehrwald, 2010). Li et al., (2019) used methods to evaluate presence by Witmer and Singer and the Slater-Usoh-Steed questionnaires and found that participants felt physically and emotionally closer by shared experiences through gaming, meet ups, photos and videos through Social VR. Li et al., (2019) articulated, “Particularly, the emphasis is on the ability to produce a sense of presence or “being there: simulating face to face interactions” (p. 3).

Social Presence has a positive influence on learning (Bronack et al., 2008; Merchant, et al., 2014). Studies show that Social VR supports social presence (Annetta & Holmes, 2006; Caspi & Blau, 2008; Hew & Cheung, 2010, Omale, et al., 2009; & Castronova et al., 2019). Social VR provides a) support for natural, spatial communication, b) authentic learning spaces, c) group formation to foster creating individual social presence and group cognitive presence, d) peripheral awareness and e) representation of users and digital information sharing and collaboration within a single display space (Pomerantz, 2018). McKerlich et al., (2011) studied presence- having a sense of active participation in online education through a community of inquiry. The researchers found from a student’s perspective, learning in a virtual world was an effective experience because three types of presences occurred (social, cognitive, and teaching) thus creating a community of inquiry. Community of Inquiry methods have been used to measure presences in discussion board and Social VR research.

Oprean et al. (2018) conducted an exploratory quantitative study using VR technology to identify benefits for remote collaborators. Researchers found VR improved feelings of presence and increased feelings of being team members. Spatial experiences have

positive influences on knowledge development and transfer to real world applications (Choi & Hannafin, 1995).

Bronack's et al., (2008) research study looked at pedagogical approaches as they related to social presence and co-presence in a 3D virtual world. The authors stated traditional tools for distance education make it difficult to support the social side of learning. Specifically, traditional distance education tools do not account well for social presence, serendipitous interaction, and informal learning as well as virtual worlds (Sanders et al., 2007).

Annetta and Holmes (2006) conducted a cross case study looking at the role's avatars play in creating social presence. The study found students liked having a choice of avatars. What they choose relayed information to the instructor about each student. The study found students have a need to feel "unique" or individual from others in the class. The findings also determined in order for the VE (Virtual Environment) to work students needed to feel safe and have a sense of social presence. Students in case study two were only offered two avatar choices and they reported not liking it at all. Responses from Case two shown students lacked individuality and subsequently presence (Annette & Holmes, 2006).

In Social VR most platforms such as AltSpace and RecRoom offer avatars that resemble a person's own physical characteristics. However, some platforms such as VRChat offer other alternatives such as animals. Woofendale (2007) described users attaching themselves to an avatar regardless of physical self-representation with their own personality ques in which they felt 'distressed' if their avatars were harmed by others. Previous studies found that users feel an identity with an avatar (Ducheneaut et al., 2009; Mills, 2017; Schroeder, 2012). Steed et al. (2016) conveyed that using VR in smartphones, even

contributed to the sense of social presence and embodiment. Freeman and Maloney (2020) found that avatars were being used in Social VR in the form of praising others and giving positive feedback. Thus, Freeman and Maloney (2020) pointed out that users regard an avatar as 'their own alter-ego'. Therefore, Social VR becomes a form of self-expression through embodiment.

Oyanagi et al. (2021) studied the illusion of virtual body ownership (IVBO) and concluded that IVBO contributes to a person's perception of a virtual body being his own. It was reported that IVBO affects behavior and social presence. They investigated long term use of an avatar and how it impacts IVBO within a Social VR app VRChat. They hypothesized that avatar identification would increase the longer they used the avatar, regardless of avatar appearance thus boosting IVBO. The results found that IVBO could be improved daily up to day 10 and then 'saturates' regardless of what type of avatar they possessed which differed from Annetta and Holmes (2006). However, this effect was not collated with avatar- identification because the user did not customize their own avatar and avatar identification could not be correlated within a specific number of days (Oyanagi et al. (2021). Oyanagi et al. (2021) concluded that IVBO improves after about 2 weeks of use regardless of the type of avatar represented by a user. With this in mind, the researchers assert if avatars are used from Social VR in training VR applications, more immersive learning could occur.

2.1.4 Existing Studies on Interpersonal Relationships and Social VR

Freeman and Acena (2021) conducted a study investigating how Social VR builds interpersonal relationships in an immersive, and embodied way. The researchers declared, "Embodiment refers to ownership, agency and self-location. Avatars are the sole interface

between the user and their digital identity. This creates a strong sense of self-location and co-presence" (Freeman & Acena, 2021, p.92). Social VR helps users get to know, interact and develop relationships with others through embodied interactions and experiences in contrast to textual chat in other social media digital spaces. The presence of a personal avatar can increase interpersonal trust (Freeman & Acena, 2021).

They conducted 30 interviews with people who currently use Social VR platforms. The focus was on avatars, interactive activities, and social experiences within the Social VR platform. Freeman and Acena (2021) wanted to know what motivated people to build and develop relationships in Social VR. They found the following: a) users were initially there to explore Social VR, relationships naturally emerged and were not sought out, b) meeting people beyond geographic limitations in a realistic means such as meet ups, to connect and hang out without physical limitations, seeking the feeling and experience of talking with people in real life and c) to learn how to maintain established relationships with people they already knew for example-long distance girlfriend.

The second research question focused on how people fostered relationships in Social VR. The researchers found that users engaged in activities in an embodied way such as watching videos, concerts, talk shows, browsing the internet, and experiencing everyday activities. For example, one popular activity is called 'Sleep Worlds'. In VRChat users meet up, converse and fall asleep with friends. Users reported that it created closeness, intimacy and connectedness (Freeman & Acena, 2021). Social VR fostered relationships with others over time due to the direct relationship between their physical body and avatar body and finally, actively extending relationships beyond Social VR thru third party messaging applications. Freeman and Acena (2021) stated, "Few existing technologies can offer

embodied and immersive experiences that seamlessly replicate people's everyday activities, which play a significant role in forming and maintaining relationships" (p. 85).

The third and final research question, Freeman and Acena (2021) studied was how Social VR relationships affected users offline as well as online. The results showed that 75% reported having enriched online and offline social lives. One participant pointed out that a Social VR friend from another country introduced her to another friend which happened to be someone she went to high school with and they had never really interacted with each other before in the physical world. It was less awkward and uncomfortable and they eventually built an offline friendship. Participants also articulated that they had new self-insights as well as personal improvements such as learning about gender identity, practicing social skills and applying new skills in their offline lives. Lastly, (Freeman & Acena, 2021) imparted that some participants revealed tensions between VR relationships and offline social circles because they had two separate social lives and that caused stress.

2.1.5 Existing Studies on Sense of Community, Interactivity and Social VR

Wayne (2020) stated that the goal of social media is to connect people all over the world. Social VR can do many activities that require physical presence within VR to bring that world closer. Huang and Liaw (2010) proposed three types of essential interactions in a virtual environment. They are learner-to-instructor, learner-to-learner, and learner-to-content interactions. The ability of providing highly interactive learning experiences is one of the best-valued features of VR (Barker, 2016). Abidi et al. (2012, p. 98) state, "Collaborative virtual environments provide gathering grounds for new communities and types of interactions, and they give people a voice like they have never had before. We can share experiences and visions and learn to understand the other person's point of view."

2.1.6 Existing Studies on Immersion and Social VR

"Immersion can be defined as a mediums technological capacity to generate realistic experiences that can remove people from their physical reality" (Slater & Wilbur,1997, p. 3). Immersion in virtual worlds provides new opportunities for practical experience in higher education as well as immersive and engaging experiences during the learning process (Winn, 1993; Janssen et al., 2016). Immersion in a virtual world allows participants to construct knowledge from direct experience and allows risk-taking without real- life consequences (Stefan, 2012; Barker, 2016).

Maloney et al. (2021) studied how teens interacted with Social VR. They interviewed teens introduced to Social VR within the last two years. They found that teens were introduced to Social VR mainly through YouTube videos, influenced by offline friends and free to play business models. Their research indicated teens are attracted to Social VR because of the immersive social hub and ability to game with other people in the immersive environment. Another strong element was that it was a way to stay socially connected during Covid-19 (Maloney et al., 2021). Challenge's teens reported facing were mental well-being from possible harassment or bullying, overusing social VR affecting offline lives and inappropriate behavior. Teens noted that there were some privacy tradeoffs but that wasn't a huge concern (Maloney et al., 2021).

2.1.7 VR Problems/Drawbacks

Wang (2020) described several technical problems while operating Social VR. There is a slow data transmission delay because of general system requirements. This can frustrate many users. In the past, VR price has been an issue with the capability of users being able to afford head mounted displays and software. However, the last few years prices have dropped

and many Social VR platforms are free. The portability and popularity of mobile phones has affected user acceptance, even though Social VR provides numerous benefits. Finally, Wang (2020) expresses that security issues, personal privacy and negative social interaction continue to shape users concerns for using Social VR.

Liu and Steed (2021) **s**ite a substantiative body of work for HCI in social VR systems, functionality, interface design, role of avatar representation, but less in social context. They conducted a usability study and compared 6 commercial social VR platforms: Altspace VR, RecRoom, VRChat, Bigscreen, Spatial and Mozilla Hub via a guided group walkthrough method. The researchers found that users had the most common problem with confusion and hesitation over how to locate and activate features within each platform. Secondly, controller use for each platform using Oculus Rift caused uncertainty because the joystick contained many different buttons. Even with an included tutorial it posed a problem with users learning how to use it. Actions are found in the menu which is invisible making it difficult for users to orient to task actions. Colliding with objects in the environment and avatars simply disappearing if bumped into a wall disabled the ability for users to re-enter the environment. Manipulating objects caused problems because an object would appear to not be interactive only because another user was already holding it, while the other user could not see that. Finally, room coordination- traveling to other rooms via the menu posed a challenge. The authors made recommendations for each of the six platforms in how future usability designs could better be developed for users to have a satisfying Social VR experience (Liu & Steed, 2021).

Huang and Liaw (2010) reported five issues to consider when employing virtual environments (VEs). First is the usability of the VR interface design and secondly, educators

may be challenged by the skill levels required to design a VR course. Third, a simulated world is not a real world. Learners may have a negative attitude toward learning in a VE since current VEs only approximate reality. Fourth is cost effectiveness and fifth is overall effectiveness of using VEs.

Abidi's et al., (2012) article explores VR as a teaching tool for online education. Their research found some of the same hindrances in using VR including cost, usability, fears, maintainability, and security of data. Below is a description of some potential problems and drawbacks cited by Huang and Liaw (2010) and Abidi et al. (2012).

Cost and Maintainability

Today's commercial VR systems prices have decreased due to popularity but are still unaffordable for many schools. Lower end hardware and software have been introduced in the past few years have afforded more educators the ability to use them as educational tools. Logistics and maintaining upgrades and equipment are challenging for many educators (Abidi et al., 2012; Huang & Law, 2010).

Usability and Skill Level, Technology Distraction

A crucial issue for educators and students has been usability and management of the system in the classroom (Abidi et al., 2012). Learning to navigate through the 3D interface is a common difficulty for students as well as teachers. Educators report the amount of time it takes to learn the system is time consuming. Many teachers reported they are not tech savvy and do not want to try it. Poor usability often limits the effectiveness to deliver instructionally (Huang & Liaw, 2010).

Abidi et al. (2012) reported some people do not like wearing the headgear and suffer from motion sickness. Educators also reported fear of not knowing how to use the VR system.

Omale et al., (2009) study findings suggest the Social VR promoted social presence for the participants, but online social experience did not contribute greatly to participant's cognitive presence. Learning was not enhanced and technology became a distraction rather than an enabler. The researchers suggest building in entertainment time for the novelty to wear off. Omale et al., (2009) also suggested in order to increase cognitive presence, activities should be well structured with clearly defined roles and responsibilities and students should be directed to challenge others' opinions (Kanuka et al., 2007).

2.1.8 Existing Studies on Student and Educator Perceptions and Social VR

Studies show that students are eager to engage with and master using VR. Teachers reported students self-identifying into collaborative communities identifying student "experts" (Castaneda & Pacampara, 2016).

Karaman and Özen (2016) conducted a social VR project for 6 weeks using second life virtual campus. Students communicated in SL as well as a closed FB group. Fourteen Turkish students in the teaching department were subjects. Researchers adapted Salmons 5-stage model (2000) and surveyed student experiences. Researchers found each stage provides different learning opportunities. Main themes discovered learners in virtual environments felt more confident, open, creative and engaged; however, participants reported feeling bored if they were the only one in the virtual environment. Students found SL beneficial for collaborating with students from other Universities within SL. Karaman and Özen (2016) declared students associated their experiences in virtual campus with real life, and thus

developed opinions about the effectiveness of SL. Domingo and Bradley (2018) conducted a study to determine student perceptions in 3D virtual environments. Over 50% of the students reported they had a positive experience with the virtual space, in part, because many technical difficulties occurred. The majority reported they thought it increased meaningful social interaction and reduced social anxiety.

Educator Perceptions

Castaneda and Pacampara (2016) investigated how secondary education teachers implemented VR into the classroom. The researchers looked at set-up, challenges of hardware, system management, content and the role of the teacher in the VR setting. Overall (Castaneda & Pacampara, 2016; Robertson & Howells, 2008) found inserting VR technology into the classroom without a connection to the course curriculum is ineffective; teachers must take time to scaffold, discuss and reflect. After conducting pre and post VR, implementation interviews several focus themes emerged. Most match problems and drawbacks findings.

Teachers primarily used commercial simulations with VR content. Teachers noted content selection took a significant amount of time for true integration of course objectives. A few teachers did use Unity and noted several students decided to use Sketch-Up. Teachers reported struggling with scaffolding and pacing (Castaneda & Pacampara, 2016).

Castaneda and Pacampara (2016) reported teachers had limited prior experience with VR hardware. Most chose to use the affordable option Google Cardboard and 90% of the students had compatible smartphones. The remaining teachers used Oculus Rift. Logistical challenges emerged from managing the large number of phones as well as computer processing speed and graphics capabilities. Teachers reported a team effort, involving students, was required to get things running again, but most looked at this as a positive

learning experience. Teachers using the Oculus Rift reported establishing clear guidelines for use was vital. For hardware including controllers, guidelines had to be set up for how to use and store. Teachers also reported it was important to manage students' expectations of what the technology could do by providing demonstrations (Castaneda & Pacampara, 2016).

In summary, Social VR and VR have been researched heavily in the fields of HCI, usability, social presence, immersion, digital social spaces, design strategies, communication modes, interactive activities, and avatar perceptions but little in the areas of dialogic strategies and knowledge construction. Social presence is one of the mediums major strengths as well as immersion and embodied interaction. There are many affordances and drawbacks but most can be overcome and seen as effective by students and teachers if the technology is used along with an appropriate instructional method contributing to the learning design. Therefore, Social VR can be seen as a potential effective support within the learning design.

2.2 Theoretical Framework

To explore the use of Social VR on the quality of student online dialogue (main goal of this study), there is the need to describe the instructional design decisions that one needs to consider designing the entire learning design (as the environment for student dialogue).

The conclusion of the debate between Clark (1983) and Kozma (1991) shows that it is not the technology nor the instructional methods that influence student achievement. Kozma (2000) admits that there is a "complex mess between media and instructional design," meaning the elements of media and instructional design are intertwined and it is not the one or the other, rather both together affects learning. (p.14). Similarly, Jonassen said the technology-intertwined instructional design is in the environment of the students and the

environment affects their learning. Thus, this dissertation argues that the relationship between the media (digital technology) and instructional method together creates the learning design for learners to construct new knowledge from digital discourse. Yang et al. (2014) note the following: As Kozma (1991) observed, a good design incorporates media and instructional methods, and the two often affect learning through their influence on each other. Therefore, in the media debate, both Kozma's views about media attributes and Clark's observations on the persistence of instructional methods are correct. (p. 1088).

In summary, in this study, Social VR and the instructional design method of IDS will be intertwined and designed as independent variables to study the outcome of quality dialogue (dependent variable).

2.2.1 The Theory of Constructing Dialogic Pedagogy

Freire (1993) questioned conventional education and used the term 'banking education' to mean those that had the 'gift' of knowledge bestowed it upon others that did not have it. Freire (1993) viewed dialogic pedagogy as 'problem-posing education' in which "dialogue is indispensable to the act of cognition which unveils reality" (p.72). Freire (1993) stated that dialogical pedagogy takes place when teacher and student learn together and provide personal growth opportunities through meaningful dialogue in the learning environment. This assumes that students and teacher are actively engaged with discussion and practice critical reflection.

Rule (2004) considered dialogue that causes tension and growth through an argumentative strategy whereas Bakhtin (1984) framed dialogic interaction as a means to find a collective answer or understanding through conversation with others. Gilbert and Dabbagh (2005) specifically defined dialogic pedagogy whereas students are able to

demonstrate critical thinking through dialogue with one another. They stated that in order for this to occur a) students should be able to relate course content to prior knowledge and experience, b) understand content through articulating, negotiating and reflecting with others, and c) developing conclusions. Farooq and Benade (2019) noted that virtual learning environments posed a challenge to dialogic pedagogy in the classroom because of asynchronous lag time intervals in discussion forums, blogs and email. In Farooq & Benade's literature review (2019) they concluded that online education "is moving away from what Freire termed 'banking education' towards what he called 'problem-posing' education" (p. 10).

Digital technologies and the way they are used can shape and direct thinking and reasoning as well as enhance dialogue according to Rasmussen and Ludvigsen (2010). Major et al. state, "Proponents of dialogic pedagogical practices maintain that classroom dialogue is central to the meaning making process and thus central to learning" (p. 3). Major et al., (2018) conducted a scoping review of 72 studies looking at the role of technology in supporting classroom dialogue. The researchers asserted that in recent years, focus has been on the interdependency of dialogic pedagogy and digital technologies in which Littleton and Mercer (2013) refer to as 'extending interthinking.' Computer Supportive Collaborative Learning (CSCL) advocates suggest that new forms of discussion can occur through technology mediated forms of discourse and collaboration (Stahl et al., 2014 as cited in Major et al., 2018). Major themes in the scoping review included: a) dialogue activity, b) technological affordances, and c) learning environments.

Digital activity described four sub themes in which digital technologies enhanced students' abilities to be able to recognize alternative viewpoints, purposeful knowledge co-

construction, meta-cognitive learning and scaffolding of dialogic and technological skills. Technological affordances were identified in 11 studies that found digital technology can provide both a tool and environment to create a shared collaborative dialogic space. Finally, learning environments connecting dialogue and digital technologies were divided into five sub themes across studies. These included: a) digital technology and pedagogy can increase student ownership and responsibility for their own learning, b) promote learner inclusion and participation, c) create a sense of community and a positive learning environment, d) positive interpersonal relationships and e) learner motivation and engagement. Major et al. (2018) asserted, "Affordance, interdependency and dialogue itself are key concepts that frame the social situation in which students build knowledge and meaning with and through digital tools (p.21)."

In this study, I am incorporating the three main themes that literature supports (Major et al., 2018): a) dialogue activity using IDS, b) technological affordances from Social VR and c) instructional design for knowledge co-construction. Incorporating these three elements and using the Tech-SEDA coding scheme will show what types of dialogue categories occur and if quality dialogue is achieved.

2.2.2 Instructional Dialogic Strategies

Robin Alexander (2001) coined the term Dialogic Teaching. From the theory of Constructing Dialogic Pedagogy, the method of instructional dialogic strategies my study uses were developed by Dabbagh & Bannan-Ritland (2005) and Hung, Chee Tan & Chen, (2005). IDS is a specific strategy for fostering critical thinking and co-knowledge using language through social interaction to gain a better understanding of prior knowledge through cognitive scaffolding.

2.2.2 Dialogue vs. Discussion

It is important in this study to clarify the differences between dialogue and discussion. I chose dialogue in this study, not the concept of discussion.

Kent & Taylor, (2002, p. 329 as cited by Romenti et al., 2015) define dialogic communication as "a specific form of communication aimed at creating dialogic conversations that result in dialogue. Dialogic conversations require the presence of at least two entities. These entities have to discuss something that give each other reciprocal respect and recognition. Dialogic conversation is not dialogue. Dialogue requires conversation, but conversations do not infer dialogue" (Romenti et al., 2015).

Bird (2007) defines dialogue as, "a process of inquiry, investigation and questioning, is a crucial element for online development of new concepts, knowledge construction and internalization of learning" (p.153). Mercer et al. (2017) express 'dialogic pedagogy' and dialogic teaching' as:

> "An approach to teaching that is predicated on the active, extended involvement of students as well as teachers in the spoken interaction of the classroom, so that teaching and learning becomes a collective endeavor in which knowledge and understanding are jointly constructed" (p.3)

2.2.3 Dialogic Argumentation

In physical classrooms students can debate an idea, belief or concept. Toulmin (1958, as cited by Chadha & Vechten, 2017) asserted that 'argumentation' is a process of an individual or group that tries to convince others that their view is valid by presenting ample evidence. Argumentation is a critical reasoning process that can lead to learning because of the knowledge building among participants as they form their own positions. During this

formation, change can occur because of other students' perspectives 'arguments' changing their opinion and/or they are able to critically reflect to refine an idea or concept (Chadha & Van Vechten, 2017). Several researchers have asserted that in online learning environments, learning can occur through an uncensored dialogic process in which students co-construct knowledge by generating, challenging, reflecting and defending their ideas (Rowntree 1995; Chu et al., 2017; Cooper, 2001; Gordan & Conner, 2001; and Wilson 2001 as cited in Chadha & Van Vechten, 2017). Dialogic argumentation is a method that instructors can use in online learning environments in which students engage by expressing their perspectives, challenging peers with counter arguments and articulating their own positionings.

The scientific community often uses argumentation in physical and online learning communities. Clark and Sampson (2007) wanted to assess the quality of dialogic argumentation within the national science standards in the classroom. Within their study they presented an analytic framework for coding students' dialogic scientific argumentation in asynchronous discussion boards that has been used by many researchers since. One example of their coding framework is described in the following paragraph.

Chadha & Van Vechten (2017) analyzed 375 peer-to-peer responses among 160 students in three different online classes using argumentative interactions to see if this method led to higher level engagement. The researchers used Clark & Sampson's (2008) framework to analyze argumentative quality which depicts six levels of increasing types of argument characteristics that represent higher level reasoning. The researchers adapted the typology to measure interactive argumentative dialogue rather than focusing on strictly factual claim/ counter claim rebuttals. Chadha & Van Vechten (2017) found statistically significant evidence that students engaged the learning process through arguing with each

other. The researchers also found that the students who employed argumentative components were more reflective in their responses and invested more in their learning.

2.2.4 Types of Dialogue for Learning

Learning through dialogue and argumentation has a rich history beginning with Socrates and Plato (Swann, 2009; Hennessey et al., 2015). Dewey, Vygotsky, Piaget, Lave and Wenger among others have contributed to the development and influence of constructivist pedagogy which supports online learning. Mikhail Bakhtin (1895-1975), a contemporary of Vygotsky developed literary theory but also viewed language as a social practice (Lyle, 2008). Bakhtin (1981) asserted a distinction between monologic and dialogic discourse. Monologic discourse in instructor to student, focusing on the knowledge of the teacher and the students learning it. This structure is known as the IRF (Initiation/Response/Feedback) technique where recitation and recall are knowledge (Lyle, 2008). It does not promote dialogue among students and generating ideas. In contrast, dialogic talk is instructor and students as co-learners, promoting communication through authentic exchanges, sharing ideas and meaning making. Lyle (2008) states:

> "Bakhtin's concept of 'dialogical meaning making' allows the learner to play an active role in developing a personally constructed understanding of the curriculum through a process of dialogic interchange. Dialogism stresses the intersubjective nature of language as a social system". (pp. 224-225)

Swann (2009) cites three main themes of learning theory that are uniquely social in nature. These include learning is socially situated, meaning is distributed across groups and learning takes place in communities (Swann, 2009).

There are several types of dialogue based on socio cultural theory. 'Exploratory Talk'

(Barnes, 1976, 2008; Mercer 1995, 2000 as cited by Mercer et al., 2017) is dialogue in which a) active learning with critical and constructive ideas: b) everyone's ideas are considered and presented by pertinent facts: c) critical reasoning and reflection by everyone and d) group consensus is reached for co-learning. 'Accountable Talk' (Resnick, 1999; Wolf, Crosson, & Resnick, 2006; as cited by Mercer et al., (2017) is very similar and the two get interchanged depending on geographic location. In order for Exploratory Talk to be successful Mercer (2013) states that the instructor must create 'ground rules' for the class in order for all students to participate and form ideas, express opinions and information, and think together to create new knowledge.

Researchers in the field state that the quality of dialogue is a key factor in academic attainment (Littleton & Howe, 2010; Mercer & Hodgkinson, 2008; Mercer et al., 2015). Mercer et al., (2017) studied Exploratory Talk with ground rules using digital technologies (Interactive White Boards). In order for quality dialogue to occur they suggest instructors use ground rules or some variation: a) all relevant information is shared: b) active learning is encouraged by everyone: c) listen to suggestions and carefully consider them; d) provide reasons and evidence: e) if an idea is challenged a response is expected: f) options are considered and discussed before a decision is made: g) the group works together specifically to reach an agreement: h) the group takes responsibility for the decisions made.

As a result of the study Mercer et al., (2017) created a model for productive student interaction involving digital technologies. The technology can produce artifacts in the case, the interactive white board, which serves as a visual representation of the students' thinking and interpretations as they made decisions. The researchers stated that "A crucial factor was that the teacher had a dialogic intention for the task, meaning rather than considering the

technology only as a tool for teaching science, he also used it as a tool for mediating dialogue" (p. 8).

Besides Exploratory Talk, (Mercer, 1995; Wegerif & Mercer 1996) identified two other types of dialogue; disputational and cumulative. 'Disputational Talk' allows students to disagree without giving reasons, each wanting to be correct. 'Cumulative Talk' is group think when all agree, not wanting to criticize or give reasons. Wegerif & Major (2017) discuss Buber's notion of dialogic space. Shared space allows for dialogic education to take place so differing perspectives can be expressed and shared so new learning can occur. Digital technologies afford shared space to include multi-modal voices in exchanging ideas. Wegerif and Major (2017) conclude:

> "Digital technology is an extension of us, a reified part of our language. Simondon (2001) argued that it is in the nature of technology to create globalizing systems. We see this logic of technology working out today in the emerging internet of things…a globalizing network that already includes us". (p. 118)

In summary, dialogic pedagogy has an abundant history. Several different types of dialogue have been identified as well as different definitions which have evolved over time. Digital technologies offer the affordances to create dialogic shared spaces where interactions can occur in online environments. My study design includes Exploratory Talk using ground rules because researchers have articulated that it lends to productive and quality dialogue (Mercer, 1995; Wegerif & Mercer, 1996).

2.2.5 Framework to Measuring Online Dialogic Conversations

Several tools have been developed to assess online dialogue but not necessarily the quality of dialogue. Systematically developing instruments to analyze classroom dialogue

across an array of educational settings has been challenging. Nevertheless, researchers are trying different instruments, relying on various theoretical contexts. Romenti et al., (2015) conducted a study to develop a measurement scale for assessing the quality of dialogic conversations between companies and their potential customers in social media. The scale depends on the concepts of online dialogic communication, interactivity and engagement. Three dimensions of dialogue were characterized (turn-taking, sequencing, and resolutions). Each dimension contains variables, ten in total that compromise the components of dialogic conversations. Each variable is defined by an indicator for coding. The researchers analyzed conversations from Starbucks' Facebook and Twitter pages during a six-month time period. Random sampling of posts was coded using their scale. Romenti et al., (2015) found that their scale did measure the company's dialogue conversations but differently between the social media. The scale measured more dialogic conversation for Facebook than it did for Twitter. They offer that this might be because Twitter imposes space limits. The end results showed a general level of reliability for most of the ten variables and indicators for Facebook.

Hennessey et al., (2015) assert that despite the growth and advances in dialogic pedagogy there is a lack of instruments to measure and assess levels of dialogic interactions. The coding scheme developed reflects Dialogic Teaching and Learning (DTL) (Rojas-Drummand et al., 2013) that is an off shoot of dialogic teaching. DTL a) uses language to stimulate thinking, understanding and learning: b) is reciprocal, supportive and purposeful: c) uses authentic contexts: d) teachers and students are co-learners: e) critical reasoning; f) promotes democratic environments where voices can be expressed, challenged, reflection and transformed (Nystrand et al., 2003: Rojas-Drummond 2000 as cited by Hennessy et al.,

2015).

The scheme uses Hymes Ethnography of Communication to establish levels of analysis from conversational turns (Hymes, 1972; Saville-Troike, 2003 as cited by Hennessey et al., 2015). The present tool was adapted from the origins of an earlier scheme developed by Rojas-Drummond et al., (2013). The original scheme drew upon guided participation (Rogoff, 1990) and scaffolding. The scheme (Scheme for Educational Dialogue Analysis- SEDA) consists of 33 communicative acts that each contain a code level, key words summary, basic and extended code definition, and illustrative examples. Hennessey et al., (2015) contended that the current scheme relies on metacognition, "as more contemporary literature emphasizes its social nature, as well as its pivotal role to help achieve collective goals when meta cognitive reflections are shared amongst participants during dialogic interactions" (p. 28). The SEDA tool was used in the UK and Mexico as a socio-cultural paradigm across ages, subjects, whole class dialogue and group work. It has since been used and further developed for use with digital technology to support multi-modal types of dialogue.

Chapter 3: Methodology

This is a qualitative case study (Yin, 2018) that offers new knowledge in how Social VR can be an effective support within a specific learning design that applied instructional dialogue strategies (IDS). The study investigates how synchronous Social VR can be utilized in asynchronous online courses to support student online dialogue. The research goal for this study is to contribute to a body of knowledge demonstrating how Social VR can promote quality dialogue among students by using the Tech-SEDA coding scheme model.

3.1 Researcher Role

My role as researcher in the online course was ‘observer as participant’ meaning that the students knew that I am a researcher providing research goals with limited interactions (Merriam & Tisdell, 2016). I was the graduate assistant as researcher in conjunction with the online course instructor. Before my data collection began, I gained permission to access the course to upload the IRB consent form and other protocols for the study as well as the Social VR app tutorials and dialogue assignments. I posted to the announcements a welcome message about my project, along with my defined role. The online course used Canvas LMS, which already had use of discussion boards and other tools. The students knew I was conducting research with access to the course but that I did not have any input into their course grade or assignments. A zoom session was offered during week 2 to introduce myself, describe the project and answer any questions. It was recorded for those students who could not participate.

3.2 Sampling of Participants

The participants for the study were students enrolled in this 16-week Advanced Game Design spring semester course who gave their consent to participate (see Appendix B). Seven

graduate level students enrolled in a sixteen-week semester graduate level Advanced Game Design online course at a Midwestern higher educational institution in the United States in 2022. This course had a pre-requisite of taking Intro to Game Design (I assume that is a reason that it did not draw too many students). They were divided into two groups by self-choosing a game design team on a first come first serve basis in week 3. To encourage participants to join the study, most of the data collection was integrated within the course assignments except for the surveys and interviews.

Students received participation points for each Social VR dialogue assignment by the instructor towards their course grade as well as a $50.00 gift card for completing all aspects of the study.

Five students consented to the full study and two students consented to the Social VR team dialogue assignments that were already integrated into the course.

3.3 Context of the Study: Social VR App

The participants used vTime XR mobile app (Social VR) which is a free platform for iOS and android and allows use with mobile smart phones and Google Cardboard for the first two dialogue assignments (contextual questions) and Mozilla Hubs, a 3D virtual collaboration platform that runs with a browser for the last discussion assignment (game-based design). vTime XR is a social community available in almost 200 countries and uses three realities (VR, AR and Magic Window). Magic Window is for users who do not have VR headgear and who just want to use their mobile phone for a 2D experience. AR mode allows users to use any flat surface to project the 3D scene and use any 360-degree model to explore with other group members. This platform was chosen initially because it was mobile, which would lend itself to synchronous dialogue, accepted a variety of VR viewers including

Google Cardboard and had options for those that did not have viewers. Most importantly vTime originally had a recording and photo option which was instrumental for the assignment uploads to the course. vTime also included private virtual rooms so people could not enter without an invitation and screen sharing function.

This study strongly encouraged students to use the VR reality with viewers so everyone could share the same immersive experience. However, if students did not have VR viewers and did not purchase them, they could still participate using the other two features. vTime XR does not have a desktop application unless certain VR viewers are being used in which it then must be downloaded. Certain resolutions and graphics cards are needed to access this function. Students received instructions and tutorials for using vTime XR and a pre-activity to complete before the Social VR dialogue assignments began. I additionally provided a tutorial page within the online course that included: a) downloading the app and creating an account, b) navigating the menu, c) taking selfies d) creating an avatar e) using gestures and changing seats, f) selecting destinations g) special features and h) compatible VR viewers. The pre-activity 'introduction' in self-selected small groups gave students novice experience in navigating the platform and its features to be used in their dialogue as well as getting to know each other and establishing their small group game design team.

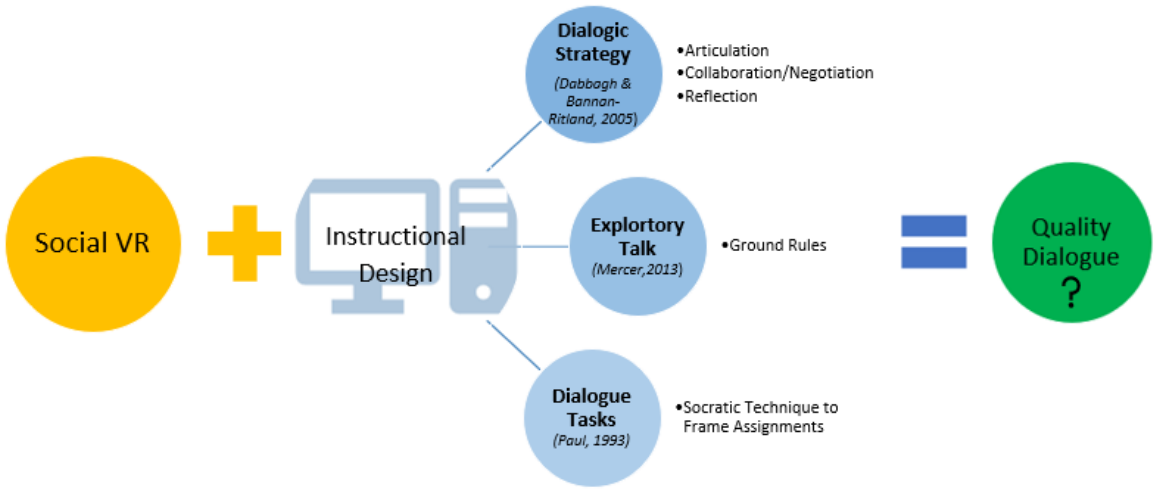
3.4 Context of the Study: Course Design

I used an existing Spring 2022 (planned) 16-week online graduate course 'Advanced Game Design' from a Midwestern University. Each of the five dialogue assignments (Section 3.4.2 Table 1 through 4) used Social VR as the digital dialogic support. The first two assignments were subject matter contextual questions and the remaining three were game design specific. Using successful components from dialogic models presented in the

literature review, the Instructional Design components for the exploratory talk dialogic assignments included three activities from the IDS conceptual framework a) articulation, b) collaboration/social negotiation, and c) reflection which included dialogic ground rules and the Socratic questioning technique to create Quality Dialogue that was measured using the Tech-SEDA Coding Scheme (see Figure 2).

Figure 2

Learning Design



Note: Social VR is the technology that provides effective support together with the components of IDS (instructional design) including ground rules and the Socratic questioning technique to measure Quality Dialogue using the Tech-SEDA Coding Scheme.

Students were presented with two client game-based design proposals. The game designs were centered around Social Emotional Learning and Geology. They were allowed to choose the game design team (up to four people) they wanted to participate with on a first come first serve basis. Within these two teams, students used vTime as the web-based dialogue tool and then switched to Mozilla Hubs another Social VR tool after the mid-point

for usability reasons. This study focused on the *student dialogue* through shared social interaction while using Social VR. There are three roles each team member was assigned during the Social VR assignments (host, timekeeper, and recorder). Each team member took a turn in each role at least once. The host chose the VR destination, coordinated meeting time with the group, and invited members to the Social VR session. The timekeeper was responsible for the flow of the dialogue assignment and kept track of the time which was a minimum of 20 minutes per assignment. The recorder was tasked with recording the session and uploading it to the LMS course for the group. The recording took some effort to put together, so as an incentive, the recorder did not have to submit an individual discussion board summary of the dialogue assignment that was required for all other team members.

3.4.1 Pre-Activity before the actual study

Students had access to a vTime tutorial and Zoom conference that they reviewed and participated in during week 2 to become familiar with the Social VR app. Students downloaded the application to their smartphone. Instructions were given on how to create a personal avatar for use during the course in week 2. After completing the introductory tutorial and creating a personal avatar, students could test out the app individually and explore its features. The students completed a discussion board assignment introducing themselves by posting an image of their personal avatar and individual game designer type profile. During week 3, students chose their small game design team on a first come first serve basis. A total of two small groups were formed with three in Team SEL (Social Emotional Learning) and four in Team GEO (Geology). Week 4 student activity allowed groups to meet in vTime for the first time and test out the navigation and functions. During the meeting, each group member introduced themselves. This activity is called “more about

you in two." Each member had two minutes to introduce themselves via oral presentation. This was meant to be fun and informal. Topics could include a favorite hobby, an exotic or interesting place visited, a club or organization they belonged to or anything that sparked their interest to share.

Pre-Activity instructions: Each group met in vTime. Groups each selected a host to coordinate the date and time. The host was responsible for selecting the virtual room and inviting group members to join. Groups were able to choose a room setting that is life-like or fantasy. The room that groups could decide to meet in was not a classic academic lecture hall or lab. Among some of the choices were a Zen Garden, wilderness camp, beach, Paris rooftop, outer space or under the sea for their VR meeting setting. The recorder was responsible for recording and posting the assignment to Canvas and the timekeeper was responsible for tracking time and leading the discussion. Each member introduced themselves using the "More about You in Two" activity instructions. After each member introduced themselves, they discussed their personal goals for the course while testing out some of the non-verbal app features. The instructor touched base with each team recorder after the pre-activity to see if there were issues or difficulties that needed to be addressed. Those were discussed with me and as a result some extra tutorials were made and announced.

3.4.2 Social VR Assignments Aligned With IDS

To conduct the study, I designed questions with the instructor fostering IDS in each dialogue assignment using Social VR (synchronously) to articulate, collaborate, negotiate, and reflect on the assigned discussion. Questions were designed to align with the course objectives and design framework. Weeks 4 through 9 allowed groups to meet once per week to discuss a question created prior to the course. To keep the design valid by designing five

equal dialogue tasks, each included two of six Socratic questioning techniques from Richard Paul (1993): 1) conceptual clarification questions; 2) probing assumptions; 3) probing rationale, reasons, and evidence; 4) questioning viewpoints and perspectives; 5) probe implications and consequences; and 6) questions about the question. Each team was presented with five discussion assignments. The first two assignment questions focused on Socratic questioning technique dialogue tasks, a) conceptual clarification on key concepts and design principles related to game design and b) questioning viewpoints and perspectives. The final three assignments were project-based representing each phase of game design in which the groups chose 3 of 4 topics listed (concept testing, game elements, achievement and assessment and prototyping) as teams were developing their projects (see Table 4). Questioning viewpoints and perspectives and probing implications and consequences were the Socratic techniques for these dialogue tasks.

Below (see Table 1) for dialogue assignment ground rules.

Table 1

Exploratory Talk: Ground Rules for Assignments with Social VR

Roles: Host, Timekeeper, Recorder (There are 5 discussions. Each team member takes a turn in each role at least once.)
• Select a Host from your team. • As a group select a meeting time. • Host - select a destination in vTime. • Host will invite team members to meeting destination- Prior to the first meeting invite team to friends list in vTime. • Recorder: One team member will screen record the meeting using Panopto or Zoom and upload it in assignments unless there is another mobile screen recorder that you prefer. Please test this out before the first assignment. The team member that uploads the group recording to the DB post does not have to summarize the discussion for that assignment. • Timekeeper: One team member is responsible for keeping time so that the discussion flows. A minimum of 20 minutes is required.

• Use gestures and emoticons, take "groupies", switch chairs if you like- upload "groupies" with assignment.
Group Discussions: Each member must discuss their understanding and application of the concept for the assignment. Within the group, articulate and negotiate a position and supportive talking points. Provide evidence to back your claims (use citations from readings). Each member will discuss and share their viewpoint. After everyone has shared, as a group come up with an agreed approach or application and reflect on the process. **After the vTimeXR discussion:** • The recorder uploads the DB post assignment for the group. • Each team member uploads a summary statement in the DB except the member who uploads the video. Did your views change or stay the same? Why? Lessons learned? • Instructor will respond to summaries.

Table 2-Table 4 outlines each dialogue assignment using Social VR within project teams. Students used Social VR to (articulate) discuss (collaborate and negotiate) and make final comments (reflect).

Table 2

Assignment 1: Distinguish Between Games and Simulations

Social VR **Assignment 1**	Socratic Questioning Techniques: Conceptual Clarification Questioning Viewpoints and Perspectives Probing Rationale, Reasons, and Evidence
<u>Assignment 1: Level 2, Week 4 Simulations and Clients</u> Greetings from your vTime Master! This will be your first dive into Social VR. You should have created your avatar and become familiar with the app functions. This discussion will give you the opportunity to try different functions out and become more familiar within the vTime System. **Group Discussion Assignment: (2 parts!)** **Part 1: Icebreaker** This assignment will be longer because it is the first-time teams are meeting. To get better acquainted we will start with an ice breaker. The activity is called "More About You in Two." Each team member will have 2 minutes to introduce themselves and discuss something fun like a hobby, vacation, favorite type of pet...anything you are comfortable sharing. The point is to make it fun and get to know each other better. This is informal but come with something in mind to share. Have a timekeeper ready and stop at 2 minutes per person. **Part 2: Games and Simulations** Simulations today are almost synonymous with games in a lot of ways, yet we do still refer to	

some simulations as simulations and some games as games. This Level, you have had the opportunity to play some simulations and some simulations-games and explore what those were. Now, in your small group discussion, you are asked to talk about the differences between the two. Does the reading from 2006 still hold true in distinguishing between simulations and games and what exactly makes a simulation-game? Is it dependent on the gaming elements or something else? Keep in mind there is no truly correct answer here, which makes this a great first discussion!

Initial Discussion: (Each team member will take a turn in sharing)

- Which simulation options did you analyze for your Blog Entry?
- Based on the readings support your thoughts on the posed questions above. What makes a simulation versus a game and what makes a simulation-game? Why?
- Share your own thoughts (comparing/contrasting) on the simulations you analyzed and what your teammates analyzed.

As a group, reflect and discuss the following question together:

- What is the most helpful way to distinguish between games and simulations, today, and if we need to at all? Why?

Table 3

Assignment 2: Gamestorming and Game Ideation

Social VR **Assignment 2**	Socratic Questioning Techniques: Conceptual Clarification Questioning Viewpoints and Perspectives Probing Implications and Consequences

Assignment 2: Level 3, Week 6 Gamestorming and Needs Assessment

Greetings again from your vTime Master! I hope your first experience with Social VR was successful.

Part 1: Gamestorming- (*Complete Part 1 before meeting with your team using your Gameplay and Blog Assignment)

You are in your newly formed group for the semester to work on your client's project... so first things first, you need to learn a bit more about your client's problem (i.e. researching what is out there already) and start coming up with ideas -- we are back to Gamestorming, trainees! Part of your task with Gamestorming as you have already learned in this Level is to get to know what exists already in your project's topic area and the learning goals/problem for your idea. Once you have that, you can start coming up with ideas!

Remember Game Ideation is a quick activity (as you may recall from our early Training) but to provide you a quick refresher on brainstorming ideas, here is the reading from Kultima (2010) again that was posted in our Resource Exploration.

Make sure you have completed your initial research and posted it to your Blog.

Your second part to this task for this activity is to use one of the many gamestorming techniques out there (even ones not mentioned in the Kultima article) to generate a list with some basic descriptions of potential ways to address your client's project.

For each idea, you should include the following:

- Game, simulation, simulation-game?
- Potential title
- Core dynamic
- Description of the idea
- How does this idea address the client's problem?

You are asked to have a minimum of 2 ideas and your Blogged Research on at least 2 games/simulations on the topic ready to discuss.

Initial Discussion: (Each team member will take a turn in sharing)

- Share both ideas and your initial research with the team.
- Discuss the pros and cons for each.
- What is the feasibility of carrying out your ideas in the time allowed for completing this project (roughly 6 weeks)?

As a group, reflect and discuss the following question together:

- Compare games/simulations found and discuss their relevance as resources to inform your team's design.
- Based on the readings (and any previous knowledge of game storming), which seems to be the best idea for moving forward? Why? Interject your own experiences.
- Decide which idea the team wants to consider pursuing. This must be a consensus (it is possible this will change after talking to the client or later as you start the early design process in Level 4).
- Discuss the pros and cons as they align to the client's needs. (This can be more detailed if you have your client meeting before this discussion, otherwise note down some initial talking points to have with your client.)
- Which option is the most feasible to carry out in the time allowed?

Table 4

Assignments 3-5: Game Design Phases

Social VR **Assignments 3-5** **Game Design**	Socratic Questioning Techniques: Conceptual Clarification Questioning Viewpoints and Perspectives Probing Implications and Consequences

Assignments 3-5: Level 4 Road of Trials (Advanced Game Design Weeks: 7-11

Greetings from your Mozilla Hubs Master! This is the last team discussion assignment using Social VR for the course. You are welcome to continue using the app as a group for your project, but you won't need to record or upload anything after this final assignment.

In level 4, each team will have 3 separate discussions over the 6-week period. Four topics are presented below, each with different aspects you can focus your discussion on. Each team will need to choose 3 of the 4 topics listed below to discuss. The order of the topics is up to the team based on the planning phases of the project. One discussion topic should focus on *at least 2 of the suggested aspects* though you are welcome to talk about more!

Topic 1: Concept Testing (select to discuss at least 2 of the below options)

- Problem Description
- Research on Existing Games
- Feedback on game/simulation idea(s)
- Gee's Principles/Narayanasamy et al., Distinguishing Characteristics
- Motivation

Topic 2: Game Elements (select to discuss at least 2 of the below options)

- Look and Feel of the Game
- Story/Narrative
- World/Environment
- Characters (playable and non-playable)
- Core Dynamic
- Mechanics
- Gameplay (Rules)
- Storyboarding
- LM-GM Mapping

Topic 3: Achievement & Assessment (select to discuss at least 2 of the below options)

- Assessment Plan
- Reward Structure
- Game/Simulation Progression
- Formative vs Summative Assessment

Topic 4: Prototyping (select to discuss at least 2 of the below options)

- Description of Functional Prototype
- Issues/Concerns with Prototyping
- Game Engine
- Paper Prototyping

- Summary of Prototyping Efforts

Discussion 1 (*Same for the remaining two discussions*)

Each team will select their first topic from Level X: Mozilla Hubs Team Discussion Instructions . It should reflect where your team is currently in the design process. Follow the instructions and upload the discussion video and summary statement as in previous discussion assignments.

Screen-recorders ***only need to post the video*** (please make it downloadable so your team members can access the video outside of Canvas). Team Members, please post your summaries of your thoughts from your team's discussion session to the video post. Did your views change or stay the same? Why? Lessons learned?

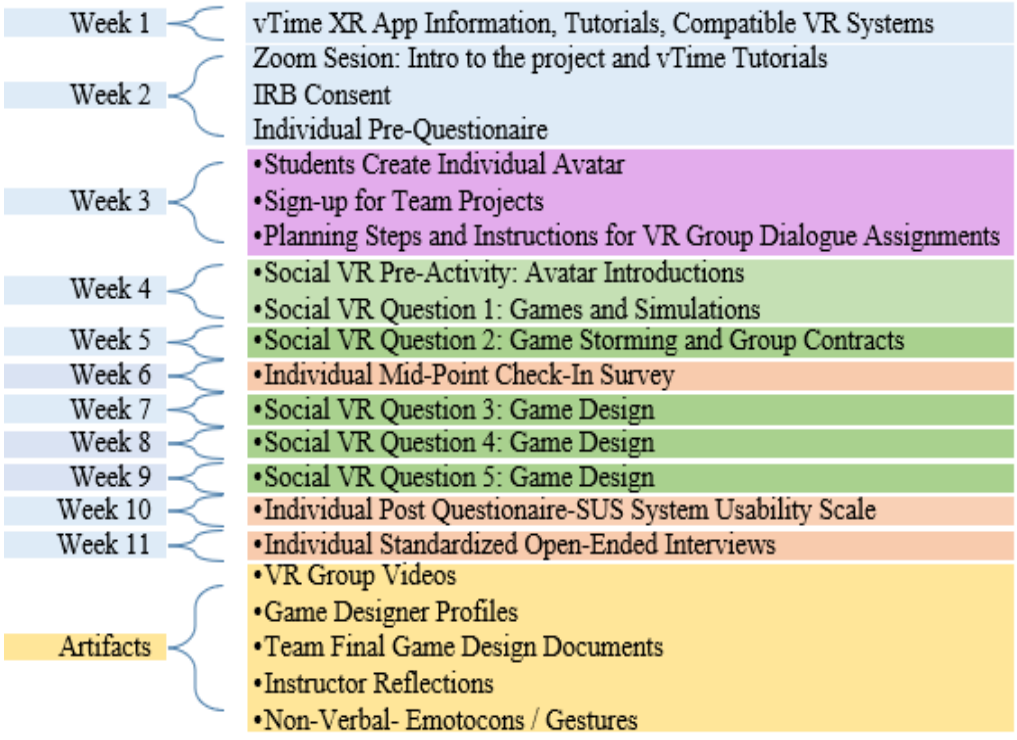
Note. Concept Testing, Game Elements, Achievement and Assessment, Prototyping.

3.5 Data Collection

Data was collected over the first 11 weeks of the 16-week online course chronologically capturing all time points as shown in Figure 3.

Figure 3

Data Collection Schedule



This allowed students to engage with each other and create a social presence that helped establish teams for the remaining five weeks in which they finalized their game prototypes and play tested their game-based design to pitch to the client.

Data collection included the following protocols and brief descriptions of their usage.

The pre-screening questionnaire (see Appendix C) included Likert Scales statements (1-5) and demographics created in Qualtrics that provided student baseline data as a starting point during week 2 as well as gathering information on their confidence level going into the course using Social VR.

The Mid-Point Qualtrics Survey (see Appendix E) is a touch point Qualtrics survey to check in with students for any issues or problems appearing after using the Social VR app after the second assignment.

The SUS Survey (Brooke, 1996) is a reliable and validated tool used during week 10 with Qualtrics (see Appendix D). It is a ten item Likert scale that assesses subjective usability of the technology system, in this case, Social VR. This score reports the student's perceived usability of vTime and their satisfaction level.

Tech-SEDA (Hennessy et al., 2016) In my study, I adopted the Tech-SEDA coding scheme to apply the three activities from IDS (articulation, collaborate/ negotiate and reflection). I extracted codes from Tech-SEDA that match each activity from the 33 communicative acts within each code level. Articulate and reflect each have three sub-category code levels and collaborate and negotiate included four sub-category code levels. Each code level includes individual communicative acts definitions and examples (see Appendix G- Full Coding Scheme).

Standardized open-ended interviews (see Appendix F) was conducted during week 11 with each student, screen recorded and transcribed. Lincoln and Guba (1996) Thematic Analysis criteria was used for data analysis (see section 3.6.2).

Quality dialogue is being defined from the IDS framework that includes the three activities presented earlier (Articulation, Collaboration/Social Negotiation, Reflection-1.3, Figure 1). To measure quality dialogue the Tech-SEDA coding tool measured beginning, mid and ending analysis of digital dialogue during the IDS intervention (see Appendix G). Two groups (7 participants) met a total of five times (weeks 4-9) with a minimum of 20-minute dialogues per assignment. Small group Social VR discussions were screen-recorded using Zoom by the students and uploaded to Panopto within the LMS course. Transcripts were created for each recorded session and coded using Tech-SEDA. There is a minimum of 200 minutes of video ethnographies from vTime and Mozilla Hubs to transcribe as well as tracking non-verbals. MAXQDA software was used to code the data using the Tech-SEDA coding scheme (see Appendix G).

3.6 Data Analysis

Thematic analysis was used to create rigorous and trustworthy analysis of the data (Lincoln & Guba, 1985) as well as descriptive statistics (SUS). The main analysis method is the Tech-SEDA priori coding that I describe next.

3.6.1 Tech-SEDA coding scheme and analysis

Student dialogue has been measured with an extensive coding system developed by Hennessy et al., (2016). It is known as the Scheme for Educational Dialogue Analysis (SEDA, ©2015) is rooted within a sociocultural paradigm, and derives from Hymes' Ethnography of Communication to focus on the importance of context (see Appendix G).

The coding tool contains 33 dialogic criteria and 8 clusters that can be adapted to measure and support the quality of student digital dialogue (the method is IDS conceptual framework). The SEDA tool has been used mainly in physical classroom spaces but can be adapted and used to measure digital dialogue (see Table 5).

Table 5

Example of Tech-SEDA Coding Structure for Articulation /Defining Sub-Category /Criteria

DIALOGUE CODES		DEFINITIONS	EXAMPLE
ARTICULATION (IDS Activity)			
Defining (Sub-category)			
RE (Criteria)	Reasoning	Explain or justify own contribution. Draws on evidence, analogies, distinctions, and speculating, hypothesizing, predicting, grounds.	"I think for me. Initially after reading that my initial thought process was more for it to be a simulation…" Ex: Explains how to do something like a tutorial
REI	Reasoning Invitations	Explicitly invites explanation or justification of another's contribution	"How's that going to work?" "What did you say about the cut scene?"
F	Focusing	Guiding or focusing group dialogue on key aspects of the assignment /activity.	"Today's assignment focuses on prototyping, here is the current working prototype of our very basic first level..."

Training: I traveled to the University of Cambridge and met with the faculty that created the SEDA tool. I spent the week reviewing the protocol, how it had been used and how it could be used measuring digital dialogue. This was important to me that I use the tool accurately and how it was meant to be used. I adapted the tool to match the criteria and sub-categories with the IDS lens I'm using for my research project described in Chapter 1 (see Appendix G) Tech-SEDA adapted coding scheme. In addition, I have had follow-up meetings as they have currently updated the Tech-SEDA Scheme to which I contributed.

3.6.2 Thematic analysis

Thematic analysis for standard open-ended interviews (Braun & Clarke, 2008) has been applied as well as Hennessy's et al. (2016) priori coding scheme for data analysis. The Tech-Seda will provide initial codes for dialogue categories along with emergent open codes. The data will be tagged and labeled and organized as categories emerge. From those categories, themes will be generated to describe the quality of dialogue that occurred. Guba and Lincoln's (1981) trustworthiness criteria was used to measure qualitative research quality: credibility, transferability, dependability, and confirmability. Qualitative data analysis will be conducted using MAXQDA software.

Data analyzed included (five pre and five mid-point individual Qualtrics questionnaires, 10 small group assignment Social VR dialogue video ethnographies and 30 individual reflection assignment discussion board summaries, five SUS surveys, five standard open-ended Zoom interviews, one instructor reflection questionnaire and additional digital graphic and text-based artifacts). These forms of data provided an opportunity to produce triangulated data analysis, increasing the reliability of the results (Creswell et al., 2003; Yin, 2018), see Table 6 for an overview of how RQ and methods are aligned.

Table 6

Overview of RQ and Methods

Research Question	Method	Data Collected	Tools/ Instruments	Measures
What is the quality of online student dialogue when using Social VR?	Qualitative	SVR- video transcripts Discussion Board	Tech-SEDA Coding	Video Ethnographies Discussion Board digital dialogue

Research Question	Method	Data Collected	Tools/ Instruments	Measures
		Reflection Assignments Mid-Point check In Survey	Descriptive Statistics and Thematic Analysis	Qualtrics Survey- Multiple choice and text based
	Quantitative	Individual Pre-Questionnaire SUS Usability	Descriptive statistics SUS Scale	Demographic and Likert scale items (1-5) Usability Score
	Consent form given second week of class			
What are additional factors that foster student dialogue with Social VR in online asynchronous courses?	Qualitative	Interview Guide Protocol Instructor questionnaire	Thematic Analysis	Standard Open-Ended Interviews Written Feedback Responses

Chapter 4: Findings

In this section, the results are presented and offer new knowledge in how Social VR can be an effective support within a specific learning design that applies IDS. It shows how synchronous Social VR can be utilized in asynchronous online courses to support student online dialogue. It contributes to a body of knowledge demonstrating how Social VR can promote quality dialogue among students by using the Tech-SEDA coding scheme.

The section is organized along two research questions. First, what is the quality of online student dialogue when using Social VR? (applying the Tech-SEDA Coding Scheme) including description of participants and teams, and second, it gives recommendations for additional factors within online courses using Social VR on how to foster student dialogue.

4.1 Participants

Eight students signed up for the advanced gaming course with one student dropping before the course began with seven students participating (four male and three female). All students were in the same graduate program, (1) PhD, (1) EdS, (3) Masters, (3) Certificates and (1) other. These professions were represented by (3) teachers, (1) graphic designer, (2) fulltime graduate students and (1) medical sims trainer.

Students were between the ages of 31 and 41, with 34.5 being the average.

In the pre-questionnaire students indicated they were from various parts of the country occurring in three different time zones including Eastern Standard Time, Central Standard Time and Pacific Standard Time from (3) Missouri, (1) California, (1) Texas, (1) Pennsylvania and (1) Maine. All 7 students reported that English was their native language and that each of them had taken at least 5 or more online courses (see Table 7).

The pre-questionnaire asked students how confident they felt using discussion boards,

Zoom and Social VR. All 7 replied that they “strongly agreed” to feeling confident using discussion boards and Zoom. However, 5 “somewhat agreed” and 2 “strongly agreed" to feeling confident in using Social VR. This is good because it shows students are comfortable and willing to try a new technology for their dialogue assignments.

4.2 Let’s Meet the Teams!

Students were able to sign up for a team on a first come first serve basis in week 3 choosing from two different client profiles and descriptions for their game-based design project (see Table 7). Team GEO (Geography) consisted of 4 students and Team SEL (Social Emotional Learning) was comprised of 3 students.

Table 7

Team Demographics

TEAM	GENDER	AGE	DEGREE	STATE	OCCUPATION
GEO 1	Male	41	Other	Missouri	Medical Sims Trainer
GEO 2	Male	N/A	Masters	Pennsylvania	Teacher
GEO 3	Female	31	PhD/Certificate	Missouri	Full-Time Student
GEO 4	Female	32	EdS/Certificate	California	Full-Time Student
SEL 1	Female	N/A	Masters	Texas	Graphic Designer
SEL 2	Male	N/A	Masters	Missouri	Teacher
SEL 3	Male	34	Certificate	Maine	Teacher

Figures 4 and 5 illustrates each team represented by their personal avatars.

Figure 4

Team GEO

Note. Team GEO consisted of two full-time students and two professionals, dubbed as the "young professionals" team.

Figure 5

Team SEL

Note. Team SEL consisted of working professionals with young children nicknaming them the "balancing work and family" team.

4.3 Time spent on each assignment

The main purpose of this study was to collect data with the Tech-SEDA scheme (see Appendix G) to measure the quality of student dialogue using Social VR in an online course. Each team was presented with five discussion assignments. The first two assignment questions focused on Socratic technique dialogue tasks, a) conceptual clarification on key concepts and design principles related to game design and b) questioning viewpoints and perspectives. The final three assignments were project-based representing each phase of

game design in which the groups choose 3 of the 4 topics listed (concept testing, game elements, achievement and assessment and prototyping) as teams were developing their projects (see Table 4). Questioning viewpoints and perspectives and probing implications and consequences were the Socratic techniques used for these dialogue tasks.

Teams were able to choose destinations for each Social VR meeting. Table 8 compares the **time** spent on each assignment, the virtual destination and non-verbal avatar behaviors. The teams were limited to a minimum of 20 minutes per assignment (see below). Across all Social VR assignments, the least amount of time recorded was 20:36 with the longest being 48:00 with a mean time of 34:15. Times were shorter on assignment 3 because of audio issues and some teams made the choice to cut off the recording after the required minimum 20 minutes even if they were still engaged in dialogue. After the first few assignments teams let the conversation flow and weren't concerned about the time. While using vTime for the first three questions avatars could switch seats, take group photos (groupies) and make gestures but were unable to move around in the environment making physical distance predetermined (see Figure 6).

Figure 6

vTime Social VR Destinations for Team Assignment Discussions

Table 8

Discussion Assignments by Groups

ASSIGNMENTS	TIME	DESTINATION	NON-VERBAL BEHAVIORS
Assignment 1:			
Team GEO	31:09	vTime-Library	no gestures or groupies
Team SEL	36:34	vTime-Zen Garden	no gestures or groupies
Assignment 2:			
Team GEO	39:41	vTime-River Rocks	no gestures or groupies
Team SEL	39:36	vTime-Auditorium	no gestures or groupies
Assignment 3:			
Team GEO	25:26	vTime-Outer Space	gesture thumbs up, no groupies
Team SEL	20:36	vTime-Library	no gestures or groupies
Assignment 4:			
Team GEO	30:18	Mozilla-Lecture Hall	Used a timer (buzzed at 20 minutes). Avatars: Fox, Squirrel, Scuba Diver, Superhero. Shared screen to work on game design.
Team SEL	45:00	Mozilla-Lecture Hall	Avatar walking around, trying to find team in rooms. Added virtual objects spider and fish to room. Avatars: girl, robot, man. Left VR @ 24 minutes to screen share for character sprite sheets. Re-entered VR at 30 minutes.
Assignment 5:			
Team GEO	26:51	Mozilla-Family room	Avatars: fox, squirrel, superhero, scuba diver. Demonstrated game and elements by sharing floating screen in Mozilla.
Team SEL	48:00	Mozilla Lecture Hall	Avatars: Robot, Man, Girl. Avatar added a toy horse object to room. Shared screen and documents in room using Mozilla Hubs screen share.

Social VR (vTimeXR) only allows for personal likeness **customization of avatars** whereas Mozilla Hubs grants users the choice of choosing an avatar or creating something with personal assets. Students used ready to go avatars such as a fox, superhero, and robot instead of electing to make personal avatars which takes more time and they had already created a customized avatar in vTime, expressing they enjoyed both options.

The Mozilla Hubs environment (see Figure 7) allowed avatars to move around so **social distancing** becomes an option. In one scenario the superhero avatar moved to close to another avatar and the person said, “Whoa, you are a little too close.” Most of the time avatars were socially distant from each other within this environment. This shows that the virtual environment mimics the real-world physical environment in that people still need appropriate social distance.

Figure 7

Mozilla Hubs Destinations for Social VR Team Assignment Discussions

Note. Social Distance between avatars and added virtual objects (fish, spider, and duck).

The Mozilla Hubs environment was animated as team members actively moved

around, explored the environment, screen shared on the floating screen and added virtual objects while engaged in dialogue. In vTime they did not use the screen share function or photos. Gestures were used only once by a student even when prompted to do so in the vTime assignment. As comfort levels were gained students used more features, for example, the screen share with prior experience using Mozilla Hubs, they were able to readily use these features.

4.4 Quality of online student dialogue using Social VR

The first section examines how the entire online classroom performed investigating overall conversational turns in dialogue activities and criteria occurrences (see Appendix G). The second section compares the two groups (teams SEL and GEO) and particular patterns.

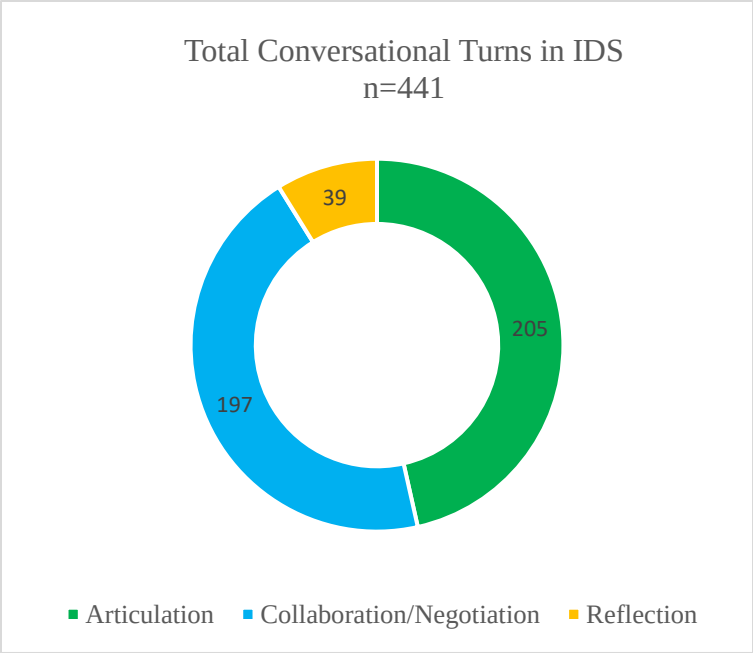
As mentioned in the Method section, the Scheme for Dialogue Analysis (SEDA) provided a framework for identifying key features of the online classroom dialogue. I focused on conversational turns and SEDA-criteria occurrences (Hymes, 1972; Saville-Troike, 2003 as cited by Hennessey et al., 2015). Conversational turns (CT) have been defined as participants - or participant configuration (class, group, or dyad) - take turns in speaking and listening for a task or topic that remains constant. Changes in these factors introduce a new CT (Hennessy et al., 2016). Conversational turns were coded from IDS activities. Conversational turns between student and instructor were not counted since it did not exist because of the nature of peer-led dialogue in the learning design.

Results show that the total number **of conversational turns** for the entire classroom for each of the three IDS activities is n=441(see Figure 8). Data shows conversational turns in the following three activities: Articulation (46%), Collaboration and Social Negotiation (45%) but is deficient in Reflection (9%). Participating students articulated (n=205) a bit

more than they collaborated or negotiated (n=197). However, participants did not apply reflection (n=39).

Figure 8

Number of Conversational Turns in the 3 Activities of Instructional Dialogic Strategies (IDS)



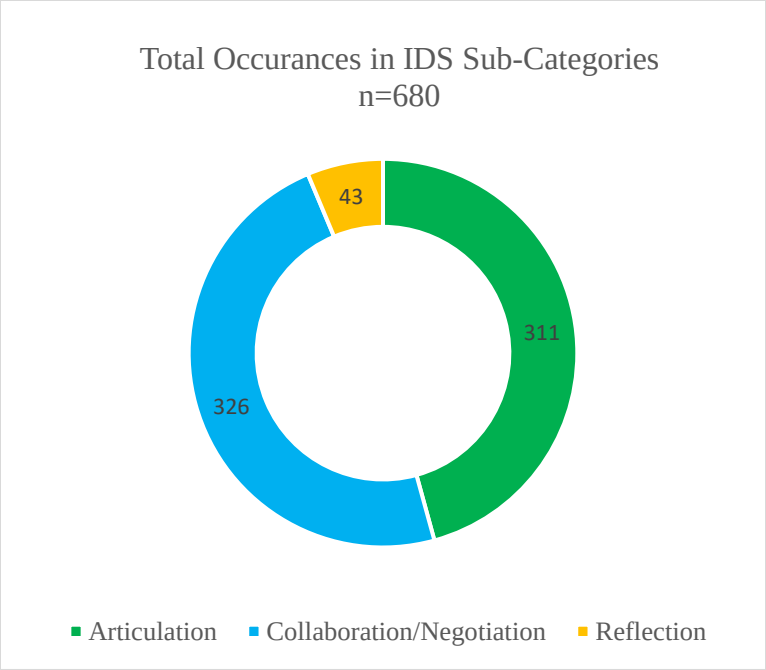
Using Dabbagh's (2012) definition for 'dialogic learning', this study result shows that the three activities of Articulation (n=205), Collaboration/Social Negotiation (n=197) and Reflection (n=39) were present in conversational turns. Each IDS activity contains sub-categories (10 in total) that are attached to each criterion (total 26) to determine number of occurrences (see Figure 9). Total occurrences within the three IDS activities are n=680. Data shows occurrences in the following three activities: Articulation (n= 311), Collaboration/Social Negotiation (n=326) and Reflection (n=43).

Whereas articulation (n=205) slightly edged out collaboration/social negotiation (n=197) in *conversational turns*, it was flipped in *number of occurrences* where participants

collaborated and negotiated (n=326) a bit more than articulated (n=311). Reflection (n=43) was least applied by participating students and mirrored conversational turns (see Figure 9).

Figure 9

Number of Occurrences in all Sub-Categories in the 3 Activities (IDS)



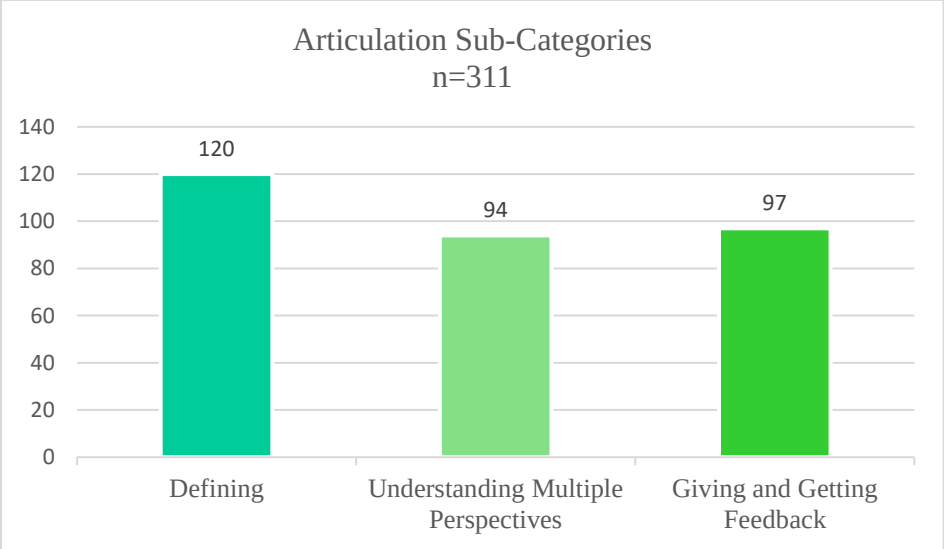
Results indicate that Social VR is an effective support meaning that the technology used with the learning design does produce these three dialogic activities. However, research by Hennessy et al. (2020) does not show how many **conversational turns** or **occurrences** must be present to be considered quality because it is also determined by context from the instructor.

Hence, I looked closer at each of the three IDS activities individually starting with the Articulation activity and analyzed the **occurrences** (see Table 9). In Tech-SEDA, each dialogue activity has a set of sub-categories.

Articulation is comprised of 3 sub-categories (together: n=311) including defining (39%), understanding multiple perspectives (30%) and giving and getting feedback (31%). All three sub-categories were strongly represented and fairly even. This covers all 3 sub-strategies of IDS theory and means, that participants in this study discussed definitions of terms 120 times (defining), they gave and received feedback 97 times, and contributed to multiple perspectives 94 times.

Table 9

Number of Occurrences: Articulation Sub-Categories



Each of the three sub-categories (defining, multiple perspectives and feedback) is attached to one of 9 criteria, each coded with a definition. Examples of each coded criteria are in Appendix G for reference.

The Articulation activity (n=311) includes the criterion reasoning (RE, n=46) within the defining sub-category (120 occurrences in total) and shows that while engaged in dialogue, students were able to reason by explaining or justifying their own contribution drawing on evidence and asking others to explain their contribution (for details, see

Appendix G). In addition, also within the defining sub-category (n=120) they were adept in focusing (F, n=68) guiding the group and staying on task for key aspects of the assignment, proficient in understanding multiple perspectives while comparing and contrasting ideas and capable of group consensus. Table 10 is an excerpt of dialogue from Team GEO as they are "defining" potential research for game ideas using reasoning (RE).

Table 10

Excerpt of Team GEO Dialogue "Defining" (in the Context of Game Design Ideas)

Articulation	Team	Line	Dialogue	Criteria
Defining	GEO	1	*"Yeah, I would agree with that. In my opinion simulation tends to be something that you're trying to master and or learn."*	CA RE
		2	*"Yeah, so like saying simulations are a small subset of games."*	RE
		3	*"Can you think of anything that you would say would be a game but not a simulation?"*	REI
		4	*"So, most of the games that I found when I did the research for geology-based games, I think, (name) you and I probably hit the same thread.* *There was a website called legends of learning. They were only 15- to 20-minutes-long according to the description. But there was about eight games that I found in my search that had association with geology, Most of them seemed to be kind of pre-built environments and the player character would kind of dig down through levels and find fossils or bones or whatever and to be able to help identify the layers. So that was my initial kind of thought of how this content is being delivered currently.*	RE
		5	*But the ones that I liked the most. There's one called Dr. Fossil. It was kind of cool, where you're like a paleontologist and a little more focused on fossils and rock formations that you did have to kind of dig for fossils in different layers and the components that were in our learning objectives, but definitely for a lower age, you know, range."*	BOI

Understanding multiple perspectives (94 occurrences in total) contained the criterion coordination of ideas and agreement (CA, n= 62) which means students were able to verbalize agreement to others' contributions and contrast and synthesize ideas. Table 11 is an excerpt of dialogue from Team SEL discussing game design ideas through coordination of ideas and agreement (CA).

Table 11

Excerpt of Team SEL Discussing Game Design Ideas Through Multiple Perspectives

Articulation	Team	Line	Dialogue	Criteria
Understanding Multiple Perspectives	SEL	1	*"I was thinking the same thing and do like the story dialogue text type stuff. Does that make sense?"*	CA
		2	*"Yeah, that does. Would we have, a whole group that we could choose from? Artwork for the building and everything I wouldn't mind doing that either. It just all fits my vision. Okay, yes, I wouldn't mind doing that."*	CA
		3	*"Okay, that sounds good. So I won't look for that then, but certainly let us know if that ends up being too much."*	RC
		4	*"That's cute. Yeah, we could grab this. It would be ready to go out of the box but if I want to, I can make it all a cohesive art style. I'll just take a screenshot of that."*	CA
		5	*"That's great, so we get down to this one question I had thought and I don't know how much we should complicate this … So that really helps with just visualizing what that looks like."*	REI
		6	*"Thank you for sure. Great work. Yeah, honestly, I think that helps with that character's point. I think that's a pretty solid plan and I don't think we should get too overboard with the narrative."*	SI

The sub-category giving and getting feedback (97 occurrences in total) includes criterion building on ideas (BOI, n=36) in which students were able to contribute to an idea

or opinion (INV, n=43) and build on it with multiple perspectives and inviting possibility (IP, n=18) in which students interacted by inviting others to imagine new scenarios or speculate on possibilities (see Appendix J). Table 12 is an excerpt of dialogue from Team SEL discussing a potential game element by inviting contributions and building on ideas.

Table 12

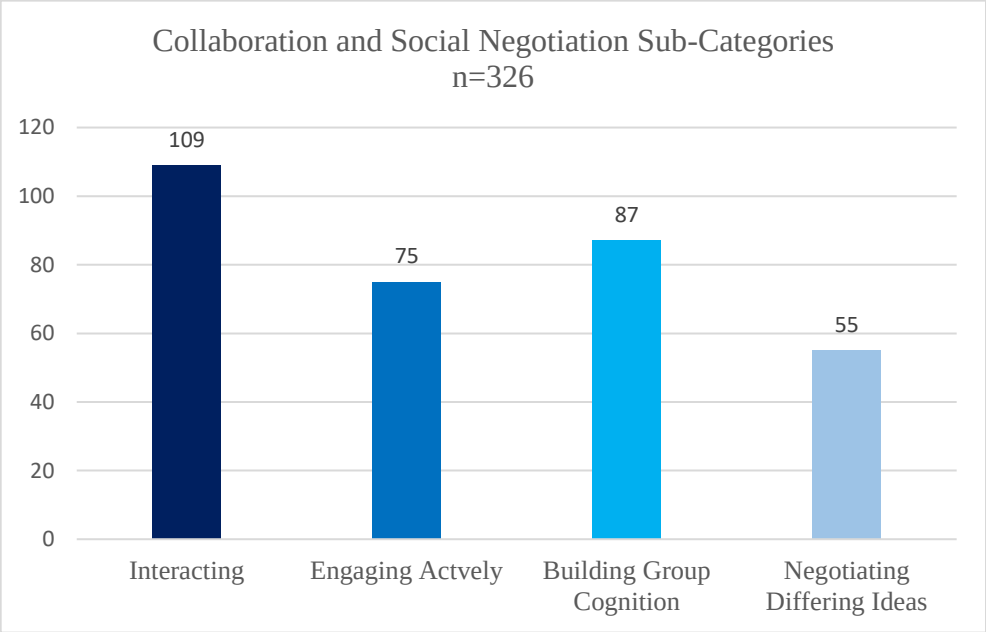
Excerpt of Team SEL Discussing Pet Store Game Concept

Articulation	Team	Line	Dialogue	Criteria
Giving and Getting Feedback	SEL	1	*"Store needs an owner or worker and then they're in front of the door, and they can choose to enter it.* *We're only going to give them so many choices… But once they have a choice then have 2 options that they're given. Do you want to clean the store, or do you want to order pets right away....* *I just kind of envisioned it, starting like that and then you're taken into the world."*	BOI
		2	*"I was even thinking trying to match the pets with the right owner."*	INV
		3	*"One thing is having an avatar that looks like you, and we would have to look into a way for kids to pick, maybe not make an avatar but maybe they could pick from a dozen different ones that they would want to identify with.* *I'm sure that'll be easy enough I think, and this is something else I wanted to mention tonight."*	INV
		4	*"But it's still teaching them new things like teaching about materialism through the Monopoly game that most people know how to play.* *I had one of my students make up a new board where all the properties were changed to countries that were controlled by…. traced the colonies, just like you would in Monopoly, except instead of buying with money…. They seemed to like it and it's a lot faster to explain because they already know how the game works."*	INV EL

Collaboration and Social Negotiation activity (n= 326) incorporates 4 sub-categories that include interacting (33%), engaging actively (23%), building group cognition (27%), and negotiating differing ideas (17%). Interacting (n=109) and building group cognition (n=87) were the top two sub-categories within this IDS activity. This covers all 4 sub-strategies of IDS theory. Collaboration and social negotiation participation included 3 of the 4 sub-categories fairly steady (see Table 13).

Table 13

Number of Occurrences: Collaboration and Social Negotiation



Attached to each sub-category are 11 coded criteria in total. This demonstrates that these criteria tasks were very present while engaged in dialogue, students were able to express (EX, n=47) and connect ideas (CO, n=24), ask for explanation or clarification (IR, n=38), invite problem solving (II, n=31), shift their position (SP, n=11), add substantive new information or a new perspective(EL, n=69), add scaffolding strategies (GD, n=33), as well

as question, doubt or reject a statement(QU, n=8, and CH, n=27) while having the ability to seek group consensus (PR, n=20). Within negotiation differing ideas sub-category (55 occurrences) querying (QU, n=8) was the weakest dialogic criteria within this group (see Appendix J). Table 14 is an excerpt of dialogue from Team GEO discussing the prototype assessment by expressing or inviting ideas and connecting.

Table 14

Excerpt of Team GEO Interacting and Engaging for the Prototype Assessment

Collaboration Negotiation	Team	Line	Dialogue	Criteria
Interacting	GEO	1	*"I had emailed my initial thoughts that first time we did the prototype. I think, specifically asked a question in response to the progression of what needs to happen right here.*	EX
			So is this a true assessment of what we just learned? Because there's a pattern… am I really showing that I know the knowledge?	IR
			Because I'm literally just starting at the bottom and going up like there's no challenge for me to get that wrong."	EX
		2	*"Yeah, I was debating on that because we could just technically move it down and get rid of one. But I did think about that.*	CO
		3	*"(Name) what grade are you teaching right now?*	II
			"I teach fifth grade."	
			"I was wondering. I don't know from your perspective as a current teacher, what you think that's actually assessing, Do you think it's the content actually being given?"	
		4	*"I don't know it's hard. I'm a little too far removed from it at this point, because we've been over this information a lot …my thought is that we need to assume that the lecture does not exist. Then this game could be used as a learning module, so that when they play the mini game, they can then turn around and take that assessment and say, Oh, I learned X."*	EX

The last activity, **Reflection**, (n= 43) consists of 6 total criteria and 3 sub-categories involving reviewing (58%), comparing (26%), and analyzing (16%). Again, it covers all three sub-strategies of IDS theory (see Table 15). Reviewing (n=25) was the main sub-category identified in this activity with minimal activity in comparing (11) and analyzing (7). This means that participants spent more time reflecting on learning (RL, n=16) and referencing back (RB, 9) to previous knowledge and experiences than connecting learning pathways (CO, n=7) and making links beyond what is being learned (RW, n=4).

Table 15

Number of Occurrences: Reflection Sub-Categories

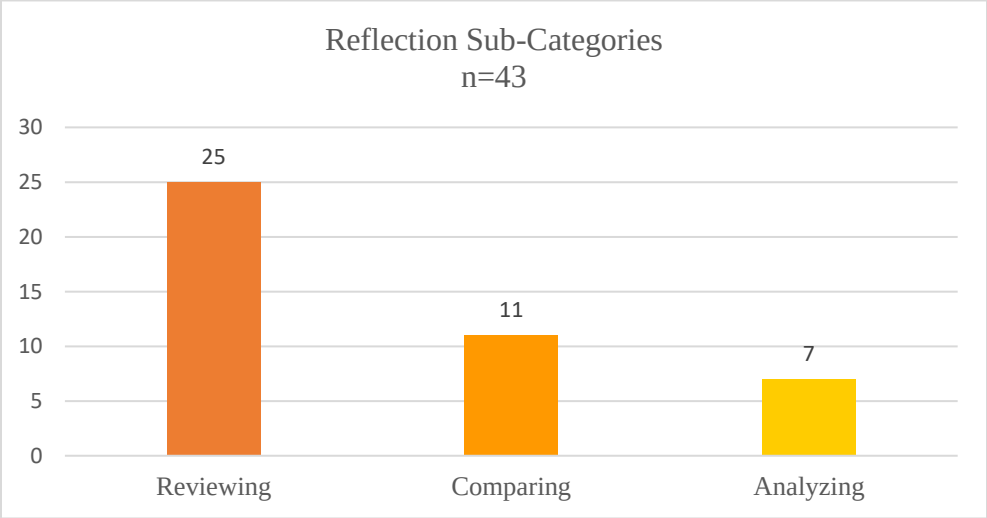


Table 16 is an excerpt of dialogue from Team GEO reflecting on the concepts of games and simulations.

Table 16

Excerpt of Team GEO Reflecting on Learning from the Concept of Games and Simulations

Reflection	Team	Line	Dialogue	Criteria
Reviewing	GEO	1	*"It makes me wonder I imagine there's not a right answer necessarily."*	RL
		2	*"I'm still trying to wrap my head around it, you know, when I think of simulation I think of learning and when I think of the game, I think of I don't want to say not necessarily learning because our games that are fun but when I think of simulation, I think, I'm being taught something."*	RL
		3	*Now the one thing I will say, I'm definitely not so set in that that I'm like you know, this is why I think I could definitely go either way. I could see all games being simulations not all simulations games. I am definitely not saying I disagree or I'm just saying this is my first passive conversation of thinking just out there by myself so nothing set in stone, I went back and forth on every one of them and I'm still not sure of my answers. I haven't posted my blog yet because I'm unsure.*	RL
		4	*"So you could definitely see an argument that maybe not all games are simulations, but also that they are possibly as well."*	RL
		5	*"The other one I did the deep dive on was a circuit lab which I mentioned earlier, I chose simulation for that one.* *I think for me the real distinction that I saw … it didn't really have a goal, it was just kind of here play with these items and develop your skills in whatever way you choose, and that kind of struck me as something like more of a simulation. More than here's a goal and you're getting points like, into the game, it was more just like exploration.* *So I think that's where I thought that one was more solid the simulation."*	RL RB RL

While engaged in dialogue, the Reviewing sub-category (n=25) demonstrated students having the ability to reference back (RB, n=9) to previous knowledge and reflect on the learning process (RL, n=16) criteria as it related to the assignment. However, in these sub-categories there were few occasions where students exhibited Comparing (n=11)

demonstrating linking learned experiences (CO, n=7) or speculating about possibilities to explain a phenomenon (SP, n=4). Lastly, the Analyzing (n=7) sub-category was the weakest link in the dialogue or activity where referencing to a wider context by making links to what was being learned to outside experiences (RW, n=4) and reflecting metacognitively on the process occurred only (RD, n=3), see Appendix G for details.

Table 17 (see below) is a **summary of the top 10 dialogic criteria** for the entire online class across all 5 assignments (see Appendix J). This further dissects each dialogic activity and sub-categories to investigate which dialogic criteria occurred the most. This is important to understand how the learning design (Socratic questioning techniques, exploratory talk and ground rules) with Social VR was able to deliver on each IDS activity and sub-categories within IDS theory, and if so, which sub-categories and criteria were strongest. As Table 17 shows the three leading dialogic criteria in the overall class were

- building group cognition through building on, elaborating and clarifying their own contributions (EL, n=69)
- or adding a new perspective, defining by guiding or focusing (F, n=68) and
- understanding multiple perspectives by contrasting, synthesizing ideas and confirming consensus (CA, n=62).

Reflect on learning (n=16) was the only criteria out of 6 for the reflection dialogic activity that showed up in the top 10 occurrences. Participants activities such as “speculate or predicting” (SP, n=4), “referencing to a wider context” (RW, n=4)”, or “reflect on activity” (RD, n=3) almost did not happened at all. Again, showing that Social VR in this learning design effectively supports articulation, collaboration and social negotiation but is weaker in reflection dialogue, which might be an issue because learning without reflection is a part of

IDS (Dabbagh & Bannan-Ritland, 2005; Dabbagh, Marra & Howland, 2018; Hung, Chee Tan & Chen, 2005; Rojas-Drummand et al., 2013); (see Chapter 5 for further discussion).

Table 17

Summary of Top Ten Dialogic Sub-Categories and Criteria

Dialogic Activity	Sub-Category	Criteria	Occurrences
Collaboration Social Negotiation	Building Group Cognition	Elaboration (EL)	69
Articulation	Defining	Focusing (F)	68
Articulation	Understanding Multiple Perspectives	Coordination of Ideas and Agreement (CA)	62
Collaboration Social Negotiation	Interacting	Express or Invite (EX)	47
Articulation	Defining	Reasoning (RE)	46
Articulation	Giving/Getting Feedback	Invite to Build on Ideas (INV)	43
Collaboration Social Negotiation	Interacting	Invite Reasoning (IR)	38
Articulation	Giving/Getting Feedback	Building on Ideas (BOI)	36
Collaboration Social Negotiation	Engaging Actively	Guide Direction of Dialogue (GD)	33
Reflection	Reviewing	Reflect on Learning (RL)	16

4.5 Comparison of Groups

This section compares the two groups (GEO and SEL) with dialogic criteria codes for each sub-category using the three IDS activities. First, I provide the number of occurrences for all dialogue criteria and sub-categories for each team. Then, I explore the entire dialogic

pattern for all 5 assignments per group. Finally, I break it down between assignments 1-2 (conceptual clarification) and assignments 3-5 (project-based) to understand if the dialogic pattern varies based on the Socratic questioning techniques to framing assignments (which was introduced in Chapter 3 as an essential piece to the instructional design model).

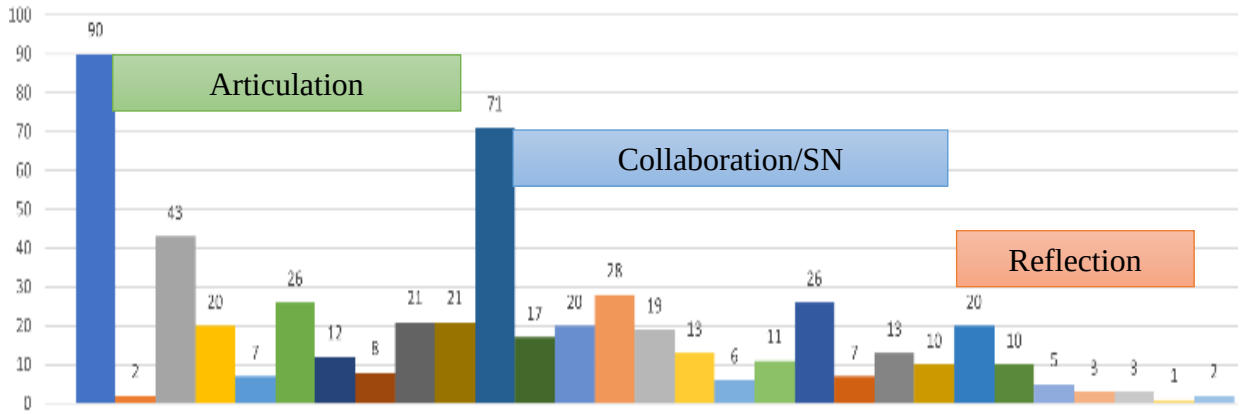
4.5.1 Team GEO

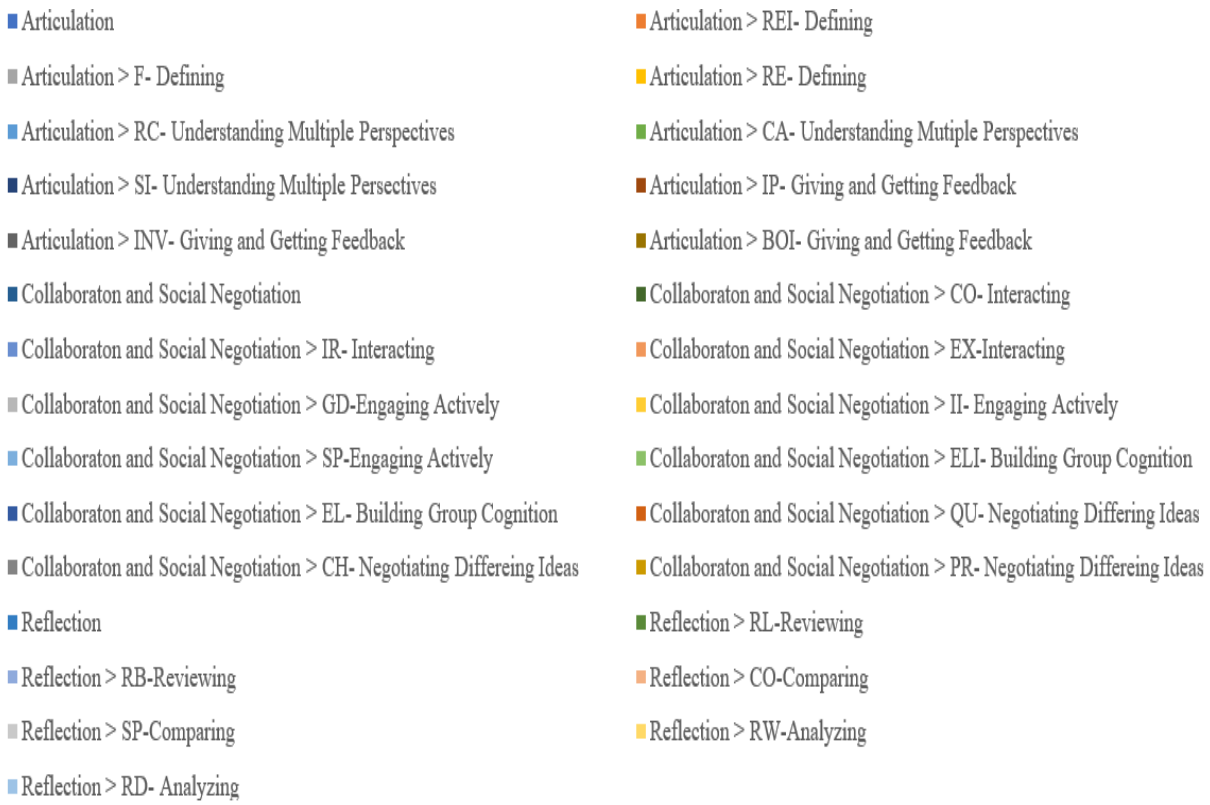
Team GEO had overall 354 criteria occurrences from a total of 680. There were (n=90) articulation, (n=71) social negotiation and (n=20) reflection conversational turns. For the first group, Team GEO, the dialogic sub-strategies and criteria codes for all assignments are presented in Table 18. For the sake of space the legend will not be repeated after each table. The legend is magnified in Appendix H for easier access to reading the tables.

Table 18 shows the number of occurrences for dialogue strategies according to IDS theory listed in Appendix G. For example, Articulation has three sub-strategies and a total of 9 coding items. So, Table 18 shows all 9 coding items and number of occurrences: same for collaboration and reflection strategies.

Table 18

Team GEO Dialogic Sub-Categories and Criteria Codes for All Assignments



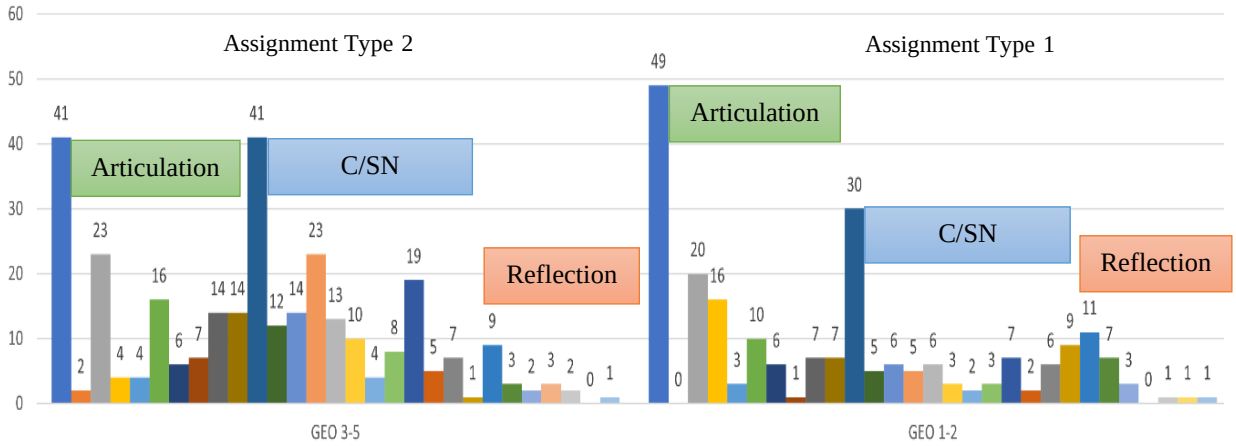


There were substantial criteria occurrences for Team GEO for the articulation IDS activity and was represented by each sub-category: Defining (Focusing, F, n=43, Reasoning, RE, n=20, Understanding Multiple Perspectives (coordination of ideas and agreement, CA, n=26) and Giving and Getting Feedback (building on ideas, BOI, n=21 and invite to build on ideas, INV, n=21). However, reasoning invitations (REI) only had 2 occurrences meaning that students did not really discuss comparing or evaluating two or more contributions in a reasoned fashion. Within the collaboration/social negotiation IDS activity Team GEO had a higher number of occurrences in Express or invite ideas-(EX, n=28), and Elaboration Invitation (EL, n=26). The sub-category negotiating differing ideas occurred less, Querying (QU n=6) however, students did show (n=13) occurrences is challenging or questioning and idea or viewpoint (CH). Reflect on Learning (RL, n=10) was the only main occurrence for the Reflection IDS.

As part of the instructional design dialogue assignment questions were designed around Socratic questioning techniques. All questions were framed using conceptual clarification, questioning viewpoints and perspectives, and probing implications and consequences. Questions 1-2 (assignment type 1) were framed specifically around course theoretical content and questions 3-5 (assignment type 2) were project-based and open-ended. Table 19 shows both assignment types were strong in articulation and social negotiation and deficient in reflection.

Table 19

Team GEO Dialogic Sub-Categories and Criteria Comparison of Assignments



Assignment type one permitted for 75% (n=16) more occurrences for reasoning (RE) than assignment type two (n=4). This justifies assignment type one since students were explaining, justifying and drawing on evidence to defend their positions on the concepts presented. This assignment type also permitted more reflection on the learning (RL) process by over 50% more occurrences (n=7). The interacting sub-category embodied all three criteria (express or invite ideas (EX, n=23), connect (CO, n=12) and invite reasoning (IR, n=14) for assignment type 2 but had between 50% to 75% fewer occurrences for assignment

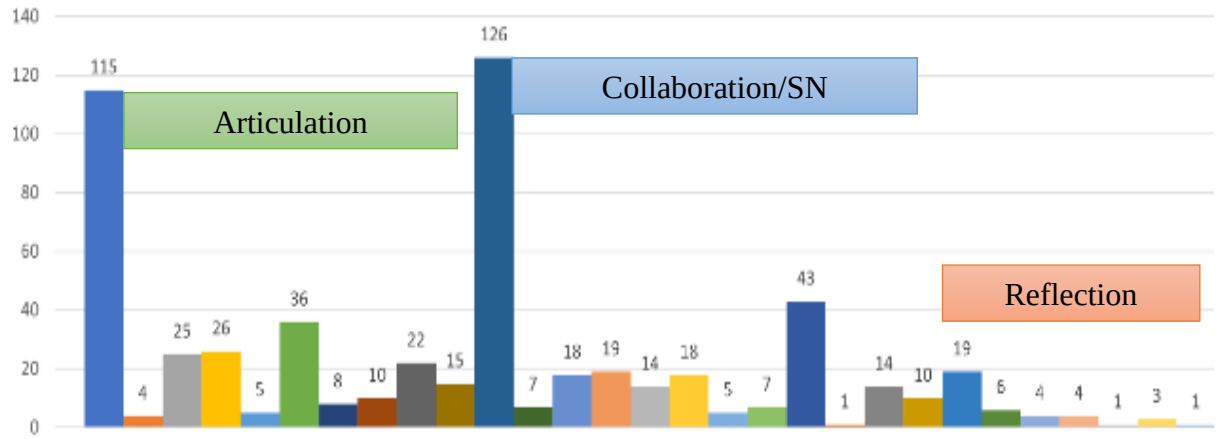
type 1. This reflects that assignment type 1 Socratic questioning technique for contextual clarification was reinforced in the learning design because interacting criteria for expressing ideas and connecting was significantly found in assignment type 2. Assignment type two allowed for a significant increase in expressing or inviting ideas (EX, n=23), elaborating (EL, n=19), coordination of ideas and agreements (CA, n=16), building on ideas (BOI, n=14) and inviting possibilities (IP, n=7) which supports the aspect of a project-based assignment.

Noteworthy criteria shown in Table 19 for the IDS Reflection activity included each sub-category but missed one criterion in each assignment type. Assignment one did not have any occurrences of connecting by making links to knowledge or experiences (CO, n=0). Assignment type two had no occurrences of referencing to a wider context (RW, n=0). Lastly, for both assignment types the Reflection IDS activity was meaningfully expressed through only one of three sub-categories, reviewing, by criteria's reflection on learning (RL) and referencing back (RB).

4.5.2 Team SEL

Table 20

Team SEL Dialogic Sub-Categories and Criteria Codes for All Assignments



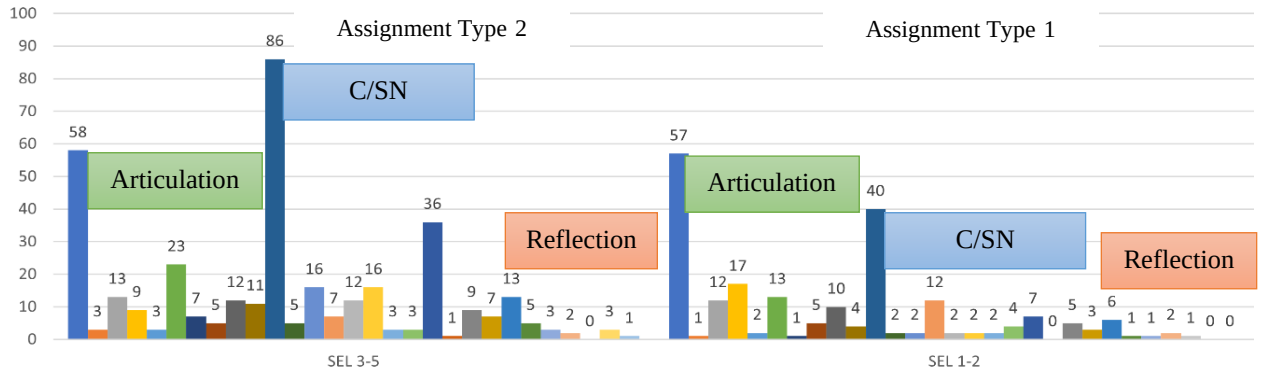
Team SEL had overall 326 criteria occurrences from a total of 680. There were (n=115) articulation, (n=126) social negotiation and (n=19) reflection conversational turns. Team SEL's articulation IDS activity was represented by each sub-category: Defining (focusing and reasoning n=51), Understanding Multiple Perspectives (coordination of ideas and agreement, CA, n=36) and Giving and Getting Feedback (invite to build on ideas, INV, n=22), just as Team GEO was. The top three criteria represented by the three articulation sub-categories were coordination of ideas and agreement (CA, n=36), reasoning (RE, n=26) and focusing (F, n=25).

Collaboration/social negotiation IDS activity sub-category had substantial occurrences in one sub-category, building group cognition the criteria elaboration (EL, n=43), whereas in Team Geo it occurred (n=26). Team SEL had a lengthy conversation around designing in Unity in their game design plan and could be a reason for more elaboration occurrences. The reflection IDS activity was expressed through two of the three sub-categories, reviewing, by criteria's reflection on learning (RL, n=6) and referencing back (RB, n=4) as well as the comparing sub-category, by criteria connecting (CO, n=4), making a pathway of learning explicit by linking to knowledge discussed.

Team SEL's strongest IDS activity was in collaboration/social negotiations (n= 86) in the second assignment group (SEL 3-5) that is project based and open-ended. It was strong in Team GEO (n =41) but almost twice as many occurrences in Team SEL. There were similar patterns found in the articulation and reflection IDS activities. Both assignment types were strong in articulation and social negotiation but insufficient in reflection with similar results in Team GEO (see Table 21).

Table 21

Team SEL Dialogic Sub-Categories and Criteria Comparison of Assignments

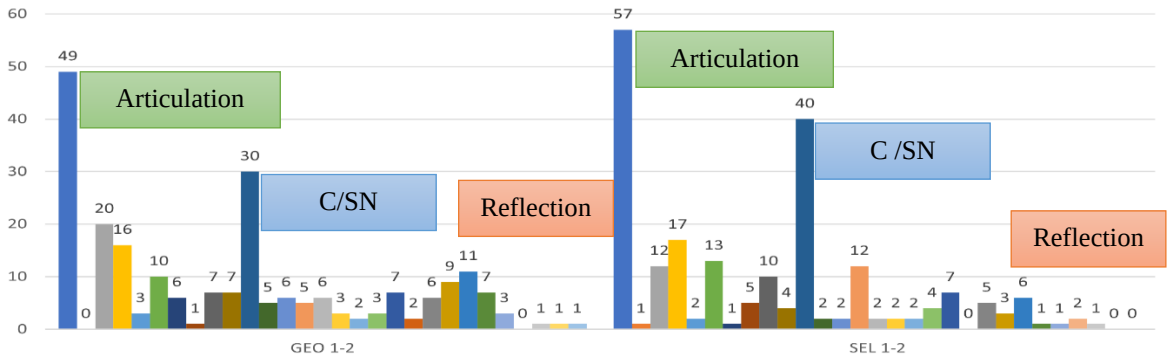


Assignment type two had more criteria present in collaboration and social negotiation (n=86) than in assignment type one(n=40) which confirms the learning design for project-based questions. Project-based assignments led students to dialogue further in asking others to coordinate ideas and agreement (CA, n=23), clarify and invite reason (IR, n=16), guide direction of assignment (GD, n=12) and invite problem posing and feedback (II, n=16). These are all types of dialogue that one would expect with this assignment type.

4.5.3 Team Comparisons for Assignments

Table 22

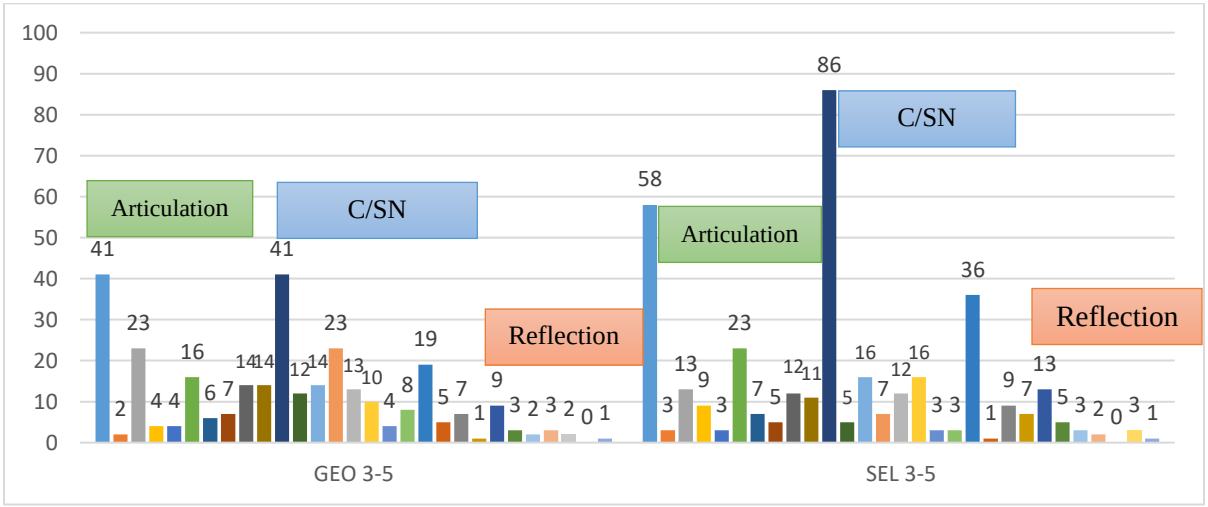
Team Sub-Categories and Criteria Comparison for Assignment Type 1: Conceptual



Both teams had very similar patterns for this assignment group with little substantive differences. Team GEO had more occurrences in guiding (GD, n=6) and focusing (F, n=20) group dialogue, synthesizing ideas (CA, n=6), proposing resolutions (PR, n=9) and reflection on learning (RL, n=7), whereas Team SEL engaged further in expressing and inviting ideas (EX, n=12). Team SEL had more overall occurrences in IDS activities articulation (n=57) and collaboration/social negotiation (n=40), but Team GEO had almost 50% more occurrences (n=11) in the reflection IDS activity. Team GEO met outside of the Social VR assignment and used Zoom and other platforms as an unintended consequence. This may be a reason that they had less dialogue because they had already processed some outside of the actual assignment.

Table 23

Team Sub-Categories and Criteria Comparison for Assignment Type 2: Project-Based



The number of occurrences overall are larger for Team SEL in particular for the collaboration/social negotiation IDS activity (n=86) but reflect the same pattern as Team GEO. Both patterns for this assignment group are similar but a few differences stand out in

the IDS collaboration activity. Team SEL had many more occurrences for elaborating (EL, n=36) than Team GEO (EL, n=19). Team GEO displayed more expressing and inviting ideas (EX, n=23) compared to Team SEL (EX, n=7). Team SEL did not meet as much outside the Social VR assignment group to hold additional discussions as Team GEO did. This could explain why there is more articulation and collaboration in this group.

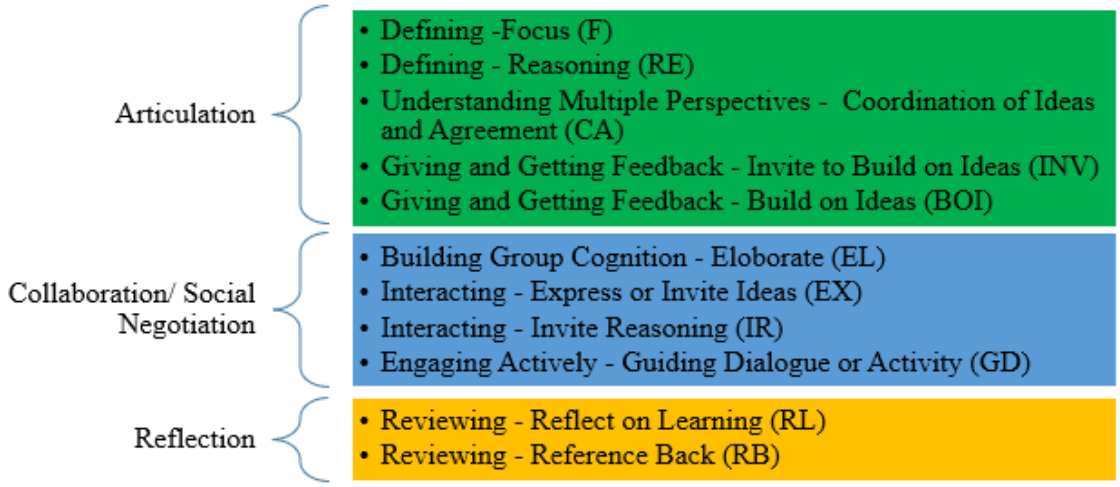
A significant finding is that out of 26 criteria both Team SEL and Team GEO had the same top criteria within each sub-category but by different number of occurrences in all IDS activities except reflection, as it was the same (see Figure 10). Articulation included coordination of ideas (CA, n=36), reasoning (RE, n=26), inviting others to build on ideas (INV, n=25), focusing (F, n=22), and building on ideas (BOI, n=15).

Collaboration IDS activity had some similarities and notable differences. Both teams contained criteria (elaboration-EL, invite reasoning-IR, express or invite ideas-EX, and guiding discussion-GD) but Team SEL had almost twice as many occurrences in elaboration for building group cognition (EL, n=43) than Team GEO (EL, n=26). Team SEL had 63% more occurrences of inquiring invitations to problem pose (II, n=16) than Team GEO (n=10).

The Reflection IDS activity had the same order of criteria and by occurrence for both teams: reflect on learning (RL, n=5) and referencing back (RB, n=4). Only Team SEL contained the comparing sub-category with the connecting criteria (CO, n=4) by linking learning explicitly to contribution, knowledge or experiences discussed. For a multi-level hierarchy (see Appendix K).

Figure 10

Shared Sub-Categories and Criteria Among the 3 IDS Activities



Note: Team SEL and GEO differed in one criterion each for the collaboration and social negotiation sub-category. *Team SEL added (II)- inquiry invitations.*

Two additional appendices were created to further analyze the data by each IDS activity, sub-category and criteria dialogue code for each group. The first visual tool in MAXQDA aids in visualization for each dialogue assignment. The transcript is shown as a picture of all the coded segments based on the order and colors of the codes. The document portrait shows the sequence of codes for each assignment. The color attributes of the codes are displayed in a matrix by squares. The portrait will display the same colors stacked in a bar chart with the most frequent codes starting from left to right. Appendix I illustrates the sequence of codes by frequency for each assignment by Team SEL and GEO (see Appendix I).

In Appendix J, data is examined by both teams individually looking specifically at each IDS activity of articulation, collaboration/social negotiation and reflection by dialogic criteria and then compares each group by IDS activity between Assignments 1-2 and Assignments 3-5 (see Appendix J).

4.6 Discussion Board Summaries

The discussion board summaries (n=30) were posted by each student following each assignment. Students received participation points for completing the assignment including discussion board summaries. All students received full marks on participation – there was no loss of points as the participation was simply that – it was for being present and fulfilling the requirements which each participating student did.

These discussion board summaries asked students to reflect on consensus within the group, did their position shift or stay the same, reasons for the shift or non-shift and any other key insights they wanted to share. The discussion boards were not necessarily reflective but rather a summary or report of 'brass tacks" what happened in the assignment. This finding was also reinforced by the instructor (see 4.9.1, Table 20). From 30 individual discussion board summaries, (n=75 total occurrences) students did convey (n=13) examples of connecting learning and understanding multiple perspectives. There were (n=13) mentioned instances reported on consensus being reached or not reached. Three occurrences resulted in a shift in position and (n=2) indicated that they did not change their mind.

Summary of RQ1

In summary, based on the data presented and analyzed, several key findings emerged. Social VR has shown that it is an effective IDS support for instructional design that provides for quality articulation (n=311), collaboration and social negotiation (n=326) but is insufficient in reflection (n=43) occurrences, even when discussion board reflections were added to the Social VR assignments. A significant finding is that out of 26 criteria both Team SEL and Team GEO had the same top criteria within each sub-category but by different number of occurrences in all IDS activities except reflection, as it was the same (see

Appendix K). Similar patterns emerged for assignment type 1 and 2 for both groups indicating that the learning design using Socratic questioning techniques affects the type of IDS conversation turns and occurrences.

4.7 SUS Usability Score

The System Usability Scale (SUS) is a reliable tool to measure usability developed by John Brooke (1996). A poor score can indicate issues or "pain points" of the system by the user. Based on research (Brooke, 2013), a SUS score of 69 to 80.3 is good to excellent. A score of 68 would be considered average at the 50% percentile and anything below 68 is below average and rated as poor. Scores below 51 are rated as awful and require immediate attention. The students were asked to use this scale to rate the vTime Social VR app. The lowest individual score was 25 and the highest score was 87.5. The SUS score was 54.5 which ranks the vTime system as poor. All students "Strongly Agreed" that the recording and screen capturing functions were very awkward to use in addition with vTime, as it took away from the immersive experience and made it unnecessarily complex. For these reasons after the mid-point check-in the Social VR platform was changed to Mozilla Hubs in which all students had experience in using from a previous course.

4.8 Mid-Point Check-In

The mid-point check-in is a touch point with students to gain information about their experiences and challenges so that adjustments could be made if needed (see Table 24). One student reported having issues with setting up vTime and creating an avatar. Students reported participating in at least two different roles at the mid-point check-in (Team Host and Timekeeper) being the most, with 2 reporting their role as recorder.

All reported using the magic window feature, which is a mobile phone browser,

whereas two students used the VR feature with viewers once and another student used the AR feature projecting the 3D immersive group on a flat surface such as a desk. One student had viewers but opted not to use them. One student tried the Google Daydream Viewer and said, “The immersive view was a much better experience than the magic window but I don’t know how to set the audio settings for other people to hear with my headset.”

Table 24

Challenges and Benefits of Using vTime Social VR

CHALLENGES		STUDENT STATEMENTS
Audio	Sound Quality	“I also found consistent issues with sound quality throughout both sessions that made it more difficult to understand team members when compared to a traditional video meeting like Zoom etc.”
		“Audio has been an issue while using social VR, mostly because various headsets and voice options people use with their phones.
Recording	Uploading from phone storage took several hours	“The main challenge I've found so far is related to the application only being available for my phone (my computer is a Mac). My phone auto-locks after a few minutes of inactivity, so if I don't actively touch the screen I get kicked out of the application and have to re-join.”
	Phone screen slept caused getting kicked off platform	“Also, recording seemed to be very cumbersome at first and we have ended up using Zoom... which in my opinion, doesn't make sense.”
Functionality	Cumbersome	“If we have to use a second application to facilitate the meeting, it just adds to the complexity of something relatively easy.”
BENEFITS		STUDENT STATEMENTS
Novel and Fun	Icebreaker Intuitive Easy to use	“It definitely provides a new and novel experience for learners that breaks up the monotony of discussion boards. The locations and ability to customize your avatar are engaging.”

Cool Space for Collaboration	Fun virtual environments to choose from	"I like the idea of VR better than other synchronous meeting software like Zoom because I'm not worried about my appearance or trying to maintain eye contact with others while talking. I like that I'm not on camera and it makes it more comfortable for me to share because no one is asking me to turn on my camera. The interesting environments also keep me engaged better than just seeing other faces. It is nice that I can look around a cool virtual environment while listening to others. VR removes the most stressful part of synchronous meetings for me."
Bridging the Gap	People who don't like Zoom	"It's good for discussions, to a point. I noticed that one team member seems more comfortable sharing his thoughts in VR. When we zoom, he is much more reserved. If there was a way to share screens to show documents, and to take notes, it would be better. Overall, it's been fun to try!"

4.9 User Recommendation for Factors

The first section explores instructor feedback and factors that foster student dialogue. The second investigates student feedback, experiences and suggestions. Students were labelled as SEL or GEO which represents the Group and the number is the participant number in each Group 1 to 4, e.g., GEO-3 means 'Group GEO, Participant 3'.

4.9.1 Instructor Feedback

After the course, the instructor was sent a questionnaire asking what benefits and challenges were observed using Social VR in their online course and what recommendations does, he/she have for instructors wanting to use Social VR in an online course (see Table 25).

The instructor provided several recommendations for using Social VR in an online course which included a) providing multiple choices of software so students can use what best suits them, b) Making it clear! Extra meetings should not be a part of the process,

anything extra detracts from what they should be doing in a projects-based course, c) discussions should focus on concepts that require dialogue to improve results, not just a reporting of tasks completed, d) follow-up after each Social VR discussion beyond written feedback; some students perceived their discussions as not being used as a fundamental part of the course, and e) create guidelines so that all students have a voice and can share ideas in the group, not just the "more vocal" ones.

Final instructor thoughts included two main recommendations. Recommendation one reports that the instructor liked the inclusion of Social VR in the course and plans on keeping it as a component in lieu of some discussion boards with these caveats:

1. Revisit how to facilitate and incorporate Social VR for meaningful student dialogue as it relates to the objectives and context of the course.
2. Synchronous discussions are not a norm in online programs without the presence of an instructor. Be mindful of how it is incorporated into the course.

Recommendation two suggests that Social VR is not a" plug n play" replacement for discussion boards.

1. Social VR addresses discussion very differently and it can't "really be swapped out in the same way." Assignments should be well thought out for the dialogue outcomes.
2. There will be growing pains in implementing assignments for dialogue to be meaningful.

The course instructor indicated, "In my specific case, the dialogue did help because it was open-ended for them to discuss the concepts in relation to their projects, so they had the lead on that, but there were still some growing pains in getting the dialogue where it needs to be."

Table 25

Social VR Instructor Take Aways

BENEFITS	CHALLENGES	EFFECTIVENESS
Instructional Design • Students worked primarily in their own groups with little input from the instructor, except feedback. • Reflection about updating instructions and details within assignments.	Technical Issues • Recording became an added hardship for students. • Notable difference in how students responded to social VR once platforms were changed. • Reception from students may have been better at beginning if technical issues were not as severe.	Synchronous Meetings • Forced synchronous meetings, rather than all asynchronous work.
Team Dynamics • Ability to "see" teams in action. • Understand team dynamics, nuances and issues to provide effective feedback.	Unintended Outcomes • Students rehearsed meetings. • Held extra meetings outside of required VR time. • Unfocused discussion on record. • How recording was implemented within platform. • Caused workload to focus on what and how to discuss rather than on their game design project.	Gained insights into an online course that normally only occurs if the course was held in-person. • Observe nature of dialogue- Ability to see how groups behaved online. • Hierarchy of Groups Structure.

4.9.2 Student Feedback

Individualized Standard Student Semi-Structured Interviews were conducted using Zoom after all five Social VR assignments were finished. Five students indicated that when

they first started using Social VR in the course they had little to no experience and felt slightly confident and two students were very familiar and felt very confident. At the end of the course, all reported that their confidence level increased.

Five clear characterizations emerged when students were asked how Social VR facilitated team engagement. These included a) developing camaraderie, b) team building, c) fostering live communication, d) increased personal interaction and e) learning the course material together. Here are some examples stated by the students below:

> SEL 2: “We went from strangers essentially in our first meeting, to where we are right now, which is working pretty closely together. The time spent versus just jumping on a Zoom meeting and intended effect is where I could turn towards somebody talking and basically give them my attention like in real life. That’s a pretty subtle but impactful thing.”
>
> SEL 1: “It gave us something to gripe about at first. It was kind of funny. But it was great for brainstorming and effective. We had to slice out the time to do it. I think we would have cut corners a lot more if we hadn’t have used Social VR.”
>
> GEO 1: “I think it led to more personal interaction than a discussion board or email. I think it’s really fun and an innovative way to so a social meeting but I don’t know that it could really replace Zoom.”
>
> GEO 3: “It fostered that live communication for most of us. We're all very busy grad students so we kind of tend to lean away from that live communication because it requires all of us to be in one place at a time and we have conflicting schedules. I think that it really facilitated that personal interaction for us that we wouldn't have necessarily done on our own.”

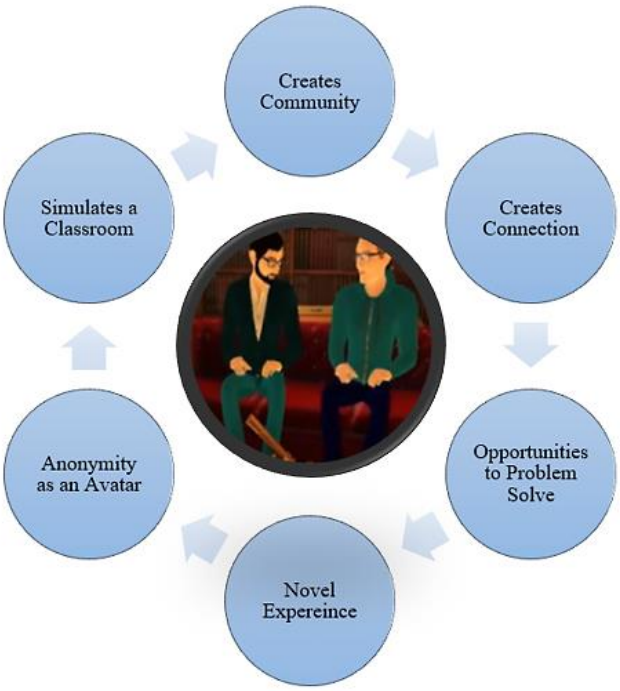
GEO 4: “We had some great conversations and learned some of the course information together. It was like a team building thing, getting to work with people.”

4.9.3 New Experiences Gained

Students expressed that using Social VR in this online course brought them new and different experiences that they would not have encountered if they only used asynchronous tools such as discussion boards and blogs (see Figure 11).

Figure 11

New Experiences Using Social VR



The following statements describe a) creating community and connection, solving problems, c) novelty, d) anonymity and e) classroom simulation.

SEL 2: “It’s a sweet spot of not seeing the actual person or real face but it was still having an authentic experience.”

GEO 1: “I don’t think that I would have the interaction and connection with my classmates and team members, because, you know. There’s something different when in a virtual space than when communicating in discussion boards or email.”

GEO 3: “We have this special platform that brings us together in a different way.”

SEL 1: “He's very quiet, just very. but when we would meet virtually, he was very talkative, and I just thought, wow, that was funny. And so now, when we meet on zoom, he's a little more talkative. But when we do VR, he's a lot more talkative, and I don't quite know why that is. But for him that seemed to make him more comfortable.”

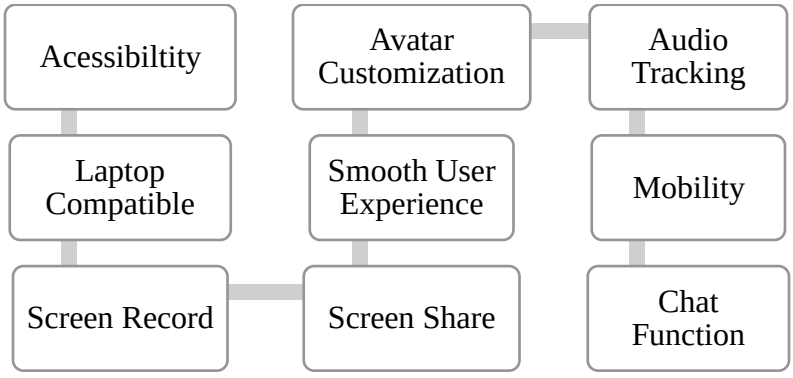
GEO 4: “I’ve never really tried this before and then after using it was in a context that’s like in a classroom. I think I prefer Zoom because I like seeing people’s faces, but it was kind of novel.”

4.9.4 Social VR Affordances

Students listed the following affordances as very important in Social VR when meeting online for successful dialogue assignments (see Figure 12).

Figure 12

Social VR Affordances for Successful Dialogue



The top two affordances were accessibility to platforms that use a browser that is laptop compatible for Mac and Windows. Secondly, must haves include the ability to screen record and upload to the cloud due to storage space and screen share for collaborative workspaces. The following affordances are 'wish list' items that are important but rank as secondary a) smooth user experience, b) avatar creation and customization or picking other characters c) audio tracking for real time effect, d) selection of VR meeting environments, e) avatar mobility in the VR environment and f) chat function. The following statements discusses Social VR affordances:

> GEO 3: "I liked that we were able to use a non-human avatar but I liked the customization as well, so it could really look like me. So I enjoyed both sides of that."
>
> GEO 1: "Mozilla Hubs I like being able to move around in the environment but I can see where that would be a distraction when having a meeting. In vTime we met in outer space and that was really cool. It felt more immersive and I liked having the feature of different virtual rooms."
>
> SEL 1: "I liked the audio tracking. I could turn my head and tell how close I was to a person or if they were to the left or right of me."

4.9.5 VR Headsets

Students were asked if they used VR headsets and if it made a difference in their overall experience. Two students did not use a headset at any time, one student reported having a headset but didn't take the time to use it. Two students did try the headsets once and reported that it really added to the experience through immersion. Here is what they said about their experience and some of the challenges using the headset.

GEO 3 “I used Google Daydream and that made it actually really cool to enter vTime, but nobody could hear me when I put my phone inside the headset and I didn’t know how to make that work. It was very unfortunate, because the headset actually makes it a super fun experience, I can walk around and stuff, and it just moves with me, you know, which is kind of the point, right?”

GEO 1 “I have an Oculus Quest and was excited to use it with vTime but I never did. It would be really, really cool. I didn’t have the time to try it out but it really is a different experience when you use the headset.”

SEL 1: “My kids were like Oh, mom you're so cool. It was a different experience, more immersive.”

4.9.6 Mobile or PC?

Two Social VR platforms were used in this study, vTime and Mozilla Hubs. In the context of this course, students preferred using both the smartphone and laptop while using Social VR. Students replied that it was a personal preference, about 50% liked the mobile phone and 50% would rather have a larger screen and use a PC, although some expressed that it felt more like a video game. Students liked the mobility and the ability to use the magic window and AR (Augmented Reality) function with the phone and felt it was more immersive. Here are some commentaries:

GEO 1: “The mobile phone with the headset compared to the PC would have given me a sense of more immersion, because, I think, at least for myself, when I used Mozilla Hubs on the computer it broke the idea of a virtual space for me. At that point I was just playing a video game, being in a virtual world, whereas on my mobile

device, I felt like there was more immersion because I could pan and tilt and use the AR feature which I couldn't do on the PC."

SEL 1: "I used the magic window a lot but it was cumbersome to use the mobile phone."

GEO 4: "It was kind of nice to have mobile to move around easily and stuff but I did wish the screen was bigger at times and I found myself watching the recording that we were doing instead of watching the actual live thing."

4.9.7 Software Matters

Software definitely matters! The biggest obstacles and challenges started at the beginning of class when vTime removed its recording function a week before we were to begin. An effort was made to rectify it but it caused more frustration and work on the students end. Besides not having a recording function the audio remained choppy and unreliable as mentioned in the Mid-Point check-in. The final obstacle were phones going into sleep mode and students having to keep touching their screens. Other issues with vTime is that random people wanted to enter their chat group (students did not use the block feature). Students overwhelmingly liked using Mozilla Hubs better because it was user friendly, contained a recording function, presented no audio problems, was available on PC and had screen share capability (vTime did as well but it was not used). Despite the obstacles and challenges the students did recall some positive things about each platform:

vTimeXR

GEO 1: "I was excited to try vTime. This was my first time so I was interested in how it worked. It took some time to figure out what was actually possible but it was pretty

intuitive. The audio was frustrating and caused many issues. I'm a trouble shooter and I think it was mostly how people were holding their phones."

GEO 4: "vTime was frustrating and stressful because of the audio and recording issues but it was still cool and kind of novel. It was really awesome to make your own avatar in vTime like a person that was kind of like you, and Mozilla Hubs you have a choice of a character which was fun as well. They both were a different take."

SEL 2: I could see the value in it. It did do a good job of giving the feeling of simulating being in a real meeting with the effects, hand movement and the ability to turn and look at somebody. It visually gave them attention. That was really successful, and I like the different meeting spaces, even the kind of ambient sound effects with the positional audio, all cool things, but so many issues with the audio."

Mozilla Hubs

SEL 2: "This space felt more less like an intimate meeting and more of a feeling like an open gymnasium, it was fun to throw virtual objects up and have this be like an open playroom. I'm a high school teacher and I could see using it with my students, not as a CEO in a boardroom, vTime would work better for that. They are both good in their own way. They both have issues."

GEO 1: "Interaction and interactivity was far superior to vTime, it made it more enjoyable from a Social VR aspect, it seemed to work without hiccups so you can just get to the social aspect of it."

GEO 3: "One thing I really liked about Mozilla Hubs is the ability to share screens within the room, it just pops up with a little screen in front, click on it to maximize it. In vTime you have to go to a specific room to be able to do that."

4.9.8 Maximizing Learning Using Social VR in Online Courses

Table 26 represents students' responses for suggestions they have for instructors and other students who are using Social VR in online courses for maximizing the learning experience. Students also gave input into ways Social VR could be used in the context of an online learning course.

Table 26

Suggestions for Instructors and Students

INSTRUCTORS	STUDENTS	SOCIAL VR USES
• Provide a pre-session to demonstrate the platform in real time with students.	• Willingness to engage and interact.	• Project-based Courses
• Be ready to troubleshoot.	• Approach it with an open mind. "It's only going to be fun if you let it be fun."	• 3-D Model Sharing
• Accessibility- something with live captions would be ideal.	• Having patience and understanding to learn something new.	• Communication tool with anonymity
• Know the context for using Social VR with the course objectives and choose the one that has the needed features.	• Test it out before the first assignment- make sure everything is working so it is not last minute or during the assignment.	• Collaboration
• Clear tutorials for accessing platform, how to get started, step by step guide, features.	• Having an actual headset to use- (teachers could provide them if everyone is local).	
• Caution students not to take it too seriously. Have fun.		

Here are students' insight into suggestions for instructors:

> GEO 4: "Even though tutorials and pre-sessions can be provided, I know often times students won't do it, if you are in a classroom everyone can do it together."
>
> SEL1: "Just make them do it. I know that sounds really weird but it's one of those things where I remember when the iPad came out. I listened to tech shows and everyone was like, who needs one of those? Nobody needs that. I started using it, I do my artwork on it and I couldn't do without it. As a teacher have the forethought to have things planned out, perhaps a scavenger hunt to learn about it, but to get them used to it to kind of shake up the monotony of just discussion boards. In another class a woman I worked with never wanted to Zoom so we just exchanged emails but I wonder if Social VR would have worked for her? Maybe it would have been more comfortable that way like for my teammate and we might have gotten a little more done."

Summary of User Recommendations

Part of the draw for students using Social VR was that it is novel and shook things up from the regular communication tools like discussion boards or email. It allowed students an opportunity to try new technology and problem solve. Furthermore, it created a classroom community where students could engage and connect. GEO 3 said, "I love asynchronous classes but I did find that having the sort of small group in virtual reality really enhanced the discussion in a way that I had not expected."

The frustrations of recording and audio issues early on did not deter them from continuing their assignments. Students reported that they actually enjoyed getting to learn two different platform types and investigate what was available. This is what GEO 1 said,

“I’m sad that we had those kind of issues and problems because it took away from the experience but at the same time, I’m glad that we got to experiment with two different kinds of platforms to see what’s out there and experience them both.”

Both the instructor and students identified detailed recommendations to be proactive in their roles and responsibilities for Social VR to be successful in online courses. These recommendations will provide insight for instructional design and technology choices that will not hinder the overall learning experience.

Chapter 5: Discussion

This chapter includes a discussion of key findings related to Social VR as an effective support for quality dialogue in online courses as well as discussion on recommendations to foster student dialogue within the learning design. The chapter closes with limitations, areas for future research and a brief conclusion. The central research questions (RQ) are:

1. What is the quality of online student dialogue when using Social VR? (Applying the Tech-SEDA Coding Scheme; Appendix G)
2. What are additional factors that foster student dialogue with Social VR in online asynchronous courses?

The main purpose of this qualitative case study was to investigate to what extent Social VR is an *effective support* that promotes synchronous student dialogue in asynchronous online course environments using Instructional Dialogic Strategies, in short IDS. Dabbagh (2005) specifically **defined dialogic pedagogy whereas students are able to demonstrate critical thinking through dialogue with one another.** The three activities necessary for dialogue learning to occur are

- articulation,
- collaboration/social negotiation and
- reflection (Dabbagh & Bannan-Ritland, 2005; Dabbagh, Marra & Howland, 2018; Hung, Chee Tan & Chen, 2005; Rojas-Drummand et al., 2013).

Within these three activities learners construct knowledge through dialogue and social interaction.

Based on this study, Social VR – embedded into this specific learning design as described in Chapter 3 (Methods) – has shown that it is an effective support for student

dialogue. In more detail, this *Social VR learning design* supported two of the three learning activities, which are articulation (n=205) as well as collaboration and social negotiation (n=197). However, it was insufficient in supporting student reflection (n=39), even when discussion board reflections were added to the Social VR assignments. A distinct finding is that out of 26 different criteria in Tech-SEDA both student groups analyzed had the same top criteria in all three IDS activities of articulation, collaboration/social negotiation and reflection (see Chapter 4 and Appendix K). This is important because it shows a similar pattern for both groups indicating that the learning design had an impact on the IDS activities that emerged through the Socratic questioning techniques of framing the assignments (for a multi-level hierarchy see Appendix K).

One of the primary affordances and attractions of Social VR is social presence, the subjective feeling of being present with a "real" person (Biocca, 1997) compared to other forms of virtual-mediated communication platforms such as Zoom. According to Oh et al., (2018) studies have shown that social presence is associated with a variety of positive communication outcomes. Social VR affects student dialogue (learning) due to its technological embedded features that learners immerse themselves in the dialogue while creating a shared social presence. Spatial experiences have positive influences on knowledge development and transfer to real world applications (Choi & Hannafin, 1995). In this study, I incorporated the three main themes that literature supports (Major et al., 2018): a) dialogue activity using IDS, b) technological affordances from Social VR and c) instructional design for knowledge co-construction. Social presence generated from the technology environment and the learning design included regimented Socratic questioning with ground rules from exploratory talk. This combination mutually blended into a very well-defined learning

environment for the student-directed discussions (no instructor involvement) and influenced student dialogue.

Implications for Theory and Research

Chapter Two discussed Social Constructivism and how it is rooted in the Theory of Constructing Dialogic Pedagogy. This section will discuss how these theories were integrated into the learning design for this study and the overall implications for research and practice will be discussed in the following sections.

5.1 Social Constructivism

Dialogic pedagogy has its roots in social constructivism theory in which people construct knowledge through interactions with others (Vygotsky, 1978). Students bring prior knowledge into a learning situation in which they must articulate, critique and re-evaluate their understanding (Vygotsky, 1978). A *dialogic pedagogy* requires instructors and learners to actively engage in dialogue to build on a set of ideas to construct shared knowledge and interpretations (Mercer et al., 2012; Hennessy et al., 2017). *Dialogue* occurs when students are socially collaborating to construct knowledge and engaged in knowledge creation (Moen et al., 2012; Stahl, Koschmann, & Suthers, 2006).

5.1.1 Results for RQ1

The results of this study show that the three leading dialogic criteria in the class were building on, elaborating and clarifying their own contributions or adding a new perspective (EL, n=69), guiding or focusing group dialogue on key aspects of the assignment (F, n=68) and contrasting, synthesizing ideas and confirming consensus (CA, n=62). However, reflect on learning (RL, n=16) was the only criteria out of 6 for the reflection dialogic activity and

clusters with minimal incidences. Students were able to articulate, build group cognition, synthesize ideas and come to a consensus in both teams. Although reflection was not strong, it did exist, whereas they were able to reflect on the learning experience. These code criteria indicate that students socially constructed knowledge, means social constructivism were seen in action, and students were able to critically think as they socially interacted through Social VR to construct knowledge together.

5.1.2 Implications for RQ1

Many researchers have cited social constructivism in dialogic research. These findings align with social constructivism in that students were able to construct new knowledge in small groups in an online course using 'Exploratory Talk' (Mercer & Wegerif, 1997) using all 3 IDS strategies in this learning design. These results provide further support for more research using Social VR and this learning design as well as to study other possible synchronous technology supports for quality dialogue in online classrooms in general. However, the study also shows that student reflection was rather weak. Hence, further research should focus on this activity. Reflection is an integral part of learning and important for learning growth ((Dabbagh & Bannan-Ritland, 2005; Dabbagh et al., 2018; Hung et al., 2005; Rojas-Drummand et al., 2013) and this study raises the new question whether Social VR learning design neglects student reflection.

5.2 The Theory of Constructing Dialogic Pedagogy

From the theory of Constructing Dialogic Pedagogy, the method of instructional dialogic strategies this study uses were developed by Dabbagh and Bannan-Ritland, 2005 and Hung et al., 2005. IDS is a specific strategy for fostering critical thinking and co-knowledge using language through social interaction to gain a better understanding of prior knowledge

through cognitive scaffolding.

Dialogue was defined in this study as students that are able to demonstrate critical thinking and build group knowledge using 'exploratory talk' (Gilbert & Dabbagh, 2005; Mercer & Wegerif, 1997). Researchers have stated that in order for this to occur a) students should be able to relate course content to prior knowledge and experience, b) understand content through articulating, negotiating and reflecting with others, and c) developing conclusions (Dabbagh & Bannan-Ritland, 2005; Dabbagh et al., 2018; Hung et al., 2005; Rojas-Drummand et al., 2013).

5.2.1 Social Presence Implications

Social VR offers a certain degree of social presence that might be influential or affect student dialogue. A number of factors encourage or discourage social presence. Oh et al., (2018) stated that visual representation, level of interactivity, haptic feedback, high audio-quality in addition to physical proximity and task type contribute to the level of social presence an individual can experience. Oh et al., (2018) identified 10 studies comparing social-presence in immersive and non-immersive modalities. Only two of the ten found significant differences in social presence between an immersive platform and a non-immersive one, meaning that either modality will give the user a level of social presence quality.

While Zoom might be different, where students see themselves, Social VR provides anonymity through avatars in which students might be more comfortable using online dialogue. Avatars are the sole interface between the user and their digital identity as well as with others in the shared virtual space. Social VR helps users get to know, interact and develop relationships with others through embodied interactions and experiences in contrast

to textual chat in other social media digital spaces. The presence of a personal avatar can increase interpersonal trust (Freeman & Acena, 2021). Oh et al., (2018) reported that one feature that influences social presence in virtual environments is the visual representation of the other participants and the appearance of that person influences upon one's own sense of social presence. It means that Social VR is able to offer social presence while being "anonymous" or at least students do not feel totally exposed such as in a real meeting using virtual conferencing technology.

> One student said, "He's very quiet, just very, but when we would meet virtually, he was very talkative, and I just thought, wow, that was funny. And so now, when we meet on zoom, he's a little more talkative. But when we do VR, he's a lot more talkative, and I don't quite know why that is. But for him that seemed to make him more comfortable."

Social VR provides a) support for natural spatial communication, b) authentic learning spaces, c) group formation to foster creating individual social presence and group cognitive presence, d) peripheral awareness and e) representation of users and digital information sharing and collaboration within a single display space (Pomerantz, 2018). Social presence was influential on the quality of student dialogue with indirect influences as a result of the built-in affordances of Social VR within the learning design which was not measured in this study. However, students did report that the Social VR environment with the added affordance of social presence had behavioral impact. For instance one student said,

> "We went from strangers essentially in our first meeting, to where we are right now, which is working pretty closely together. The time spent versus just jumping on a Zoom meeting and intended effect is where I could turn towards somebody talking

and basically give them my attention like in real life. That's a pretty subtle but impactful thing."

The Mozilla Hubs Social VR environment allowed avatars to move around the virtual space whereas vTime, they did not have that option except for switching seats. One student commented that vTime was a more intimate meeting environment but Mozilla Hubs gave us the ability to move around and explore. S**ocial distancing** now becomes an option. In one scenario the superhero avatar moved to close to another avatar and the person said, "Whoa, you are a little too close." Most of the time avatars were very spread out and socially distant from each other within this environment. This shows that the virtual environment mimics the real-world physical environment in that people still need appropriate social distance. Unlike Zoom, these affordances that social presence introduces indirectly through Social VR influence dialogue (learning) and coalesce with the Theory of Constructing Dialogic Pedagogy to foster critical thinking and co-knowledge through dialogue.

5.2.2 Results for RQ1

Using IDS in the learning design to support the Constructing Dialogic Pedagogy revealed that all three IDS activities (Articulation n=311, Collaboration/SN n=326, and Reflection n=43) transpired. Furthermore both teams produced similar dialogic patterns: Articulation for Team GEO and SEL included coordination of ideas (n=36), reasoning (n=26), inviting others to build on ideas (n=25), focusing (n=22), and building on ideas (n=15). Collaboration IDS activity had some similarities and notable differences. Both teams contained criteria in Appendix G (elaboration-EL, invite reasoning-IR, express or invite ideas-EX, and guiding discussion-GD) but Team SEL had almost twice as many occurrences in (n=43) elaboration for building group cognition than Team GEO (n=26). I speculate that

this occurred because Team GEO met outside the Social VR assignment time on Zoom to discuss before the assignment as an unintended consequence. Team SEL had (n=16) occurrences of inquiring invitations to problem pose that Team GEO (n=10) did not have as sizeable occurrence in.

5.2.3 Implications for RQ1

This study set out to use a specific IDS learning design with Social VR to explore if quality dialogue could occur without an instructor being present. Social constructivism and the theory of constructing dialogic pedagogy was the basis to create the learning design incorporating IDS. One important implication of this study to begin with, is that this is a novel method for dialogic pedagogy research because students are not in a physical classroom where an instructor is present and facilitating the dialogue but critical thinking and co-knowledge still occurs. Students in an online immersive environment, are actively engaging and interacting within a Social VR environment to construct new knowledge that is peer led by using 'exploratory talk.' Major et al. (2018) asserted, "Affordance, interdependency and dialogue itself are key concepts that frame the social situation in which students build knowledge and meaning with and through digital tools" (p.21). The gap in this research study was exploring quality dialogue among student groups in online courses using a synchronous support like Social VR without an instructor guiding the dialogue in which studies have not been located.

5.3 Empirical Research Implications

In reviewing previous research, I have found that there is not a clearly defined measure or Scheme used for 'quality' dialogue but rather definitions of what quality should look like without a standard measurement tool. For instance, how many occurrences in a

criterion determines quality? To determine quality, the codes themselves have a specific quality that have meaning based on dialogic pedagogy. These codes have been validated in previous qualitative studies (Hennessey et al., 2020).

Previous research says that dialogic learning is based on these three activities of articulation, collaboration/social negotiation and reflection but there is not yet a standard measurable tool available to indicate dialogue quality and one step further, in an asynchronous online course environment.

Hence, I applied the Scheme for Dialogue Analysis (SEDA) – originally meant for synchronous dialogue with an educator present – as a framework for identifying key features of synchronous dialogue with peers only and with no educator at presence. Traditionally, the Tech-SEDA scheme refers to ‘classroom dialogue’ as a productive form between student-teacher and peer group discussions that ‘stimulate students’ critical thinking to cultivate learners' knowledge making. The scheme uses Hymes Ethnography of Communication to establish levels of analysis from conversational turns (Hymes, 1972; Saville-Troike, 2003 as cited by Hennessey et al., 2015). As shown in the Method chapter, the scheme is adaptable and contains 8 clusters (sub-categories) and 33 criteria. Micro-level coding allows for systematic analysis that capture detailed dialogue through interaction. The Tech-SEDA defines quality by number of code occurrences and conversational turns based on context of the student dialogue. Conversational turns were coded from IDS activities and identified clusters. Conversational turns between student and instructor were not counted because of the nature of peer-led dialogue in this study. Hennessey et al., (2016) assert that despite the growth and advances in dialogic pedagogy there is a lack of instruments to measure and assess levels of dialogic interactions. SEDA provides such an instrument.

5.3.1 RQ1 Results

Using Tech-SEDA implies that quality dialogue using Social VR can be assessed by 26 micro-level criteria based on Tech-SEDA code occurrences and group pattern results. There were 1,237 total coded tags using Tech-SEDA in this study. I adapted this scheme to include the three IDS activities (macro-level), removing seven criteria that was instructor focused. I organized the scheme criteria (communicative acts; micro-level) under each IDS activity type and sub-categories (1.3, Figure) to determine quality dialogue. Tech-SEDA codes are quality indicators to determine quality IDS activities. Table 27 provides examples and definitions of quality codes for Articulation, Collaboration/ Social Negotiation and Reflection using Tech-SEDA.

Table 27

Tech-SEDA Code Quality Examples

IDS Activity	**Articulation**	**Collaboration/ Social Negotiation**	**Reflection**
Sub-Category within IDS Activity	Giving and Getting Feedback	Negotiating Differing Ideas	Analyzing
Code	Build on Ideas (BOI)	Challenging (CH)	Reflect on Dialogue (RD)
Definition	Applies when the same person makes a new comment/ response based on their previous comment or elaborates their own previous question.	Questioning, disagreeing with, or challenging an idea or viewpoint.	Evaluate or reflect "metacognitive" on processes of dialogue or learning activity.

IDS Activity	**Articulation**	**Collaboration/ Social Negotiation**	**Reflection**
Examples of Dialogue	"I feel like it wouldn't be ideal for tiny random fossils throughout the level to have a purpose." "But I think that should be like our lowest priority." "All the tools and systems are in place. We just have to expand it to where we want it to be."	"I think my only hesitation or concern is …. just based on some of the comments" "I'm just throwing it out and playing the devil's advocate."	"It's like building a house. You want to make sure you have four walls and a roof, and then you can add more. That's just my relatively limited experience. It's much, much easier to add to a small prototype with minimal mechanics than it is to go the other direction."

5.3.2 Implications for RQ1

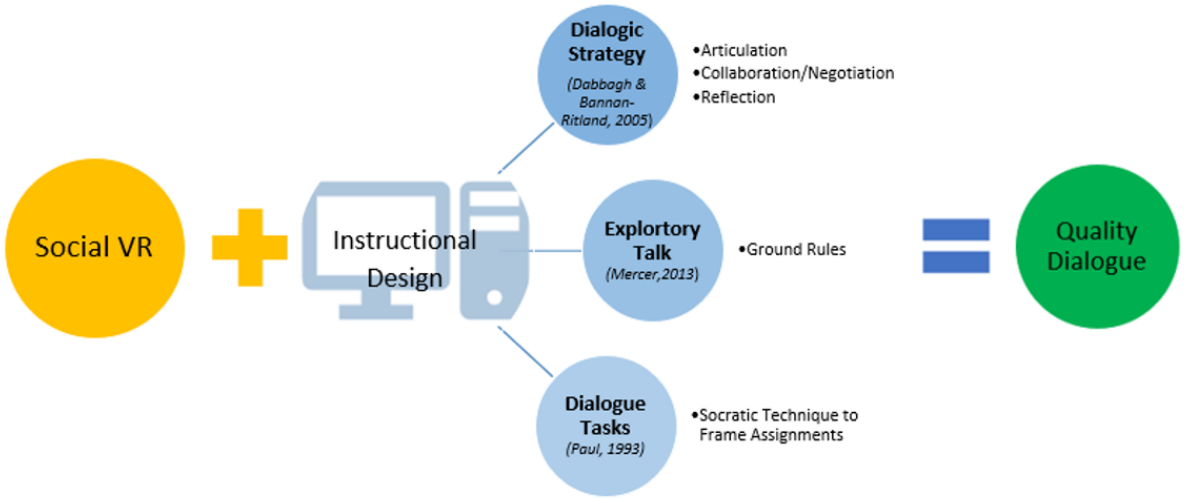
An important contribution from this study for other interested researchers is showing that Tech-SEDA can be used to study dialogic pedagogy in online asynchronous learning designs without an instructor present for synchronous dialogue assignments. It can be used outside a physical classroom without an instructor leading or facilitating dialogue in which this scheme has mostly been used for in previous research.

5.4 Practical Implications for RQ2

Research (Johnson & Mercer, 2019; Rojas-Drummond et al., 2010) has indicated that dialogic pedagogy supports student "critical thinking and reasoning skills and self-regulated learning and yields evidence of subject learning gains" (Hennessy et al., 2017, p. 147) which was the basis for this learning design (see Figure 13).

Figure 13

Learning Design



Note: Social VR is the technology that provides effective support together with the components of IDS (instructional design) including ground rules and the Socratic questioning technique to measure Quality Dialogue using the Tech-SEDA Coding Scheme.

The Social VR learning design consisted of three critical components addressing self-regulated learning and group knowledge making through peer dialogue assignments in an asynchronous online course. The first element was IDS which allowed for critical thinking through reasoning skills and building group cognition through peer led dialogue. Roles were crucial for students using Social VR (Host, Recorder, and Timekeeper) to stay on task and complete the assignment. The second factor included 'Exploratory Talk' (Mercer, 1996; Mercer & Wegerif, 1997) which is a type of dialogue that encourages students to critically listen and engage constructively to build on each other's ideas. They were the first authors to define a specific talk valuable for learning in small groups in the context of the mathematics classroom and coin the term 'exploratory talk' (Mercer, 1996; Mercer & Wegerif, 1997). The

purpose of this type of interaction is to reach an agreement or consensus in which students explore possibilities. Ideas are exchanged and built on to gain group cognition and to solve problems. Exploratory Talk is a great dialogue type for project-based learning because it provides an intentional goal for exploring different ways of thinking and understanding to create new knowledge. The dialogue talk type is an important factor when determining course context and objectives as an instructor. This study used a pre-existing online course that was project-based. Mercer and Wegerif (1997) convey that ground rules must be included with Exploratory Talk to direct collaborative interaction. Several include listening respectfully, committing to learning and not debating and allowing everyone a chance to speak. This learning design had the same set of ground rules (see Chapter Three, 3.4.2, Table 1) that students followed for each assignment. The third component applied Socratic questioning techniques (Paul,1993) which promoted critical thinking.

5.4.1 Results for RQ2

Results showed that question types using Socratic questioning techniques allowed IDS dialogic activities and criteria (26 codes provided by SEDA) to emerge based on how the question was framed. Articulation and collaboration/social negotiation were strong and emerged as a pattern in both groups as well as reflection being insufficient. For instance, a conceptual clarification question about a theory or method will result in dialogue that contains more articulation and reasoning, understanding multiple perspectives and reflection on learning. Questions that are open-ended, project-based on best practices and theory will result in more collaboration/social negotiation, building group cognition and less on reflecting on the process of learning unless this IDS activity is effectively built into the assignment.

The discussion board exercise after each assignment gave students a second opportunity for reflection activity but ended up being a review of what was covered in their assignment than a true learning reflection. There were brief code occurrences reported for position shifting because it was exclusively asked about in the summary assignment. The lack luster result reflects prior research that finds discussion boards as ineffective dialogue tools (AlJeraisy et al., 2015; Hew et al., 2010; Fung, 2004; Khine et al., 2003; Rourke and Kanuka, 2007).

5.4.2 Implications for RQ2

Following this learning design model promotes quality dialogue with Social VR as an effective support if all the components are included and adhered to. Specific components to pay attention to are framing dialogue assignments using Socratic questioning techniques.

This learning design was weak in producing reflection criteria. In the assignments, students were asked to reflect as a group and discuss if their position had shifted or not. Instructions were given but not detailed. I contend that if the reflection activity had been designed clearer and rigorously by framing within the assignment more criteria would have surfaced similar to articulation and collaboration/social negotiation. In future research, it would be interesting to see if including more explicit reflection assignments in the learning design would render more reflection criteria to see if my assumption of the learning design is correct.

5.4.3 Practical User Recommendations for RQ2

Practical user recommendations for instructors are provided for how this research could be applied in the real world are described below. These four themes emerged from instructor and student data and are also in alignment with previous research:

Usability and Skill Level by the instructor and the student play a role in determining overall course satisfaction and quality of dialogue. As students moved through the course their confidence level increased as they were willing to try new features within the Social VR software system. Despite providing tutorials and a pre-training session by Zoom, students did not take the time to explore vTimeXR before they first used it. They did not test it out before the first assignment. Providing graded pre-assignments or scavenger hunts to help them onboard with a new technology would help ensure that they were able to use the software features needed to complete the course assignments leading to less user frustration. Going beyond students creating their avatar and posting it with an introduction in the discussion board is recommended. Features such as screen sharing and setting meetings to private were not utilized until Mozilla Hubs was used in which students had previous experience.

VR software should be chosen wisely to meet course objectives through the assignments students are asked to produce. In this study it was imperative that students could screen record and share screens for their project-based work. vTimeXR removed the recording feature which caused undue stress and frustration for both the instructor and students. Giving students the freedom to choose the software that will work best for their needs will aid them in being more present for course assignments and dialogue rather than searching for a needed feature.

Avatars provide a sense of anonymity that allows for expression and interaction that might not occur if using a video conferencing tool such as Zoom. Students did not have to worry about their physical environment being shown on screen or even how they appeared when they engaged with Social VR. Students who are inclined not to engage and interact as much in a video conferencing setting enjoy the anonymity of being represented by an avatar.

Students liked having both options of customizing an avatar or choosing a pre-designed character.

Social VR provides a sense of community through active engagement and interaction thus creating an authentic learning space and community of inquiry. Instructors can choose to participate synchronously with students in Social VR assignments to facilitate dialogue similarly to the physical classroom or choose to create a method to provide frequent and needed feedback after each peer-based assignment. Students stated that they would not have put as much work or effort into dialoguing with fellow team members if using traditional modes of communication like email, discussion boards or chat. Social VR provided an alternative authentic classroom format and community of inquiry where students could think critically, invite possibility, problem solve and construct shared knowledge.

This study echoes other research results in which technological affordances were identified in 11 studies that found digital technologies provided both a tool and environment to create a shared collaborative dialogic space (e.g., Major et al., (2018); Ravenscroft et al., (2007); Rojas-Drummond et al., (2013); Stahl et al., (2006). Learning environments connecting dialogue and digital technologies were divided into five sub themes across studies. These included: a) digital technology and pedagogy can increase student ownership and responsibility for their own learning, b) promote learner inclusion and participation, c) create a sense of community and a positive learning environment, d) develop positive interpersonal relationships and e) increase learner motivation and engagement (Stahl et al., 2014 as cited in Major et al., 2018).

Future Research

This study suggests recommendations for academic research to investigate further.

5.5 Future Work (Academic Recommendations)

Online courses in different disciplines with larger sample sizes would provide further data on how students experience Social VR within an instructional dialogic strategy and can identify if there are differences or similarities in dialogic activities with previous research. Furthermore, framing questions that target specific dialogic activities such as reflection could further provide data on the quality of dialogue for IDS and dialogic pedagogy using Social VR. Courses that provide students with the proper VR headsets for the software that is being used will give students a more immersive experience as reported from those students who experimented.

Finally, but most importantly, future research efforts can be directed towards studying how to measure quality dialogue and developing methods in synchronous discussions without the presence of an instructor. This is new and exciting because most dialogic studies are conducted in the classroom with teacher and student interaction. The teacher plays a significant role in guiding the dialogue and cognitive learning process. Whereas in this research design, it is peer led using ‘exploratory talk’ to influence building group cognition with no teacher present.

Limitations

5.6 Study Design Challenges

This study focused on asynchronous online learning in one course. The small number of participants (n=7) were limited to those who enrolled in this advanced online graduate course because there was a pre-requisite. Hence, in future research, this learning design with Social VR, partly revised as suggested in this study, can be conducted again with another student population with the goal of checking if similar or different results would occur.

The ultimate challenge in this study was designing an instructional design model with the technology tool (Social VR) as an *effective support* to have successful, quality student dialogue without the instructor being present. This study did not measure directly for social presence but this affordance probably had an indirect impact combined with the rest of the learning design conditions. Two instruments that I used in my study were the Tech-SEDA and SUS Scale which are both reliable and valid (Brooke, 2013; Hennessey et al., 2020).

The Tech-SEDA is a priori coding scheme that allowed me to code both groups in a consistent manner as I was able to provide examples for each code to produce intracoder reliability. I went to Cambridge, England and met with the faculty who developed SEDA and participated in training on using the scheme. A detailed user manual for coding was followed that their team developed with the framework, definitions and examples for each code, and templates for observing and coding. It has been used by over 360 practitioners beyond the team in a range of schools and higher education institutions in different countries, across age groups and subject areas. Hennessey et al. (2020) conducted an Inter-coder reliability test with the range of Cohen's kappa for moves being 0.58-0.80 (mean 0.68). I developed open codes outside of the scheme that addressed issues with the implementation of the Social VR software such as audio and recording issues. I sent the Tech-SEDA coding scheme for this study to Dr. Sara Hennessey in December 2022 for peer review (Harding, 2013) with my coded examples in which she requested samples to be used in an upcoming journal article submission.

5.7 Implementation Challenges

Using a synchronous tool like Social VR for small group dialogue can be challenging when students live in a variety of time zones. This may affect student perceptions on using

Social VR but in this study, students were rather curious and excited about it. It is not the norm in asynchronous online courses to have synchronous assignments where the instructor is not present. Students could participate with or without headsets with the software that was chosen and were encouraged to use VR headsets. This study did not provide VR headsets to students but rather relied on students to use their own VR headsets if they owned them. Students were given a $50.00 study participation stipend at the end of the course to apply towards the purchase of a VR headset. None of the students purchased a headset during the course, not even Google Cardboard which is an inexpensive model which costs around $15.00. Two students owned headsets and one student borrowed a headset from the instructor. Interestingly enough, one student did not bother trying to use the headset during the class due to time constraints as he/she stated but admitted that it would have been a more immersive experience. Thus, only two students experienced a truly immersive environment. Those students reported that it was a different experience because of the immersion and that they wished everyone could have tried it out.

Navigating and learning a new digital tool, long download time and screen freezing can be frustrating to users and impact their overall opinion of the digital tool and the quality and content of the dialogue. Additionally, access to Wi-Fi and broadband speed can be an issue when using a mobile app or desktop to access the virtual environment. The quality of audio and phone functions can be limited. In vTimeXR there were extreme audio issues that caused issues of hearing and recording quality for group assignments. For example, a mobile phone timing out and kicking a student off the platform causing them to sign back in was distressing and interrupted the flow of the dialogue, especially if they were responsible for the teams recording. This was supported in the data including the SUS Usability Scale results

which ranked the vTimeXR app as poor and established Mozilla Hubs as the Social VR platform they preferred using.

The Social VR app, vTimeXR, dropped the recording feature a week before the course started. This triggered additional steps in planning and providing instruction to students for recording and uploading assignments through other screen capturing alternatives. This caused students to put in more effort and concentration to record rather than on the dialogue assignment. One team decided to have additional discussions outside of the assignment with Zoom that was an unintended result meaning less time spent with an authentic dialogue during the assignment. This may have inadvertently caused some dialogue not to occur because it already had before the assignment, thus having coding results 50% or more with the same criteria for the other team.

It was decided to change to the Mozilla Hubs platform which was browser based and easier to record and upload. Students did not drop out of the study despite these limitations, but it remains a possibility in future research due to technical problems or frustration for students learning how the software application works.

Ground Rules were followed during assignments but turn taking could have been promoted more using course announcements and reminders to allow for more dialogue from quieter or less vocal students although this was not a major factor in this study. Social VR did play a role in allowing quieter students to be more vocal and contribute more than when Zoom or another tool was used reported by other students.

Conclusion

The results from this research study contributes to new knowledge about dialogic pedagogy and to what extent Social VR with its proposed learning design contribute to

quality student dialogue in synchronous assignments without the presence of an instructor. Typical online courses are asynchronous in nature and by using a synchronous tool such as Social VR we have learned that it is an *effective support* for this learning design using Instructional Dialogic Strategies (IDS) to promote quality dialogue. Social VR within this learning design lends itself for students to articulate (n=205) and collaborate/social negotiate (n=197) but lacks considerably in opportunities for reflection (n=39) mainly because there was not a strong enough focus within the current learning design.

Instructors should be very mindful in how Social VR is incorporated into the course. The learning design in this study includes IDS activities incorporating exploratory talk, ground rules and Socratic questioning techniques to frame the assignment. Assignments should be well thought out for dialogue outcomes. As results have shown, this ultimately guides the type of dialogue that occurs. For instance, if the IDS assignment is asking for defining a concept, justifying a conclusion and querying or challenging a viewpoint, then the question should be framed using Socratic questioning techniques that will highlight those criteria to provide quality dialogue around that specific IDS activity. This is important because the instructor does not have the ability to guide the conversation, keep things from getting sidetracked or make corrections to a misleading claim within a peer led exploratory talk model. The instructor can make use of engaging and interacting through effective feedback measures such as deliberate commentary using a rubric. Reflection can be utilized with Social VR but will need to be meticulously built into the learning design.

Finally, the context of the course, objectives and learner characteristics help dictate if Social VR is the synchronous technical tool to be considered as an effective support to promote IDS within an asynchronous online course. Social VR is still novel in education and

it does break up the monotony for students who are used to discussion boards and conference software such as Zoom. Social VR does give students who prefer anonymity a chance to actively engage and interact with other students. However, not allowing students enough time with pre-assignments and tutorials to get accustomed to using new software and features for assignments can cause undue frustration and unintended focus on the technology instead of the learning activity. Social VR does not necessarily replace discussion boards or other collaborative tools but can be used as an additional tool to effectively and synchronously support a learning design to promote quality dialogue (articulation, collaboration/social negotiation but not reflection) through social presence in an immersive environment. It offers its own set of affordances that should be considered. In conclusion, if an instructor is looking for an alternative way to engage students and social presence in online asynchronous courses to build group cognitive skills through IDS, then Social VR is an effective support (synchronous) within this learning design as a model that can help achieve quality dialogue – however, reflective learning with Social VR settings needs to be designed in a different way and needs further studies.

References

Abidi, M., El-Tamimi, A., & Al-Ahmari, A. (2012). Virtual reality: Next generation tool for distance education. *International Journal of Advanced Science and Engineering Technology*, *2*(2), 95-100.

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayanan, V. (2017). NMC horizon report: 2017 higher education edition. *Austin, Texas: The New Media Consortium*. Retrieved from: http://academedia.org/2017_NMC_horizon.pdf

Allen, I. E., & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States*. Sloan Consortium. Newburyport, MA.

AlJeraisy, M. N., Mohammad, H., Fayyoumi, A., & Alrashideh, W. (2015). Web 2.0 in education: The impact of discussion board on student performance and satisfaction. *Turkish Online Journal of Educational Technology-TOJET*, *14*(2), 247-258.

An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers & Education*, *53*(3), 749-760.

Andresen, M. A. (2009). Asynchronous discussion forums: Success factors, outcomes, assessments, and limitations. *Educational Technology & Society*, *12*(1), 249–257.

Annetta, L., Lamb, R., Minogue, J., Folta, E., Holmes, S., Vallett, D., & Cheng, R. (2014). Safe science classrooms: Teacher training through serious educational games. *Information Sciences*, *264*, 61-74.

Arbaugh, J. B., Cleveland-Innes, M., Diaz, S. R., Garrison, D. R., Ice, P., Richardson, J. C.,

& Swan, K. P. (2008). Developing a community of inquiry instrument: Testing a measure of the community of inquiry framework using a multi-institutional sample. *The internet and higher education*, *11*(3-4), 133-136.

Askell-Williams, H., & Lawson, M. J. (2005). Students' knowledge about the value of discussions for teaching and learning. *Social Psychology of Education*, *8*(1), 83-115.

Aukstakalnis, S. (2016). *Practical Augmented Reality: A guide to the technologies, applications, and human factors for AR and VR*. Addison-Wesley Professional.

Bakhtin, M. M. (1994). The Bakhtin reader: selected writings of Bakhtin, Medvedev, and Voloshinov.

Barker, V. E. (2016). Flow in virtual worlds: The interplay of community and site features as predictors of involvement. *Journal for Virtual Worlds Research*, *9*(3).

Biocca, F., Harms, C., & Burgoon, J. K. (2003). Toward a more robust theory and measure of social presence: Review and suggested criteria. *Presence: Teleoperators & virtual environments*, *12*(5), 456-480.

Bird, L. (2007). The 3 'C' design model for networked collaborative e-learning: a tool for novice designers. *Innovations in Education and Teaching International*, *44*(2), 153-167.

Bleakley, A. E. (2020). Towards an Interaction Design Framework for Conversation Roles in VR. *Mensch und Computer 2020-Workshopband*.

Bliss, C. A., & Lawrence, B. (2009). From posts to patterns: A metric to characterize discussion board activity in online courses. *Journal of Asynchronous Learning Networks*, *13*(2), 15-32.

Bures, E., Abrami, P., & Barclay, A. (2010, October). Assessing online dialogue in higher

education. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 438-448). Association for the Advancement of Computing in Education (AACE).

Bound, H. (2010). Developing quality online dialogue: Dialogical Inquiry. *International Journal of Teaching and Learning in Higher Education*, *22*(2), 107-124.

Bronack, S., Sanders, R., Cheney, A., Riedl, R., Tashner, J., & Matzen, N. (2008). Presence pedagogy: Teaching and learning in a 3D virtual immersive world. *International journal of teaching and learning in higher education*, *20*(1), 59-69.

Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability evaluation in industry*, *189*(194), 4-7.

Brooke, J. (2013). SUS: a retrospective. *Journal of usability studies*, *8*(2), 29-40.

Brown, A. H., & Green, T. D. (2019). *The essentials of instructional design: Connecting fundamental principles with process and practice*. Routledge.

Caspi, A., & Blau, I. (2008). Social presence in online discussion groups: Testing three conceptions and their relations to perceived learning. *Social Psychology of Education*, *11*(3), 323-346.

Caspi, A., & Gorsky, P. (2006). Instructional dialogue: Distance education students' dialogic behaviour. *Studies in Higher Education*, *31*(6), 735-752.

Castaneda, L., & Pacampara, M. (2016, March). Virtual reality in the classroom-An exploration of hardware, management, content and pedagogy. In *Society for Information Technology & Teacher Education International Conference* (pp. 527-534). Association for the Advancement of Computing in Education (AACE).

Castronovo, F., Nikolic, D., Ventura, S. M., Shroff, V., Nguyen, A., Dinh, N. H., ... &

Gaedicke, C. (2019, June). Design and development of a virtual reality educational game for architectural and construction reviews. In *2019 ASEE Annual Conference & Exposition*.

Chadha, A., & Van Vechten, R. B. (2017). Learning from each other: Dialogical Argumentation in an Online Environment. *International Journal of Learning, Teaching and Educational Research*, *16*(8), 1-17.

Cho, M. H., & Kim, B. J. (2013). Students' self-regulation for interaction with others in online learning environments. *The Internet and Higher Education*, *17*, 69-75.

Cho, M.-H., & Summers, J. (2012). Factor validity of the motivated strategies for learning questionnaire (MSLQ) in asynchronous online learning environments (AOLE). Journal of Interactive Learning Research, 23(1), 5–28.

Cho, M. H., & Tobias, S. (2016). Should instructors require discussion in online courses? Effects of online discussion on community of inquiry, learner time, satisfaction, and achievement. *The international review of research in open and distributed learning*, *17*(2).

Choi, J. I., & Hannafin, M. (1995). Situated cognition and learning environments: Roles, structures, and implications for design. *Educational technology research and development*, *43*(2), 53-69.

Cipresso, P., Giglioli, I. A. C., Raya, M. A., & Riva, G. (2018). The past, present, and future of virtual and augmented reality research: a network and cluster analysis of the literature. *Frontiers in psychology*, *9*, 2086.

Clark, R. E. (1994a). Media Will Never Influence Learning. Educational Technology Research and Development, 42, 21-29. http://dx.doi.org/10.1007/BF02299088

Clark, D. B., & Sampson, V. (2008). Assessing dialogic argumentation in online environments to relate structure, grounds, and conceptual quality. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 45*(3), 293-321.

Coole, H., & Watts, M. (2009). Communal e-learning styles in the online classroom. *Research in Education, 82*(1), 13-27.

Dabbagh, N. (2007). The online learner: Characteristics and pedagogical implications. *Contemporary Issues in Technology Teacher Education, 7 (3), 217-226.*

Dabbagh, N., & Bannan-Ritland, B. (2005). *Online learning: Concepts, strategies, and application*. Prentice Hall.

Dabbagh, N., Marra, R., & Howland, J., 2018. Meaningful Online Learning: Integrating Strategies, Activities and Learning Technologies for Effective Designs. 1st Edition, Routledge.

Danesi, M. (2016). *The semiotics of emoji: The rise of visual language in the age of the internet*. Bloomsbury Publishing.

Davies, J., & Graff, M. (2005). Performance in e-learning: Online participation and student grades. British Journal of Educational Technology, 36(4), 657–663. doi:10.1111/j.1467- 8535.2005.00542.x

Dennen, V. P. (2005). From message posting to learning dialogues: Factors affecting learner participation in asynchronous discussion. *Distance Education, 26*(1), 127-148.

Domingo, J. R., & Bradley, E. G. (2018). Education student perceptions of virtual reality as a learning tool. *Journal of Educational Technology Systems, 46*(3), 329-342.

Ducheneaut, N., Wen, M. H., Yee, N., & Wadley, G. (2009, April). Body and mind: a study

of avatar personalization in three virtual worlds. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 1151-1160).

Dyke, M., Conole, G., & Ravenscroft, A. (2006). Learning theory and its application to e-learning. In *Contemporary perspectives in e-learning research* (pp. 100-116). Routledge.

Farrow, E., Moore, J., & Gašević, D. (2020, March). Dialogue attributes that inform depth and quality of participation in course discussion forums. In *Proceedings of the tenth international conference on learning analytics & knowledge* (pp. 129-134).

Ferdig, R. E., & Roehler, L. R. (2003). Student uptake in electronic discussions: Examining online discourse in literacy preservice classrooms. *Journal of Research on Technology in Education*, *36*(2), 119-136.

Firer, E., Slakmon, B., Dishon, G., & Schwarz, B. B. (2021). Quality of dialogue and emotion regulation in contentious discussions in higher education. *Learning, Culture and Social Interaction*, *30*, 100535.

Freeman, G., & Acena, D. (2021, June). Hugging from A Distance: Building Interpersonal Relationships in Social Virtual Reality. In *ACM International Conference on Interactive Media Experiences* (pp. 84-95).

Freire, P. (1996). Pedagogy of the oppressed (revised). *New York: Continuum*.

Fung, Y. Y. H. (2004). Collaborative online learning: Interaction patterns and limiting factors. Open Learning, 19(2), 135–149. Doi:10.1080/0268051042000224743

Glaser, B. G. (1965). The constant comparative method of qualitative analysis. *Social problems*, *12*(4), 436-445.

Guichet, P. L., Huang, J., Zhan, C., Millet, A., Kulkarni, K., Chhor, C., ... & Fefferman, N.

(2021). Incorporation of a Social Virtual Reality Platform into the Residency Recruitment Season. *Academic Radiology*.

Harding, T., & Whitehead, D. (2013). Analysing data in qualitative research. *Nursing & midwifery research: Methods and appraisal for evidence-based practice*, *5*, 141-160.

Hennessy, S., Calcagni, E., Leung, A., & Mercer, N. (2021). An analysis of the forms of teacher-student dialogue that are most productive for learning. *Language and Education*, 1-26.

Hennessy, S., Dragovic, T., & Warwick, P. (2018). A research-informed, school-based professional development workshop programme to promote dialogic teaching with interactive technologies. *Professional Development in Education*, *44*(2), 145-168.

Hennessy, S., Howe, C., Mercer, N., & Vrikki, M. (2020). Coding classroom dialogue: Methodological considerations for researchers. *Learning, Culture and Social Interaction*, *25*, 100404.

Hennessy, S., Rojas-Drummond, S., Higham, R., Márquez, A. M., Maine, F., Ríos, R. M., & Barrera, M. J. (2016). Developing a coding scheme for analysing classroom dialogue across educational contexts. *Learning, Culture and Social Interaction*, *9*, 16-44.

Hernandez-Serrano, J., Choi, I., & Jonassen, D. H. (2000). Integrating constructivism and learning technologies. In *Integrated and holistic perspectives on learning, instruction and technology* (pp. 103-128). Springer, Dordrecht.

Hew, K. F., & Cheung, W. S. (2013). Audio-based versus text-based asynchronous online discussion: Two case studies. *Instructional Sciences*, 41, 365–380. doi: 10.1007/s11251-012-9232-7

Holquist, M. (2003). *Dialogism: Bakhtin and his world*. Routledge.

Hou, H. T., & Wu, S. Y. (2011). Analyzing the social knowledge construction behavioral patterns of an online synchronous collaborative discussion instructional activity using an instant messaging tool: A case study. *Computers & Education*, *57*(2), 1459-1468.

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. *Cambridge journal of education*, *43*(3), 325-356.

Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher–student dialogue during classroom teaching: Does it really impact on student outcomes? *Journal of the Learning Sciences*, *28*(4-5), 462-512.

Hrastinski, S. (2008). What is online learner participation? A literature review. Computers & Education, 51, 1755–1765. doi:10.1016/j.compedu.2008.05.005

Huang, H. M., Rauch, U., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers & Education*, *55*(3), 1171-1182.

Hung, D., Tan, S. C., & Der-Thanq, C. (2005). How the internet facilitates learning as dialog: Design considerations for online discussions. *International Journal of Instructional Media*, *32*(1), 37.

Hymes, D. (2005). Models of the interaction of language and social life: toward a descriptive theory. *Intercultural discourse and communication: The essential readings*, 4-16.

Gabrielson, A. T., Kohn, J. R., Sparks, H. T., Clifton, M. M., & Kohn, T. P. (2020). Proposed changes to the 2021 residency application process in the wake of COVID-19. *Academic Medicine*.

Garrison, D. R., Anderson, T., & Archer, W. (2003). A theory of critical inquiry in online distance education. *Handbook of distance education*, *1*(4), 113-127.

Geiger, L. A., Morris, D., Suboez, S. L., Shattuck, K., & Viterito, A. (2014). Effect of student readiness on student success in online courses. *Internet Learning*, *3*(1), 8.

Gilbert, P. K., & Dabbagh, N. (2005). How to structure online discussions for meaningful discourse: A case study. *British Journal of Educational Technology*, *36*(1), 5-18.

Girvan, C. (2018). What is a virtual world? Definition and classification. *Educational Technology Research and Development*, *66*(5), 1087-1100.

Guba, E. G., & Lincoln, Y. S. (1981). *The Jossey-Bass higher and adult education series and the Jossey-Bass social and behavioral science series. Effective evaluation: Improving the usefulness of evaluation results through responsive and naturalistic approaches.* San Francisco, CA, US: Jossey-Bass

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research*, *2*(163-194), 105.

Guichet, P. L., Huang, J., Zhan, C., Millet, A., Kulkarni, K., Chhor, C., ... & Fefferman, N. (2021). Incorporation of a Social Virtual Reality Platform into the Residency Recruitment Season. *Academic Radiology*.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of educational computing research*, *17*(4), 397-431.

Jahiel, K. (2009). Collaborative reasoning: A dialogic approach to group discussions. *Cambridge journal of education*, *39*(1), 29-48.

Janssen, D., Tummel, C., Richert, A., & Isenhardt, I. (2016). Virtual environments in higher education–Immersion as a key construct for learning 4.0. *International Journal of Advanced Corporate Learning (iJAC)*, *9*(2), 20-26.

Jensen, C. G. (2017). Collaboration and dialogue in Virtual reality. *Journal of Problem Based Learning in Higher Education*, *5* (1).

Jeno, L. M., Vandvik, V., Eliassen, S., & Grytnes, J. A. (2019). Testing the novelty effect of an m-learning tool on internalization and achievement: A Self-Determination Theory approach. *Computers & Education*, *128*, 398-413.

Johnson, C. M. (2016). Rethinking online discourse: Improving learning through discussions in the online classroom. *Education and Information Technologies*, *21*(6), 1483-1507.

Johnson, M., & Mercer, N. (2019). Using sociocultural discourse analysis to analyse professional discourse. *Learning, Culture and Social Interaction*, *21*, 267-277.

Jonassen, D. (1999). Designing constructivist learning environments. *Instructional Design Theories and Models: A New Paradigm of Instructional Theory*, *2*, 215–239.

Jonassen, D. H., Campbell, J. P., & Davidson, M. E. (1994). Learning with Media: Restructuring the Debate. Educational Technology Research and Development, 42, 31-39. http://dx.doi.org/10.1007/BF02299089

Jordan, P., Ringenberg, M., & Hall, B. (2006). Rapidly developing dialogue systems that support learning studies. In *Proceedings of ITS06 Workshop on Teaching with Robots, Agents, and NLP* (pp. 1-8).

Kanuka, H., & Rourke, L. (2006, July). The Impact of eLearning on higher education. In *2006 7th International Conference on Information Technology Based Higher Education and Training* (pp. 922-926). IEEE.

Karaman, M. K., & Özen, S. O. (2016). A survey of students' experiences on collaborative virtual learning activities based on five-stage model. *Journal of Educational Technology & Society*, *19*(3), 247-259.

Kehrwald, B. (2010). Being online: Social presence as subjectivity in online learning. *London Review of Education*, *8*(1), 39-50.

Khine, M. S., Yeap, L. L., & Lok, A. T. C. (2003). The quality of message ideas, thinking and interaction in an asynchronous CMC environment. Educational Media International, 40(1/2), 115–125. doi: 10.1080/0952398032000092161

Kerslake, L., & Wegerif, R. (2017). The Semiotics of Emoji: The Rise of Visual Language in the Age of the Internet (book review). *Media and Communication*, *5*(4), 75-78.

Kozma, R. B. (1991). Learning with Media. Review of Educational Research, 61, 179-212. http://dx.doi.org/10.3102/00346543061002179

Kozma, R. B. (1994). Will Media Influence Learning? Reframing the Debate. Educational Technology Research and Development, 42, 7-19. http://dx.doi.org/10.1007/BF02299087

Li, J., Kong, Y., Röggla, T., De Simone, F., Ananthanarayan, S., De Ridder, H., ... & Cesar, P. (2019, May). Measuring and understanding photo sharing experiences in social Virtual Reality. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1-14).

Li, J., Vinayagamoorthy, V., Williamson, J., Shamma, D. A., & Cesar, P. (2021, May). Social VR: A New medium for remote communication and collaboration. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1-6).

Liu, Q., & Steed, A. (2021). Social Virtual Reality Platform Comparison and Evaluation Using a Guided Group Walkthrough Method. *Frontiers in Virtual Reality*, *2*, 52.

Littleton, K., & Howe, C. (Eds.). (2010). *Educational dialogues: Understanding and promoting productive interaction*. Routledge.

Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work*. Routledge.

Littleton, K., & Whitelock, D. (2005). The negotiation and co-construction of meaning and understanding within a postgraduate online learning community. *Learning, Media and Technology*, *30*(2), 147-164.

Liu, Q., & Steed, A. (2021). Social Virtual Reality Platform Comparison and Evaluation Using a Guided Group Walkthrough Method. *Frontiers in Virtual Reality*, *2*, 52.

Lowood, H. (November 16, 2018). Virtual reality. *Encyclopedia Britannica*. Encyclopedia Britannica, Inc., Accessed April 2019. Retrieved from: https://www.britannica.com/technology/virtual-reality

Lyle, S. (2008). Dialogic teaching: Discussing theoretical contexts and reviewing evidence from classroom practice. *Language and education*, *22*(3), 222-240.

Major, L., Warwick, P., Rasmussen, I., Ludvigsen, S., & Cook, V. (2018). Classroom dialogue and digital technologies: A scoping review. *Education and Information Technologies*, *23*(5), 1995-2028.

Maloney, D., & Freeman, G. (2020, November). Falling asleep together: What makes activities in social virtual reality meaningful to users. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play* (pp. 510-521).

Maloney, D., Freeman, G., & Robb, A. (2021, June). Stay Connected in An Immersive World: Why Teenagers Engage in Social Virtual Reality. In *Interaction Design and*

Children (pp. 69-79).

Mann, S. (2005). The language teacher's development. *Language teaching*, *38*(3), 103-118.

McKerlich, R., Riis, M., Anderson, T., & Eastman, B. (2011). Student perceptions of teaching presence, social presence, and cognitive presence in a virtual world.

McVeigh-Schultz, J., Kolesnichenko, A., & Isbister, K. (2019, May). Shaping pro-social interaction in VR: an emerging design framework. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1-12).

Mercer, N., & Hodgkinson, S. (Eds.). (2008). *Exploring talk in school: Inspired by the work of Douglas Barnes*. Sage.

Mercer, N., & Howe, C. (2012). Explaining the dialogic processes of teaching and learning: The value and potential of sociocultural theory. *Learning, culture and social interaction*, *1*(1), 12-21.

Mercer, N., Hennessy, S., & Warwick, P. (2019). Dialogue, thinking together and digital technology in the classroom: Some educational implications of a continuing line of inquiry. *International Journal of Educational Research*, *97*, 187-199.

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education*, *70*, 29-40.

Merriam, S. B., & Tisdell, E. J. (2016). Qualitative research: A Guide to Design and Implementation, 4th Edition. San Francisco: Wiley.

Moen, A., Mørch, A. I., & Paavola, S. (Eds.). (2012). *Collaborative knowledge creation: Practices, tools, concepts* (Vol. 7). Springer Science & Business Media.

Mooney, M., Southard, S., & Burton, C. H. (2014). Shifting from obligatory discourse to rich

dialogue: Promoting student interaction in asynchronous threaded discussion postings. *Online Journal of Distance Learning Administration*, *17*(1).

Mørch, A., Moen, A. I., & Paavola, S. (2012). Collaborative knowledge creation: Practices, tools, concepts. Rotterdam, Netherlands: Sense. doi:10.1007/978-94-6209-004-0

Moustafa, Fares, and Anthony Steed. "A longitudinal study of small group interaction in social virtual reality." *Proceedings of the 24th ACM Symposium on Virtual Reality Software and Technology*. 2018.

Muhonen, H., Pakarinen, E., Poikkeus, A. M., Lerkkanen, M. K., & Rasku-Puttonen, H. (2018). Quality of educational dialogue and association with students' academic performance. *Learning and Instruction*, *55*, 67-79.

Narayan, B., Talip, B. A., Watson, J., & Edwards, S. (2013, December). Social media as online information grounds: a preliminary conceptual framework. In *International Conference on Asian Digital Libraries* (pp. 127-131). Springer, Cham.

National Center for Education Statistics (2016). Distance education in postsecondary institutions. Retrieved from https://nces.ed.gov/programs/digest/d17/tables/dt17_311.15.asp?current=yes

Nistor, N., Trăuşan-Matu, Ş., Dascălu, M., Duttweiler, H., Chiru, C., Baltes, B., & Smeaton, G. (2015). Finding student-centered open learning environments on the internet: Automated dialogue assessment in academic virtual communities of practice. *Computers in Human Behavior*, *47*, 119-127.

Oh, C. S., Bailenson, J. N., & Welch, G. F. (2018). A systematic review of social presence: Definition, antecedents, and implications. *Frontiers in Robotics and AI*, *5*, 114.

Omale, N., Hung, W. C., Luetkehans, L., & Cooke-Plagwitz, J. (2009). Learning in 3-D

multiuser virtual environments: Exploring the use of unique 3-D attributes for online problem-based learning. *British Journal of Educational Technology*, *40*(3), 480-495.

Oprean, D., Simpson, M., & Klippel, A. (2018). Collaborating remotely: An evaluation of immersive capabilities on spatial experiences and team membership. *International journal of digital earth*, *11*(4), 420-436.

Oyanagi, A., Narumi, T., Aoyama, K., Ito, K., Amemiya, T., & Hirose, M. (2021, July). Impact of Long-Term Use of an Avatar to IVBO in the Social VR. In *International Conference on Human-Computer Interaction* (pp. 322-336). Springer, Cham.

Palmer, S., Holt, D., & Bray, S. (2008). Does the discussion help? The impact of a formally assessed online discussion on final student results. British Journal of Educational Technology, 39(5), 847–858. doi:10.1111/j.1467-8535.2007.00780.x

Farooq, S., & Benade, L. (2019). Constructing a dialogic pedagogy in virtual learning environments: A literature review.

Paul, R., (1993). Critical Thinking: How to Prepare Students for a Rapidly Changing World, 1993. Plan for Effective Discussion Boards, *Online Classroom*, May 2007

PC Magazine Encyclopedia. March 2018. Retrieved from: https://www.pcmag.com/encyclopedia/term/69486/social-vr

Pehmer, A. K., Gröschner, A., & Seidel, T. (2015). How teacher professional development regarding classroom dialogue affects students' higher-order learning. *Teaching and Teacher Education*, *47*, 108-119.

Petrová, Z. (2013). On the relevancy of using Vygotsky's theoretical framework to legitimize dialogic teaching/learning. *Journal of Pedagogy*, *4*(2), 237-252.

Pomerantz, J. (2018). Learning in Three Dimensions: Report on the EDUCAUSE/HP

Campus of the Future Project. *EDUCAUSE*.

Prensky, M. (2001). Digital natives, digital immigrants' part 1. *On the horizon*, *9*(5), 1-6.

Rasmussen, I., & Ludvigsen, S. (2010). Learning with computer tools and environments: A sociocultural perspective. *International handbook of psychology in education*, 399-433.

Ravenscroft, A., Wegerif, R., & Hartley, R. (2007). Reclaiming thinking: dialectic, dialogic and learning in the digital age. In *BJEP Monograph Series II, Number 5-Learning through Digital Technologies* (Vol. 39, No. 57, pp. 39-57). British Psychological Society.

Reznitskaya, A., Kuo, L. J., Clark, A. M., Miller, B., Jadallah, M., Anderson, R. C., & Nguyen-Romenti, S., Valentini, C., Murtarelli, G., & Meggiorin, K. (2016). Measuring online dialogic conversations' quality: A scale development. *Journal of Communication Management*.

Robertson, J., & Howells, C. (2008). Computer game design: Opportunities for successful learning. *Computers & Education*, *50*(2), 559-578.

Rojas-Drummond, S., Torreblanca, O., Pedraza, H., Vélez, M., & Guzmán, K. (2013). 'Dialogic scaffolding': Enhancing learning and understanding in collaborative contexts. *Learning, Culture and Social Interaction*, *2*(1), 11-21.

Rogoff, B. (1998). Cognition as a collaborative process.

Romenti, S., Valentini, C., Murtarelli, G., & Meggiorin, K. (2016). Measuring online dialogic conversations' quality: A scale development. *Journal of Communication Management*.

Rubio-Tamayo, J. L., Gertrudix Barrio, M., & García F. (2017). Immersive

environments and virtual reality: Systematic review and advances in communication, interaction and simulation. *Multimodal Technologies and Interaction*, *1*(4), 21.

Rule, P. (2011). Bakhtin and Freire: Dialogue, dialectic and boundary learning. *Educational philosophy and theory*, *43*(9), 924-942.

Sanders, J. (2007). Distance education: can it go the distance? *Imprint*, *54*(5), 33-34.

Schmeil, A., & Eppler, M. J. (2008). Knowledge sharing and collaborative learning in Second Life: a classification of virtual 3D group interaction scripts. *Journal of Universal Computer Science*, *14*(3), 665-677.

Schroeder, R. (Ed.). (2012). *The social life of avatars: Presence and interaction in shared virtual environments*. Springer Science & Business Media.

Sener, John, Online Learning Consortium (April 4, 2015) Definitions of E-Learning Courses and Programs Version 2.0 Retrieved by: https://onlinelearningconsortium.org/updated-e-learning-definitions-2/

Shattuck, K. (Ed.). (2014). *Assuring quality in online education: Practices and processes at the teaching, resource, and program levels*. Stylus Publishing, LLC.

Sherman, W. R., & Craig, A. B. (2018). *Understanding virtual reality: Interface, application, and design*. Morgan Kaufmann.

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *6*(6), 603-616.

So, H. J., & Brush, T. A. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors. *Computers & education*, *51*(1), 318-336.

Song, L., & McNary, S. W. (2011). Understanding Students' Online Interaction: Analysis of Discussion Board Postings. *Journal of Interactive Online Learning*, *10*(1).

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), Cambridge Handbook of the Learning Sciences (pp. 409-426). Cambridge, UK: Cambridge University Press.

Ştefan, L. (2012). Immersive collaborative environments for teaching and learning traditional design. *Procedia-Social and Behavioral Sciences*, *51*, 1056-1060.

Steed, A., Pan, Y., Zisch, F., & Steptoe, W. (2016, March). The impact of a self-avatar on cognitive load in immersive virtual reality. In *2016 IEEE virtual reality (VR)* (pp. 67-76). IEEE.

Swann, J. (2010). A dialogic approach to online facilitation. *Australasian Journal of Educational Technology, 26*(1).

Uzuner, S. (2007). Educationally valuable talk: A new concept for determining the quality of online conversations. *Journal of Online Learning and Teaching*, *3*(4), 400-410.

Vickers, H. (2010). VirtualQuests: Dialogic language learning with 3D virtual worlds. *CORELL: Computer resources for language learning*, *3*, 75-81.

Vygotsky, L. (1978). Interaction between learning and development. *Readings on the development of children*, *23*(3), 34-41.

Wang, M. (2020, April). Social VR: A New Form of Social Communication in the Future or a Beautiful Illusion? In *Journal of Physics: Conference Series* (Vol. 1518, No. 1, p. 012032). IOP Publishing.

Wang, W., Baker, S., & Irlitti, A. (2020, December). Exploring the Effects of User Control on Social Engagement in Virtual Reality. In *32nd Australian Conference on Human-*

Computer Interaction (pp. 253-262).

Webb, N. M. (2009). The teacher's role in promoting collaborative dialogue in the classroom. *British Journal of Educational Psychology*, *79*(1), 1-28.

Wegerif, R. (2005). Reason and creativity in classroom dialogues. *Language and Education*, *19*(3), 223-237.

Wegerif, R. (2013). *Dialogic: Education for the internet age*. Routledge.

Wegerif, R., & Major, L. (2019). Buber, educational technology, and the expansion of dialogic space. *AI & SOCIETY*, *34*(1), 109-119.

Wegerif, R., & Mercer, N. (1996). Computers and reasoning through talk in the classroom. *Language and Education*, *10*(1), 47-64.

Wiederhold, B. K. (2020). Connecting through technology during the coronavirus disease 2019 pandemic: Avoiding "Zoom Fatigue".

Winn, W. (1993). A conceptual basis for educational applications of virtual reality. *Technical Publication R-93-9, Human Interface Technology Laboratory of the Washington Technology Center, Seattle: University of Washington*.

Wright, P. (2015). Comparing e-tivities, e-moderation and the five-stage model to the community of inquiry model for online learning design. *The Online Journal of Distance Education and e-Learning*, *3*(2), 17-30.

Yang, K. T., Wang, T. H., & Chiu, M. H. (2014). How technology fosters learning: Inspiration from the "Media Debate". *Creative Education*, *2014*.

Yin, R. K. (2018). *Case study research and applications: Design and methods*. Sage publications. Sixth edition. Clark, R. E. (1983). Reconsidering Research on Learning from Media. Review of Educational Research, 53, 445

459. http://dx.doi.org/10.3102/00346543053004445

Zibrek, K., Kokkinara, E., & McDonnell, R. (2018). The effect of realistic appearance of virtual characters in immersive environments-does the character's personality play a role? *IEEE transactions on visualization and computer graphics*, *24*(4), 1681-1690.

Appendix A: Definition of Terms

Key terms are defined to help the reader understand the context of each term in this study.

Articulation: Methods that guide students to explain and reflect to make tacit knowledge explicit by various activities such and negotiating and defending knowledge acquired through learning (Oliver, Herrington & Omari, 1996).

Asynchronous: A communication technology that excludes place and time in the relationship between student and instructor interactions that allows students to have chronological communications that support collaborative learning and reflective commentary, which are usually grouped in threaded discussions (Online Learning Consortium & Sener, 2014).

Avatars: "Personalities" assumed by users in a social virtual reality environment for the purpose of group discussion that includes social presence.

Collaborative Learning: Interactions between small groups of learners to maximize their own and others learning through the joint construction of knowledge and social negotiation and articulation through discourse (Dabbagh & Ritland, 2005).

Constructivism: An epistemology that refers to students *constructing* individualized knowledge based on interactions and interpretations based on experiences (Vygotsky, 1980).

Critical Thinking: The ability of a student to analyze, synthesize, and evaluate new information (Driscoll, 2000).

Instructional Dialogic Strategy: Instructional strategies that promote discursive student activities (articulation, reflection, social negotiation and reflection).

Interpersonal Social Dialogue: "Discursive relationship in which participants project

themselves socially and emotionally" (Gorsky & Caspi, 2005, p. 139).

Learning Management System: A software application system used to design, develop, deliver and manage web-based remote learning courses.

Meaningful Discourse: "Learning environments in which the emphasis is on social interaction through dialogue and conversation supported by asynchronous and synchronous communication technologies" (Dabbagh & Ritland, 2005, p.327).

Meaningful Learning: Meaningful Learning results when technology applications engage learners in knowledge construction, conversation, articulation, collaboration and reflection. Characteristics of Meaningful Learning include active, constructive, cooperative, authentic and intentional tasks (Howland, Jonassen & Marra, 2012).

Metacognition: Awareness and understanding of your own learning process.

Online Course: All course activity is done online; there are no required face-to-face sessions or on campus assignments within the course (Online Learning Consortium & Sener, 2014).

Online Discussion Evaluation Rubric: A pedagogical tool that is a scoring guide that is used to assess the quality of discourse within an assigned online discussion task (Dawson, 2015).

Online Discussion Boards/Forums: A type of threaded communication that facilitates topical discussions that is created in a "public" discussion area within the course management system that archives the groups' discussion (Dabbagh & Ritland, 2005).

Perception: The way in which students determine the effectiveness of a particular learning strategy (Social VR) in affecting their view and understanding of course content.

Reflection: A learning metacognitive activity that includes students analyzing and

making judgements and relating it to what they already know and adapting it for their own purposes (Dabbagh & Ritland, 2005).

Social Negotiation: Interactions between students to achieve consensus in shared knowledge meaning.

Social Presence: Indication and confirmation of social interaction in online discourse.

Social VR: "Individuals meeting together in a simulated world using a virtual reality (VR) system and Social VR app" to discuss course concepts to construct knowledge. Participants appear as avatars in environments, which can be lifelike, or fantasy (PC Magazine Encyclopedia).

Synchronous Communication: A communication technology that supports real-time communication and interactions in an online environment.

VoiceThread: A cloud application that increases social presence by allowing online users to upload, share and discuss documents, presentations, images, audio files and videos (VoiceThread, 2018).

Appendix B: Consent Form

WAIVER OF DOCUMENTATION FOR CONSENT-QUALTRICS

INVESTIGATOR'S NAME: MICHELE M KROLL

STUDY TITLE: Exploring the Quality Of Multi Modal Student Dialogue Using Social Virtual Reality Technology In An Online Course

We would like to ask you to participate in a study that involves research on digital dialogue using Social VR. Participation is voluntary and your decision not to participate will not involve any penalty to your ISLT course grade. We are inviting you to take part in this research because you are enrolled in this online course. We will only include you in the study if you first give us your permission.

STUDY PURPOSE

The purpose of this study of exploratory nature is to investigate Social VR as a new tool for meaningful student discourse (quality dialogue). To support quality dialogue in online environments, different tools can be used by the teacher/faculty. Online discussion boards have been seen as effective in the past, however, there are students who view them as ineffective and burdensome, thus minimally participating (AlJeraisy et al., 2015; Cheung, & Ng, 2010; Fung, 2004; Hew, Khine; Yeap, & Lok, 2003). We would like to examine how effective Social VR is.

WHAT AM I BEING ASKED TO DO?

The study is the same length and time of the course, over 16 weeks. Additional tasks for this study include a pre and post electronic questionnaire during the first and last month that contains a Likert Scale and demographic questions that will take about 10 minutes to

complete. In addition, two interviews by Zoom (one at mid-point and one towards the end of the class) which will take about 30-35 minutes each.

ARE THERE ANY RISKS TO TAKING PART IN THIS STUDY?

You would not be exposed to any risks greater than what you would experience in everyday life. Some risks/discomforts from being in this study might include being physically uncomfortable when wearing VR viewers.

WILL INFORMATION ABOUT ME BE KEPT PRIVATE?

If you choose to participate, your data will not be linked to your identity. You would use a unique student identifier to access Qualtrics pre-post questionnaires, and your name will be removed from all dialogue assignments prior to analysis. Data files stripped of identifying information are stored securely on the university Box server and will only be accessible to the research team. The information we collect from you for this study will not be used or shared with other investigators for future research studies. This applies even if we remove all information that could identify you from your information.

ARE THERE ANY BENEFITS TO ME FROM TAKING PART IN THIS STUDY?

We hope that by taking part, you will benefit from knowing that you are contributing to learning technologies pedagogy and knowledge/helping us to learn more about digital dialogue and what are effective uses in online course design, which may benefit students in the future.

WILL I BE PAID FOR TAKING PART IN THIS STUDY?

If you participate fully by completing all study measures, for your time and effort, you will be given a gift card of $50.00.

WHO CAN I CALL IF I HAVE QUESTIONS, CONCERNS, OR COMPLAINTS?

If you have any questions regarding your rights as a participant in this research and/or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study, you may contact the University of Missouri Institutional Review Board (which is a group of people who review the research studies to protect participants' rights) at (573) 882-3181 or by emailing irb@missouri.edu.

If you have any problems or questions about the study, you may contact the principal investigator, (Michele Kroll) at email at krollm@missouri.edu

ELECTRONIC CONSENT

Please select your choice below. You may print or save a copy of this consent form. Clicking on the "Agree" button indicates that:

- You have read the above information
- You voluntarily agree to participate in the study
- You give us permission to use the images/photographs/audio recordings/video recordings that are produced during the study for analysis only. (ex: Zoom interviews and Social VR recordings).
- You give permission to use screen captures of VR rooms in research publications if needed.

☐ AGREE

☐ DISAGREE

Appendix C: Pre-Questionnaire

The following questions will ask some brief demographics and your experience using three web 2.0 dialogue tools that will be used in this course. The information you provide will help us understand which tools are more conducive to online learning environments. Thanks for your contribution.

In this section, we want to know more about your background. Please indicate what applies to you.

1.1. How old are you? _____

1.2. What is your gender?
□ Male □ Female □ Non-Binary □Transgender □Intersex
□Prefer not to say

1.3. What degree level are you currently at? Check all that apply.
□ Certificate
□ Masters
□ Ed Specialist
□ PhD
□ Other _____

1.4. What is your degree major? _____

1.5. Is this a required class?
□ yes □ no

1.6. Is English your native spoken language?
□Yes □No (If no, what is your native language?)

1.7 How many online courses have you taken as a student?
□ First Course □ 2-3 □ 4-5 □ More than 5

1.8. Confidence Level in Using…

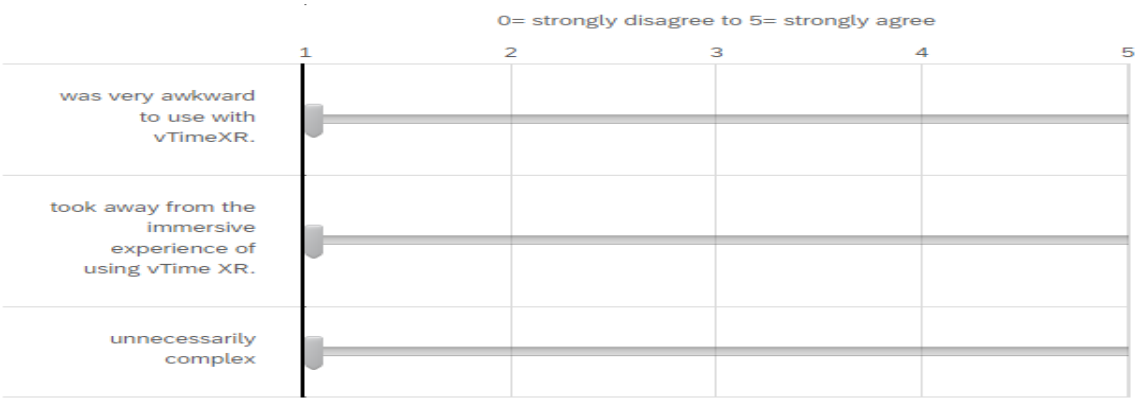
Statement I feel absolutely confident using…	Strongly Disagree 1	Disagree 2	 3	Agree 4	Strongly Agree 5
Discussion Boards					
Zoom					
Social VR (Virtual Reality)					

Appendix D: System Usability Scale (SUS)

The SUS is a 10-item questionnaire with 5 response options. Read and rate each statement as it only pertains to the vTime app.

Statement	Strongly Disagree 1	2	3	4	Strongly Agree 5
1. I think that I would like to use vTime XR frequently.					
2. I found vTime XR unnecessarily complex.					
3. I thought vTime XR was easy to use.					
4. I think that I would need the support of a technical person to be able to use vTime XR.					
5. I found the various functions in vTime XR were well integrated.					
6. I thought there was too much inconsistency in vTime XR.					
7. I would imagine that most people would learn to use vTime XR very quickly.					
8. I found the vTime XR very awkward to use.					
9. I felt very confident using vTime XR.					
10. I needed to learn a lot of things before I could get going with vTime XR					

Recording and Screen Capturing vTime Discussions…



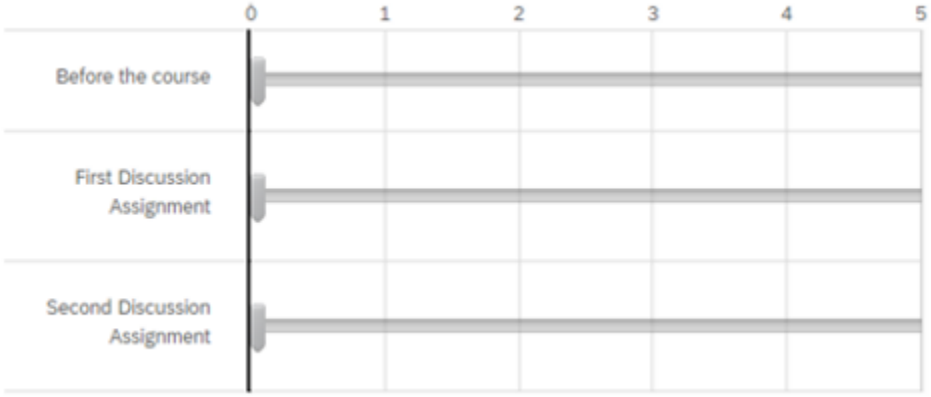
Appendix E: Mid-Point Check -In Survey (Qualtrics)

This is mainly a mid-point check-in to see how using vtime is working and what I can do to support you. Your input will help instructors aid students in using Social VR. Thank you for your time in completing this survey.

Q1. Select your team:

- ☐ Team GEO
- ☐ Team SEL

Q2. I feel confident in using Social VR: (O not very confident to 5 very Confident)



Q3. Did you have any issues setting up a vTime account and creating your avatar?

- ☐ No
- ☐ Maybe
- ☐ Yes

Q4. Which roles have you particiated in during the discussion asignments.
(select all that apply)

- ☐ Recorder
- ☐ Time Keeper
- ☐ Team Host

Q5. Which viewing features are you using in vTime (select all that apply)

- ☐ VR
- ☐ Mgic Window
- ☐ AR

Q6. If you have used a VR viewer what challenges or nuances have you experienced during the vTime discussion assignments?

Q7. If you have used magic window or AR, what challenges or nuances have you expereinced during the vTime discussion assgnments?

Q8. What are some benefits about using Social VR in this course, and does it lend to working in teams? Please share your thoughts.

Q9. Are there other Social VR apps that you would recommend using for discussion assignments? Check all that apply.

- ☐ Rec Room
- ☐ AltspaceVR
- ☐ Mozilla Hubs
- ☐ VR Chat
- ☐ Other

Q10. Is there anything else you would like to tell me that we haven't covered in regards to using Social VR and the discussion assignments (The good, the bad and the ugly)?

Thank you for sharing your experiences and thoughts.

Appendix F: Standard Open-Ended Interview Guide

PART 1: INTRODUCTION AND WARM UP

1.1 Thank you for participating in this research project. I hope that you found something beneficial by participating. First, I want to remind you that this video will not be shown to the public but will be recorded and transcribed for analysis. There will be no personal identifiers. Do I have your permission to record? I will begin recording now. (Zoom)

PART 2. SOCIAL VR

2.1 What was your confidence level using Social VR starting out and what is it now?

Describe your overall experience using Social VR in this course? Compare and contrast vTime/ Mozilla Hub. What features and abilities did you like that added to the experience?

2.2 Did you use a VR headset at any point during the course? Did it make a difference? Tell me about that experience compared to using a smartphone or laptop.

In the context of this course, do you prefer using a smartphone or laptop while using Social VR? Why?

2.3 What did using social VR bring to this course that you would not have had if it weren't used?

2.4 What were the biggest obstacles or challenges?

2.5 What affordances in Social VR are important to have when meeting online in your teams? ex: different rooms, avatar creation, desktop ability, recording?

2.6 What would you suggest for instructors using Social VR in online courses to help students have the best possible experience?

2.7 What would you suggest for students using Social VR in online courses to help them have the best possible experience?

2.8 Do you want to see more online courses use Social VR? Why or why not? What is the best context in using Social VR in online courses?

PART 3: ONLINE COURSE DESIGN

3.1 How did social VR lend itself to building and engaging in dialogue as a team?

PART 4. COMPARISONS

4.1 You used several different types of digital tools in this course. DB, Zoom, Social VR, Blogs, teams. What digital tools do you want to have in an online course? Why?

PART 5. WRAP UP

5.1 Is there anything else you want to tell me that I haven't asked?

Thank you for your contributions to this study!

Appendix G: Tech-SEDA Coding Scheme with Occurrences (Adapted from SEDA*)

DIALOGUE CODES		DEFINITIONS	EXAMPLE
ARTICULATION (n=311)			
Defining (n=120)			
RE n=46	Reasoning	Explain or justify own contribution. Draws on evidence, analogies, distinctions, and speculating, hypothesizing, predicting, grounds.	"I think for me. Initially after reading that my initial thought process was more for it to be a simulation…" Ex: Explains how to do something like a tutorial
REI n=6	Reasoning Invitations	Explicitly invites explanation or justification of another's contribution	"How's that going to work?" "What did you say about the cut scene?"
F n=68	Focusing	Guiding or focusing group dialogue on key aspects of the assignment /activity.	"Today's assignment focuses on prototyping, here is the current working prototype of our very basic first level..."
Understanding Multiple Perspectives (n=94)			
RC n=12	Reasoned co-ordination	Compares, evaluates, and resolves two or more contributions in a reasoned fashion.	"You know just the supposition, and the other one that you mentioned, and then (person's name), maybe you'd mentioned it on one of our calls that you know, if we are teaching the idea of ..."
CA n=62	Coordination of ideas and agreement	Contrast and synthesise ideas, confirm agreement and consensus.	"I agree." "So that's correct, right?" "I was thinking the same thing and do like the story dialogue…"
SI n=20	Synthesise Ideas	Bringing multiple perspectives or ideas to a summarizing or recapping.	"I think either direction is fine, but I think you are kind of saying…" 'I think we got that pretty well locked down, I would agree, so the next thing would be core dynamic."
Giving and Getting Feedback (n=97)			
BOI n=36	Build on ideas	Applies when the same person makes a new comment/response based on their previous comment or elaborates their own previous question.	"She didn't realize she could move up a level…she didn't comprehend she could do that."

DIALOGUE CODES		DEFINITIONS	EXAMPLE
INV n=43	Invite to build on ideas	Make a responsive contribution based on another person's previous comment, argument, idea, and opinion.	"I think for me the real distinction was it didn't really have a goal…" "It's still teaching them new things about…"
IP n=18	Invite possibility	Includes inviting others to imagine new scenarios and to wonder and speculate about possibilities connected to previous contributions.	"I thought about the same problem. What if we had 5 people browsing the pet store and…" "X. I know you had some different ideas about the assessment with your idea, do we want to discuss…"
COLLABORATION AND SOCIAL NEGOTIATION (n=326)			
Interacting (n=109)			
EX n=47	Express or invite ideas	Offer or invite relevant contributions to initiate or further a dialogue.	"You could do this…match it or be able to afford different items in the environment."
CO n=24	Connect	Linking contributions/ knowledge/experiences / Comments on or compliments other contributions.	"I like that idea; it basically shows how they could use the knowledge…"
IR n=38	Invite Reasoning- Ask for Elaboration or Clarification	Asking another for explanation or clarification.	"My other question is there a stock version of that?" "Does it matter if it's on an iPad?" "How do we do this?" "What do you mean by Sprites and background for animation?"
Engaging Actively (n=75)			
GD n=33	Guide direction of dialogue or activity	Take responsibility for shaping assignment or focusing the dialogue on a desired direction; can suggest scaffolding strategies for project.	"Each member can take a turn sharing and then as a group we reflect and discuss the following question together. What is the most helpful way to distinguish between games and simulation today." "How are they seeing this happen as kind of their scaffolding?"
II n=31	Inquiry Invitations	Invite problem posing and feedback. Ex: Game design mechanics solutions or suggestions	"Okay, I know we talked a little bit about this, but I wanted to come to a settling point on the camera perspective. I didn't know if we want to do top-down isometric or side scrolling…" "If we're using the game to help augment what the lecture is, and

DIALOGUE CODES		DEFINITIONS	EXAMPLE
			then you throw in an assessment, is the assessment being done based off of what was taught in the lecture or what they're doing in the game?"
SP n=11	Shift in Position	Acknowledges shift in own opinion in response to the preceding dialogue.	"Maybe I'm wrong?" "I think that's a huge kind of shift from what I was initially thinking my game was going to be."
Building Group Cognition (n=87)			
ELI n=18	Elaboration Invitation	Invites building on, elaboration, evaluation, clarification of own or another's contribution: Invites others to participate.	"Can you think of anything that you would say that would be a game but not a simulation?"
EL n=69	Elaboration	Builds on, elaborates, clarifies own or other's contribution. Adds substantive new information or a new perspective.	Ex: Design on Unity Tasks; explaining game design components "I wanted to show you that this is what it looks like without having to program it." "If you were to play this game and have this dialogue system open side by side, it will show you the flow, the logic, flow of the conversations." "Is it possible to have the same rocks falling initially, and then a different type of rock for the next round to show that, like the same rocks, form the same type of layer?" "But again, I think it could be stated, you know, from a prototype standpoint just captured X rock, and then in our game design part, we could say, you know it would be identified."
Negotiating Differing Ideas (n=55)			
QU n=8	Querying	Doubting or rejecting a statement.	"I mean not necessarily" "I'm not saying I disagree or that nothing is

DIALOGUE CODES		DEFINITIONS	EXAMPLE
			set in stone but...” “I don’t know if we should score like that.”
CH n=27	Challenge	Questioning, disagreeing with or challenging an idea or viewpoint. Ex: states concern or caution	“I think my only hesitation or concern just based on some of the comments” “I’m just throwing it out and playing the devil’s advocate.”
PR n=20	Propose Resolution	Seeking consensus of the group.	“I just want to check with everyone before I assumed anything” “So everyone understands and agrees to the contract?”
REFLECTION (n=43)			
Reviewing (n=25)			
RB n=9	Reference Back	Reference to previous knowledge, beliefs, experiences, or contributions common to the current participants. Can relate to assignment objectives.	“The game mechanics in that second mini-game actually teaches us the information we are doing right now.” “It gives you appreciation for dialogue writers, because even a simple interaction that has multiple options…” “The client did state that some of those objective’s kind of overlap so we could potentially complete some of those objectives in one level or over the course of three levels. Yeah, that kind of goes back to scaffolding, right.”
RL n=16	Reflect on Learning	Reflect on learning process/purpose/value/outcome. Can relate to the assignment objectives.	“I’m still kind of wrapping my head around it, of when I think about games and simulations” “So you could definitely see an argument that maybe not all games are simulations, but also that they are possibly as well.”
Comparing (n=11)			
CO n=7	Connect	Make pathway of learning explicit by linking to contributions / knowledge / experiences discussed.	“The only reason that I was thinking that specifically with the laws, is the client did mention that the geological cross sections are very important and how the

DIALOGUE CODES		DEFINITIONS	EXAMPLE
			geology students learn the objectives in lecture."
SP n=4	Speculate or Predict	Emphasis on the possibilities and theories to explain a phenomenon. Speculate, hypothesis, conjecture, imagine or express one or more different possibilities or theories.	"Sure, so you just said that you could easily see an argument that maybe not all games are simulations, but also that they are possibly as well?"
Analysing (n=7)			
RD n=3	Reflect on dialogue or activity	Evaluate or reflect "metacognitive" on processes of dialogue or learning activity.	"It's like building a house. You want to make sure you have four walls and a roof, and then you can add more. That's just my relatively limited experience. It's much, much easier to add to a small prototype with minimal mechanics than it is to go the other direction." "Maybe we bullet point number two which is to document the details of the research games simulations, the team found most useful for informing their design. So if X (name) want to comment about the board game that you found and X (name)if you want to comment about the Tetris game that you found."
RW n=4	Reference to Wider Context	Making links between what is being learned and a wider context by introducing knowledge, beliefs, experiences, or contributions from outside of the subject being taught in the course.	"So, the product I did in the summer I wanted to show you just a couple of pieces of it, because I think it's pretty relevant." "I worked on 3 different game projects outside of Mizzou, and every one of those, I think, getting the minimum mechanics and curriculum needed to convey… It's much easier to build the minimum prototype and expand it with features than it is to kind of preplan additional features, and then realize you don't have time."

DIALOGUE CODES		DEFINITIONS	EXAMPLE
			"I think there are learning games that are fun, but when I think of a simulation I think, I'm being taught something."

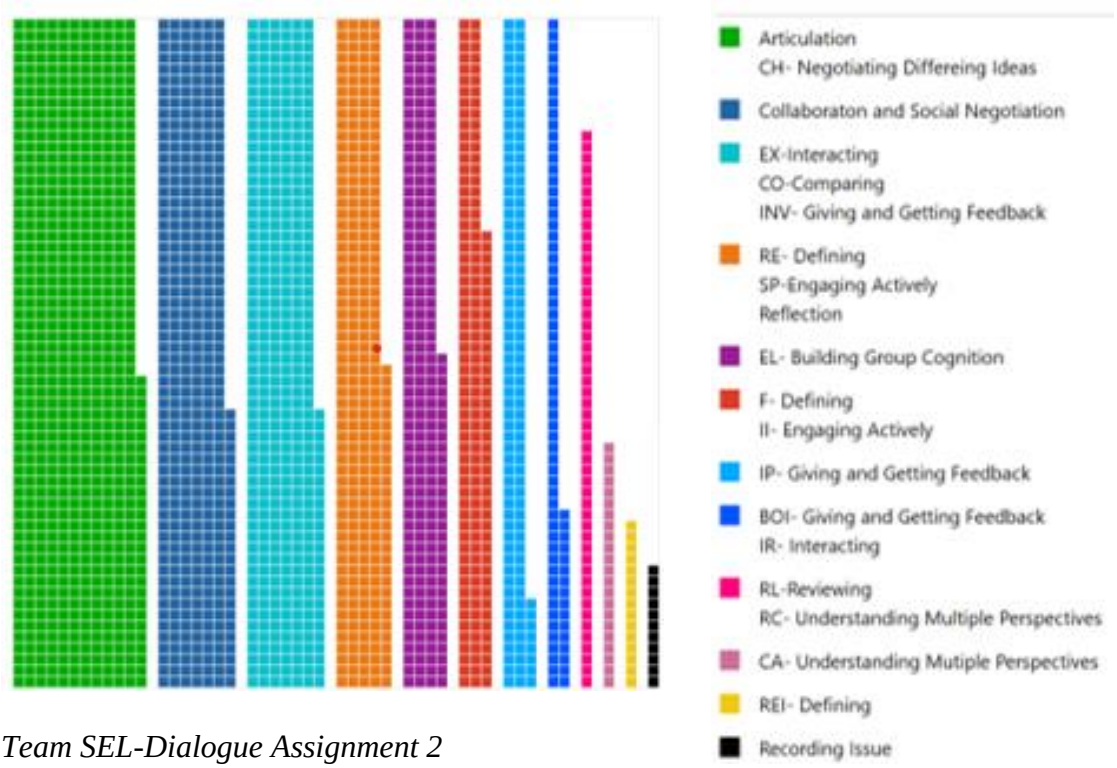
**The Cam-UNAM Scheme for Educational Dialogue Analysis (SEDA: ©2015) was developed by a research team from the University of Cambridge, UK, and the National Autonomous University of Mexico, led by Sara Hennessy and Sylvia Rojas-Drummond and funded through grant no. RG66509 from the British Academy. The original scheme and list of co-creators are available at http://tinyurl.com/BAdialogue. The Scheme for Educational Dialogue Analysis is made freely available under a Creative Commons Attribution (CC by 4.0) license (international): http://creativecommons.org/licenses/by/4.0/.*

Appendix H: Legend for Team Comparisons in 4.4

- Articulation
- Articulation > REI- Defining
- Articulation > F- Defining
- Articulation > RE- Defining
- Articulation > RC- Understanding Multiple Perspectives
- Articulation > CA- Understanding Mutiple Perspectives
- Articulation > SI- Understanding Multiple Persectives
- Articulation > IP- Giving and Getting Feedback
- Articulation > INV- Giving and Getting Feedback
- Articulation > BOI- Giving and Getting Feedback
- Collaboraton and Social Negotiation
- Collaboraton and Social Negotiation > CO- Interacting
- Collaboraton and Social Negotiation > IR- Interacting
- Collaboraton and Social Negotiation > EX-Interacting
- Collaboraton and Social Negotiation > GD-Engaging Actively
- Collaboraton and Social Negotiation > II- Engaging Actively
- Collaboraton and Social Negotiation > SP-Engaging Actively
- Collaboraton and Social Negotiation > ELI- Building Group Cognition
- Collaboraton and Social Negotiation > EL- Building Group Cognition
- Collaboraton and Social Negotiation > QU- Negotiating Differing Ideas
- Collaboraton and Social Negotiation > CH- Negotiating Differeing Ideas
- Collaboraton and Social Negotiation > PR- Negotiating Differeing Ideas
- Reflection
- Reflection > RL-Reviewing
- Reflection > RB-Reviewing
- Reflection > CO-Comparing
- Reflection > SP-Comparing
- Reflection > RW-Analyzing
- Reflection > RD- Analyzing

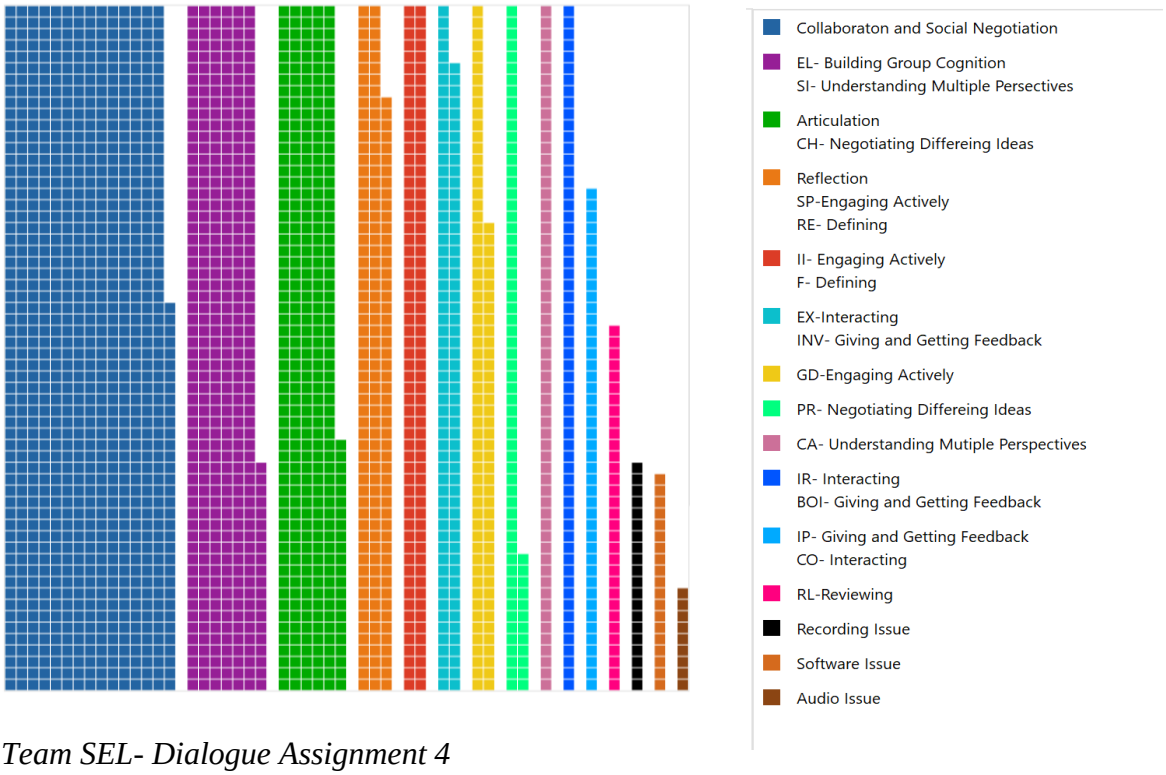
Appendix I: Team Dialogue Sub-Categories by Frequency

Team SEL- Dialogue Assignment 1

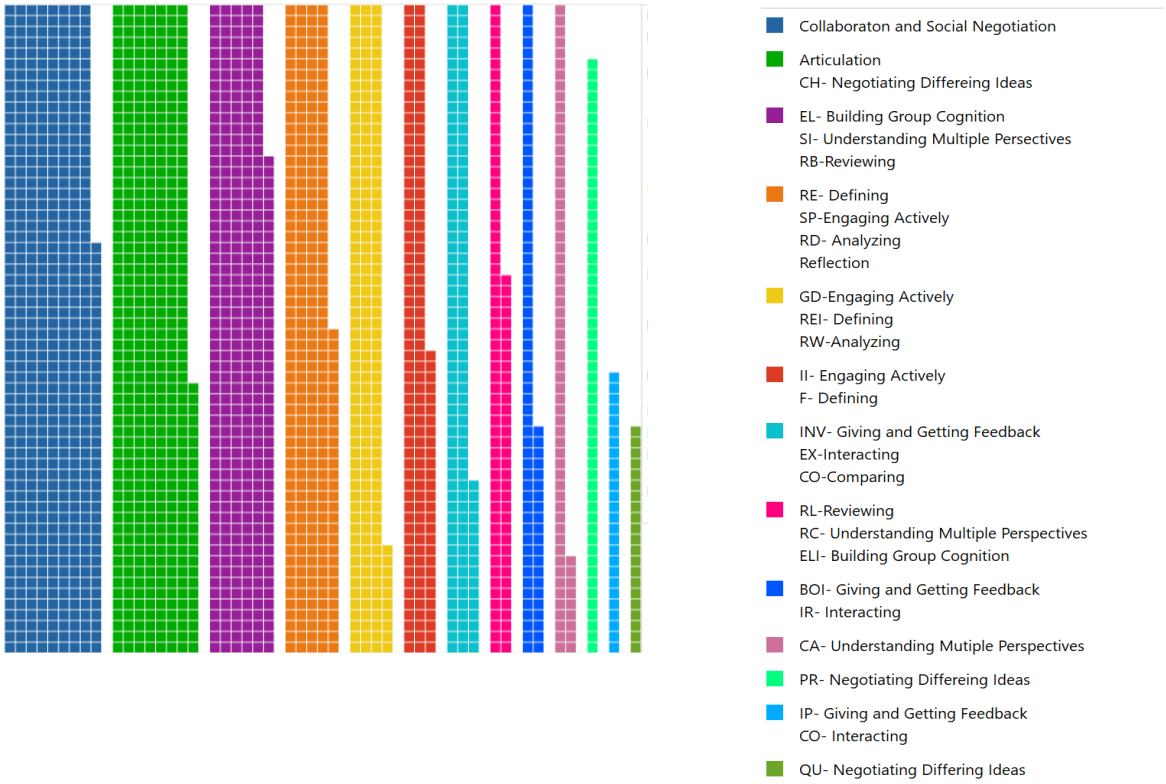


Team SEL-Dialogue Assignment 2

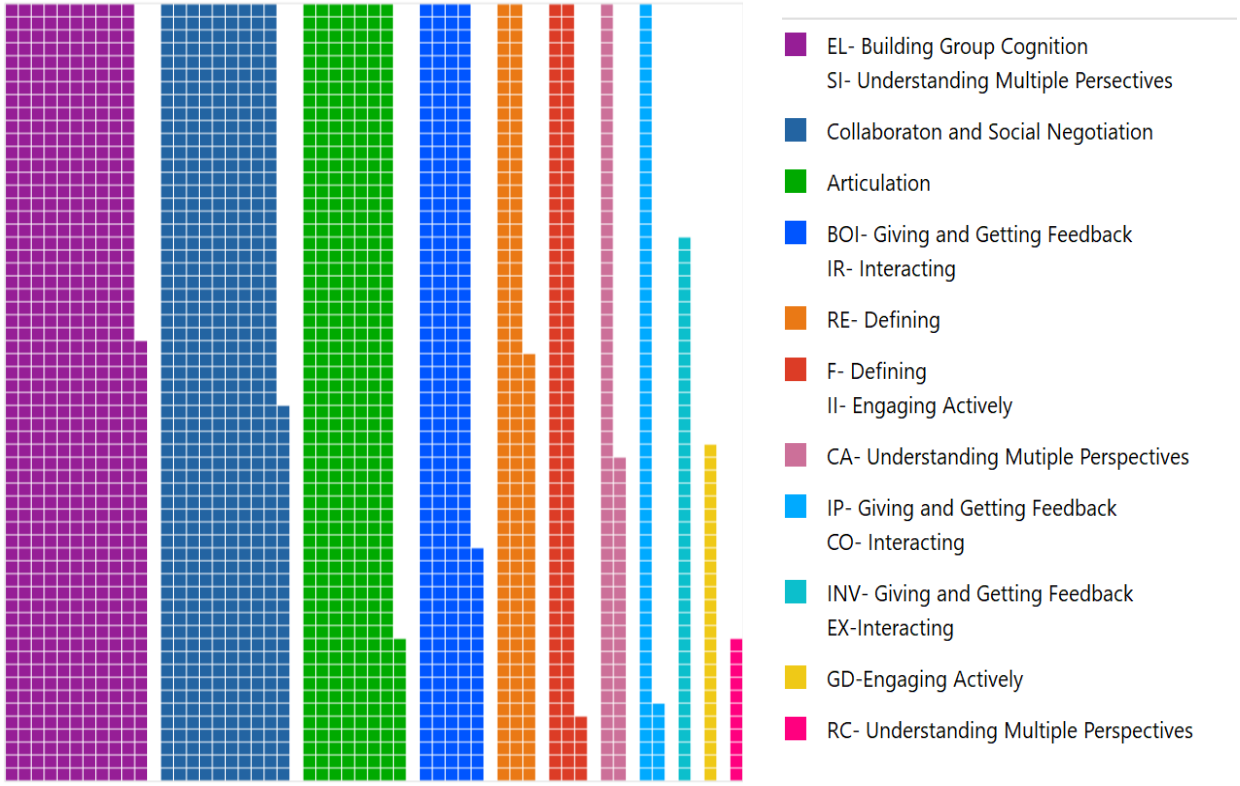
Team SEL- Dialogue Assignment 3



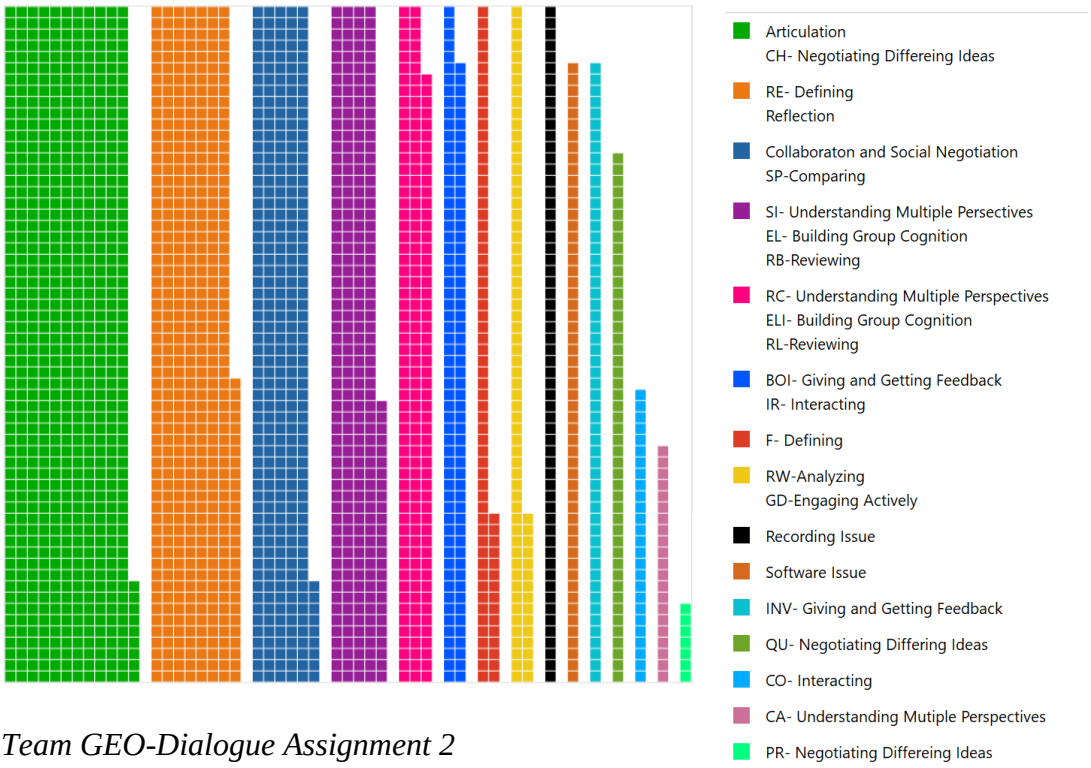
Team SEL- Dialogue Assignment 4



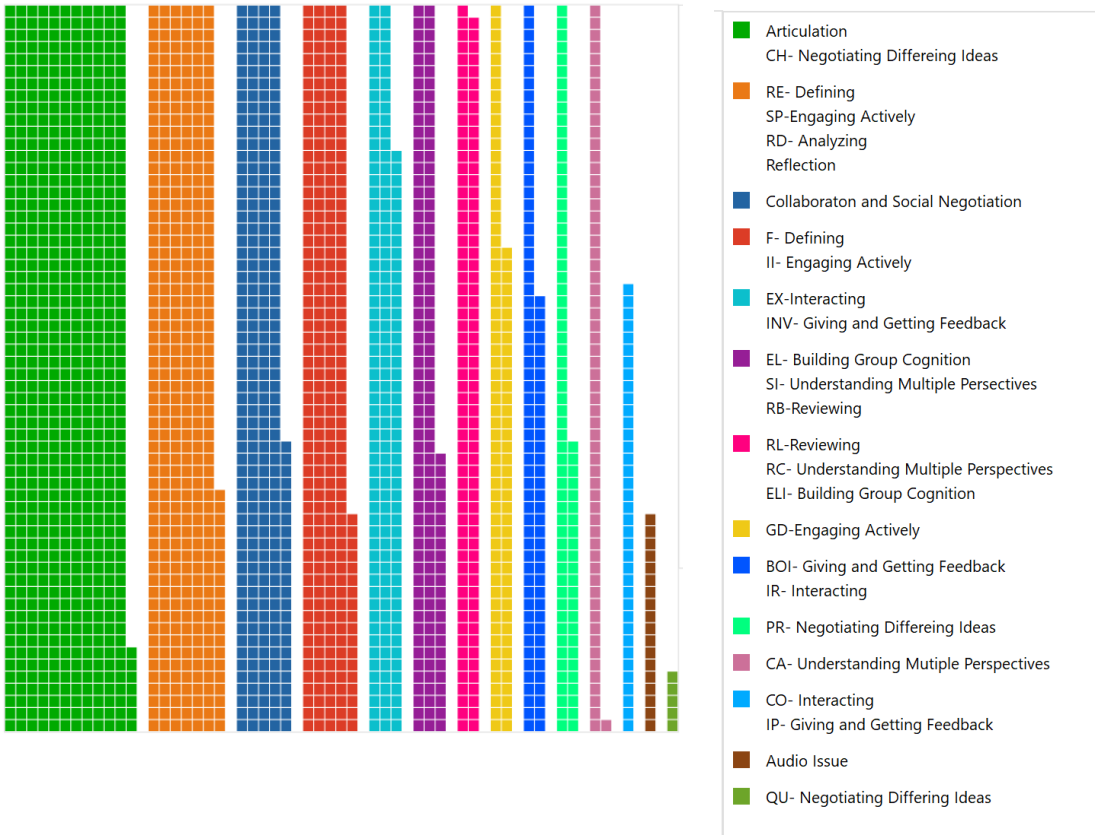
Team SEL- Dialogue Assignment 5



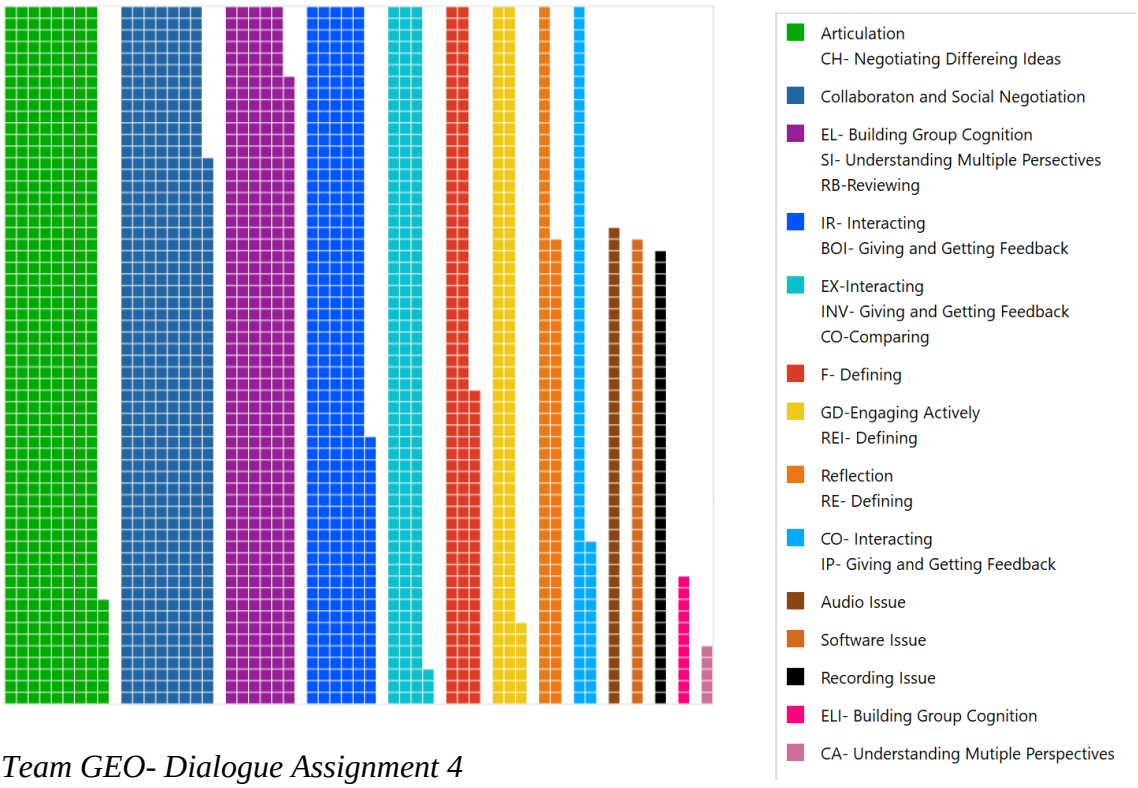
Team GEO-Dialogue Assignment 1



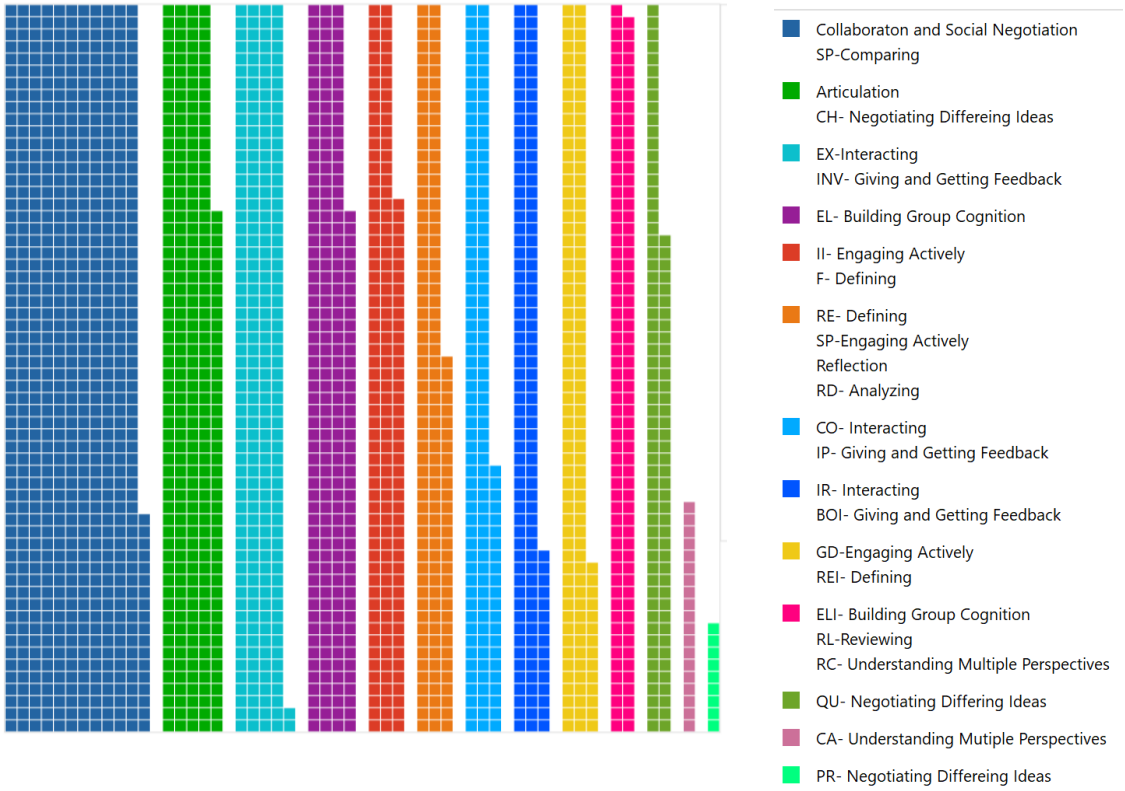
Team GEO-Dialogue Assignment 2



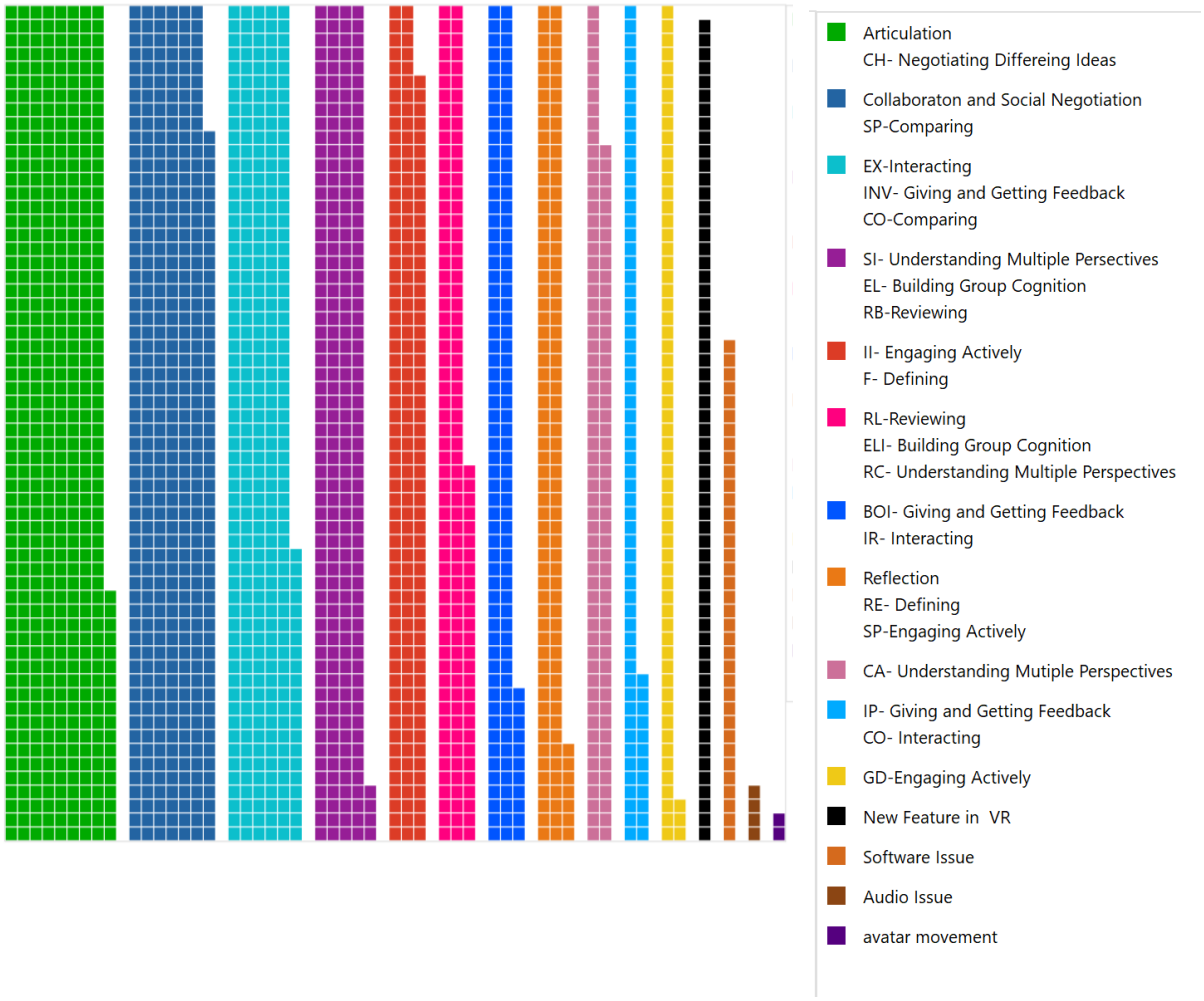
Team Geo- Dialogue Assignment 3



Team GEO- Dialogue Assignment 4

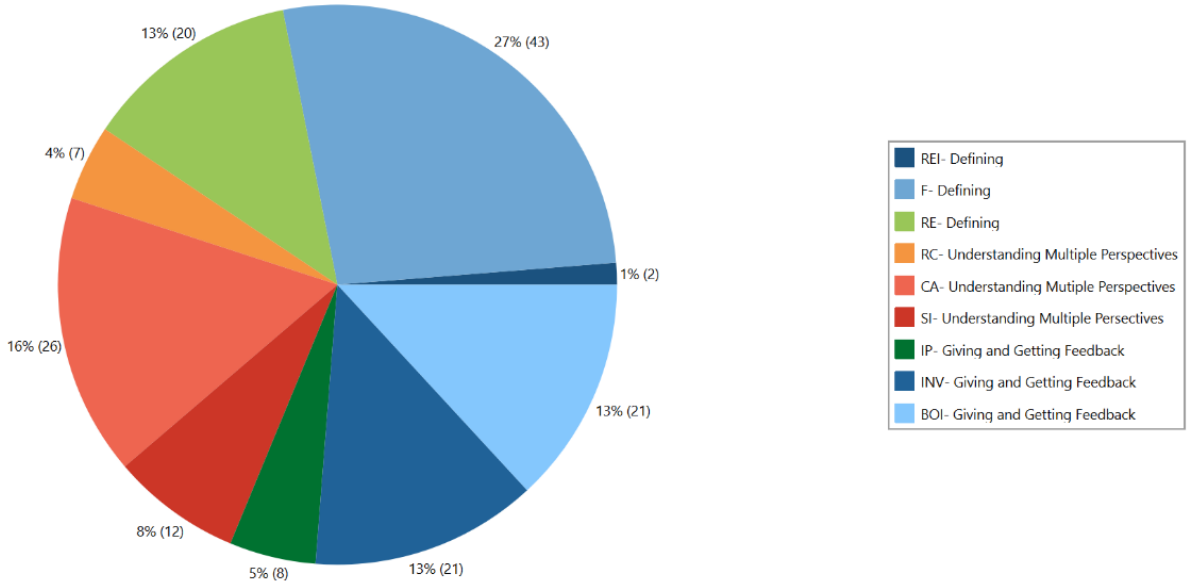


Team GEO- Dialogue Assignment 5

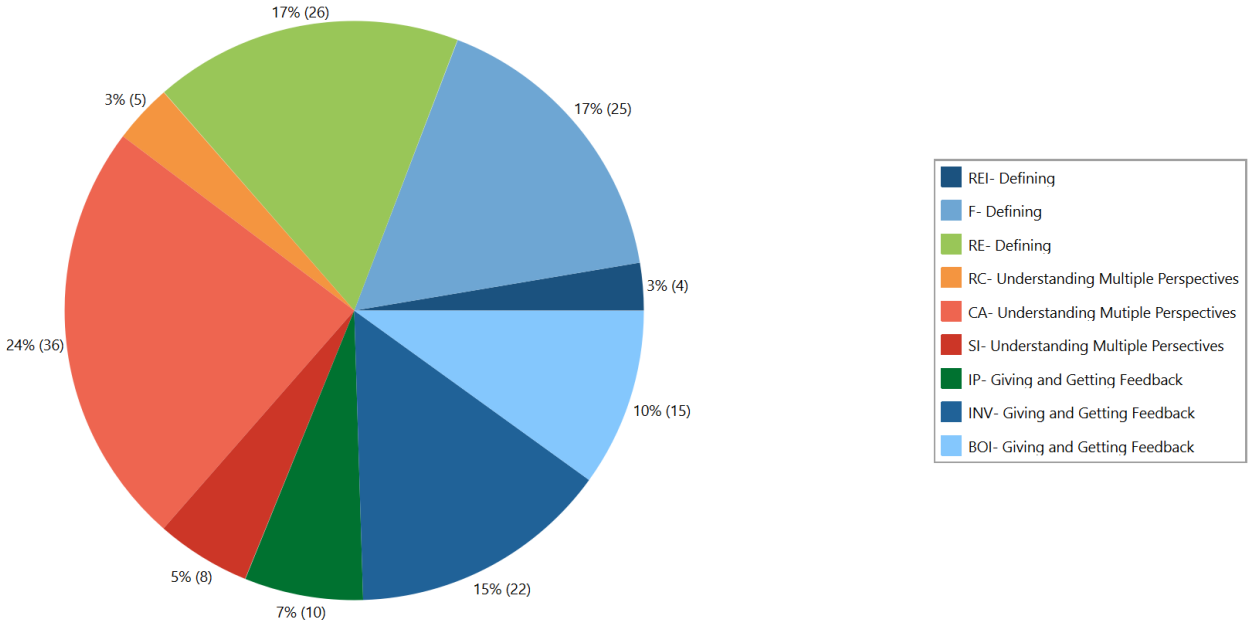


Appendix J: Team Comparisons by Dialogic Criteria

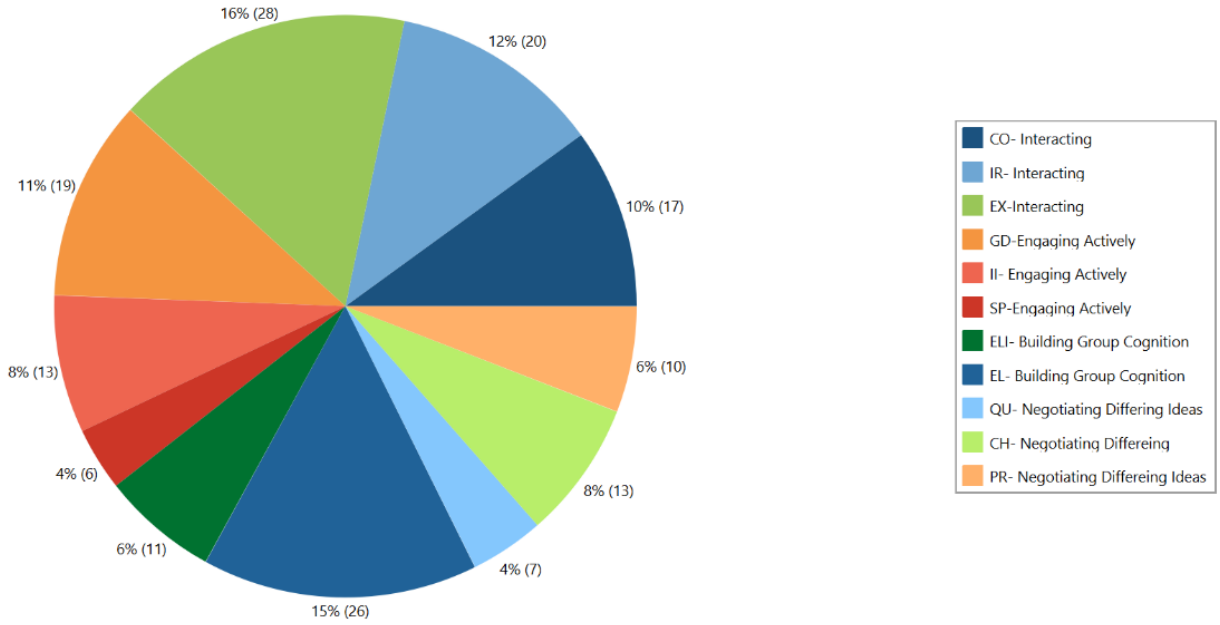
Team GEO Articulation All Assignments



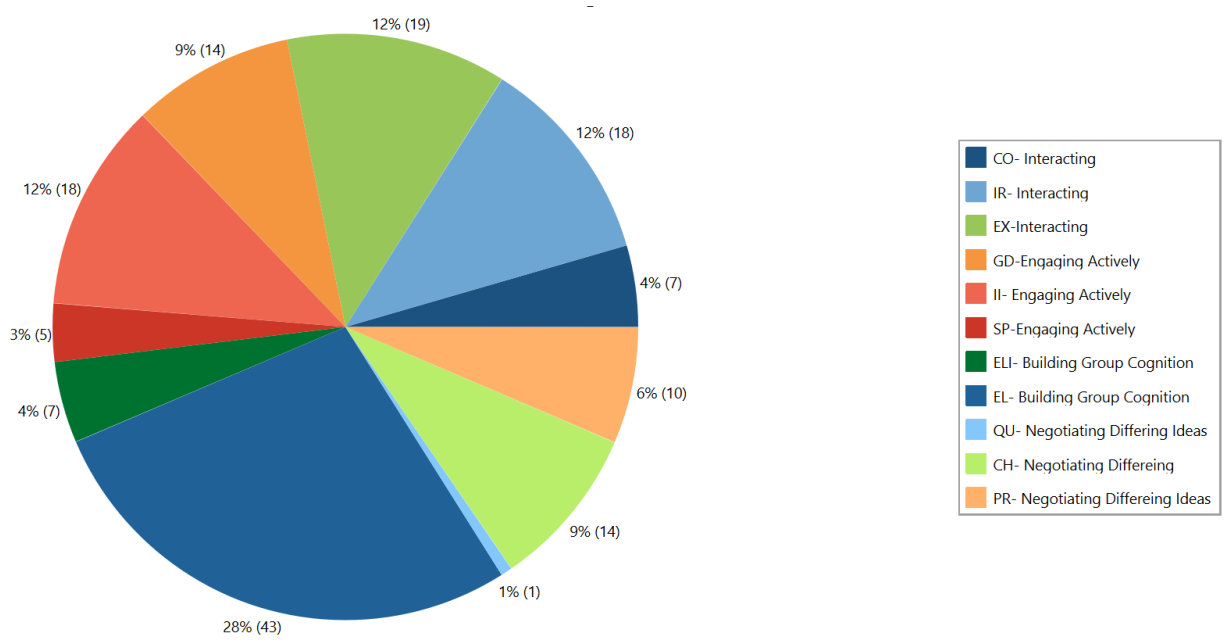
Team SEL Articulation All Assignments



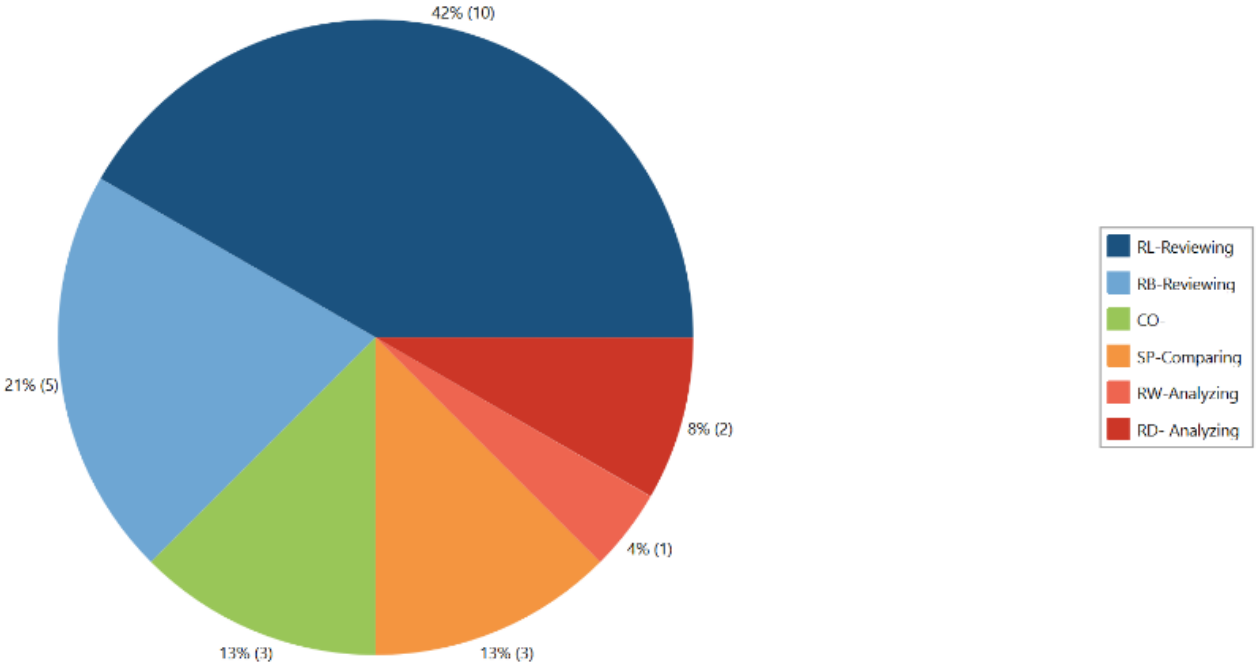
Team GEO Collaboration and Social Negotiation All Assignments



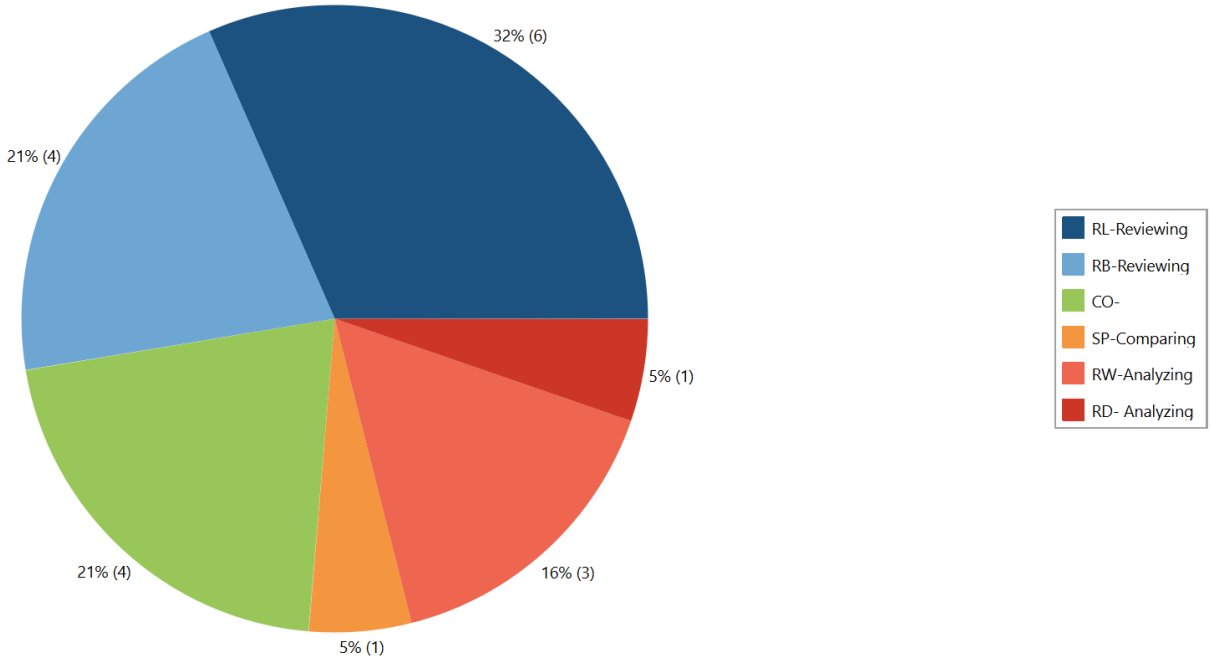
Team SEL Collaboration and Social Negotiation All Assignments



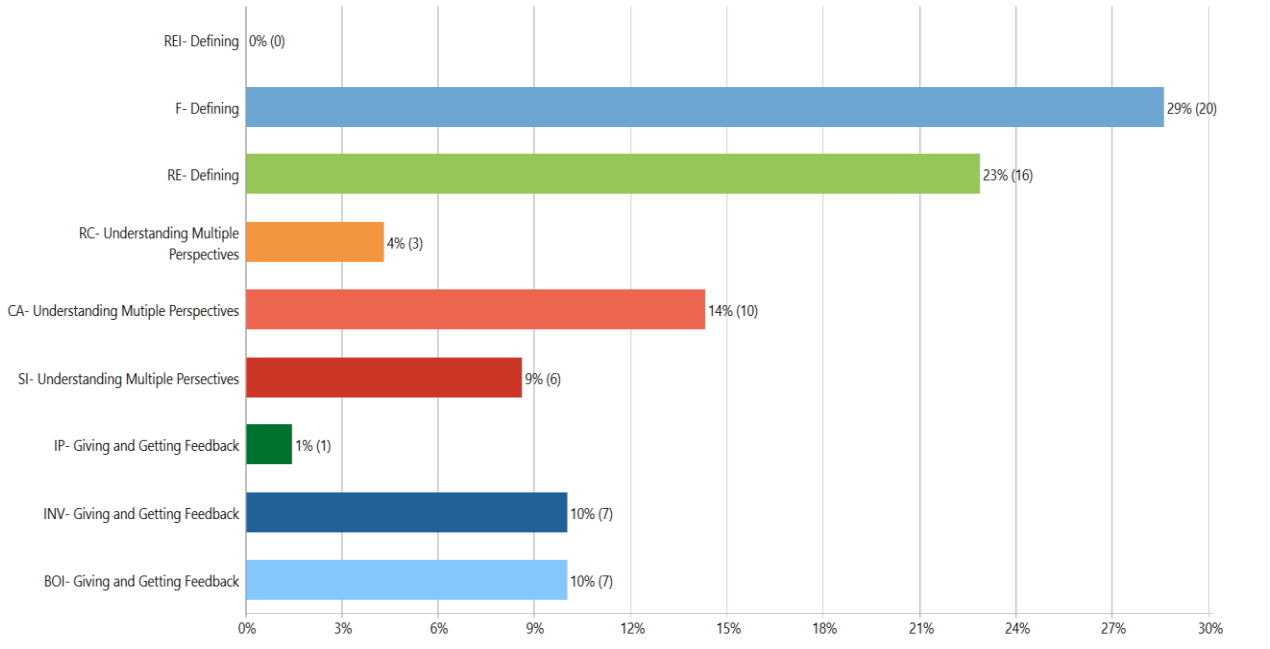
Team Geo Reflection All Assignments



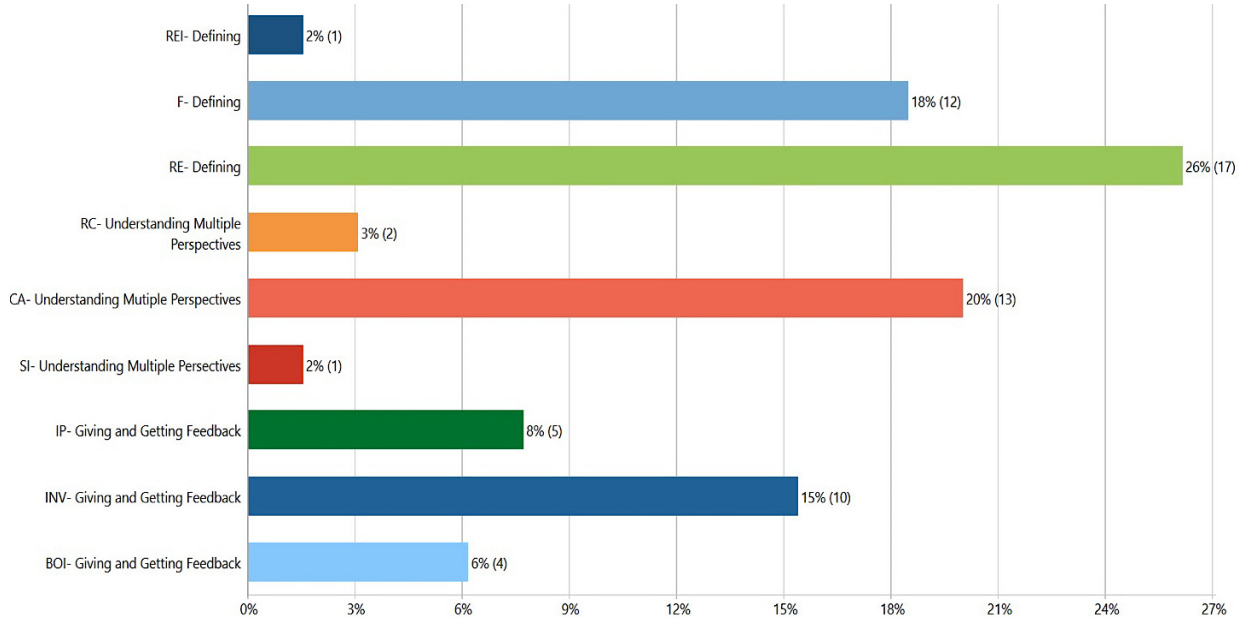
Team SEL Reflection All Assignments



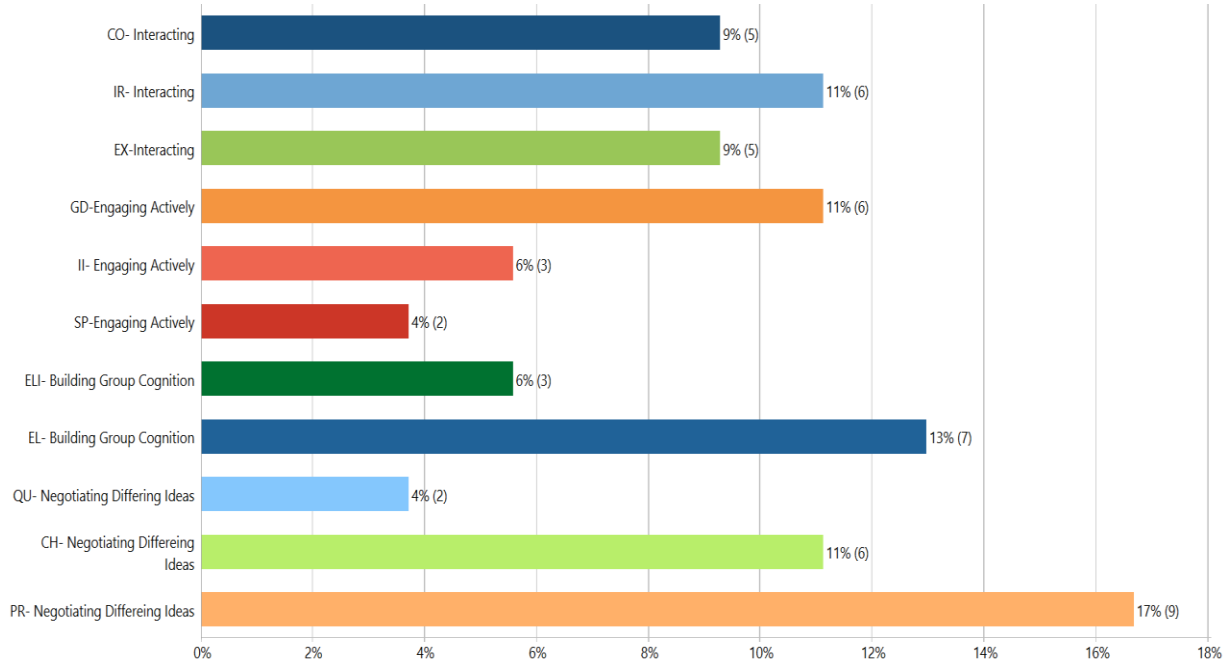
Team GEO Articulation Assignments1-2



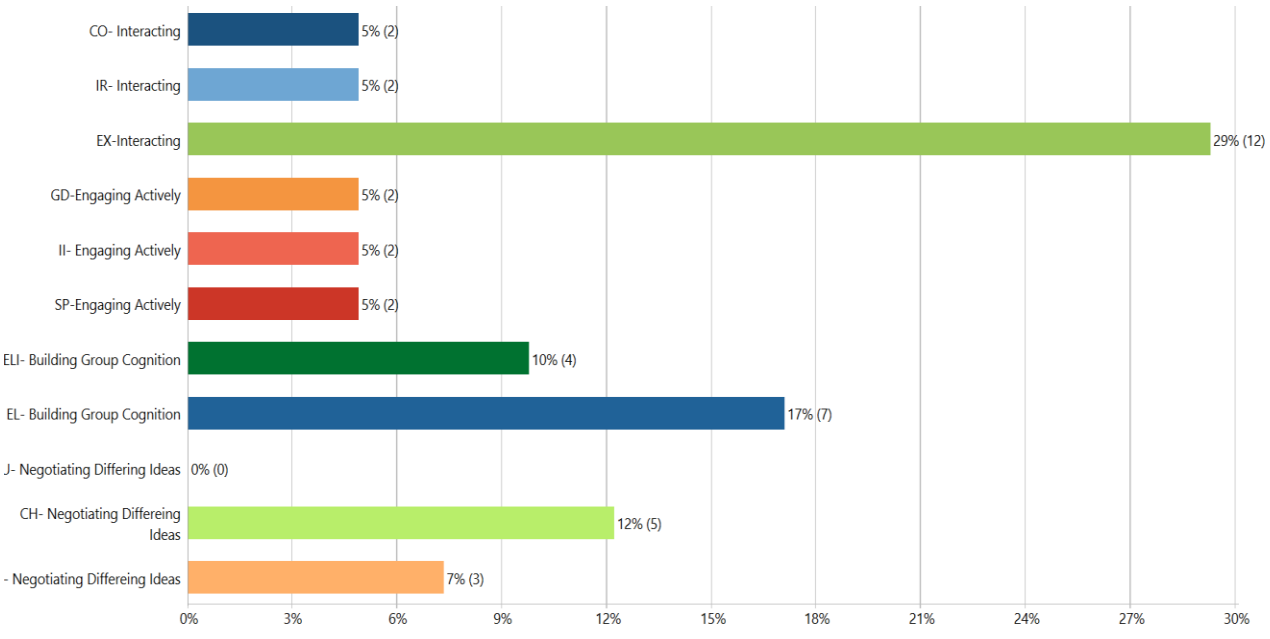
Team SEL Articulation Assignments1-2



Team GEO Collaboration/Social Negotiation Assignments1-2



Team SEL Collaboration/Social Negotiation Assignments1-2



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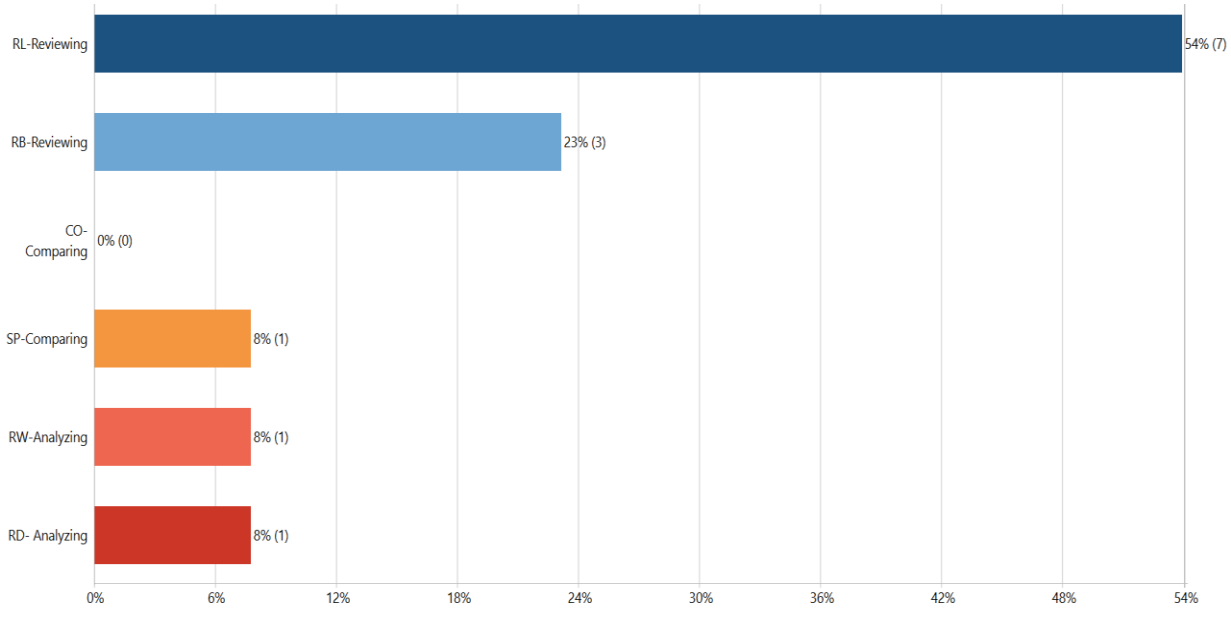

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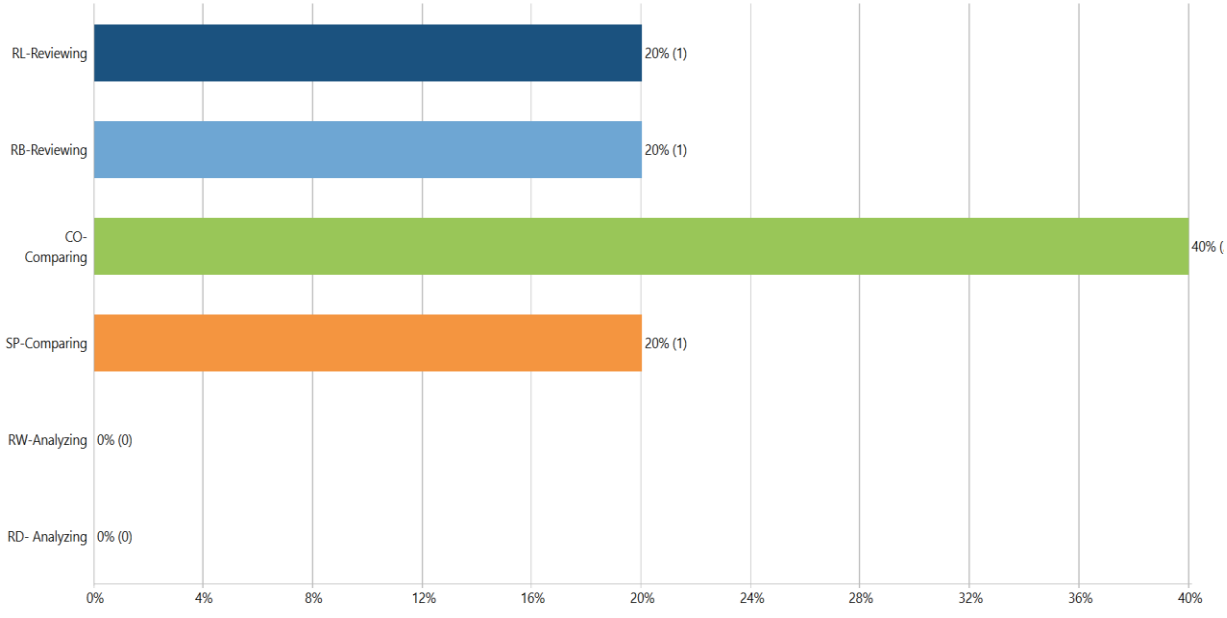
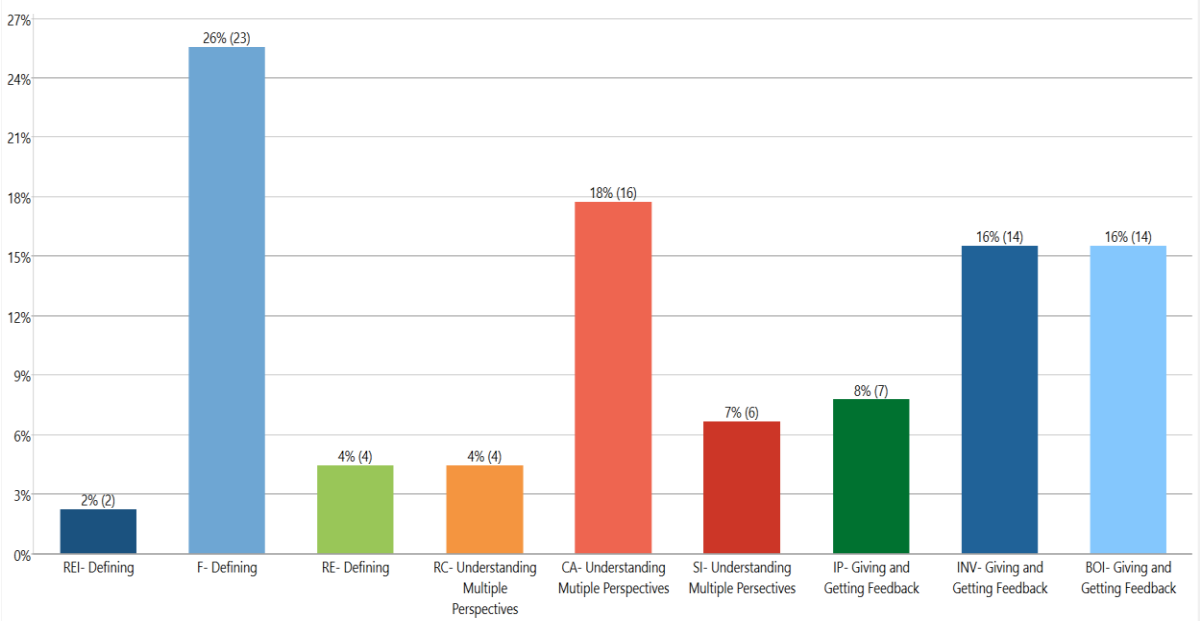
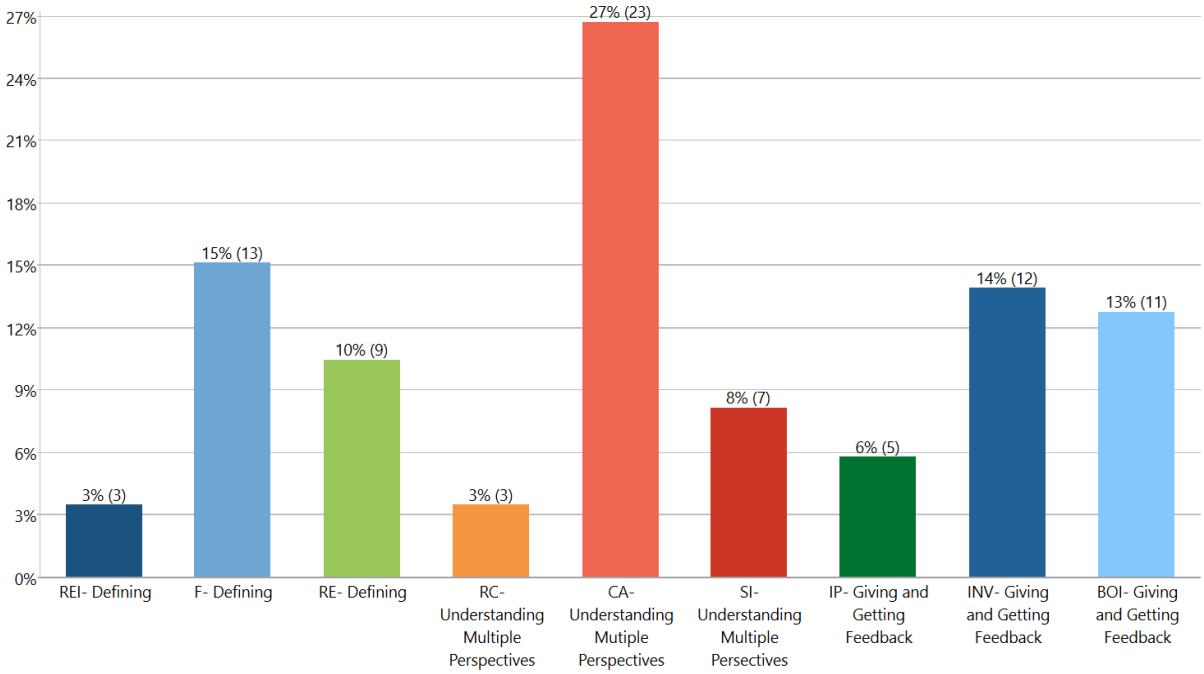


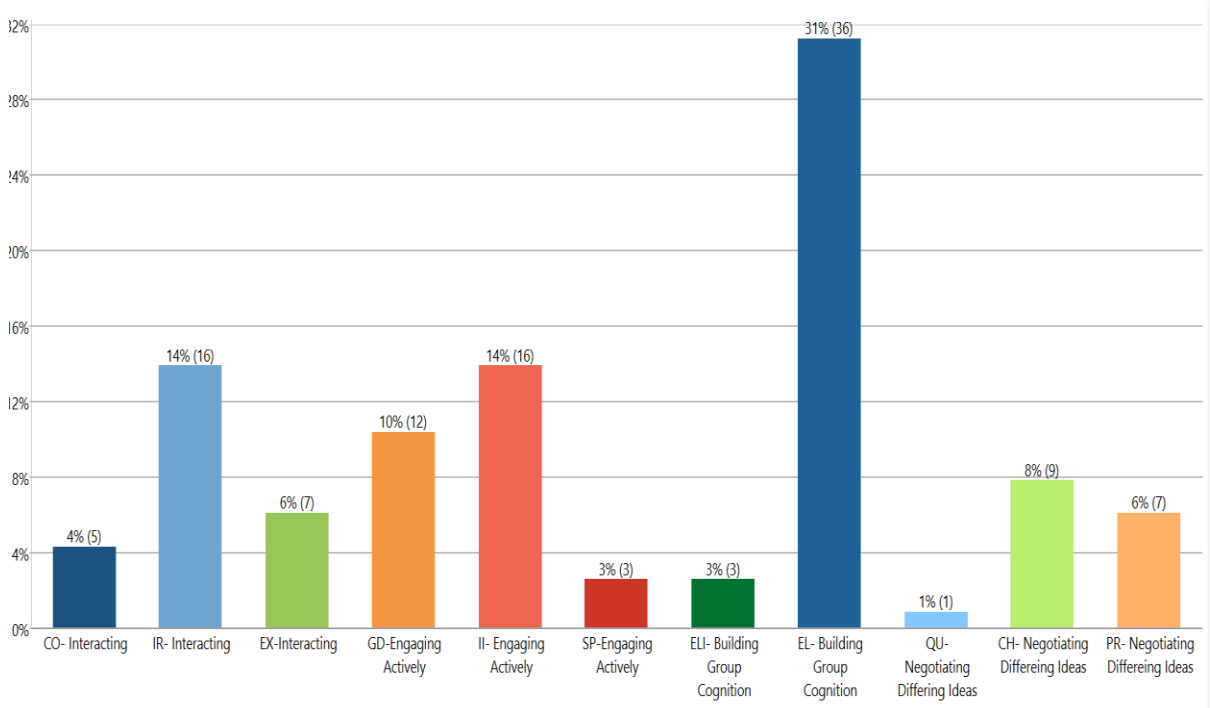
Team GEO Articulation Assignments 3-5



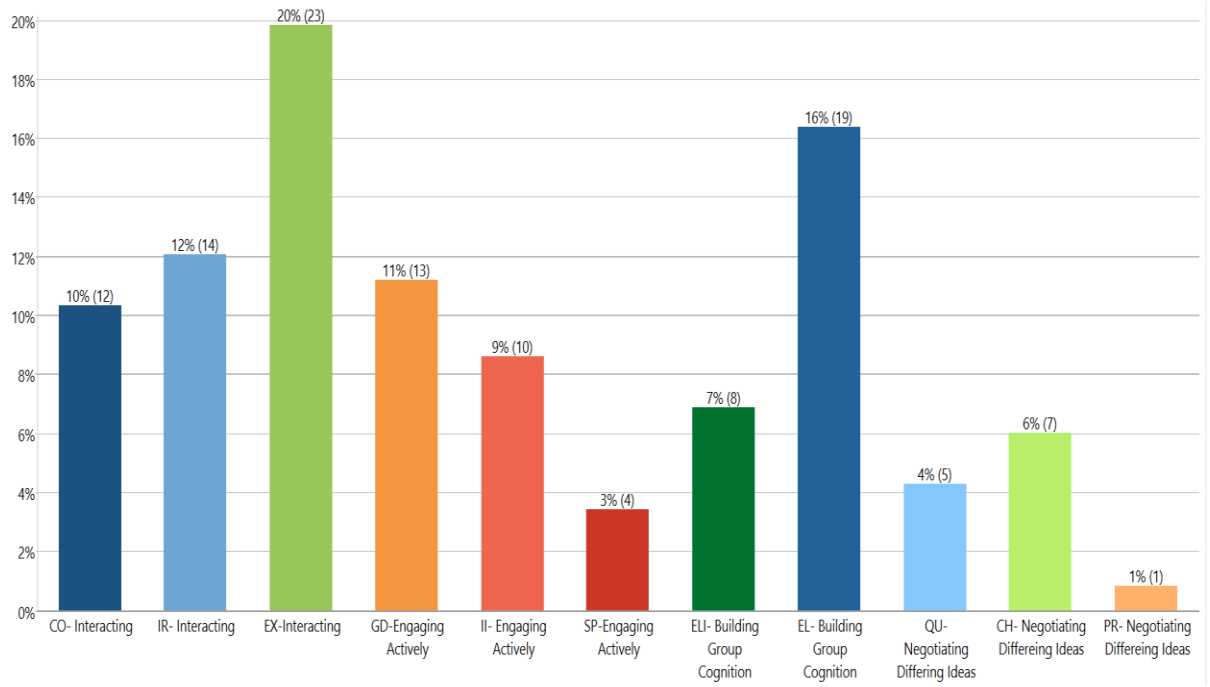
Team SEL Articulation Assignments 3-5



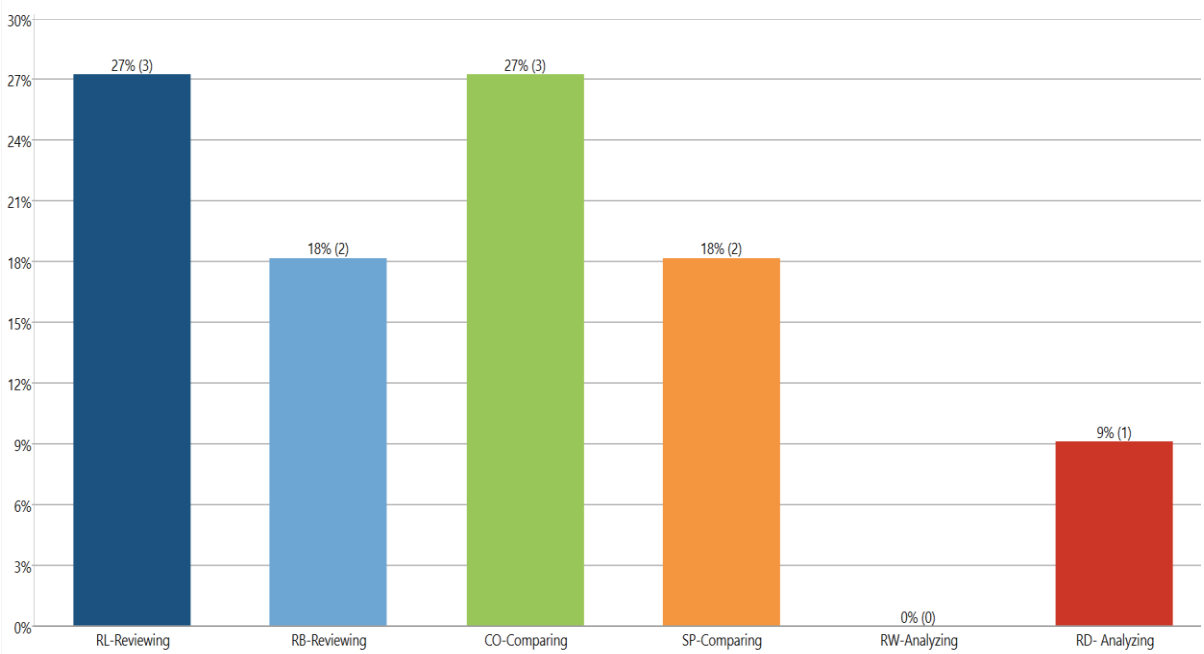
Team GEO Collaboration/Social Negotiation Assignments 3-5



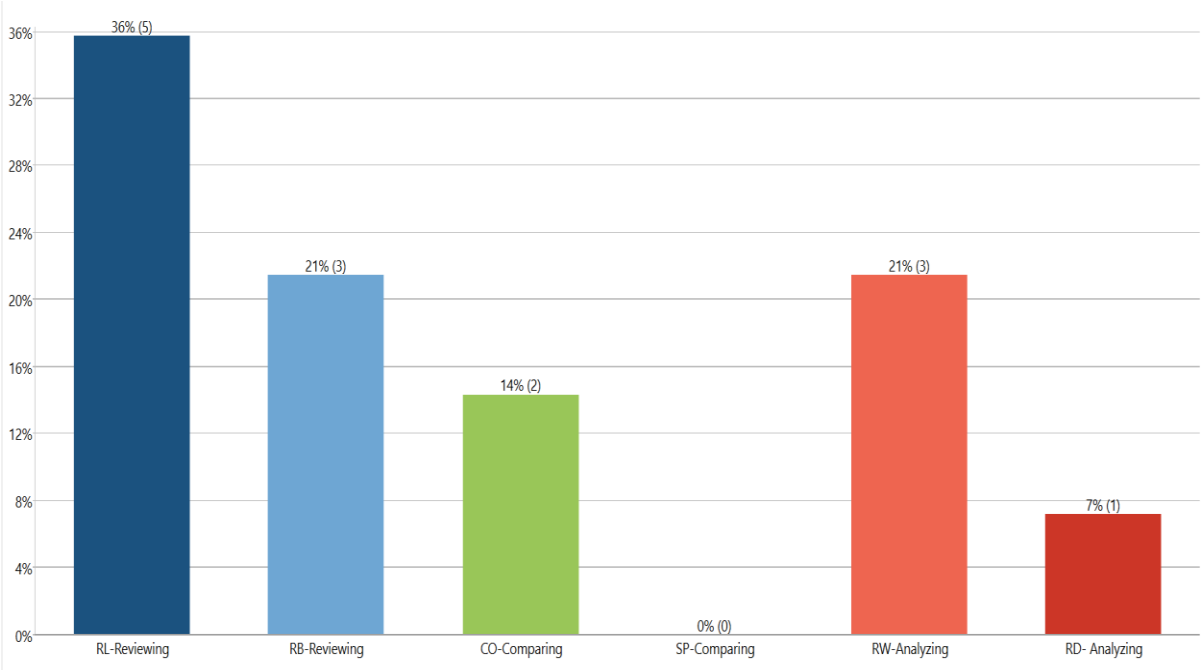
Team SEL Collaboration/Social Negotiation Assignments 3-5



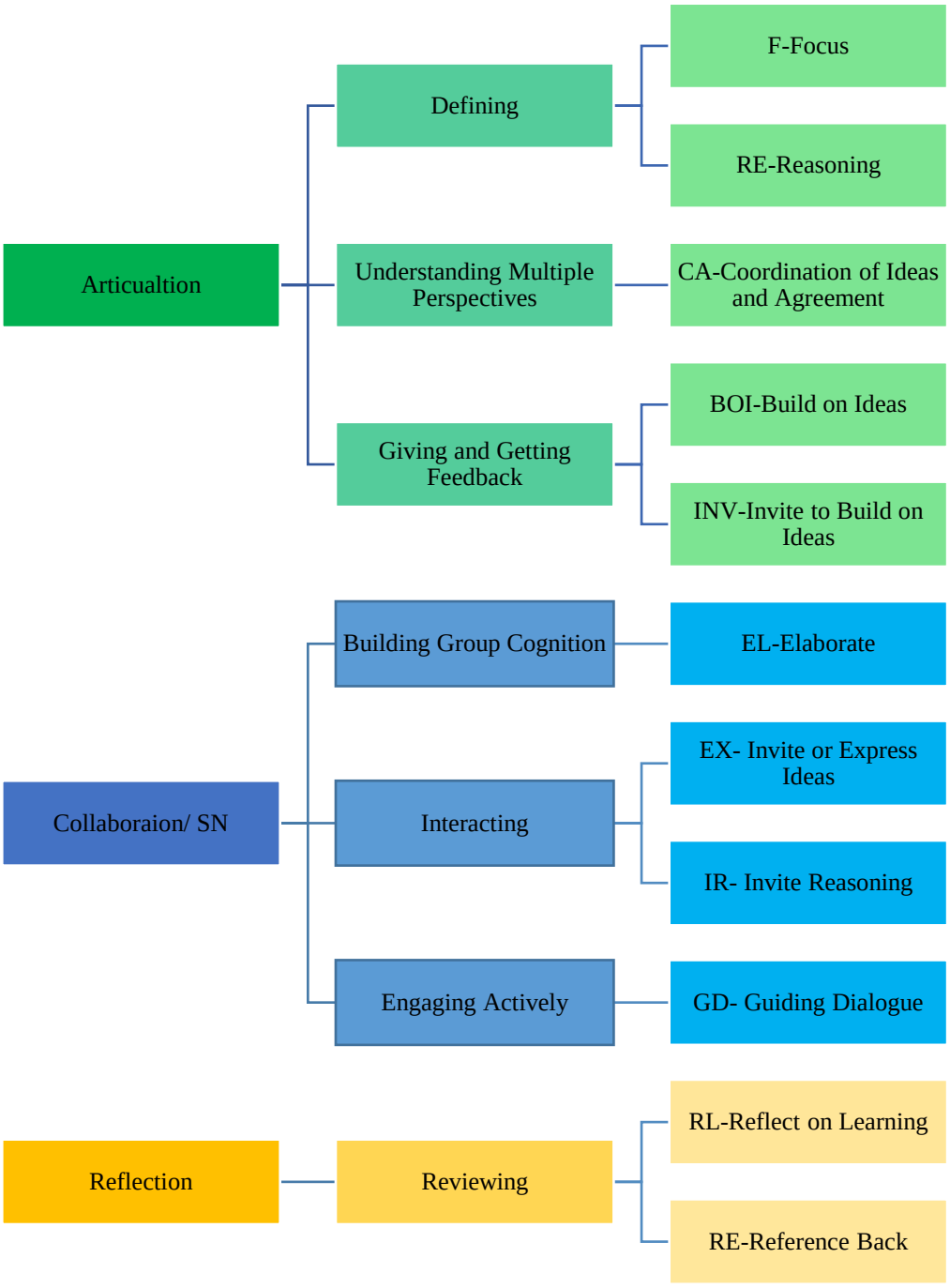
Team GEO Reflection Assignments 3-5



Team SEL Reflection Assignments 3-5



Appendix K: Shared Teams Sub-Categories and Criteria Among 3 IDS Activities



Vita

Michele Meinke Kroll returned to her alma matter in 2016, where she began working towards the PhD terminal degree in the School of Information Sciences and Learning Technologies (SISTL) at University of Missouri, Columbia. Beginning in 2013, she started her journey with the Online Educator certificate and then earned an EdS in Learning Technologies and Design. Her 8-week capstone course was titled: 'Educator Game-Based Methods and Strategies for Training and Education.' Michele's research interests include meaningful online learning pedagogy and using Social VR and other collaborative discourse applications to increase motivation, collaboration and knowledge in online higher education learning environments.

While a part of SISLT, she served as Ambassador for 2 years, and assisted teaching professor, Jane Howland in several graduate SISLT online courses creating interactive modules using Articulate Storyline for Blooms Taxonomy, ISD models and learning analytics. Michele also designed an undergraduate course for SISLT 7310 Agile Project Management. She was an intern for the (Information Experience) IE lab in 2018 and served on the Serious Games and Simulation Design certification committee. Michele's independent research project was published and gained readership due to an article from Mizzou News Bureau by Cailen Riley, 2018, "Your Social Circle Stymies Your Fake News Radar" https://www.futurity.org/group-dynamics-fact-checking-1870822/

Jahnke, I., & Kroll, M. M. (2018). Exploring students' use of online sources in small groups with an augmented reality-based activity–group dynamics negatively affect identification of authentic online information. *Heliyon*, *4*(6), e00653.

While a part of SISLT, she was selected to serve on the research team for the

LexMizzou Project, which conducted several research projects. These projects resulted in poster sessions and several publications. The research was presented at the Association of Educational Communications & Technology (AECT) at the National Conference in Kansas City, Missouri in October 2018.

Jahnke, I., Meinke Kroll, M., Todd, M., & Nolte, A. Exploring Artifact-Generated Learning with Digital Technologies: Advancing Active Learning with Co-design in Higher 279 Education Across Disciplines. Technology Knowledge and Learning (2020). https://doi.org/10.1007/s10758-020-09473-3

She presented these posters and presentations:

2018, AECT- Co-Designing for Learning with Technology-Experience From a Project for Non-IT Students (Research Presentation)

2018, AECT- Effective Design of Online Courses Promoting Meaningful Learning (Round Table)

2018, Developing a Community Heritage Tourism App- Hermann Heritage Project (Presentation)

2017, GLS Conference-Beyond the Campus Walking Tour: An Augmented Learning eXpedition (Poster)

2016, Mizzou Research Day- Beyond the Campus Walking Tour: An Augmented Learning eXpedition (Poster)

Outside of the SISTL PhD program, Michele is a full-time working professional. She currently is a Behavioral Health and Well-Being Field Specialist at University of New Hampshire Extension working with UNH Occupational Therapy faculty and UNH Telehealth Center to unite community residents, providers, faculty, and students through accessible and effective VR-based telerehabilitation. She has also developed an online dashboard assessment for the 8 dimensions of wellness that participants receive a real-time result based

polar chart and activity reflection guide. Michele currently teaches several online courses including Mental Health First Aid, Intro to Telehealth and Boost Your Brain and Memory.