Reflective Experiential Learning: Towards Improving the Communication Skills of Software Engineering Students using Active Video Watching

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ABSTRACT

Communication skills are a key competency for software engineers, as they spend a significant amount of time communicating with various stakeholders. Teaching communication skills in a conventional educational context is resource intensive. The university institutions and instructors may lack the capability and resources to provide adequate guidance, feedback and engagement to each student. Today, video-based learning is widely utilised in both formal education and informal learning in a range of settings, and it is regarded as one of the most important tools for creating engaging learning environments. Numerous studies indicate, however, that for students to learn effectively while watching videos, they must engage actively with video content. Therefore, this study employs Active Video Watching (AVW) via AVW-Space to facilitate engagement and teach software engineering students face-to-face meeting communication skills. With reference to the online training, I assess the students' experiences with AVW-Space and the effectiveness of AVW as a reflective strategy for teaching the communication skills. The findings of this study show that only students who commented on videos and rated other students' comments (constructive learners) increased their conceptual knowledge of meeting communication skills, whereas those who were less engaged with the learning materials (passive and active learners) did not. Students noted some difficulties with commenting on videos and rating comments in AVW-Space, which led to recommendations on further improvements to the platform. Overall, the students were enthusiastic about the opportunity to engage in the online training, which allowed them to reflect on prior experiences and learn from their peers, confirming the effectiveness of AVW for learning of soft skills.

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CHAPTER 1

INTRODUCTION

This chapter describes the thesis background in order to provide an overview of the thesis purpose and how it is expected to contribute to the expansion of the education methodologies used in training software engineers to become efficient communicators during face-to-face meetings. This chapter develops the thesis statement of problem, which serves as the primary foundation for this thesis. It then discusses the significance of the thesis and finally, the chapter summary is presented.

1.1 Background

Communication skills are regarded as critical competencies in a wide variety of occupations, and they are recognised as a core skill in software engineering (SE) (Ahmed et al., 2012; Matturro et al., 2019). Iksan et al. (2012) defined communication as the process of transmitting information from the person who provides the information to the person who receives it and provides a feedback, using verbal and non-verbal methods. Similarly, Fatimayin (2018) described communication as interacting with another person, whether near or far, face to face or by telephone calls or text messages, body language, and signals. Although communication proficiency is not the sole focus of the SE profession, given that one of the critical responsibilities of software engineers is to interact with a variety of stakeholders and in teams, the importance of communication competence in the software development discipline is amplified significantly (Werner et al., 2017). As a result, strong communication skills are critical in the SE profession and education (Eggleston & Rabb, 2018; Ruff & Carter, 2009). Garousi et al. (2020) identify communication ability as one of the top three critical skills for the SE industry in a systematic evaluation that included 33 studies from around the world. Passow and Passow (2017) emphasise the importance of communication proficiency as one of sixteen generic proficiencies required of specialists (software engineers) in the industry. Furthermore, the authors observe that software engineers spend a large portion of their working hours (between 55% and 60%) talking with various stakeholders. These findings support those of Sageev and Romanowski (2001), who examined the employment experiences of recent SE graduates nearly two decades ago. According to the researchers, software engineers spend 64% of their time communicating verbally or in writing. In another survey involving practicing software engineers, practitioners emphasise the importance of communication as one of the fundamental skills necessary in their jobs, alongside problem-solving and teamwork (Watson & Blincoe, 2017). Darling and Dannels (2003) assert that the software development business is an oral culture in which communication is not limited to formal public speaking. As a result, software engineers must be proficient in spoken communication in a variety of contexts, including meetings, face-to-face encounters, conflict resolution, and negotiation (Wisniewski, 2018).

Almeida et al. (2019) report that face-to-face communication amongst software engineers occurs frequently and is mostly related to team collaboration and meetings. Face-to-face communication facilitates effective communication by allowing both the speaker and listener to see and interpret body language and facial expressions and provide a feedback to the subject matter. According to Indeed Editorial Team (2021), despite the advancement of technology, many organisations continue to prefer face-to-face meetings since they promote more effective communication, contribute to the development of strong connections, and increase engagement. Norback et al. (2009) emphasise the importance of meetings in the SE workplace as the primary context for face-to-face communication. Additionally, they add that other types of meetings occur often in the sector, most notably progress report meetings, which are typically used to engage and align specialists' (software engineers') work with the organization's objectives. The authors argue that SE practitioners must exhibit certain communication skills in order to contribute to and succeed in these interactions. According to Almeida et al. (2019), the oral communication abilities required for the workplace are proficiency in face-to-face meeting interactions, dyadic interactions, interpersonal communication, and negotiation. Although the literature demonstrates the importance of face-to-face communication skills in SE activities (Ruff & Carter, 2009; Sageev & Romanowski, 2001), teaching these abilities to university students is problematic due to the additional effort and resources required (Anthony & Garner, 2016). Typically, soft skills are taught as part of a software development project course (Marques et al., 2018). Therefore, students must learn how to transfer the learning to other contexts, as well as how to receive and reflect on feedback, in order to retain and use the skills in their future employment. Instructors struggle to deliver this additional instruction effectively due to the curriculum's already full and demanding nature (Harichandran et al., 2014).

Video-based teaching is an effective virtual learning media because it successfully captures and delivers information while also offering an exciting learning environment in which students may more easily comprehend and remember information (Fern et al., 2002). Video-based education is particularly advantageous for teaching soft skills, since knowledge retention requires contextual experience (Cronin & Cronin, 1992; Mitrovic et al., 2017). While videos are a widely popular kind of educational media, students are typically passive when watching them. To effectively learn from videos, students must actively engage with the instructional information (Chatti et al., 2016; Chi & Wylie, 2014; Cronin & Cronin, 1992). This study adopts an Active Video Watching (AVW) technique to completely engage SE students during meetings in order to facilitate efficient communication. To enable the learning process using the AVW technique, we utilized the Active Video Watching (AVW-Space) system which has been employed in other studies (Dimitrova & Mitrovic, 2021; Lau et al., 2016; Mitrovic et al., 2016; Mitrovic et al., 2017). AVW-Space is a video-based online learning platform dedicated to the teaching of transferrable skills (Mitrovic et al., 2016). It can be customised by the instructor, who establishes a list of aspects that act as scaffolds for learning through the use of videos (Mitrovic et al., 2017). The AVW-Space system was initially created to evaluate the efficacy of using the AVW technique to teach soft skills (Mitrovic et al., 2017). This platform capitalises on students' prior experience commenting on videos on social media platforms (such as YouTube and Facebook) and combines it with interactive note writing during video viewing to increase student engagement with learning content (videos) and self-reflective learning (Chatti et al., 2016; Mitrovic et al., 2017). AVW-Space enables educators to construct spaces directly within the platform by embedding YouTube videos. Previous research has established AVW-Space's efficacy in training soft skills (Mitrovic et al., 2017; Mitrovic et al., 2019). However, no research effort has been made to explore the effectiveness of AVW on SE students' face-to-face meeting communication skills training and how it can aid them in successful software development projects. As a result, this thesis makes an effort to expand the communication education methodologies used in software engineering programmes by employing AVW technique as a strategy for improving SE students' face-to-face meeting communication skills.

1.2 Statement of Problem

Given the vital significance of software in modern society, there is a pressing demand for more qualified software professionals to be educated (Assyne et al., 2022). When graduates of computer science and software engineering begin their careers in the software industry, they do not always possess the requisite skills, abilities, or knowledge (Radermacher et al., 2014). Lack of these abilities and expertise can constrain newly recruited, recent graduates' productivity or perhaps prohibit them from finding work. According to some, the software engineering shortage is not a matter of quantity; it is a matter of quality - a dearth of well-studied, experienced engineers with a formal and profound understanding of software engineering and a dearth of soft skills and workplace competencies are cited as the top five challenges for hiring software engineers (Baker, 2017). Various software engineering university programmes evolved from computer science programmes and thus continue to place a strong emphasis on theoretical and technical computer science topics as well as mathematical foundations, which appears to create a disconnect between the skills acquired during university education and those required in practice (Vahid Garousi et al., 2020). The software industry is growing in importance as a sector of the economy in countries that recognise the critical nature of educating future software engineers in order to maintain a flourishing software industry (García-Peñalvo et al., 2021). As a result, a growing number of engineering programmes have recognised the importance of exposing their students to soft skills at the university level. However, the method for incorporating these abilities remains a challenge, as engineering professors may struggle to manage the various curriculum demands they confront (Oguz & Oguz, 2019). Despite efforts to integrate their curricula with contemporary market requirements, engineering programmes continue to face criticism for placing an excessive emphasis on technical abilities while neglecting non-technical skills (Itani & Srour, 2015; Oguz & Oguz, 2019). According to Zorić & Stojanov (2018), less experienced software engineers regard soft skills as being unrelated to programming abilities, and more experienced software engineers view these skills as being unrelated to techniques and technology. This is likely a reflection of the university's insufficient emphasis on the acquisition of these abilities. As a result, these software engineers overlook the critical nature of these soft skills in comprehending user requirements and maintaining regular interaction with project team members, managers, and other stakeholders.

A continuous exchange of information between team members is required to ensure the success of a software project. Meetings facilitate this information exchange by allowing team members to discuss information concurrently with the rest of the team (Prenner et al., 2018). Communication is a critical part of software development projects because it enables the constant sharing of information (Klünder et al., 2017; Marjaie & Rathod, 2011). Inadequate communication can result in the failure of a project, as critical information such as change requests or design decisions can be lost (Kluender et al., 2017). Ambler (2002) stated that the most effective mode of communication is face-to-face, that is because the best architectures, needs, and designs arise from self-organizing teams that communicate face-to-face and business people and developers need to collaborate on a daily basis (Lindsjørn et al., 2016). Meetings provide intense and effective face-to-face communication because a large number of team members are present and can easily receive a large amount of information (Schneider et al., 2015). Meetings are an integral aspect for structuring a project and ensuring a smooth flow of information (Schwaber & Beedle, 2001). Team meetings, on the other hand, are frequently less successful than anticipated because of poor communication approaches, for example, teams lose concentration, people interrupt one another, and sessions go too long (Kauffeld & Lehmann-Willenbrock, 2012). One significant barrier to productive and fulfilling meetings is improper behaviour such as complaining which points toward lack of proper communication skills among team members (Kauffeld & Meyers, 2009; Klünder et al., 2020). For instance, discussing difficulties without making an attempt to resolve them dampens the team's motivation and attitude (Prenner et al., 2018). In meetings, reflective and interactive analyses enable the assessment of suitable and inappropriate behaviour that affect the meeting's quality. As such, the present research adopts an AVW platform to train SE students about appropriate communication strategies for face-to-face interactions with other team members during a software development project through the use of interactive and active engagement activities (commenting on videos and rating other participants' comments). This research also focuses on gathering and evaluating the students feedbacks on the challenges encountered during team meetings and their experiences with AVW-Space. These evaluations will aid in the development of appropriate solutions for resolving any issues preventing SE from conducting successful face-to-face meetings.

Numerous initiatives have integrated interactive elements (such as quizzes and collaborative annotation) into video-based learning in order to increase student engagement (Chatti et al., 2016; Xia & Wilson, 2018; Yoon et al., 2021; Yousef et al., 2014a). While these strategies boost student engagement, they take considerable effort on the part of instructors during the creation of video content and also necessitate the use of advanced learning tools. This thesis strategy intends to extend Mitrovic et al.'s (2017) empirical findings by examining the effect of AVW on SE students' learning engagement and overall impact on their face-to-face meeting communication skills. Even though videos are an effective teaching tool in online training courses, students frequently struggle to maintain their attention and absorb the subject while watching videos (Tseng, 2021). This thesis adopts aspects in the form of micro-scaffolds to frame students' comments about face-to-face meeting communication skills, to strengthen their concentration on important concepts and to encourage engaged reflective learning. Accordingly, the main objectives of this thesis are to determine the experiences of the participants with AVW and the effectiveness of AVW as a reflective strategy to teach face-to-face meeting communication skills. Therefore, this thesis aims to address the following research questions (RQs):

RQ1: *How much did the students learn from their experience with AVW?*

RQ2: *What were the students' perceptions toward AVW-Space?* (*Did they experience any challenges and was the AVW-Space useful for learning?*)

RQ3: *Did participation in AVW Experiment improve students' meeting communication skills?* (*Were the team recordings during meeting useful for learning?*)

1.3 Significance of the Thesis

As a result of globalisation and rapid technological innovation, scholars and employers agree that engineers in the twenty-first century must possess a variety of skills (e.g., teamwork, communication, and management) that were previously undervalued (Vahid Garousi et al., 2019; Radermacher & Walia, 2013). Therefore, numerous education institutions have begun to alter their curricula in order to graduate well-rounded engineers and to ensure that SE education activities are most closely aligned with industrial needs (Garousi et al., 2017; Garousi et al., 2019). To contribute to the literature on students' engagement in online learning for soft skills acquisition, we adopted an online AVW-Space to assist second-year software engineering students at the University of Canterbury in New Zealand in acquiring necessary soft skills through interactive and reflective learning approaches for effective and efficient communication and collaboration during their face-to-face project meetings. Additionally, this thesis investigates SE students' feedback regarding the use of writing comments on videos while evaluating the overall success of the online training. It is evidenced that engineering faculties struggle to integrate soft skills training into their curricula due to the importance they place on hard skills (technical abilities) over soft skills (Miller, 2017) and software engineers are expected to manage projects and make decisions in a variety of circumstances. Therefore, they must develop soft skills in addition to technical abilities in order to fit effectively into this rapidly changing professional world (Rao, 2014). These assertions reinforce the need for this thesis as an effort to contribute to the ongoing studies on effective strategies for soft skills transfer.

Furthermore, Accreditation Board for Engineering and Technology [ABET] (2021) identifies one of the essential criteria for evaluating engineering education as preparing students for engineering practice. ABET expects students to demonstrate non-technical or well-rounded skills, such as good communication, teamwork, and an understanding of the social, political, economic, and global contexts in which they operate and the impact of their work in these contexts. While ABET recognises the importance of non-technical skills and knowledge acquisition in engineering education, it does not designate a specific set of soft skills on which engineering programmes should focus. Because the primary objective of engineering education is to prepare engineers for professional practice, university engineering departments must consult industry to ascertain the soft skills that employers desire from entry-level engineers (newly hired engineers) and whether employers are satisfied with the soft skills demonstrated by these new hires. Accordingly, this study evaluates and reports on industry assessments of specific soft skills, such as interpersonal communication in face-to-face meetings. The thesis findings should enable engineering education programmes to be more responsive to industry demands for non-technical entry-level skill competency.

1.4 Chapter Summary

This chapter described the thesis background and the concepts (soft skills, face-to-face communication skills, meetings, AVW, and AVW-Space) under consideration, as well as the practical and empirical gaps that inspired this research. This chapter discussed the importance of effective communication skills in software engineering and the difficulties associated with training these engineers. Following that, this chapter highlighted the main objectives of the thesis and the research questions to be addressed. The scope of the thesis was emphasised, as well as some discussions from previous studies that strengthened the significance of this thesis. The remainder of the thesis is organised in the following manner. Chapter two explores pertinent literature on important topics that underpin the thesis theoretical basis. Chapter three presents the stages of meeting communication scale development, while Chapter four describes the thesis experimental design procedures and the data analysis aimed at addressing the RQs. Chapter five presents the discussion of findings and the sixth chapter summarizes the thesis contributions, limitations, and future research directions.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents a detailed review of relevant literature with regards to different research perspectives to support the thesis. Specifically, Section 2.1 covers the introduction which acts as a guide to what other sections cover, Section 2.2 presents the concept of soft skills. Section 2.3 discusses the concept of communication followed by software engineers and communication challenges in section 2.4, and software engineering communication skills requirements in section 2.5. Section 2.6 discusses oral communication, Section 2.7 presents conceptualization of face-to-face meeting communication. The remainder of the chapter includes academic interventions to improve communication skills in software engineering in Section 2.8, videos in education in Section 2.9, Active Video Watching (AVW) approach in Section 2.10, and operationalization of the ICAP (interactive, constructive, active, and passive) framework for AVW in Section 2.11. Finally, Section 2.12 gives general summary of the sections discussed in Chapter 2.

2.2 Concept of Soft Skills

In general, skills refer to abilities that individuals gain through effort or training over time and always include an element of execution or performance (Matteson et al., 2016; Touloumakos, 2020). Unlike technical knowledge or skills which require training and practice to master, the term 'soft skills' is informally used in literature to refer to a diverse variety of personal attributes, traits, attitudes, and behaviours (Robles, 2012; Touloumakos, 2020). In contrast to technical ability or knowledge, Parsons (2018) defines soft skills as character qualities, attitudes, and behaviours that enhance a person's interactions and job performance. They are the intangible, non-technical, and personality-specific abilities that define an individual as a leader, facilitator, mediator, or negotiator. Soft skills research is conducted in a variety of fields, including labour economics (Deming et al., 2017); employability, workforce development, and human resource development (Autor, 2015; Hirudayaraj et al., 2021); management and communication (Jones et al., 2016; Robles, 2012); and industry or subject-specific literature, including information technology (Aasheim et al., 2009; Kappelman et al., 2016); science, technology, engineering, and mathematics [STEM] (John & Chen, 2017), or library and information science (Matteson et al., 2016). According to the majority of research, soft skills are synonymous with people skills, or the capacity to get along with and work effectively with others (Doyle, 2020; Jalil et al., 2021; Pandey & Anand, 2020; Robles, 2012). However, soft skills encompass more than interpersonal abilities (such as good communication, teamwork, and cooperation) required to interact with others (Robles, 2012; Touloumakos, 2020). Additionally, the term ‘soft skills’ encompasses intrapersonal elements (individual abilities such as adaptability and self-regulation), personality traits (for example, agreeableness, conscientiousness), and attributes (for example, confidence, resilience); and it spans both the cognitive (for example, analytical ability, decision-making) and affective (for example, active listening, empathy) facets (Touloumakos, 2020; Matteson et al., 2016).

Job seekers nowadays encounter numerous obstacles in today's competitive labour market. According to Mitchell et al. (2013), firms view human capital as vital to their performance and make concerted attempts to hire the best applicant. Technical expertise in the field or profession, as well as soft skills, are desirable characteristics for such applicants. This means that soft skills are becoming increasingly crucial to graduates' employability and a company's success. Concerning graduate quality, Nghia (2019) notes that limitations in soft skill development by university are regarded as one of the most significant impediments inhibiting university graduates from making a seamless transition to the workforce. Furthermore, numerous academic experts and researchers concur that the gap between expected and actual soft skills is widening (Kenayathulla et al., 2019; Patacsil & Tablatin, 2017; Sujová et al., 2021). Concerns about a shortage of soft skills among engineers and engineering graduates have gained prominence in the recent decade (Hirudayaraj et al., 2021). Recognizing the needs of rapidly changing and globally dispersed work environments, IBM (International Business Machines Corporation) recommended that technical education in the twenty-first century should focus on developing "T" shaped individuals who are not only well-versed in their field of study but also capable of demonstrating knowledge across disciplines and the ability to collaborate (Beyond IT, 2009). More recently, in its exploration of the future direction of STEM education, the STEM connector's Innovation Task Force [SITF] emphasised the importance of enabling students to master the context, which requires the ability to work in teams, demonstrate business acumen and leadership abilities, and be able to "navigate across global organisations" (SITF, 2014).

2.3 Concept of Communication

The process of sharing knowledge and common understanding from one person to another can be defined as communication (Keyton, 2011). Markovic and Salamzadeh (2018) defined communication as the act of transmitting a message through several means; it can be spoken or nonverbal, formal or informal, as long as it conveys a thought-provoking concept, gesture, or action. The term "communication" comes from the Latin word "communis," which means "common." Thus, "communicating" refers to the act of "making common," "making known," or "sharing," and it encompasses spoken, non-verbal, and electronic modes of human connection (Velentzas & Broni, 2014). The term emphasises the fact that communication is impossible without the emergence of a shared understanding as a result of the exchange of information (Cheney et al., 2011). This act of making common and known is accomplished by the exchange of opinions, ideas, and the like. When people discuss a subject, talk on the phone, or exchange information via letters, they are said to be communicating (Alawamleh et al., 2020). Communication, whether written or spoken, is fundamentally the sharing of information (Velentzas & Borni, 2014).

Effective communication is viewed as an acquired transferable skill. While the majority of people are born with the physical ability to speak, we must learn to speak clearly and communicate successfully. Speaking, listening, and our ability to comprehend verbal and nonverbal meanings are all acquired skills. Message recipients must be able to decipher the sender's intent, consider the message's context, resolve any misunderstandings, appropriately decode the information, and decide how to act on it. These abilities are necessary for learning, developing healthy relationships, cultivating a sense of community, and achieving professional success (Ihmeideh et al., 2010). The overwhelming majority of software engineers work as part of a team (Iqbal et al., 2019). As a result, they frequently communicate with technical or non-technical co-workers and clients via in-depth talks about software requirements, design, and implementation in order to complete their jobs. Clearly, communication skills are a critical component of a software engineer's skill set. Liu et al. (2005) suggest that undergraduate computer science students, many of whom would pursue careers as software engineers after graduation, receive insufficient training in collaboration and communication skills, particularly in the context of computer science curriculum and projects. As a result, many computer science students underestimate the value of communication and lack adequate communication skills, particularly when compared to industry requirements (Beaubouef, 2003; Riemer, 2007).

2.4 Software Engineers and Communication Challenges

Software engineers are facing some communication challenges in this new era of globalisation. Scott and Billing (1998) stated that although software engineers are perceived as intelligent and well-educated professionals, they have problems with communicating their ideas in public, which sometimes lead to misunderstanding and disregard of their ideas by the general audience. Tenopir and King (2004) stated that some software engineers are not well-skilled communicators, and this can affect their capabilities to design high-quality software. Al-Rawas and Easterbrook (1996) found three significant communication barriers faced by software engineers, which are communication channels ineffectiveness, restrictions on expressiveness by notations, and organisational and social barriers. Gunn (2013) is of the view that reporting the communication inadequacies of software engineers is not solely sufficient, that software engineering institutions need to inspect and identify the actual insufficiencies and interests of the affected parties (software engineering industries). Gunn (2013) surveyed both software engineering students and faculty to understand the communication insufficiency that exists among software engineers. The study observed several areas of concerns which are poor oral skills, unclear expression of ideas, spelling, grammar, trouble with writing, weak logic and lack of organisation. Similarly, Ford and Teare (2006) affirmed that there are several insufficiencies in software engineering students' communication performance that were revealed in a four-year course using the capstone design program as a technique to improve the students' communication skills. It was perceived that students had difficulties explaining a bigger picture of their tasks or projects, they have trouble speaking and thinking about system specifications, and providing appropriate materials to the target audience. Besides, software engineering students also struggle to choose content and pair it with fitting information in shorter presentation timeframe, to deliver a good background at the start of a presentation, and to organise the components of a presentation.

In a comparative survey of software engineering students and practitioners, students were reported to have trouble with sentence structuring, choosing an accurate word, grammar and punctuation errors (Conrad, 2017). Besides, software engineering students were found to have issues in genre expectations, poor language skill, and fail to recognise that calculation descriptions are crucial. Furthermore, Wren (2018) stated that the communication issues faced by software engineering student are caused by the deficiency of writing experience which includes text knowledge (e.g. text structure, genre, and distinguishing between interpretation and description). Likewise, several well-known communication skills challenges demonstrated by software engineering students during projects design presentations were indicated by Soto-Caban et al. (2011) as they identified difficulties like lack of practice or preparation, inadequate usage of presentation tools or software, putting excessive information in a single slide, improper use of graphical contents, and presenting while reading from handouts or slides. On top of understanding the challenges of communication skills faced by inexperienced software engineers, it is necessary to determine the required communication skills they will need in order to excel in their professional careers. Software engineering graduates require more than technical expertise. They must possess the non-technical skills (such as communication abilities) to work with multidisciplinary colleagues effectively (Wisniewski, 2018). Therefore, communication skills are essential requirements in the education of engineering students to facilitate not just students' education but also to prepare them for their future careers.

2.5 Software Engineering Communication Skills Requirements

Software engineering industries have some expectations in terms of communication competencies from recent software engineering graduates. Technical skills are not the main factors in hiring developers in the software industries, and this is the reason why interviewing has been part of the hiring process to evaluate the communication skills of the potential applicants (Ahmed et al., 2013). Troy et al. (2014) highlight the abilities that define a competent communicator in the field of software engineering as the ability to deliver technical designs specification in oral, written, and graphic format to various kind of audience either their colleagues or other stakeholders with no exposure of software engineering knowledge. The authors are of the view that these abilities are required to enable software engineers to deliver and present their tasks effectively and efficiently. Norback et al. (2010) describe some communication necessities that executives expect from software engineering graduates such as appropriate task description and expression of ideas, excellent communication with executives staffs in the organisation, practicing and delivering a high-quality presentation comprising suitable graphical and written materials, choosing the best medium of communication in any given situation, the effectiveness of face-to-face interaction, and effective communication with people regardless of cultural background.

Wisniewski (2018) compiled three characteristics of practical software engineering communication from the viewpoints of software engineering managers which comprise the capability:

1. To interact with various audiences (supervisor, engineer, sales, receptionist, customers and vendors) by addressing the audiences' requirements and using their preferred communication medium (such as via e-mails, text messages, graphics, face-to-face, reports and memo).
2. To use communication strategies by using suitable message structures and focus, applying precision, briefness, and professional tones.
3. To implement interpersonal communication skills by confidently presenting ideas and interacting well as a member of a team.

Furthermore, the author found some areas of communication skills in software engineering, which can be developed from the perspective of executives. First, providing a more prominent background picture of the project before explaining technical aspects for both written and oral communication. Software development practitioners need to supply a bigger picture of the project by telling a story. Second, visual material needs to be developed clearly in a manner which comprises the consciousness of the audience (internal and external), strength to the point, and using the suitable slang conventions that are understood by everyone. Third, deliver appropriate content, confidence and assertiveness at meetings, application of interpersonal skills, energetic when finding and sharing information, and initiation of discussion with proper etiquette usage by e-mail or in person. Fourth, increasing communications with the downstream audience (for example, receptionists, operators and technicians) as software engineers are bound to communicate with various levels of professionals, these engineers need to acquire strategies to manage and settle interpersonal disputes or conflicts (Wisniewski, 2018).

According to Patil (2014), there are three vital requirements for effective communication which are: First, subject competence; software engineers should possess the suitable information in a specific subject matter which can be technical or professional skills. Second, is the linguistic, which refers to the possession of adequate language skills and the capability to deliver facts or materials clearly and accurately. The last requirement is the organisational competence which is the capability of establishing the technical information in a logical and organised way that includes a process of thematic and logical organisation. Knisely and Knisely (2015) observed that software engineering communication activities could be categorised into two types which are: technical writing (such as, paper writing, e-mails, requirement gathering reports, usability test reports, user manuals, corporate letters, proposals, interface design report, and literature reviews); and oral communication (such as, conversation while participating in meetings, face-to-face dialogue, on-the-phone dialogue, and presentation to various audiences).

2.6 Oral Communication

Like many other technical fields, Software engineering acknowledges and investigates the crucial role of oral communication in its educational syllabus (Ruff & Carter, 2009). Dannels (2002) described conversation in software engineering context as the process of translating technical materials into the form that can be easily understood by a non-technical audience. Speaking is also a mechanism to translate design outcomes into graphic information, to interpret the numbers into readable form, or to interpret the design outcomes into a marketable pitch. Dannels (2002) summarised five key characteristics of effective oral communication performance in software engineering: precise, impressive or convincing, goal-oriented, numerically and visually competent. In Engineering Communication, Knisely and Knisely (2015) also listed five universal assumptions for an effective oral presentation. First, the knowledge level of the audience needs to be taken into consideration while preparing the graphics and delivery. Second, there must be a good understanding of harmony between the presenter and the audience while delivering the presentation. Third, the presenter needs to make sure that the presentation is well-organised, engrossed, and intelligible. Fourth, the audiences are pleased and persuaded they had learned new knowledge at the end of the presentation. Fifth, to deliver a successful presentation orally, the graphics must be in a simple form, straightforward and encourage the audiences to focus on the main idea.

Similarly, Knisely and Knisely (2015) highlighted that in an oral presentation, the content tends to be more selective. The authors noted that introduction became one of the essential parts of the presentation since its objective is to catch the attention of audiences. A good opening explicitly describes the motivation, along with the background and objective of the project or subject of discussion (Knisely & Knisely, 2015). They further explained that the speaker follows the opening with the body of the presentation, which are usually precise and comprise the necessary details use to elaborate and support the conclusions. Occasionally the presenter might want to emphasis more on their findings by spending less time on the methodology and more time on the graphical representation of the result (Knisely & Knisely, 2015). In the final section of the presentation, it is customary for the presenter to encapsulate the aims, findings, and conclusion of the project while highlighting the critical points to the internal or external audience (Knisely & Knisely, 2015). Kerby and Romine (2009) provided a list of verbal communication performance during a presentation, which is the use of eye contact, being conscious audience to understand the subject and presenters initiating interaction with the audience. Kerby and Romine (2009) noted that lack of adequate oral communication skills may negatively impact the career advancement or recruitment of a software engineer. In addition, Riemer (2001) stated that the possession of practical verbal communication skills is observed to be an essential factor of career success in the software development industry.

In the exploratory study carried out by Darling and Dannels (2003), the authors reported the vital oral communication classifications for software engineering professionals, types of oral communication skills, the type of audience, and the significance of verbal communication skills. The most notable oral communication classifications identified by the authors are informal or interpersonal interactions, public speaking or formal presentation, training, meetings, and selling. The daily activities of software engineers revolve around these oral communication genres, and the perceived positive outcome of possessing these skills are the advancement of professional career, increase in job performance and instrumental support. Darling and Dannels (2003) also affirmed that software engineers interact with audiences with varied background (technical and non-technical), which are their peers (workmate) in the company, audience that has no exposure in technical skills inside and outside the company, stakeholders, and government agencies. Lastly, the unique implications of oral communication skills are persuasion of the audience, analysis of audience during events, working effectively in a team, and confidently presenting ideas. The scholars are of the view that these abilities are ranked high priority than writing skills in software engineering profession because most of the tasks are done via the communication practice of oral communication than writing communication (Darling & Dannels, 2003). Although official communication activities such as writing reports and public speaking are acceptable approaches to begin practising interpersonal communication skills, other sorts of social skillset such are particularly significant for software engineering graduates in an undeniably multidisciplinary and multicultural workplace (Goldberg, 2006). Hence, professional software engineers are expected to improve and practice a more comprehensive array of interpersonal communication skills. Interpersonal communication frequently involves face-to-face sharing of information in the form of voice, facial expressions, body language, and gestures, and it is commonly utilized within an organisation during every day internal employee communication, client meetings, employee performance reviews, and project discussions (Jouany & Martic, n.d.).

2.7 Conceptualization of Face-to-Face Meeting Communication

Face-to-face communication enables individuals to convey nonverbal indicators that foster team trust, which are not possible through text-based virtual communication channels (Jimenez et al., 2017). Communication between virtual teams is often less frequent than communication between in-person teams (Layng, 2016). It is necessary for teammates to communicate continuously in order to settle disputes and avoid teammate clashes or miscommunication (Rutkowski et al., 2002). According to Ambler (2002), the most effective mode of communication is face-to-face. Schneider et al. (2015) argue that meetings encourage successful face-to-face communication because they bring together a large number of team members and enable them to receive a huge amount of information with little effort. Similarly, Klünder et al. (2017) state that in comparison to other commonly used modes of communication, meetings require relatively little time to transfer a great deal of information. This is why meetings consume a substantial portion of the software development process's time. As Schneider et al. (2015) discovered, face-to-face meetings are associated with project success. The more information that is conveyed during a meeting, the less the team will rely on other modes of communication such as e-mail, phone, or chat.

According to Klünder et al. (2017), information exchange among teams is a critical part of successful software development. For example, needs, design decisions, and guidelines must be communicated to the entire team or to specific team members, and communication is required for information exchange. Additionally, they noted that meetings are an efficient approach for a large group of team members to communicate directly (face-to-face communication). Team meetings are critical because they allow team members to pool their experience in order to explore ideas, make decisions, and initiate change processes (Kauffeld, 2006). To capitalise on this opportunity, a growing number of contemporary firms have instituted frequent team meetings. Team meetings and group talks, for example, are a component of the Continuous Improvement Process (CIP; e.g., Liker, 2006). According to Ravn (2007), meetings gained popularity as a result of the 1960s movement: "Sitting in a circle, waiting your turn to speak, and listening respectfully... were kindergarten to boardroom norms" (p. 4). Kauffeld and Lehmann-Willenbrock (2012) discovered a link between successful meetings and increased team productivity, implying that team meeting methods influence both team and organisational outcomes.

Communication often dominates skill frameworks and is regarded as one of the most critical skill sets for new graduates by employers in industrialised nations (Rosenberg et al., 2012). The skill set encompasses both oral and written communication, as business today expects graduates to communicate online, face-to-face, informally and formally with a multi-cultural and multi-generational audience on a national and international scale (Jackson, 2014). Despite being ranked as the most desired skill set, some believe it is the most inadequate among young graduates (Azmi et al., 2018; National Association of Colleges and Employers [NACE], 2010; Pazil & Razak, 2019). Communication is particularly difficult to quantify since it encompasses a wide variety of academic and professional responsibilities (Allen & van der Velden, 2005) and is interdependent with other abilities, most notably teamwork (Casner-Lotto & Barrington, 2006; Lowden et al., 2011). Oral communication skill set components are deemed less concrete than others, making it one of the more challenging employability abilities to assess (Stone & Lightbody, 2012). While undergraduate self-assessments – such as skill audits – are tremendously important (Hughes & Jones, 2011), these activities must be rated accurately by undergraduates to retain value. In combination with feedback and moderation, an online discourse between facilitators and students about defined benchmark performance should improve the accuracy of self-assessment (Andrade, 2019; Boud, 1989; Hawkins et al., 2012). This may also be beneficial for peer assessment activities, notably the usage of online self/peer assessment tools for analysing teamwork processes in small group settings (see Tucker, 2013).

Jackson and Chapman (2012) identified a competency framework with twenty abilities and forty five constituent behaviours as needed for business graduates. Their methodology was developed following a thorough examination of the literature regarding industry-required competencies for new business graduates (Jackson, 2010). Jackson and Chapman's framework has been contextualised for an undergraduate learning programme in an Australian university that explicitly develops employability skills. The framework defines a communication skill set comprising of five distinct behaviours (one of which pertains to written communication), and the remaining four behaviours comprise the measures for oral communication, which were further refined by Jackson (2014). The face-to-face meeting communication scale was developed in this thesis using the Jackson (2014) framework for oral communication, which measures three dimensions: verbal communication, giving and receiving feedback, and meeting participation. Furthermore, active listening scale was adapted in this study from Mishima et al. (2000) which was originally developed and considered a useful instrument for various mental health programs to assess the person-centered attitude (PCA). Thus, in this thesis, face-to-face meeting communication is operationalized as personal knowledge, perceptions, and assessment of verbal communication, giving and receiving feedback, active listening, and meeting participation or contributing behaviours during face-to-face meetings. The dimensions of oral communication skill set are operationalized in Table 2.1.

Table 2. 1: Oral communication skill set

Behaviour	Sub-behaviour
Verbal communication: Communicate orally in a clear and compassionate manner that is acceptable for various audiences and degrees of seniority.	Language and expression: Capable of communicating complicated concepts fluently and coherently through the use of a broad vocabulary – both general and specialised – and a sophisticated sentence structure. Can adapt language and expression to a wide variety of audiences and situations.
Giving and receiving feedback: Give and receive feedback in a constructive and acceptable manner.	Quality: Frequently provides people with clear, relevant, and helpful feedback. Respect: Consistently shows respect for people and is sensitive to their feelings when delivering feedback.
Meeting participation: Take an active role in meetings in a productive manner.	Contribution: Makes numerous recommendations, needs, and personal feelings known. Inspires others to make similar contributions. Value: Advocates for the importance and value of talks and small group interactions. Attendance: Does not require meeting reminders. Attends all meetings on time, if not ahead of schedule (except for exceptional circumstances). Takes a lead role in meeting preparation and implementation.
Active Listening: Demonstrates superior listening capabilities.	Listening: Exhibits superior listening abilities. Interrupts people cautiously and ensures that all participants have an opportunity to contribute to discussions.

Source: Jackson (2014) and Mishima et al. (2000)

2.8 Academic Interventions to Improve Communication Skills in Software Engineering

Software engineering educational researchers have made various educational efforts to improve the communication skills of prospective software engineers and active software engineers. Riemer (2007) argue that technical competence is not the only competence software engineering employers seek in graduates, but also the ability to communicate effectively orally.

The author mentioned numerous interventions to improve communication skills of software engineering students while stressing that experiential approaches such as role-play, presentation, peer assessment, and video recording of students with feedback offer encouraging results than passive classroom lectures. There are also work-based activities that provide training for engineers to sharpen their oral skills (Riemer, 2007).

Ford and Riley (2003) put together some instructive strategies to couple communication skills training with software engineering programs. The list includes integrated courses, interdisciplinary programs, writing across the curriculum techniques, and various forms of help systems like writing and communication centres, and web resources. Kedrowicz and Blevins (2011) contended that the establishment of communication centres (writing or speaking) that provides students with support on speaking and writing assignments and also provides faculty with guidelines on how to assess these assignments would be a practical approach to integrate communication and software engineering. Although software engineering faculty may not feel competent to offer communication coaching and assessments, present cooperation with communication expects has reinforced their ability to instruct and give thoughtful feedback on student's communication performance (Donnell et al., 2011). The authors also described some other teaching interventions coupled with software development programmes to improve the communication skills of software engineering students. The teaching interventions comprise of intensive communication programs in software engineering faculty collaboratively taught by the college of communication or instructed by software engineering college with the support of communication experts, technical report writing programs at the department of English Language, public speaking programmes at the faculty of communication, and engineering communication programs at software engineering faculty instructed by communication experts.

Furthermore, software engineering programs employed numerous teaching initiatives to develop student's communication skills in various settings. According to Riemer (2007), rather than integrating communication skills as a separate subject in software engineering programs, it needs to be infused through project-based methodologies to strengthen student's acquisition. Likewise, Kedrowicz and Blevins (2011), affirmed that combining communication skills exercise with a real software development project is the best method to improve student's communication skills where they can practice the aspect of communication skills in the context of technical problem-solving. Also, Donnell et al. (2011) argue that infusing communication with actual software development activities is an approach which can be improved when faculty instructing and guiding these activities are competent communicators themselves and are aware of software engineering professional communication expectations. The senior capstone programs (like design course) are one of the most widely recognised places where communication instruction happens in software engineering education (Omar, 2014). Such programs usually provide students with an opportunity to participate in exercises similar to the professional environment as well as receiving feedback from software engineering executives n student's communication performance (Darling & Dannels, 2003). Norback and Hardin (2005) described a few reasons for presenting communication instruction in capstone design programs. First of all, students practice professional communication by working with industry and different businesses to resolve real-life issues. Also, students are naturally going to begin their first professional employments; therefore, technical communication education is especially applicable and vital. Lastly, senior design programs provide a chance for students to work and receive feedback in small teams.

According to Paretti (2008), since design courses naturally engage students to participate in real software development projects, these programs offer the perfect setting for students to practice professional communication to stimulate situated learning. Paretti (2008) noted that throughout the process of software development project, frequent interaction occurs between student's team members, supervisors, and practicing software engineers from the industry for the successful completion of the project. All of these communications provide opportunities for situated learning since students can see how their technical documents and presentations work in a real software development project (Paretti, 2008). Similarly, Fries et al. (2017) observed that final year students perceived industry-sponsored capstone design program as a valuable opportunity to develop their writing communication performance. Precisely, the students noticed an improvement in the areas of spelling and grammar and content structuring. Hirsch et al. (2001) explained a different initiative called Engineering Design and Communication (EDC) that combines design and communication course. They designed EDC to teach the process of engineering design in addition to the communication process while students are participating in real design projects for actual customers. The authors explained that EDC is co-taught by faculty members from the department of engineering and department of arts and sciences, students studied written, oral, and graphical communication in addition to learning the design process. Students' learning activities also involved participating in meeting with customers, interviewing end-users, run brainstorming group, and report or present design reviews. Furthermore, students usually engaged in group progress checks which allow them to learn about interpersonal communication skills. The predicted impact of this intervention was not in the ability of conceptual designs alone but in the ability to write well-structured technical report documents and persuasive presentation skills (Hirsch et al., 2001).

In software engineering education, investigation on coupling communication and software development design as a communication-based course have stayed as an alternative to improve student's communication performance. Mullin and VanderGheynst (2018) explained an elective communication-based course offered to all engineering students, irrespective of their class level or major at the University of California Davis (UCD). The course aimed to provide associations between oral communication skills, innovative critical thinking, and engineering content. In the execution of the program in Fall semester 2017, a creative design project was integrated. Students attend interactive hour-long lectures twice per week, where various engineering design methods and communication practices were introduced. Most of the students registered in this class included second-year students, followed by first-years, upper-level students, and a fourth-year student. Engineering students from diverse engineering disciplines such as mechanical, civil, software, chemical, and others were represented. The communication-based course addressed communication areas such as structuring verbal arguments, rhetorical elements, teamwork, active listening skills, and communicating in engineering contexts. All these communication topics were coupled with system design lectures, the system design subjects comprised vital phases of system development process like problem specification, requirement identification, background research, focus group meeting, system prototype, and usability testing etc. The findings of the study conducted based on this course included students' improvements in system design self- adequacy and communication performance. They affirmed the potential of coupling communication skills training with software engineering courses.

Harichandran et al. (2014) designed the Project to Integrate Technical Communication Habits (PITCH) as another approach to incorporate communication skills in software engineering courses at the University of New Haven. The PITCH approach involves computer science and several engineering undergrads, with the overall objective to improve oral, visual and writing communication skills and professional attitudes of software engineering students. The project activities commenced at the start of students' freshmen year and continued throughout the four years course. The scholar expatiates that design capstone was implemented as the crowning practice with which students were required to exhibit the communication abilities and professional attitudes obtained through PITCH projects. They noted that the student learning achievements for the program were founded based on broad surveys including alumni, faculty and employers. Other studies have sought to combine specific projects within software engineering classes to develop or assess software engineering students' communication competencies. Colsa et al. (2015) described the successful infusing of communication instruct and software project management course. The students were given the choice of filling the role of the project manager or team member during the project, and their communication proficiency was evaluated based on the authors' derived communication competence rubric. The authors concluded that there were improvement in students' communication skills, especially those that played the role of a project manager. Similarly, Eggleston and Rabb (2018) suggested that Project-based learning (PBL), coupled with communication instruction, could effectively improve software engineering students' communication skills. The authors affirmed that software engineering students developed the skills to introduce information and deliver meaningful ideas more definitely through the incorporation of PBL with communication coaching. They concluded that creating a technical communication and writing course with the PBL method provides students with the opportunity to practice STEM-specific, situated, and professional presentation and writing communication, bringing about a positive impact on software engineering courses beside improving students' professional skillsets.

Paretti et al. (2019) examined how communication education can offer supports that is above the development of software engineering students' oral and writing proficiencies. For this instance, both participating students and faculty identified learning outcomes coupled with software engineering domain knowledge from combined communication practices. Furthermore, faculty observed that coupling presentation and writing tasks provide the opportunity for students to perceive and organise essential sections of their assignment accurately, especially in complex and big open-ended situated tasks. Also, the study proposed that by understanding and choosing necessary details or focusing on the main ideas, students participate in communication assignments within engineering courses master not only the skills their discipline desire or value, but also the abilities prospective spectators desire. Another alternative way to integrate communication education in software engineering curricula is through educational videos. Videos are a powerful tool for learning (Kosterelioglu, 2016), in particular for topics that require contextualization based on the learner's personal experience such as learning of language (Davidson, 2009) and communication skills (Galster et al., 2018). Previous research shows that well-designed, assessment-focused, and easy-to-use video tutorials improve student satisfaction and learning, because they enable students to learn how and when they want (Wells et al., 2012). A growing trend is observed, especially in among youngsters to watch videos broadcasted in social networking sites (YouTube, Twitter, and Facebook) and to communicate via social networks (Kapoor et al., 2018). A rapid increase in access to internet and internet based communications has allowed the use of videos as educational tools (Dhawan, 2020). Videos create a permanent recording environment for realized events and allow unlimited viewing opportunities to ensure detailed analysis (Tan & Towndrow, 2009). Clearly, videos are appropriate to the nature of today's youngsters and can be used educationally as practical implementations in current classrooms (Boateng et al., 2016).

2.9 Videos in Education

As digitalisation has dramatically progressed in recent decades, so is educational activities. Educational activities are no longer limited to the traditional face-to-face interaction or the seeking of information in a physical book. Through the use of innovative technology like video-based learning (VBL), education activities are now performed digitally. Video-based learning represents the skills or knowledge procured through the use of video (Sablić et al., 2020). One of its unique properties is the usage of both audio and visual prompts. The visual features of videos deliver essential information, and the audio element interprets the information (Majumdar, 2017). Video-based pedagogy owns distinctive elements that make it a powerful learning technique which has the potential to reinforce and partially replace teacher-centred learning methods. It is an effective learning approach used to improve student learning satisfaction and outcomes (Poquet et al., 2018). Video-based learning has a long-standing tradition as an instructive tool in education settings (Yousef et al., 2014b). The authors identified that the first trials with video-based learning started during World War 2 when military personnel were schooled with a mix of film tapes and audio, which led to an improvement in their skills.

Chen (2012) expatiates that traditional teaching approach typically follows the physical textbook chapters. The author noted that this teaching method makes students reluctant, sometimes inactive in the learning process and do not sufficiently develop their high-order thinking abilities. However, educational videos could facilitate the movement of teaching from the traditional educator-centred environment to students-centred environments (Guseva & Kauppinen, 2018). Brecht and Ogilby (2008) explored several reasons for introducing videos as an instructive method in classrooms. Firstly, videos provide additional processing opportunity to students who cannot entirely understand the teaching material through course books and lectures. Secondly, students can watch and re-watch the educator's lectures as many times as necessary until they fully understand the teaching contents. Thirdly, students can learn at their own pace by pausing, rewinding and repeating the lecture video. Finally, the video lectures make it easy for students to study at home or in a less distracting and comfortable environment and time where they can entirely focus and concentrate on their learning content. Similarly, Masats and Dooly (2011) also argued that using videos for informative purposes presents creative and innovative teaching opportunities. The scholars highlighted that motivating educators and students to produce, watch, and use video recordings for educational purposes empowers them to perceive the use of videotapes as a tool to facilitate collaborative learning activities and construction of knowledge. Sablić et al. (2020) sum up their findings based on a systematic review of the literature that video-based learning facilitates improvement in student learning success, attract student's attention and increases motivation to learn.

Recent studies in the community of Technology-Enhanced Learning investigates the impact of interactive video-based learning on students learning outcomes. Scholars such as Vural (2013) proposed that video-based learning tools could increase students' engagement in the learning process when they are being anchored with interactive activities. The author identified interactive activities such as designing concept map related to video learning materials and motivating students by asking them to complete learning tasks such as answering multiple-choice questions, matching questions with answers and filling in the gap's questions. Likewise, Kleftodimos and Evangelidis (2016) added their views by providing several interactive elements that educators could couple into instructive videos such as highlight points of interest, adding additional notes to video content to give more explanation to students, and creating quizzes with interactive tasks and providing feedback to students. Delen et al. (2014) argued that in term of students' learning experience and achievement, coupling interactive features with video-based learning platforms is a strategy that enhances the teaching approach compared to the typical VBL platforms. Yousef et al. (2014b) provide a list of teaching methods used in video-based learning platforms to facilitate interactive activities. These include micro-teaching, hybrid learning, summarising the video, collaborative learning, student-centred learning, and video-based assessment. Giannakos et al. (2016) concluded that irrespective of students' learning needs or the level of their prior knowledge, an interactive video-based learning platform facilitates effective learning experience and improve learning satisfaction. The following sub-section will describe the Active Video Watching (AVW) approach and the operationalization of the ICAP framework for AVW.

2.10 Active Video Watching (AVW) Approach

Active video watching approach exploits students' familiarity with commenting on videos on social media platforms (such as YouTube and Facebook) and couples interactive note taking during video watching to encourage student engagement with learning content (videos) and self-reflective learning. The AVW is demonstrated with the Active Video Watching (AVW)-Space, which was designed to teach soft skills. The AVW-Space supports engagement during video watching to facilitate informal learning (Mitrovic et al., 2016). The support includes providing micro-scaffolds to facilitate the commenting on videos and the reviewing of comments made by others. AVW-Space allows instructors to create a course by embedding YouTube videos directly to the platform. More importantly, it provides an accessible and reusable video-based learning platform for users which is considered favourable for an educational experience. Previous studies have examined the effectiveness of using AVW method in learning (Dimitrova & Mitrovic, 2021; Galster et al., 2018; Mitrovic et al., 2019). In AVW-Space, learning happens in two phases: Personal Space and Social Space (Mohammadhassan et al., 2020). Personal Space (see Figure 2.2) is where students watch videos and write comments individually, using the aspects defined by the teacher. AVW-Space also provides interactive visualisation to support social learning. The interactive visualisations include the comment timeline and comment histogram to help students recognise the parts of the video which received more comments from previous students (Mitrovic et al., 2019). In the comment timeline, comments are represented as coloured dots on the timeline where the comments were made. The colour of a dot corresponds to the aspect associated with the comment. When the mouse hovers over the dots, the learner can see the comment text. These comments are static and were selected manually from previous studies with AVW-Space. The comment histogram illustrates the number of comments made for different segments of the video. While in Social Space (see Figure 2.3), students can review and rate (anonymised) comments made by the class.

An early study with AVW-Space (Mitrovic et al., 2017) in the context of presentation skills found that students who commented on videos learnt more than their peers who watched videos passively. In order to increase learning, AVW-Space provided Reminder nudges (RN) that is personalised prompts, to encourage students to write comments and use various aspects (Mitrovic et al., 2019). An evaluation study showed the Reminder nudges resulted in a higher number of comments, better usage of aspects and increased learning (Mitrovic et al., 2019). In the case of this thesis, six tutorial video lectures were selected from YouTube that describes tactics for participating in a successful meeting, and four example videos of real meetings were chosen as examples for students to review (see Figure 2.1).

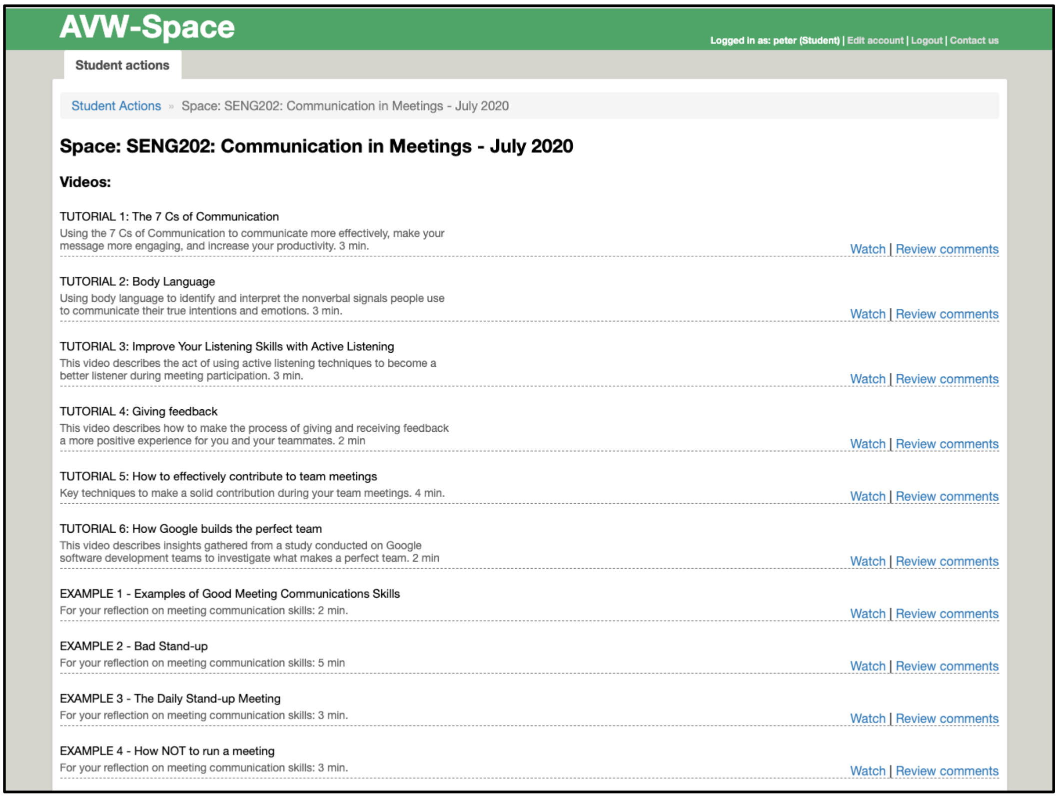

Figure 2. 1: Video selection interface within AVW-Space

Figure 2.1 shows the interface for selecting videos. All videos used on the platform were carefully selected by the instructor to ensure they were suitable for learning which consists of two phases (Personal Space and Social Space). The student initiates step 1 by choosing a video lecture, and they are directed to the watching and commenting page (otherwise called the Personal Space), as illustrated in Figure 2.2. The page integrates a regular YouTube video player and commenting features around it. In the personal space, individual students watch and comment (see the commenting section on the bottom left and the comments preview section on the right in Figure 2.2) on videos. Students can pause a video at any time, type in a comment and select an aspect. Aspects are micro-scaffolds aim to frame students' comments around a specific point related to meeting communication skills and to initiate reflective learning. They can be customised based on the kind of video (a tutorial or an example). Table 2.2 outlines the aspects based on the video type selected.

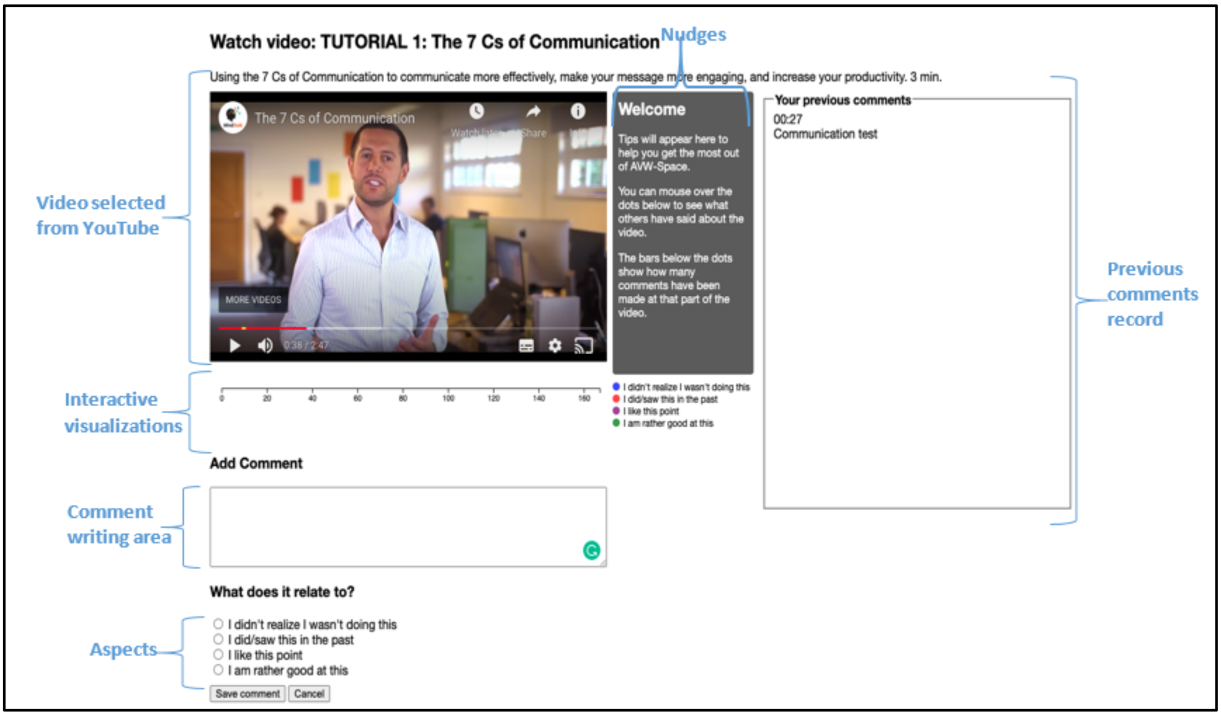

Figure 2. 2: Personal Space of AVW-Space, illustrated while adding a comment

Table 2. 2: Types of aspects and their video type

Video Type	**Aspects**
Tutorials	I didn't realise I wasn't doing this
	I like this point
	I did/saw this in the past
	I am rather good at this
Examples	Verbal communication
	Giving feedback
	Receiving feedback
	Active listening
	Meeting contribution

Once the instructor approves comments for sharing, anonymised comments are available in the Social Space for students to review and rate using one of the predefined options as shown in the drop-down menu in Figure 2.3. Students can also preview comments by sorting the comments based on timestamp or aspects, which allows students to compare their comments and reaction on a similar section of the videos. Also, students can watch the part of a video that is related to a particular comment. The rating features in this phase were specified to foster profound self-reflection.

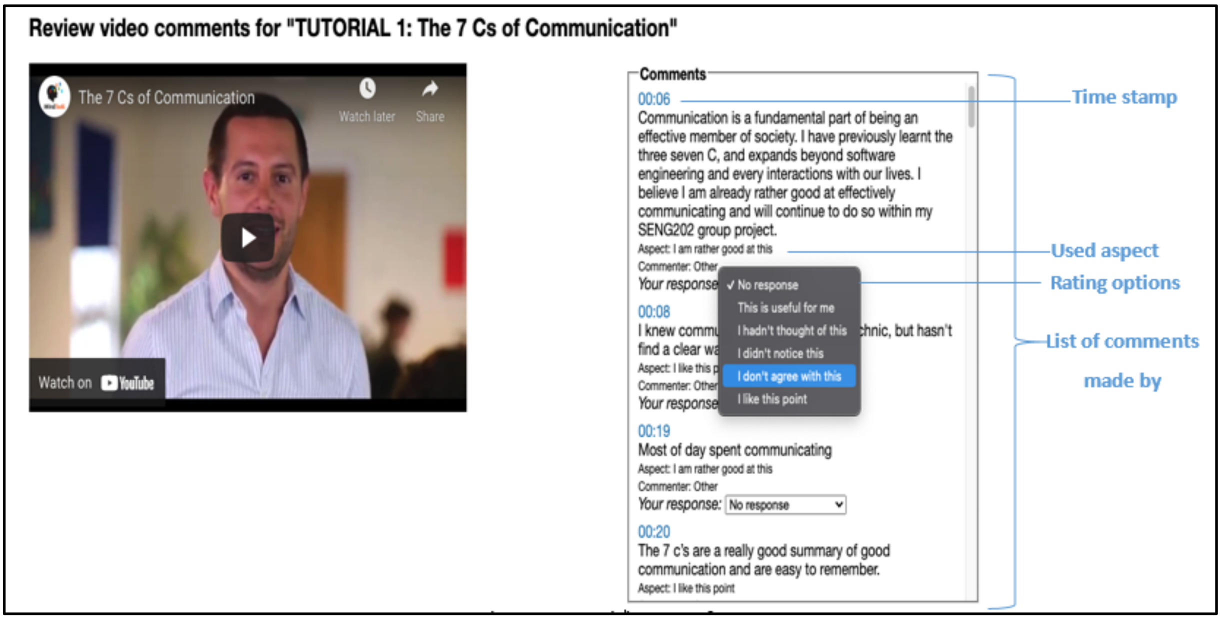

Figure 2. 3: Social Space of AVW-Space

2.11 Operationalization of the ICAP Framework for AVW

ICAP is a theory of active learning that differentiates students' engagement based on their behaviours (Chi et al., 2018). In learning activities, researchers have long documented engagement as an essential ingredient for effective learning (Chi & Wylie, 2014; Yousef et al., 2014a). Engagement refers to how a student actively participates with the learning materials in the class or anywhere else during a learning activity, reflected in the overt behaviour the student displays while preforming an instructional task, for instance, voluntarily summarising learning materials at the end of each section (Chi & Wylie, 2014). In a lecture hall, the educator can easily make conclusions about students' degree of involvement. In contrast, in an online learning environment (such as video learning platforms) student's engagement is frequently low, and overt behaviour is the primary source of information about learner's participation. The ICAP framework classifies students' involvement according to their observable behaviours during learning. The framework was first presented in 2009 where it suggested three intellectual manners of engagement (Active, Constructive, and Interactive), including evidence from the literature that supports the ICAP's hypothesis (Chi, 2009). Chi and Wylie (2014) further extended the ICAP framework to incorporate the Passive mode in light of evidence from various laboratory and lecture hall experiments. Therefore, ICAP theory classifies four degrees of observable learning practice, ranging from the highest level to lowest level of engagement: Interactive, constructive, active, and passive (Chi & Wylie, 2014).

Passive learning mode: This mode generally refers to students who sit and listen to lectures without overtly doing anything with regards to the instructional activity. For example, in AVW-Space student that just watch lecture video without performing any other acts are considered passive students.

Active learning mode: The students' involvement in the classroom that is not limited to listening to lectures but also manipulating the learning materials in the manner of taking verbatim notes, copying solution steps, highlighting or summarising by copying and deleting selected text etc. In the case of AVW-Space, active students are those that manipulate the instructional videos by re-watching the video several times or replay essential parts of the video and also write comments by merely repeating the video content.

Constructive learning mode: The student exhibit observable characteristics by synthesising the information and generating a new idea, such as drawing concept maps, asking questions, taking notes in one's own words, and reflecting on prior knowledge. The constructive mode is operationalized on AVW-Space as encouraging students to explain concepts in the video and reflect on previous experience through commenting and reviewing of example videos.

Interactive learning mode: Students are engaging in an informative dialog with others, and this mode is the most beneficial in terms of educational outcomes. The key idea is that interactivity needs to involve two persons or more (such as student-student or student-instructor), and it also needs to involve a substantial level of turn-taking to co-create a common understanding of the learning materials. For instance, defending and arguing a position in small groups, asking and answering comprehension question with a partner, and discussing similarities and difference that are brought up during a video lecture by jointly creating a shared understanding. Interactive learning mode is not currently supported in AVW-Space, and therefore not relevant for this thesis. Figure 2.4 displays the translation of the ICAP theory of cognitive engagement into practise developed by Chi et al. (2018) over the course of a five-year study in which they aimed to convert ICAP into a theory of instruction through the use of five sequential measures: (a) Teachers' comprehension of ICAP following completion of an online module, (b) Teachers' success in constructing lesson plans utilising various ICAP modes, (c) Teachers' classroom implementation fidelity, (d) Students' enacted behaviours modes, and (e) Students' learning outcomes.

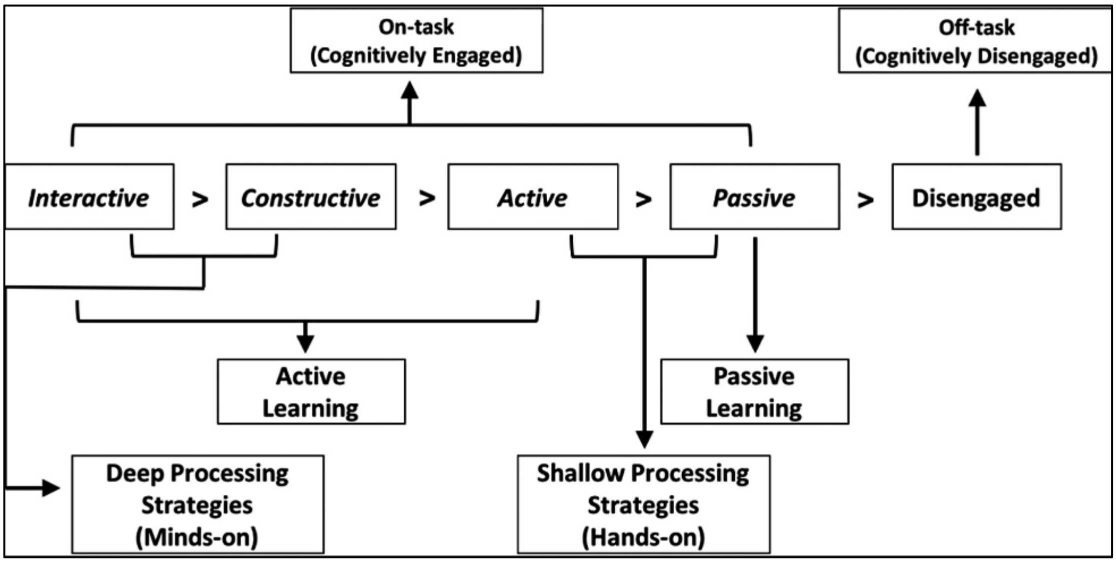

Figure 2. 4: ICAP theory of cognitive engagement
Source: Chi et al. (2018)

2.12 Chapter Summary

The review of pertinent literature revealed useful concepts about communication skills, the difficulties encountered by software engineering students in acquiring these skills, and the importance of communication skills as critical factors for a successful career and integration into the software engineering industry. It is encouraging to learn that numerous interventions have been adopted successfully in academia to improve the communication skills of software engineering students. The review continued with an examination of the usefulness of videos as effective teaching materials for soft skills and the ways in which the AVW-Space can facilitate active participation for learners with varying learning styles and levels of knowledge. Finally, the ICAP framework was used to provide foundation for this thesis and to demonstrate how SE students' levels of engagement can impact their communication abilities in the AVW-Space.

CHAPTER 3

SCALE DEVELOPMENT

3.1 Introduction

The main focus of this chapter is to introduce scale development as a means to measure face-to-face meeting communication skills. This chapter discusses all the processes undertaken for the measurement instrument and scale development, these processes include, sources of the measurements, content validity assessment, pilot study and reliability analysis of the measurements.

3.2 Measurement Instrument and Scale Development

This thesis aims to evaluate meeting communication skills, one of the domains of soft skills. Since there is lack of existing communication scale that has undergone a rigorous process of validation and reliability assessments in the software engineering field, we developed a valid and reliable measure of meeting communication skills that is appropriate for the current study. Valavosiki et al. (2019) state that the ever-increasing demands of the labour market have made soft skills assessment a topic of research. However, there is no widely accepted method for assessing the soft skills of a job candidate, despite the fact that researchers agree that this procedure is essential for hiring the most qualified candidate, particularly in the information and communications technology (ICT) industry (Gibb, 2013; Migdalas et al., 2013; Zhang, 2012). Gibb (2013) acknowledges and emphasises the necessity for soft skills to be evaluated independently, and that they should not be overwhelmed by other themes such as employability, leadership, and graduate employment. Consequently, this thesis developed an instrument for assessing face-to-face meeting communication skills of software engineering students, which can also be adopted by professionals in various contexts for assessing and recruiting skilled employees.

According to Huang and Lin (2018), there are numerous reasons why new measurement tools for communication skills are desirable in this modern age. Firstly, the authors argue that most existing communication assessment instruments are outdated, and since communication practices evolve with the change of time, more modern assessment tools are needed to assess communication skills in this new era of globalisation. Secondly, they highlight that little is known about the factor structure of the existing tools, so the validity and reliability of these measures are questionable. Lastly, to quickly analyse issues pertaining to communication competence of students, an assessment tool is desirable so that educators can pay specific attention to the exact aspect of students' communication competence that needs further attention (Huang & Lin, 2018). Therefore, this thesis makes an effort to address this gap by developing a measure and offering preliminary validation evidence for the measure.

The scale development processes adopted in this thesis aligns with DeVellis (2016) and Graziotin et al. (2021) measurement development guidelines. Figure 3.1 provides an overview of the stages involved in the development of face-to-face meeting communication scale.

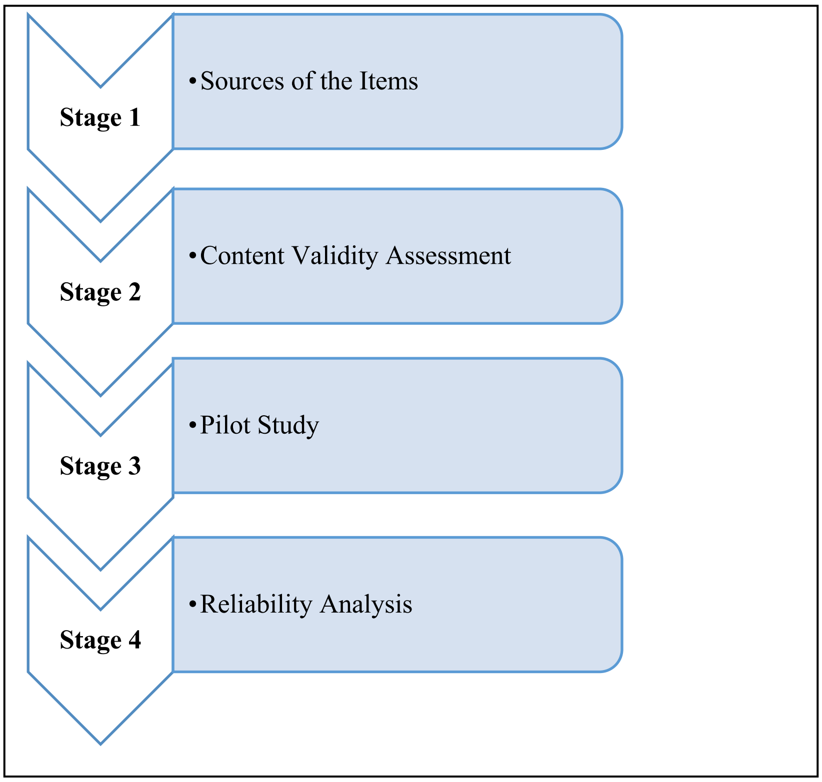

Figure 3. 1: Stages of the communication scale development

3.2.1 Stage 1: Sources of the Items

The framework of oral communication skills scale developed by Jackson (2014) served as the basis for the development of the items considered to assess face-to-face meeting communication skills. This framework included three dimensions (subscales): verbal communication, providing and receiving feedback, and meeting participation. The verbal communication subscale is comprised of three items (questions) adapted from Jackson (2014) and measures the ability to communicate orally in a clear and compassionate manner that is appropriate for a variety of audiences and levels of seniority. A sample item regarding verbal communication was, “I express technical ideas clearly, so that every meeting participant can understand them.” The giving and receiving feedback subscale is comprised of six items (Jackson, 2014) and measures the ability to give and acceptably receive constructive feedback. A sample item for giving and receiving feedback was, “I am mindful of other meeting participants’ feelings when providing feedback.” The meeting participation subscale consists of six items (Jackson, 2014) and measures the ability to actively and productively participate in meetings. The following is an example of a meeting participation item: “When other meeting participants are hesitating to contribute their ideas, I encourage them to contribute their ideas and suggestions.” The seven-item active listening subscale developed by Mishima et al. (2000) examines the ability to demonstrate exceptional listening skills in meetings. Example of active listening: “I listen to the other meeting participants, paying attention to her/his body language.”

The responses to the questions evaluating communication skills in face-to-face meetings were recorded on a 7-point Likert scale, ranging from “1=Never” to “7=Always.” A 7-point Likert scale was deemed appropriate for this study in order to obtain more reliable and valid participants’ assessments of their regular communication behaviours during face-to-face team meetings. Accordingly, Preston and Colman (2000) determined that the optimal number of response alternatives for producing accurate results is seven, eight, nine, or ten, and that questions with four or less response options provide unreliable results. It has been demonstrated that a 7-point Likert scale improves reliability and validity (Churchill & Peter, 1984). The items adapted for measuring the four dimensions of face-to-face meeting communication skills are shown in Table 3.1.

Table 3. 1: Items adapted for measuring face-to-face meeting communication skills

Dimensions	Items	Sources
Verbal communication	I express complex ideas using language understood by all meeting participants.	Jackson (2014)
	I sometimes refer to concepts that may confuse other meeting participants.	Jackson (2014)
	I can vary language and expression to suit different situations during team meetings.	Jackson (2014)
Giving and Receiving Feedback	I provide clear, appropriate and constructive feedback to other meeting participants.	Jackson (2014)
	I am consistently respectful and mindful of their feelings to other meeting participants.	Jackson (2014)
	I get defensive when receiving other meeting participants' negative feedback.	Jackson (2014)
	I receive other meeting participants' feedback as a constructive contribution.	Jackson (2014)
	I use the team's feedback to improve my participation and contribution during team meetings.	Jackson (2014)
Meeting Participation	I contribute my ideas, suggestions and needs during team meetings.	Jackson (2014)
	When other meeting participants are hesitating to contribute their ideas, I encourage them to contribute their ideas, suggestions, and needs.	Jackson (2014)
	I express my personal feelings. (e.g. if I feel uncomfortable with a design or technology decision or the project schedule, or feel pressured to work on tasks I don't have time/the required expertise to carry out the tasks).	Jackson (2014)
	I encourage other meeting participants to express their personal feelings. (e.g. if they feel uncomfortable with a design or technology decision or the project schedule, or feel pressured to work on tasks they don't have time/the required expertise to carry out the tasks).	Jackson (2014)
Active Listening	I begin to talk before the other meeting participants finish talking.	Mishima et al. (2000)
	I begin arguing with the other meeting participants before I have heard their entire idea, while I'm listening to her/him.	Mishima et al. (2000)
	When I want to say something, I talk about it, even if I interrupt the other meeting participants.	Mishima et al. (2000)
	I listen to the other meeting participants, putting myself in her/his shoes.	Mishima et al. (2000)
	I listen to the other meeting participants, paying attention to her/his body language.	Mishima et al. (2000)
	I am aware of my feelings while I'm listening to other meeting participants.	Mishima et al. (2000)
	If I do not understand what someone said, I ask questions to clarify.	Mishima et al. (2000)

3.2.2 Stage 2: Content Validity Assessment

This qualitative validation process is significant in measurement scale development (DeVellis, 2016; Graziotin et al., 2021). The qualitative validation here entails having the preliminary item pool reviewed by Subject Matter Experts (SMEs). The reviewing process involves consulting individuals regarding the relevance, clarity and singularity of the items, as well as to "confirm or invalidate [the] definition of the phenomenon" (DeVellis, 2016, p. 135). These experts may also generate other items or descriptions reflecting the variables that have not yet been included. The use of SMEs was to enhance the content validity of the scale that is in development (DeVellis, 2016). Therefore, we consulted two different types of SMEs to gather feedback on the face-to-face meeting communication skills scale. For this purpose, a mixture of members from the population under study was consulted (DeVellis, 2016). These participants were those with software engineering experience and are referred to as *population experts*. Then, academic researchers in the areas of computer science and software engineering education and psychometric development were consulted. These individuals are referred to as *content experts* (Grant & Davis, 1997).

To facilitate the validation process, two forms of data collection were undertaken: focus groups and written feedback to obtain validation feedback from both groups of recruited experts. **Focus groups** involved consulting an expert panel of researchers (*content experts*), who gave feedback on the individual items and reviewed the overall scale. Using the focus groups allowed the researcher and participants to interact and engage with each other, resulting in rich insights extending beyond answers to questions or written feedback (Carey & Smith, 1994). Furthermore, this method is an efficient way to gather rich data in a short period of time, and this data is appropriate to use to "clarify, extend, qualify or challenge" other forms of data collected (Gill et al., 2008, p. 293). The *content expert* group were made up of three academic researchers, who were the researcher's supervisors with expertise in computer science and scale development. This meant that they had expert knowledge on the topic in an academic context and could comment on both conceptual and methodological aspects of issues understudied. Table 3.2 shows the overall modifications made to the preliminary scale based on the content experts' recommendations.

Table 3. 2: Scale modifications by content experts

Dimensions	Items
Verbal communication	I express ~~complex~~ **technical** ideas **clearly, so that every** ~~using language understood by all~~ meeting participant **can understand them**.
	I express complex non-technical ideas clearly, so that every using language understood by all meeting participant can understand them.
	I ~~sometimes~~ **do not** refer to **technical** concepts that may confuse other meeting participants.
	I do not refer to non-technical concepts that may confuse other meeting participants.
	I ~~can~~ vary language and expression to suit different situations during team meetings
	I make eye contact with meeting participants during discussions.
Giving and Receiving Feedback	I provide ~~clear, appropriate and~~ constructive feedback to other meeting participants.
	I am ~~consistently~~ respectful ~~and mindful of their feelings~~ to other meeting participants.
	I am mindful of other meeting participants' feelings when providing feedback.
	I get defensive when receiving other meeting participants' negative feedback
	I receive other meeting participants' feedback as a constructive contribution.
	I use the team's feedback to improve my participation and contribution during team meetings.
Active Listening	I **often** begin to talk before the other meeting participants finish talking.
	I begin arguing with the other meeting participants before I have heard their entire idea~~, while I'm listening to her/him~~.
	When I want to say something, I talk about it, even if I interrupt the other meeting participants.
	I listen to the other meeting participants, putting myself in her/his shoes.
	I listen to the other meeting participants, paying attention to her/his body language.
	I am aware of my feelings while I'm listening to other meeting participants.
	If I do not understand what ~~someone~~ **another meeting participant** said, I ~~ask questions to clarify~~ **seek clarification by asking questions.**
Meeting Participation	I contribute my ideas **and** suggestions ~~and needs~~ during team meetings.

	When other meeting participants are hesitating to contribute ~~their ideas~~, I encourage them to contribute their ideas **and** suggestions, ~~and needs~~.
	I express my personal feelings **when I agree with other meeting participants** ~~(e.g. if I feel uncomfortable with a design or technology decision or the project schedule, or feel pressured to work on tasks I don't have time/the required expertise to carry out the tasks)~~.
	I express my personal feelings when I disagree with other meeting participants.
	I encourage other meeting participants to express their personal feelings. ~~(e.g. if they feel uncomfortable with a design or technology decision or the project schedule, or feel pressured to work on tasks they don't have time/the required expertise to carry out the tasks).~~
	I check my mobile, emails or notifications during meetings.

Note: Added words and items are bolded, while removed items or words are crossed out.

Written feedback: Four population experts with experience working in the software engineering industry were initially contacted by the researcher with an invitation to participate in providing expert feedback on the scale. Two agreed to take part and were subsequently contacted by the researcher. They were emailed with a description of the purpose of this study, and this included getting feedback on: 1) whether they agreed with the statements in terms of how they reflected the communication dimensions, 2) whether they thought any of the statements needed to be reworded, and 3) whether they had any other specific examples of face-to-face meeting communication behaviours. The population experts reviewed the scale and provided written feedbacks via email. From their feedbacks, no changes were made to the scale because they all considered the scale be acceptable.

3.2.3 Stage 3: Pilot Study

The participants for the scale development were students from the University of Canterbury, and they were invited via email (See Appendix B for email invitation) with an anonymous link to the complete survey. This email contained information on the survey, explained that participation was voluntary and anonymous, and other research ethical criteria were met. In addition to the direct email, a recruitment post and a link to the survey were posted on the university's social media groups encouraging the students to take the survey and pass the link on to their peers.

There were two phases of data collection processes. The first phase resulted in 111 responses, followed by a second data collection effort, which resulted in 147 responses.

According to DeVellis (2016), in order to prepare the responses for factor analysis, the subject-item ratio should be at least 10:1 (i.e., ten responses per scale item). The survey was created to assess the validity and reliability of the measure (DeVellis, 2016). The face-to-face meeting communication scale items were examined using Exploratory Factor Analysis (EFA) approach after the survey was conducted and a total of 258 responses were gathered. This survey resulted in creating a four-factor, 23-item face-to-face meeting communication scale that was used in the current research and could be further validated in future research.

Based on the 258 valid responses obtained, a total of 59.3% were male and 39.5% were female. Majority of the participants (71.1%) were in the age range of 18-23 years old followed by 24-29 age group (15.1%), and were native English speakers (62%). About 33.7% of the respondents reported the frequency of their face-to-face meetings experience as occasionally and a total of 31.0% have face-to-face meetings on weekly basis. The subsequent section will provide explanations to the detailed EFA procedures undertaken in this study.

3.2.2.1 Exploratory Factor Analysis (EFA)

Factor analysis is essential to ensure the validity of factors that contribute differentially to the causal explanation of variance in the understudied variables (Hair et al., 2010). Two common approaches used in factors analysis is exploratory factor analysis (EFA) and principal components analysis (PCA). The two approaches differ conceptually, the EFA is based on the assumption that there exist a smaller set of unobserved (latent) variables or constructs underlying the variables actually observed or measured, while PCA is used to achieve the goal of deriving a relatively small number of variables that will substantially convey the same information in the observed/measured variables (Graziotin et al., 2021). That is, the EFA is used to understand the relations among variables by understanding the constructs that underlie them, while the PCA is basically used by researchers when the goal is to derive a lesser number of variables that provide the same information as that of the larger set of variables.

The EFA approach is favoured in this study considering the goal of the factor analysis, which is to understand the construct or factor underlying the variables in this study using the retrieved data. The EFA procedure allows the data to load statistically on the underlying factors in the study, and it is a widely established procedure in scale development (Graziotin et al., 2021). The underlying factors were established by the assumptions that guided the development of the scale used in this study (Field, 2009). The 258 responses obtained using the meeting communication scale was subjected to an EFA using the extraction method of Principal Component with Varimax (Variation Maximization) Rotation. Principal Component with

Varimax (Variation Maximization) Rotation is a well-established and commonly used factoring technique (Bahkia et al., 2019; Ehido et al., 2020; Hoque et al., 2018).

EFA Procedure for Face-to-Face Meeting Communication Scale

The face-to-face meeting communication scale consists of 25 items, and the items are coded as VC1 to VC6, GRF1 to GRF6, AL1R to AL7, and MP1 to MP6R (see Table 3.3).

Table 3. 3: Items assessing face-to-face meeting communication skills

Item	Question
	Verbal Communication
VC1	I express technical ideas clearly, so that every meeting participant can understand them.
VC2	I express complex non-technical ideas clearly, so that every meeting participant can understand them.
VC3	I do not refer to technical concepts that may confuse other meeting participants.
VC4	I do not refer to non-technical concepts that may confuse other meeting participants.
VC5	I vary language and expression to suit different situations during team meetings.
VC6	I make eye contact with meeting participants during discussions.
	Giving and Receiving Feedback
GRF1	I provide constructive feedback to other meeting participants.
GRF2	I am respectful to other meeting participants.
GRF3	I am mindful of other meeting participants' feelings when providing feedback.
GRF4R	I get defensive when receiving other meeting participants' negative feedback.
GRF5	I receive other meeting participants' feedback as a constructive contribution.
GRF6	I use the team's feedback to improve my participation and contribution during team meetings.
	Active Listening
AL1R	I often begin to talk before the other meeting participants finish talking.
AL2R	I begin arguing with the other meeting participants before I have heard their entire idea.
AL3R	When I want to say something, I talk about it, even if I interrupt the other meeting participants.
AL4	I listen to the other meeting participants, putting myself in her/his shoes.
AL5	I listen to the other meeting participants, paying attention to her/his body language.

AL6	I am aware of my feelings while I'm listening to other meeting participants.
AL7	If I do not understand what another meeting participant said, I seek clarification by asking questions.
	Meeting Participation
MP1	I contribute my ideas and suggestions during team meetings.
MP2	When other meeting participants are hesitating to contribute their ideas, I encourage them to contribute their ideas and suggestions.
MP3	I express my personal feelings when I agree with other meeting participants.
MP4	I express my personal feelings when I disagree with other meeting participants.
MP5	I encourage other meeting participants to express their personal feelings.
MP6R	I check my mobile, emails or notifications during meetings.

n=258

The first EFA procedure executed returned a seven-factor solution based on Kaiser's Criterion (1960) for retaining factors with Eigenvalues > 1, which explained 61.10% of the total variance. The initial eigenvalues of the seven factors ranged from 1.0 to 5.73. However, the scree plot suggested a four-factor solution, as the point of inflection rests at factor number four (see Figure 3.2). In addition, Fabrigar et al. (1999) reported that Kaiser's Criterion tends to over-extract factors; thus, rerunning the analysis extracting fewer factors instead of utilizing Kaiser's Criterion for retaining factors was necessary. Moreover, the items were designed to measure four dimensions as indicated in Table 3.4. Based on these premises, four factors were specified in SPSS as the maximum number of factors to be extracted in the next step of the analysis. The scree plot in Figure 3.2 shows the four components that emerged from the EFA procedure based on the number of fixed factors to be extracted. Every component has its own group of items, and the rotated component matrix displays which items have a place with what component.

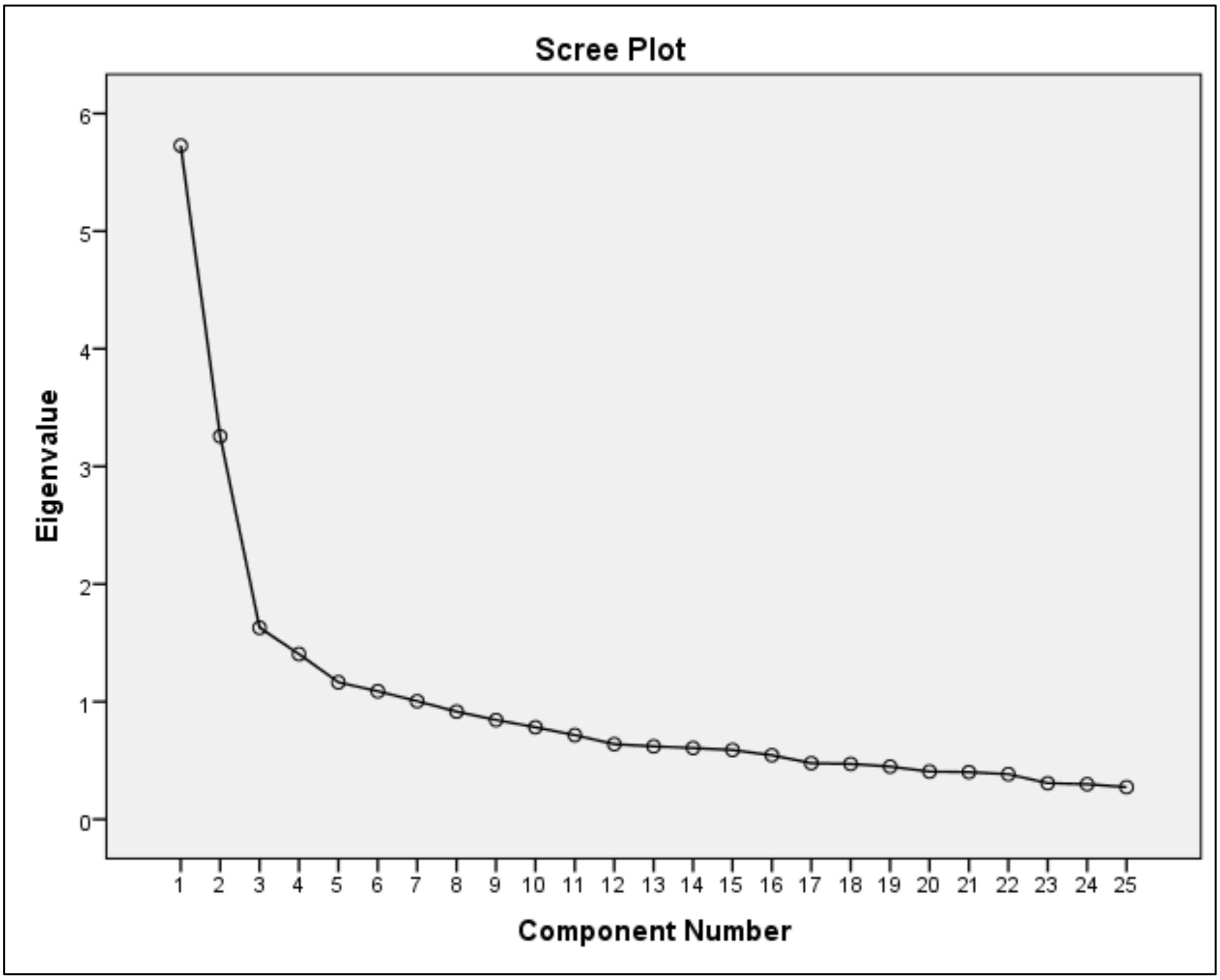

Figure 3. 2: The scree plot for face-to-face meeting communication

The Kaiser-Meyer-Olkin (KMO) is a test of sampling adequacy, and it indicates the sufficiency of the items used in measuring each factor (Hoque et al., 2018). The outputs confirm that the measure of sampling adequacy by KMO is 0.833, which falls within the commendable adequacy range of 0.80-0.89 (Kaiser, 1974). Another important statistic is the outcome of Bartlett's test, which indicates whether or not the variables are correlated highly enough to provide a reasonable basis for factor analysis. The Bartlett test should be significant at a value of less than 0.05 (Bahkia et al., 2019). Bartlett's test in this research is significant at df (300) = 2021.519, $p < 0.05$. This supports that there is a relationship between the components of the meeting communication construct, thus further providing a reasonable justification for the factor analysis.

Components and Total Variance Explained

The outcomes in Table 3.4 show there are 4 components from the EFA method based on the number of fixed factors in SPSS. The eigenvalues for the 4 components ranged between 1.405 and 5.727. The variance explained for component 1 is 24.662%, component 2 is 14.149%, component 3 is 1.629%, and component 4 is 1.405%. The aggregate explained variance by the items for measuring meeting communication scale is 50.321%. Therefore, the number of components and their corresponding items are adequate in assessing the meeting communication construct based on the recommendation of Merenda (2019, p. 158) who stated that, as a rule of thumb, ‘‘for the number of ‘real’ factors and components, the proportion of variance accounted for should be at least 50%.”

Table 3. 4: Number of components and total variance explained

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.727	24.662	24.662	5.672	24.662	24.662
2	3.256	14.149	38.811	3.254	14.149	38.811
3	1.629	6.443	45.254	1.482	6.443	45.254
4	1.405	5.066	50.321	1.165	5.066	50.321

The nature of this preliminary analysis was exploratory; therefore, no particular number of items were specified when executing the analysis. This implied that items were not limited in terms of the factors they could load onto. According to the rule of thumb outlined by DeVellis (2016), criteria for factor retention decisions includes a combination of item factor loadings greater than 0.40, single factor loadings for items (no cross-loadings values above 0.30), communalities > 0.3, Kaiser’s Criterion (eigenvalues > 1), and scree plot inspection (Hair et al., 2010; Kaiser, 1960). Hence, items exhibiting low factor loadings (< 0.40), high cross-loadings between two or more factors (> 0.30) and low communalities (< 0.30) were considered for elimination (Hair et al., 2010). Table 3.5 presents the 4 factors and their items obtained from the EFA procedure. The factor loading for every other item except VC3 and VC4 was greater than 0.40. For that reason, the two items with factor loading below the threshold of 0.40 specified above were removed, and others were retained since they achieved the minimum requirement for factor loading of 0.40 (DeVellis, 2016). As a result, twenty three (23) items were reserved and are appropriate to evaluate the meeting communication construct.

Table 3. 5: The four components and their items

		Component			
		1	2	3	4
VC1		.751			
VC2		.645			
VC3	**Deleted Item**				
VC4	**Deleted Item**				
VC5		.527			
VC6		.432			
GRF1		.696			
GRF2			.632		
GRF3			.516		
GRF4R			.632		
GRF5			.593		
GRF6			.491		
AL1R			.549		
AL2R			.610		
AL3R			.697		
AL4			.549		
AL5					
AL6				.633	
AL7		.637			
MP1		.795			
MP2		.560			
MP3				.664	
MP4				.640	
MP5					.849
MP6R					.815

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 6 iterations. Loading was suppressed below 0.40.

In total, 23 items remained following the pilot test (see Table 3.6 below).

Table 3. 6: Revised face-to-face meeting communication scale after EFA Procedure

Face-to-face meeting communication behaviour	**Items**
Verbal communication	I express technical ideas clearly, so that every meeting participant can understand them.
	I express complex non-technical ideas clearly, so that every meeting participant can understand them.
	I vary language and expression to suit different situations during team meetings.
	I make eye contact with meeting participants during discussions.
Giving and Receiving Feedback	I provide constructive feedback to other meeting participants.
	I am respectful to other meeting participants.
	I am mindful of other meeting participants' feelings when providing feedback.
	I get defensive when receiving other meeting participants' negative feedback
	I receive other meeting participants' feedback as a constructive contribution.
	I use the team's feedback to improve my participation during team meetings.
Active Listening	I often begin to talk before the other meeting participants finish talking.
	I begin arguing with the other meeting participants before I have heard their entire idea.
	When I want to say something, I talk about it, even if I interrupt the other meeting participants.
	I listen to the other meeting participants, putting myself in her/his shoes.
	I pay attention to the other meeting participants' body language.
	I am aware of my feelings while I'm listening to other meeting participants.
	If I do not understand what another meeting participant said, I seek clarification by asking questions.
Meeting Participation	I contribute my ideas and suggestions during team meetings.

	When other meeting participants are hesitating to contribute their ideas, I encourage them to contribute their ideas and suggestions.
	I express my personal feelings when I agree with other meeting participants.
	I express my personal feelings when I disagree with other meeting participants.
	I encourage other meeting participants to express their personal feelings.
	I check my mobile, emails or notifications during meetings.

3.2.4 Stage 4: Reliability Analysis

The term 'reliability' refers to the degree to which a measurement of a concept produces a steady and consistent result (Taherdoost, 2016). Reliability testing is critical because it determines the consistency across the sections of a measuring instrument (Taber, 2018). Cronbach's Alpha of 0.6-0.7 suggests an adequate level of reliability, and 0.8 or above indicates a very strong level of reliability (Hulin et al., 2001). Data from the 258 valid responses obtained for scale development was used to conduct reliability assessments on the four dimensions measuring face-to-face meeting communication skills. Table 3.7 presents the Cronbach's Alpha (internal consistency) values for the four dimensions of meeting communication scale and the values which range from 0.60 to 0.68 attained acceptable levels of reliability. Therefore, we proceeded to use this measure, however, further validation is required when utilizing on a different sample and in different context.

Table 3. 7: Reliability of the four dimensions of meeting communication scale

Dimensions	**Cronbach's Alpha**	**Number of Items**
Verbal communication	0.68	4
Giving and receiving feedback	0.68	6
Active listening	0.64	7
Meeting Participation	0.60	6

3.3 Chapter Summary

This chapter presented the procedures for developing and validating the face-to-face meeting communication scale. Specifically, four stages of scale development procedures were conducted to obtain valid and reliable measures for the meeting communication scale. As a result, the procedures produced a revised 23-item scale suitable for the actual study. The following chapter presents the detailed experimental design, data analysis and interpretation of results.

CHAPTER 4

EXPERIMENTAL DESIGN AND DATA ANALYSIS

4.1 Introduction

This chapter describes the experimental methodological procedures of the research presented in this thesis. This includes participants and selection criteria, experimental environment set-up, experimental design, and collected data. Furthermore, this chapter discusses the quantitative and qualitative findings from the analysis of primary data obtained during the field study. The descriptive statistics and other preliminary findings will be reported first, followed by data analyses aimed at addressing the following RQs:

RQ1: *How much did the students learn from their experience with AVW*?

RQ2: *What were the students' perceptions toward AVW-Space*? (*Did they experience any challenges and was the AVW-Space useful for learning*?)

RQ3: *Did participation in AVW Experiment improve students' meeting communication skills*? (*Were the team recordings during meeting useful for learning*?)

This study was carried out following approval by the University of Canterbury Human Ethics Committee Low Risk process (see Appendix A).

4.2 Participants and Selection Criteria

The participants for the study were recruited from SENG202, a software engineering project-based course run in the second year of a bachelor program in software engineering at the University of Canterbury. A total of 56 students enrolled for the course, and the students worked in small teams of 4 to 6 to develop a medium-complexity application. They performed weekly face-to-face meetings to discuss the project's progress. As part of the course, students received only introductory training on what to do before, during and after meetings in the form of a seminar, but no formal training on the interpersonal communication aspects of face-to-face meetings. Therefore, making this study relevant as a means of teaching the students appropriate meeting communication skills using AVW-Space. There were no selection criteria other than being enrolled in the course and no restrictions on the number of participants that can be supported in AVW-Space.

4.3 Experimental Environment Set-up

An AVW-Space instantiation was setup to provide an experimental environment to assess how the system can support face-to-face meeting communication skills learning. The AVW instantiation for face-to-face meeting participation includes ten YouTube videos (see Table 4.1). Six videos were tutorials covering concepts related to interpersonal communication aspects of face-to-face meetings, while the other four examples are actual recordings of real meetings. The research supervisors reviewed the videos used in this study to ensure their suitability with regard to content and pedagogical value.

AVW offers two spaces: *Personal Space* and *Social Space*. Firstly, students watch and comment on videos individually in the Personal Space. In order to type a comment, the learner needs to select an aspect. Aspects are mini-scaffolds for learning, aimed to draw the student's attention to specific points related to the target soft skill and trigger reflective experiential learning. We specified three reflective aspects for tutorials: "I am rather good at this," "I didn't realise I wasn't doing it," "I did/saw this in the past." These aspects stimulate learners to recall and reflect on their own experiences. One additional aspect, "I like this point," allows the learner to externalise learning points. For the example videos, the aspects were "Verbal communication," "Giving feedback," "Receiving feedback," "Active listening," and "Meeting contributions," corresponding to the interpersonal communication concepts of face-to-face meetings covered in the tutorial videos.

Table 4. 1: List of videos used in this study

Video	Title	Length	YouTube video id
Tutorial 1	The 7 Cs of Communication	2:46’	sYBw9-8eCuM
Tutorial 2	Body Language	2.45’	AqixzdpJL4U
Tutorial 3	Giving feedback	1.46’	Id_uG8Djdsc
Tutorial 4	Improve your listening skills with active listening	2.39’	t2z9mdX1j4A
Tutorial 5	How Google builds the perfect team	2.22’	v2PaZ8Nl2T4
Tutorial 6	How to effectively contribute to team meetings	4.05’	cKh75Po5Qsc
Example 1	Bad Stand-up	5.22’	zrmcl-pjmoc
Example 2	The Daily Stand-up Meeting	2.34’	VjNxQ-a-x2M
Example 3	Examples of Good Meeting Communications Skills	1.50’	czpBKC9Plh4
Example 4	How NOT to run a meeting	2.37’	F1qstYxrqn8

Secondly, micro-scaffolds are provided in the Social Space once the approved anonymised comments are available for the learner to review. The rating categories, which are designed to further promote reflection, are: “This is useful for me,” “I hadn’t thought of this,” “I didn’t notice this,” “I don’t agree with this,” and “I like this point.”

4.4 Experimental Design

In order to evaluate the effectiveness of using AVW to teach face-to-face meeting communication skills, we designed a user study with software engineering undergraduate students. The study consisted of five phases (see Figure 4.1), each week-long except for phase 3 (two weeks). The participants were recruited through invitations sent to SENG202 course mailing lists. Participants were instructed that their participation was voluntary and that all content would be anonymous. Participants gave consent and became study participants by completing Survey 1 (See Appendix D).

In *phase 1* (Personal Space), the participants were asked to watch the tutorial videos first and comment on them. After completing the tutorial videos, they were instructed to critique example videos on the four aspects (verbal communication, giving and receiving feedback, active listening, and meeting contributions). There was no specific guidance about what should be included in the comments (apart from the micro-scaffolds, which provided implicit guidance on aspects). In *Phase 2*, participants were directed to the Social Space where they could read comments from other participants. All comments were anonymous, only comments reviewed and approved by the researcher were visible to the participants. The participants were instructed to explore and rate the comments made by the others.

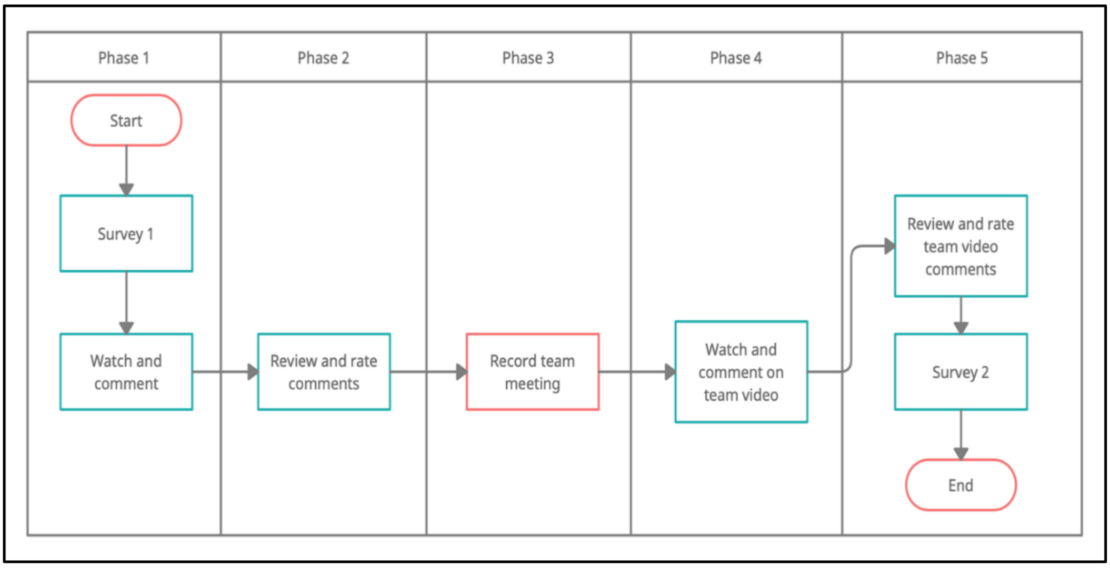

Figure 4. 1: Overview of experimental design

In *phase 3,* each team nominated one of their weekly team meetings that would be video recorded. The recording was made available for viewing and commenting through the Personal Space of AVW-Space (only team members can view their team video recordings). In *phase 4*, the participants were asked to watch and comment on their team meeting video recording. Subsequently, in *phase 5*, participants explored and rated the approved anonymised comments written by their peers on their team video recording through the Social Space of AVW-Space. At the end of phase 5, we administered Survey 2 (See Appendix E).

4.5 Collected Data

Survey 1 (Pre-questionnaire) Obtained Data

- Demographic information
- Conceptual knowledge
- Meeting communication skills level

Survey 2 (Post-questionnaire) Obtained Data

- Conceptual knowledge
- Meeting communication skills level
- CAP Perceived learning gain
- NASA Task Load Index (NASA-TLX)
- Perceived usefulness (Technology Acceptance Model)
- Qualitative feedbacks on each of the features of AVW-Space

4.6 Descriptive Statistics

Table 4.2 presents the number of participants who completed various phases of the study. Out of 56 students enrolled in the course, 49 completed Survey 1. Of those, 47 have used AVW-Space, while the remaining two participants were inactive learners. We received 32 responses for Survey 2, but that number included one inactive student and one incomplete response. After removing those responses, we had 30 students who completed both surveys and interacted with AVW-Space.

Table 4. 2: Number of participants who completed various phases of the surveys

Survey 1	Inactive	AVW-Space	Survey 2 (all)	Survey 2 (excl.IL)
49	2	47	32	30

4.6.1 Demographic Profile of Respondents

The study sample was the second year bachelor software engineering students at the University of Canterbury. Table 4.3 presents the demographic data for 49 students who completed Survey 1. The majority are male (83.7%) and only 16.3% are female, which is common for engineering programmes. Almost all the students (98.0%) were aged between 18 and 23 years old, except one student who was in the age range of 24 to 29 years old and 77.6% specified English as their first language. A large proportion of the students (79.6%) indicated having no formal training on communication in face-to-face meetings and that makes this study pertinent at this time to contribute to knowledge base in communication studies.

In addition to that, only 16% reported having previous training on communication in face-to-face meetings which took place in high school; this report is in line with the fewer students (12.2% and 4.1%) who have had some and quite a bit of formal training on communication in face-to-face meetings. A total of 44.9% of the students stated the frequency of their face-to-face meetings experience as occasionally and 36.7% of them have never had any face-to-face meeting experience. With reference to the types of face-to-face meeting experiences, 53.1% of the students have had the experience during their participation in group assignment in the university, 20.4% in high school, and 14.3% reported having the experience from other sources, such as club meetings, class representative meetings, prefect meetings in high school, afterschool kids program meetings, annual general meetings, full time summer job, and youth group meetings. A total of 75.5% of the students have never had any experience working in software development teams outside the university. About 61.2% of the students reported watching YouTube on daily basis, while only 40.8% used it for learning on weekly basis.

Table 4. 3: Demographic profile of the students who completed Survey 1

		Frequency	**Percentage**
Gender	Male	41	83.7%
	Female	8	16.3%
Age (Years)	18-23	48	98.0%
	24-29	1	2.0%
First language	English	38	77.6%
	Chinese	3	6.1%
	Filipino	1	2.0%
	Arabic	1	2.0%
	Cebuano	1	2.0%
	Dutch	1	2.0%
	Russian	1	2.0%
	Mandain	1	2.0%
	Telugu	1	2.0%
	Vietnamese	1	2.0%

Table 4.3: Demographic profile of the students who completed Survey 1 - *Continuation*

		Frequency	**Percentage**
Formal training on communication in face-to-face meetings	No training	39	79.6%
	Some training	6	12.2%
	Quite a bit	2	4.1%
	A lot	2	4.1%
	Extensive training	0	0%
Previous training on communication in face-to-face meetings	Training at high school	8	16%
	Training at University	5	10.2%
	Training at community/volunteer group	4	8.2%
	Professional development training	3	6.1%
	Other	1	2.0%
Frequency of Face-to-face meetings	Never	18	36.7%
	Occasionally	22	44.9%
	Once a month	6	12.2%
	Every week	3	6.1%
	Every day	0	0%
Type of Face-to-face meetings experience	Group assignment in high school	10	20.4%
	Group assignment in university	26	53.1%
	Meeting with lecturers	7	14.3%
	As part of an internship	2	4.1%
	Part-time job related to software development	2	4.1%
	Part-time job not related to software development	8	16.3%
	Other	7	14.3%
Experience working in software development teams outside the university	None	37	75.5%
	Some experience (less than a week)	6	12.2%
	Quite a Bit (a month)	2	4.1%
	A lot (several month)	3	6.1%
	Extensive experience (more than a year)	1	2.0%
Frequency of watching YouTube	Never	0	0%
	Occasionally	4	8.2%
	Once a month	1	2.0%
	Every week	14	28.6%
	Every day	30	61.2%
Frequency of using YouTube for learning	Never	1	2.0%
	Occasionally	13	26.5%
	Once a month	12	24.5%
	Every week	20	40.8%
	Every day	3	6.1%

4.6.2 Face-to-Face Meeting Communication Skills Level

The participants' face-to-face meeting communication skills (Surveys 1 and 2) were collected using communication scale adapted from Jackson (2014) and Mishima et al. (2000). This thesis evaluated the communication scale by conducting detailed validation and reliability assessments (See Chapter 3); these procedures confirmed a 23-item scale suitable for assessing face-to-face meeting communication skills. The communication scale measured the participants' abilities to express complex ideas using language understood by all meeting participants, to provide clear, appropriate and constructive feedback to other meeting participants, to listen to the other meeting participants, paying attention to her/his body language, and to encourage oneself and other meeting participants to express personal feelings during team meetings. The participants self-rated their face-to-face meeting communication skills levels on a scale where 1 = Never and 7 = Always.

Table 4.4 presents the participants' self-reported face-to-face meeting communication skills levels pre- and post-AVW. As shown in Table 4.4, prior to the AVW (Survey 1) all participants reported high level of face-to-face meeting communication skills with a mean value of 5.22. In Survey 2, the participants reported experiencing a higher level of face-to-face meeting communication skills after their interactions with AVW-Space, with a mean level of 5.64.

Table 4. 4: Descriptive Statistics of face-to-face meeting communication

	Survey 1	**Survey 2**
Descriptive Statistics	Face-to-Face Meeting Communication	Face-to-Face Meeting Communication
Mean	5.22	5.64
Std. Deviation	0.67	0.544
Minimum	4.04	4.74
Maximum	6.61	6.78

4.6.4 Number of User Comments and Ratings

Table 4.5 presents the total number of comments and ratings made by the participants based on the video types. A total of 452 comments were made on both *tutorial* and *example* videos. Specifically, 160 comments were made on *tutorial* videos and 292 comments were made on example videos. As expected the number of comments on *example* videos was higher than the *tutorial* videos.

Table 4. 5: Summary of the number of user comments and ratings

Video	Video Length	Comments	Ratings
Tutorial 1	2.46’	43	627
Tutorial 2	2.45’	28	347
Tutorial 3	1.46’	26	290
Tutorial 4	2.39’	17	252
Tutorial 5	2.22’	28	365
Tutorial 6	4.05’	18	211
Example 1	5.22’	43	445
Example 2	2.34’	105	975
Example 3	1.50’	69	652
Example 4	2.37’	75	746

4.6.5 Comment Quality Scheme

In order to differentiate constructive from active learners, we examined the number of high-quality comments. As the first step, we explored students’ comments and discovered that the comment quality scheme developed for presentation skills (Mohammadhassan et al., 2020) could be applied to comments made on the face-to-face communication videos. The quantitative content analysis was undertaken to assess the quality of each students’ comment using the quality scheme adapted from Mohammadhassan et al. (2020). Originally, Mohammadhassan et al. (2020) developed the quality scheme to assess the quality of students’ comments in previous studies on presentation skills. Students’ comments are classified under five categories with increasing quality of comment: (1) Affirmative, negative or off-topic, (2) Repeating, (3) Critical and analytical, (4) Self-reflective and (5) Self-regulating comments. The quality scheme also assumes that the higher quality comments pedagogically subsume the lower quality comments. Therefore, comments in categories 1 and 2 are pedagogically undesirable since they do not convey deep thinking about the videos. However, comments in category three show more critical thinking about the video, as students elaborate on the video content. In category 4, students reflect on their previous experience in relation to the video. Finally, learners indicate a high level of learning in category five by planning how to improve their future meeting participation using the ideas covered in the videos. The description and representative examples of each comments categories based on video type are given in Tables 4.6 and 4.7.

Table 4. 6: Description of tutorial video comment coding categories

Category	Definition	Example
Affirmative, negative or off-topic	Annotations that are very short, not relevant to the topic or merely affirmative/negative with no explanations.	“keep in mind.”
Repeating	Learner repeats what they observed in the video content without adding any additional input.	“Be clear - one idea per sentence.”
Critical and analytical	Learner elaborates on points covered in the video or shows critical thinking (i.e. analysing, synthesising, and evaluating information to reach a conclusion).	“Simplicity is the key, more like "Sometimes less is more".”
Self-reflective	Learner reflects on their behaviour and previous experience or knowledge during meeting participation.	“Feedback is one thing that I certainly feel like I don't do enough.”
Self-regulating	Learner indicates what they will do next time or what they need to work on in future meetings participation.	“I need to work on reducing detail and focussing on things that really matter.”

Table 4. 7: Description of the example video comment coding categories

Category	Definition	Example
Affirmative, negative or off-topic	Annotations that are not relevant to the topic or merely affirmative/negative with no explanations.	“Good point.”
Repeating	Learner indicates what they observed good/bad behaviour but does not indicate the effects or causes of behaviour.	“Feedback framed negatively.”
Critical and analytical	Learner criticises the behaviour and explains the effect or cause of the behaviour observed, or offers advice for improvement	“Interrupting someone talking - stops the thought flow of the person talking.”

Hence, we automatically labelled the comments from the study. Table 4.8 shows the frequency of quality categories in comments from the study. Like the previous studies on presentation skills, category 2 (repeating video content) was the most frequent category.

Table 4. 8: Distribution of comments in quality categories for tutorial and example videos

Tutorial comment categories	**1**	**2**	**3**	**4**	**5**
Count	1	70	18	51	19
Percentage	.6%	44.02%	11.32%	32.07%	11.94%
Example comment categories	1	2	3		
Count	5	220	67		
Percentage	1.90%	75.34%	22.94%		

4.7 Data Analysis and Interpretation of Findings

4.7.1 RQ1: How much did the students learn from their experience with AVW?

Conceptual Knowledge Assessment

As the first step in our analysis process, to automatically assess the participants' responses to the conceptual knowledge questions, we developed the domain vocabulary for communication skills by extracting the domain features. Therefore, generating the corpus from the transcripts of tutorial videos (N = 296 segmented text), participants' responses to the conceptual knowledge questions (N = 49) and participants' reflections on the tutorial (N = 159) and example (N = 292) videos. The tokens were extracted and lemmatised after lowercasing texts and removing punctuations and stop words (e.g., "the", "to", "am"). Next, using collocation statistics (Mikolov et al., 2013) implemented in the Phrases module of the Genism library 7, words and bigram phrases that appeared more than twice in the corpus were extracted automatically. In addition to collocation statistics, following the work of Pennington et al. (2014), we extracted the most relevant and similar words using Global Vectors (GloVe) Word Representation to represent each word. In total, 225 words and phrases were extracted from the texts, along with 225 synonyms defined for them. Next, three independent expert coders, including the course coordinator, verified whether the extracted words should be in the domain vocabulary. Each word was coded with "1" or "0", depending on whether a particular word was relevant or not. The pairwise Cohen's Kappa test revealed moderate (0.55), substantial (0.61) and nearly perfect (0.91) agreement between the coders (Landis & Koch, 1977). Similarly, the Fleiss' kappa showed substantial inter-coder agreement for the extracted words ($\kappa = 0.69$) (Landis & Koch, 1977). However, Krippendorff's alpha coefficient ($\alpha = 0.31$) was lower than the minimum acceptable value ($\alpha > 0.66$) for inter-coder agreement (Krippendorff, 2010). Therefore, a meeting was organized for the three coders to review and discuss their comments with a fourth coder to resolve differences in codes using the majority vote to achieve agreement. After the meeting, eleven words were discarded, and ten new words were added to the domain vocabulary for communication skills. Following the development of the domain vocabulary, this study implemented the earlier work by Mohammadhassan et al. (2020) to automatically assess each student's entries for the conceptual knowledge question to produce the conceptual knowledge pre-and post-test scores (CK1 and CK2). The conceptual knowledge assessment is designed to assess participants' change in knowledge of effective communication technique due to usage of AVW-Space (See Appendices D and E). The assessment asked participants to list as many phrases or words as they can recall within three minutes, which are associated with effective communication in SE meetings.

Table 4.9 presents the average score for conceptual knowledge from Survey 1 (CK1) was 6.71 (SD = 4.51) and Survey 2 (CK2) was 9.90 (SD = 6.91) indicating an increase in the level of conceptual knowledge reported by the participants.

Table 4. 9: Level of conceptual knowledge

	Mean	**Std. Deviation**
CK1 (Survey 1)	6.71	4.51
CK2 (Survey 1)	9.90	6.91

All the 49 participants completed Survey 1, while only 30 of them filled Survey 2, thus, we reported exact numbers of the participants who have completed the surveys according to their engagement category in Table 4.10. There are four engagement categories being studied in this thesis: Inactive learners, passive learners, active learners, and constructive learners. Inactive learners were characterised as those who had not watched any videos, whereas passive learners were identified as those who had watched videos but had not manipulated them or added comments to them (Mitrovic et al., 2017). By examining the quantity of high-quality comments, we could differentiate constructive from active learners. High-quality comments demonstrate self-awareness, critical thinking about the video's content, and planning for future performance, whereas low-quality comments merely restate the video's content verbatim or are brief (Mohammadhassan et al., 2020). The median number of high-quality comments on tutorial videos was 2. As a result, we categorized active learners as individuals who contributed up to two high-quality comments. By contrast, participants who wrote more than two high-quality comments were classified as constructive learners.

Table 4.10 presents the conceptual knowledge scores from the two Surveys. The inactive learners demonstrated a much lower level of conceptual knowledge compared to other learners in Survey 1, Mean = 5.50 (3.53) and there was no data in survey 2 to confirm if there is any difference in their conceptual knowledge scores. There was a noticeable increase in the conceptual knowledge for passive learners from survey 1 to Survey 2, from 5.95 (3.17) to 8.10 (5.34). Likewise, active learners reported improved conceptual knowledge which ranged from 8.17 (5.28) in survey 1 to 11.20 (5.81) in survey 2. The constructive learners also reported a higher level of conceptual knowledge from both surveys which accounted for 7.09 (5.28) in survey 1 and 10.67 (8.20) in survey 2.

Table 4. 10: Conceptual knowledge comparison by engagement category

	Inactive Learner	Passive Learner	Active Learner	Constructive Learner
Survey 1	5.50 (3.53)	5.95 (3.17)	8.17 (5.28)	7.09 (5.28)
CK1 - Mean (SD)	n = 2	n = 19	n = 6	n = 22
Survey 2	N/A	8.10 (5.34)	11.20 (5.81)	10.67 (8.20)
CK2 - Mean (SD)		n = 10	n = 5	n = 15

Furthermore, Figures 4.2 and 4.3 show the average conceptual knowledge level for each engagement category. As can be seen, the active and constructive categories have the highest conceptual knowledge mean scores for surveys 1 and 2.

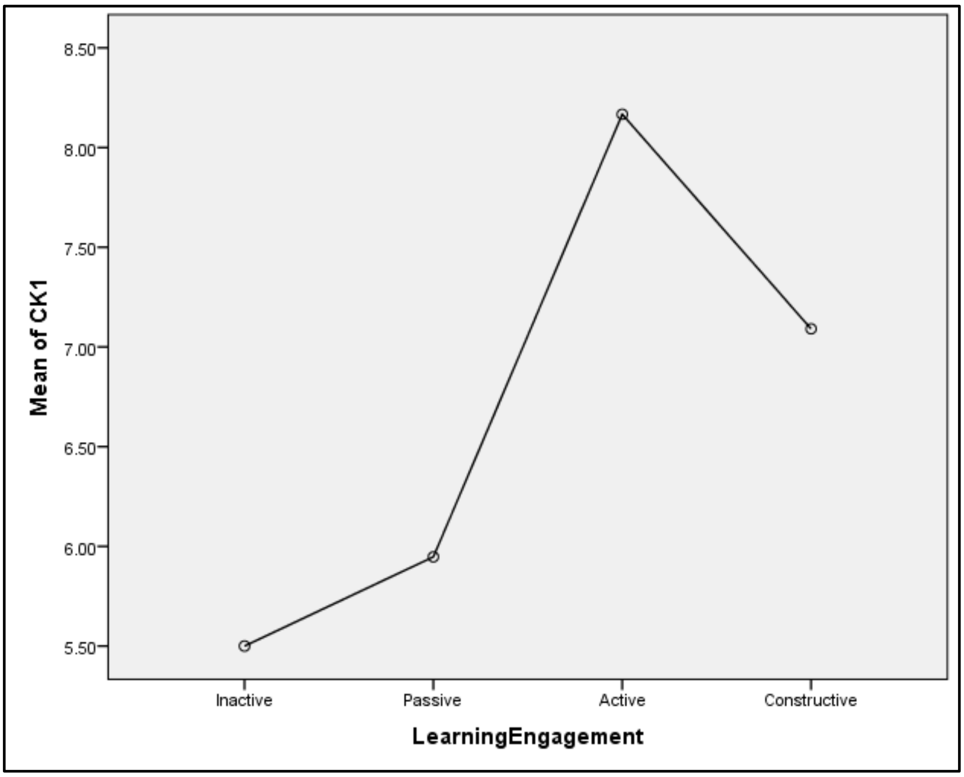

Figure 4. 2: Means plot for CK1 1 by engagement category

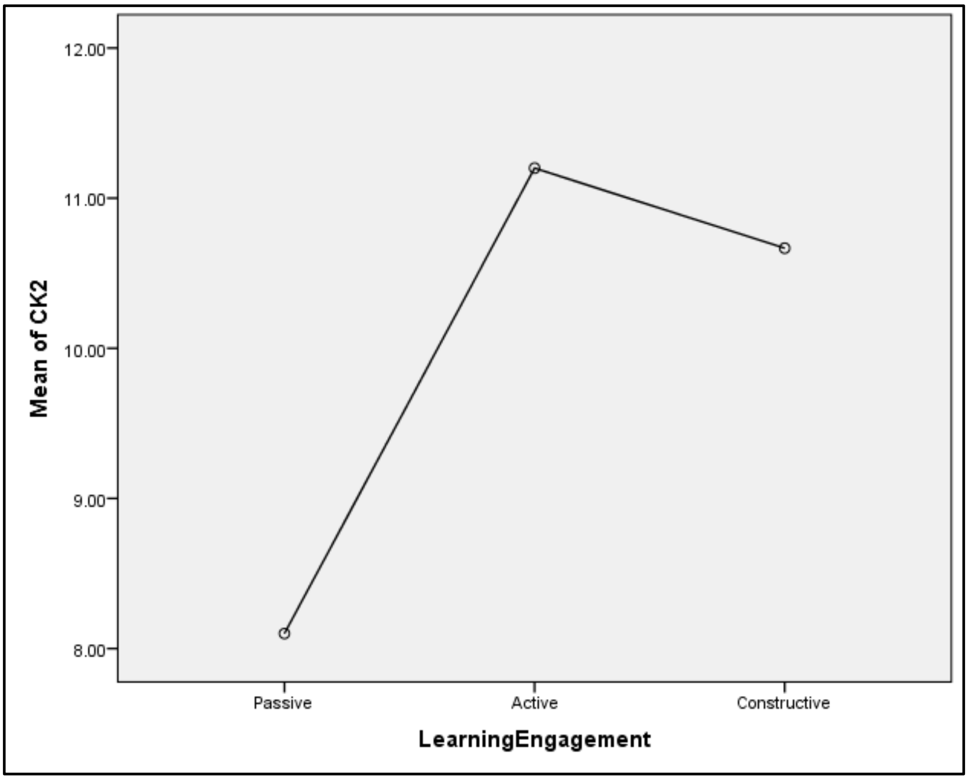

Figure 4. 3: Means plot for CK2 by engagement category

There were no significant differences between the engagement categories on the conceptual knowledge scores from Survey 1 ($F(3,45) = 0.47$, $p = 0.70$). This indicates that the different categories of learners started with the same level of conceptual knowledge. Using ANCOVA with CK1 as co-variate, we found a statistically significant difference in the CK2 scores ($F(3, 26) = 10.98$, $p = .01$) with a large effect size of 0.54. The result is consistent with Wilcoxon signed-rank test output which shows that the median CK2 scores (MD = 9.00) were significantly higher than the median CK1 scores (MD = 6.00), further indicating that there was a significant increase on the participants' conceptual knowledge as a result of their participation in AVW ($Z = -3.21$, $p = 0.01$). The Wilcoxon signed-rank test also revealed a significant increase on conceptual knowledge scores from CK1 to CK2 for constructive learners only ($W = 100$, $p = 0.01$). There were no significant differences on conceptual knowledge scores for passive and active learners. Additionally, there was no data to analyze statistical significance of difference for inactive learners because none of them participated in Survey 2. There is empirical evidence that AVW facilitates learning and improves conceptual knowledge related to face-to-face meeting communication skills, particularly for constructive learners who not only watched and restated video contents in their annotations but also made high-quality comments and rated the comments of other participants in AVW-Space. As a result, it can be established that only constructive learners increased their conceptual knowledge and no significant improvement in conceptual knowledge was observed for passive, active, or inactive learners.

Perception of Learning Gain Assessment

The perception of learning gain (PLG) scale (Rovai et al., 2009) was used to capture students' estimates of learning gains from their experience with AVW. The PLG scale consists of 8 items with a high reliability coefficient (Cronbach's alpha, α = 0.85) (Hulin et al., 2001). A total of 30 participants completed this scale in Survey 2 (See Appendix E). Their responses were recorded on a Likert scale of 1-7, where 1 = strongly disagree and 7 = strongly agree. This thesis adopted the interpretation of Van Boxem et al. (2011) level of score of the 7-point Likert scale as shown in Table 4.11.

Table 4. 11: Likert scale 7-point scoring system: global perceived effect

Score	% Change	Description	PLG Ratings - Frequency (%)
7	75% improvement	Very good	-
6	50–74% improvement	Good	4 (13.3)
5	25–49% improvement	Fairly good	9 (30.0)
4	0–24% improvement or worse	Same as before	14 (46.7)
3	25–49 % worse	Fairly bad	2 (6.7)
2	50–74% worse	Bad	1 (3.3)
1	75% worse	75% worse	-

The average score for PLG was 4.36, with a standard deviation of 0.95. The mean value for PLG was at the moderate level, indicating that most of the participants reported having moderate level of PLG. Additionally, a small standard deviation value shows that the ratings given by the participants were similar or homogenous. This was further supported by the categorized data, in which a total of 46.7% of the participants reported having 0–24% PLG from the online training, this indicates that their knowledge level on the concepts thought in the AVW-Space increased by about 24%. Following, 30.0% of the participants believed that they attained 25–49% increase on their PLG, and 13.3% reported having up to 74% increase on their PLG. A negative skewness value of -0.04 indicates that only a few participants rated their PLG as low. In other words, most of the participants reported gaining about 24% to 74% knowledge increase on their face-face meeting communication skills from the AVW participation.

4.7.2 RQ2: What were the students' perceptions toward AVW-Space? (*Did they experience any challenges and was the AVW-Space useful for learning?*)

The NASA-TLX questionnaire on cognitive workload (Hart & Staveland, 1988) and the TAM questionnaire on perceived usefulness of the online training (Davis, 1989) were used to evaluate students' views of AVW-Space in terms of commenting on videos and rating comments (post-questionnaire). The four components of NASA-TLX cognitive workload that were assessed in this thesis are listed in Table 4.12. The four components evaluated how much mental and perceptual activity was required; how hard the participants worked to attain certain level of performance; how discouraged, insecure, stressed, annoyed and irritated versus relaxed, secure, content, complacent and gratified the participants felt during the task; and how successful they were in achieving the objectives of the task. The scores of inactive students were omitted because no engagement with AVW was recorded for them.

Table 4. 12: NASA-TLX cognitive load and TAM perceived usefulness of the online training

		Passive	**Active**	**Constructive**
NASA-TLX Mental Demand	Personal Space	7.58 (4.98)	8.00 (4.24)	6.21 (3.95)
	Social Space	5.92 (4.48)	6.00 (2.71)	5.86 (5.05)
NASA-TLX Effort	Personal Space	9.75 (4.47)	6.25 (6.18)	7.36 (4.72)
	Social Space	5.25 (4.33)	3.73 (2.50)	6.93 (4.62)
NASA-TLX Frustration	Personal Space	5.75 (4.54)	8.00 (4.69)	6.14 (6.05)
	Social Space	5.08 (4.19)	6.50 (2.65)	6.14 (4).55
NASA-TLX Performance	Personal Space	7.75 (3.84)	10.50 (2.52)	7.07 (5.03)
	Social Space	9.33 (4.52)	11.25 (4.79)	7.64 (5.29)
TAM Perceived Usefulness	Personal and Social Space	3.89 (1.45)	3.54 (1.89)	3.60 (1.36)

**NASA-TLX cognitive load responses were recorded on a Likert scale of 1-20, where 1 = very easy and 20 = very hard, and TAM perceived usefulness on a Likert scale from 1 = extremely likely to 7 = extremely unlikely)*

Writing Comments: There were no significant differences between the engagement categories on any of the cognitive load values and no significant pairwise differences. The average scores across the four measures of NASA-TLX cognitive workload for different categories were at low to moderate levels, therefore, the participants found commenting on the videos and rating comments somewhat demanding, effort intensive, frustrating and successful.

Some of the students reported that they experienced some challenges with commenting on the videos.

Demand: A total of 26.7% of the participants stated unequivocally that commenting on videos stimulated thinking and concentration., example: "*Only a little of thinking and remembering was required for commenting on videos*," "*It wasn't too mentally demanding, but it did require constantly thinking about when you should add comments about something*," "*I had to be more attentive than I normally would*," and "*I found it difficult to decide what comments to write on the videos*."

Effort: A larger proportion (73.3%) of the participants agreed that they didn't have to put so much effort to write comments on videos, however, only two students reported working mentally hard to perform the task, example, "*The hardest part was determining how to phrase the comment correctly*."

Frustration: The participants said that they experienced little to no frustration while writing comments on the videos, with the exception of one who stated: "*The only annoying thing I found was I already knew a lot about how to have a good team meeting, given my leadership experiences in the past, so the only thing that was annoying was having to write about something I'd already learnt*."

Performance: Four of the participants did not find the videos helpful for soft skills acquisition because they reported being familiar with most of the concepts taught, example, "*I don't think I was that successful as I thought most points were common sense*" and "*Some of the videos did help me to verbalise my approach to meeting communication, however I didn't write about it given it was common knowledge to me*." Six of the participants noted that overall they were successful at identifying useful points about effective meeting participation when commenting on videos in AVW-Space.

Rating comments: The participants expressed experiencing some difficulties with rating comments. Accordingly, the participants rated the NASA-TLX cognitive workload as fairly demanding, effort tasking, frustrating, and successful.

Demand: Majority (80%) of the participants did not find rating comments mentally demanding, as some noted that it only required a little thinking. One of the participants reported that rating comments was quite demanding, as they were so many of them to be reviewed. Therefore, commenting on videos was regarded as more mentally demanding than rating comments.

Effort: A total of 83.3% of the participants indicated not working that hard to review and rate comments as the comments were often very similar, but a few of them reported that it was time consuming because there were so many to look at.

Frustration: From the assessment of the participants' feedbacks, 36.6% of them were discouraged by the amount of comments they had to review and rate, example, "*I was slightly discouraged by the large number of comments that had to be reviewed and rated*." Generally, it can be argued based on their feedbacks, they found rating comments more frustrating than commenting on videos.

Performance: 53.3% of the participants reported being successful at identifying useful points about effective meeting participation when reviewing and rating comments made by others in AVW-Space. Some believed it aided in the development of their ideas while also allowing them to learn from the perspectives of others, example, "*Quite successful, as it allowed me to think about my ideas that I had while watching the videos, while also considering the ideas of my peers*" and "*I think I was successful with rating comments and was able to learn other points of views*." One of the participants' stated: "I don't think reviewing others comments were as helpful as it could have been" and recommended including "expert answers/comments" in the AVW-Space.

Perceived usefulness: Technology Acceptance Model (TAM) questions (Davis, 1989) were integrated into Survey 2 to quantify the perceived usefulness of AVW-Space. The TAM obtains perceived usefulness data which is demonstrated to be exceptionally associated with real usage patterns; thus, TAM values for perceived usefulness show how much the students are very likely to use AVW-Space more often intentionally. Table 4.12 shows the average scores of the TAM questions assessing the perceived usefulness of using AVW-Space for the online training for each engagement category. The average scores reveal that the participants found AVW-Space moderately useful for informal learning of soft skills. There was no significant difference on usefulness of AVW-Space across the engagement categories.

Furthermore, this thesis investigated the usefulness of the features embedded in the AVW-Space, such as pausing video to write comments, indicating aspects, reviewing comments, and rating comments. The findings revealed the strengths and limitations of these features, which provide the basis for future improvements.

Usefulness of pausing video: Majority (86.7%) of the participants indicated that pausing a video to write a comment was a useful technique and encouraged more concentration, example, "*It is useful in preventing me from getting distracted from the video*" and "*You won't* *miss any important points while writing a comment, your focus wouldn't be shared between writing a comment and trying to watch/listen to the video*."

Usefulness of indicating aspects: The participants' feedbacks on commenting are indications of the effectiveness of aspects to support reflective learning. Not all participants found the aspects useful, some reported it was restrictive, example, "*Not very useful as often I had a comment that did not fall into these categories*" and "*I think that not every comment I wanted to make fit clearly into those categories*," and they suggested having a larger variety to choose from. *One participant stated that "It's good for categorizing comments, but would be more effective with more categories*."

Usefulness of Reviewing Comments: 83.3% of the participants found reviewing comments from their peers very useful, as it helped them to understand different perspectives and revealing issues that may have gone unnoticed, example, "*It allowed me to see that ideas that my peers had, and thus allowed me to see some points that I missed, or otherwise see some points from a different point of view*," "*Extremely useful, allowed me to get other student's perspectives that I might have missed*," and "*It's useful for being able to understand other people's perceptions and opinions of things. Some people might perceive body language or actions differently to you and it's important to understand those differences*." One of the participants' indicated that not all the videos and comments were very useful: "*It was useful for some videos, such as the videos of my own and other peoples meetings. However, for videos where the content was already very explicit, such as the instructional videos, I felt it was not very helpful as the video was already very easy to understand and the comments didn't tell me anything that I hadn't already thought of*." Some of the participants felt that reviewing comments was not useful because there were a lot of comments to get through and the purpose and how it might help was unclear.

Usefulness of Rating Comments: 43.3% of participants stated that rating comments encourages learning by sharing ideas and determining what they were currently doing well and what needed to be worked on as an individual and as a team. They also indicated that this feature was useful, since it facilitated the organisation of their peers' comments on the team meeting video, which is expected to enhance the success of their team meetings. A total of 36.6% of the participants did not find rating comments useful; some stated that the ratings are rather restrictive, and thus they could not express their opinions on a comment properly and that more options are needed.

4.7.3 RQ3: Did participation in AVW Experiment improve students' meeting communication skills? **(*Were the team recordings during meeting useful for learning?*)**

Meeting communication scale, questions on usefulness of watching and commenting on own team video and questions on usefulness of reviewing and rating the comments made by other team members on their team video were used to understand the participants' typical behaviour during face-to-face team meetings and how effectively they applied the communication concepts taught in AVW-Space in their meeting participation.

Meeting communication scale: Out of the 49 participants who completed Survey 1, only 30 participants filled Survey 2. Table 4.13 shows the meeting communication scores from the two Surveys. There was no data in survey 2 to confirm if there is any difference in meeting communication scores for inactive learners. Between surveys 1 and 2, there was a notable increase in the meeting communication scores for passive learners, from 5.08 (0.73) to 5.56 (0.50). Similarly, active learners reported increased meeting communication skills, ranging from 5.51 (0.54) in survey 1 to 5.73 (0.64) in survey 2. Additionally, constructive learners demonstrated improved meeting communication skills in both surveys, achieving an average scores of 5.26 (0.65) in survey 1 and 5.66 (0.57) in survey 2. A one-way repeated measured analysis of variance (ANOVA) on meeting communication skills for surveys 1 and 2 indicated a significant effect overall, Wilks' Lambda = 0.55, $F(1, 29) = 23.50$, $P = 0.01$ with large effect size of 0.45. The pairwise difference from Survey 1 to Survey 2 was significant ($p = 0.01$). The paired samples t-test revealed a significant difference in the participants' face-to-face meeting communication skills from survey 1 to survey 2 ($t = -4.85$, $p = 0.01$). There were no significant differences on meeting communication scores between the engagement categories. As a result, there is statistical evidence that participation in AVW enhanced participants' meeting communication skills.

Table 4. 13: Face-to-face meeting communication skills comparison by engagement category

	Inactive	Passive	Active	Constructive
Pre-AVW (Survey 1)	5.24 (0.65) n = 2	5.08 (0.73) n = 19	5.51 (0.54) n = 6	5.26 (0.65) n = 22
Post-AVW (Survey 2)	N/A	5.56 (0.50) n = 10	5.73 (0.64) n = 5	5.66 (0.57) n = 15

**Face-to-face meeting communication skills responses were recorded on a Likert scale of 1-7, where 1 = never and 7 = always.*

Usefulness of watching and commenting on own team video: The students were organised in 10 groups, seven of the groups of six students, two groups of five students and one group of four students. These groups held their weekly meetings after their participation in AVW and recorded the processes involved. Each group uploaded their recording to AVW-Space for other members of each group to watch and comment on their meeting, and then rate the comments written by their peers in the same team. The participants provided qualitative responses pointing towards how watching and commenting on their meeting recording prompted some constructive discussion within their teams and caused them to make some changes to enhance their meeting communication skills. As a matter of fact, majority (93.3%) of the participants found watching and commenting on their meeting recording very useful, as it helped them to reflect on their own behaviours and to assume the role of a third party in order to ascertain the participants' successes and failures during meetings, example, "*Very useful as an outsider's perspective allowed me to see things (good and bad) that I did in the meeting more clearly," "Allows you to see how effective your team meetings are from an outside perspective, and you can see what kind of interactions you have with your team mates," "You're able to see your meetings from an outside perspective, which enables you to see things you might've missed in the moment such as team members not contributing as much or not paying attention," "You can't always see what every team member is doing when you're part of a meeting so it enables you to view it and reflect on it, so that you can all find ways to improve your meetings. You also may have been doing things yourself that you don't notice without watching yourself back on video," "It allowed me to review how my team communicates from an outsiders point of view - this provided insight into some weaknesses and strengths that we have in our communication methods. It also made me more considerate of my communication while being filmed," "Very useful, it provides me with many of my weakness and my improvements,"* and *"It indicated what areas we can improve on as a team and what we did well."* Only two of the participants indicated that watching and commenting on own team video was not useful; one stated that a shorter video could be more beneficial and the other student made no further comment to justify the claim.

Usefulness of reviewing and rating the comments made by other team members: 73.3% of the participants found reviewing and rating comments on recording by other team members very useful, as it highlights points they may have missed while watching their team video and also gets others view points on their overall performance during meetings for better collaboration and communication, example, "*To show how I missed or saw things that were mentioned by other participants*," "*Understanding your team members views, feelings, and* *opinions, leading to better communication and teamwork*," "*It allows you to reflect on how your team members thought the meeting went*," "*Forced each team member to consider how others feel and facilitates team growth*," and "*With other team members advises, I can improve my skill more*." Seven of the participants did not find reviewing and rating comments made by others useful, as one noted that the indicators are too broad. One of the students reported that reviewing other students' comments was useful, but there was no point in rating them and another mentioned that "*Due to how the team bonded, our perspective of our team meeting performance would be very similar*."

4.8 Summary of Findings

The analysis of data obtained from the software engineering students at the University of Canterbury provided meaningful insights on their characteristics and meeting communication skills level. The demographic data revealed that majority of the participants were male. Almost all the participants are in their early twenties (below 25 years), this can be explained because the study sample was drawn from second year undergraduate students. A larger proportion of the respondents are English speakers which was an advantage for easy communication and data collection. Generally, the participants are inexperienced in terms face-to-face meeting communication concepts and that was a motivation to conduct this online training by utilizing AVW-Space for learning of soft skills.

The data analysis revealed that the AVW was overall an effective approach to teach soft skills, for example, based on the average scores reported, there was an obvious increase on conceptual knowledge for different categories of learners, however, only constructive learners experienced a significant increase on their conceptual knowledge from Survey 1 to survey 2. This finding was reinforced by majority of the participants who reported having up to 49% improvement on their perception of learning benefits from the online training.

Additionally, the participants indicated experiencing some difficulties with commenting on the videos and rating comments; a larger percentage of the participants stated being more frustrated with rating comments than commenting on videos because of the overwhelming number of comments from other students to be reviewed and rated. Despite the difficulties experienced, the majority of participants believed that the commenting and rating activities were beneficial for learning; when participants commented on videos and rated comments in AVW-Space, they reported being successful at identifying useful points about effective meeting participation because it allowed them to develop their ideas while learning from others' perspectives. Rating comments also aided participants in identifying areas they needed to address for effective and efficient meeting participation. Additionally, participants acknowledged the usefulness of pausing a video to leave a comment: it promoted attentiveness, and indicating aspects aided in reflective learning. Watching, commenting and rating team recordings were believed to be very useful activities, as participants were able to reflect on their behaviors during meetings and to identify areas for improvements for enhanced communication and team collaboration.

In general, the students' participation in AVW-Space was effective at teaching them meeting communication skills.

4.9 Chapter Summary

This chapter presented the participants' characteristics and other pertinent preliminary analysis, including the participants' level of face-to-face meeting communication skills, the number of participants who completed various phases of the surveys, the number of user comments and ratings, and the number of comments by each team. IBM SPSS version 21 was used to analyze the data, which was beneficial in addressing the research questions. Finally, the findings were interpreted and summarized. As a result, this chapter concluded that AVW is a highly effective strategy for transfer of soft skill.

CHAPTER 5

DISCUSSION

5.1 Introduction

The purpose of this thesis was to conduct a survey of software engineering students' overall experiences with AVW and the effectiveness of AVW as a reflective strategy to teach face-to-face meeting communication skills. The findings that addressed the research questions contribute to the existing body of knowledge by providing more insight into how AVW aid students' soft skills training. This chapter presents the discussion of findings by providing explanations based on the interpretations of research questions (RQs) with relevant literature to strengthen the results.

5.2 The Students' Learning Experience with AVW

The first research question was "*How much did the students learn from their experience with AVW?*"

To promote student engagement and reflective learning, we used the AVW-Space platform (Mitrovic et al., 2017), which enables teachers to quickly and easily create video-based learning spaces without the need for video editing. AVW-Space includes reflective learning aspects that are used when commenting on a video. We operationalized the ICAP framework (Chi & Wylie, 2014) to better characterise learners' engagement in AVW-Space. The ICAP framework examines four levels of cognitive engagement: interactive, constructive, active, and passive learning behaviours. We have investigated passive, active, and constructive learners in AVW-Space, and we also reported on some results from inactive learners (see Section 4.7.1). Only constructive learners who demonstrated self-awareness and critically analysed the videos' contents, as well as wrote and rated comments in Personal and Social Spaces, increased their conceptual understanding of effective meeting communication skills when compared to their peers who were less proactive with the provided learning materials (see Section 4.7.1). All students who remained in the experiment to the end achieved certain levels of communication proficiency that will aid the success of their team meetings.

Prior to participating in AVW, participants reported some levels of meeting communication skills. The average level of meeting communication skills was rated as high in

Survey 1. The finding was not surprising, considering the frequency with which students engage in verbal and nonverbal communication activities, whether at school, home or elsewhere. After completing the online training, the participants self-reported considerably higher levels of meeting communication skills in Survey 2. The increase in self-reported meeting communication skills reflects the participants' improvement in communication competence and conceptual knowledge after their participation in AVW. Additionally, all participants, with the exception of passive learners, reported an increase in conceptual knowledge in Survey 2, indicating that interactions with AVW improved their meeting communication skills.

The ontology utilised in this thesis to measure participants' conceptual knowledge was derived from those used by Dimitrova et al. (2017) and Mitrovic et al (2017). The undergraduate and postgraduate university students within Mitrovic et al. (2017) study reported a significant increase on conceptual knowledge from pre- to post-questionnaire and the study confirmed that only constructive learners experienced increased conceptual knowledge. This finding is in accordance with this thesis finding; thus, this study concurs with Mohammadhassan et al. (2020) and Dimitrova and Mitrovic (2021) on the importance of incorporating more interactive features into AVW-Space in response to students' feedbacks in order to promote a more constructive learning approach. Mohammadhassan et al. (2020) confirmed that students who made high-quality comments (constructive learners) significantly improved their conceptual knowledge between pre- and post-AVW.

In light of the conceptual knowledge increase in Survey 2 among the engagement categories, it was anticipated that participation in AVW would result in greater learning. The perception of learning gain assessment revealed evidence of learning in AVW-Space, but at a much slower rate, as some participants reported knowledge gain on meeting communication skills between 0 percent and 24 percent, which could mean no gain at all for some and up to 24 percent gain for others. The reason that they gained less had less to do with the AVW-Space system's design, but more to do with the fact that they had less to learn, given their high level of meeting communication skills and the fact that some participants said they were already familiar with the concepts taught. Thus, improving the learning materials by incorporating various communication tactics that are different from the experimental materials employed in this thesis may benefit the participants more.

5.3 Effectiveness and Challenges of Commenting on Videos and Rating Comments in AVW-Space

The second research question was "*What were the students' perceptions toward AVW-Space*? (*Did they experience any challenges and was the AVW-Space useful for learning*?)"

AVW-Space encourages students to write comments and utilize a variety of aspects (Mitrovic et al., 2019) and also promotes social learning by allowing students to review and rate comments submitted by their peers using the teacher-defined rating options (Mitrovic et al., 2017; Mitrovic et al., 2019). We used the NASA-TLX workload estimating questionnaire (Hart & Staveland, 1988) to explore the challenges associated with commenting on videos and rating comments in AVW Personal and Social Spaces, as well as the TAM questionnaire (Davis, 1989) to ascertain the perceived usefulness of AVW-Space. Participants' feedback on how demanding AVW was, how much work they put in, how frustrated they felt, and how successfully they did the prescribed tasks was generally positive (see Section 4.7.2). According to the average scores obtained for each estimate of cognitive workload across engagement categories, participants found commenting on videos to be more mentally demanding and effort-intensive than rating comments. Although the textual feedback indicated that the majority of participants were more frustrated with rating comments than with commenting on videos, the quantitative scores indicated different, with active learners reporting the greatest amount of frustration with commenting on videos. These results could be because we relied on students' self-reporting and active learners found it more challenging to provide extensive descriptions of concepts and practises for good meeting communication skills in their comments. Additionally, the number of students participating in each engagement category may have influenced the results.

Furthermore, students indicated that pausing a video to write a comment and indicating aspects to guide their thoughts were useful because they prompted concentration and reflective learning. However, 13 students described AVW-Space as restrictive because the categories of available aspects did not fully represent their thoughts, preventing them from fully expressing their ideas. This limitation discouraged some students from making any comment at all. To improve, we recommend that more categories of aspects different from ones readily available be added to the AVW-Space system and that students be allowed to customize additional aspects related to the subject matter being thought in order to foster holistic training and learning approaches based on active participation and creative thinking. Overall, participants found commenting on videos and rating comments useful because they were able to learn from one another and the activities revealed areas for improvement in their communication abilities.

It should be noted that commenting on videos and rating comments in AVW-Space have been shown to be useful in terms of designing a more efficient AVW-Space, as an earlier study (Galster et al., 2018) revealed that participants' frustration was attributed to the design of AVW-Space, as some students were unsure whether comments were intended for others or for themselves. Another study (Mitrovic et al., 2017) found that when undergraduate and postgraduate university students were enrolled in AVW for soft skill training, they reported that writing comments was cognitively demanding due to the requirement to identify suitable places within the video and reflect on prior experience. Simultaneously, students found rating comments to be relatively frustrating, and feedback identified several reasons for this, including an overwhelming number of comments to review and rate; reading comments of low quality; seeing numerous comments that are similar to one's own; and a lack of structure. There is obviously room for improvement, which will require computational tools to grade comments and present users with the most relevant comments based on their engagement behaviour. As a result, we believe that responding to participants feedback by increasing the interactive aspects of the Personal Space to encourage reflection on previous experiences, encouraging users to write high-quality comments that will be accessible in the Social Space, and guiding learners' focus to high-quality comments and comments that demonstrate diverse perspectives will result in improved experience for prospective users and ultimately more constructive learning applications. For example, Mitrovic et al. (2017) stated that constructive learning; commenting on videos and rating peers' comments does result in an increased conceptual knowledge of presenting skills, and presentation skills are recognised as one of the components of a professional software engineer's communication abilities (Galster et al., 2018). Furthermore, Musa et al. (2021) discovered that when learners comment on videos and rate the comments of others, their conceptual knowledge of face-to-face meeting communication skills increases. Dimitrova et al. (2017) stated that comments from others can provide examples that can be used in a nudge to stimulate engagement because not every comment will be stimulating, and comments are used as a representation of a comment's social value in order to determine whether a comment will be of interest to others, and ratings received in the Social Space will be used.

Accordingly, students indicated that participating in AVW was worthwhile and more useful than not participating at all. This was confirmed through an analysis of the TAM questionnaire (Davis, 1989). We collected and determined the average scores of participants' responses to the TAM questions about self and knowledge assessment. The TAM average scores show that in general, participants viewed AVW to be useful for developing meeting communication skills. As a result, we recommend that AVW be regarded a useful approach for developing soft skills and that it be integrated into existing communication skills training methodologies being used in universities.

5.4 Improving Students' Meeting Communication Skills through AVW Experiment

The third research question was "*Did participation in AVW Experiment improve students 'meeting communication skills*? (*Were the team recordings during meeting useful for learning*?)"

The findings of this thesis revealed that participants considered that their involvement in AVW benefited their development of meeting communication skills and overall soft skills improvement, as evidenced by the meeting communication scale average scores recorded and the significant difference found from pre- to post-questionnaire among the engagement categories. Passive, active, and constructive learners all reported an improvement in their ability to communicate effectively between Survey 1 and Survey 2, demonstrating the effectiveness of AVW in teaching soft skills. This thesis draws on the findings of a previous study (Mitrovic et al., 2017), which involved undergraduate and postgraduate students from two universities who used AVW as an informal learning tool to improve their presentation abilities. The study explored whether AVW aids learning through the use of AVW-Space and found evidence of learning with significant increase in conceptual knowledge scores. Similarly, another study (Dimitrova et al., 2017) of postgraduate students discovered evidence of learning as a result of their participation in AVW and concluded that AVW was effective at promoting engagement and reflection, as well as identifying problematic behaviours and the support that may be required to achieve target behaviours.

AVW is a form of video-based learning that has been proven to be an effective technique for teaching soft skills such as communication, negotiation, problem solving, and collaboration (Lau et al., 2016; Mitrovic et al., 2017). It is established in previous studies (Brame, 2016; Galatsopoulou et al., 2022) that video-based learning is rapidly gaining popularity in many corporate training programmes, as educational institutions seek novel ways to increase learner engagement and effectiveness. One of the most significant obstacles is implementing an effective video-based learning strategy that fosters student engagement while also incorporating reflective learning for soft skill training. As a result of our experiment, we can shed light on the effectiveness of AVW, an engagement and reflective learning approach in closing the gap in soft skills training for software engineering students, with the chosen soft skills domain being meeting communication skills.

Furthermore, majority of the participants were excited about watching and commenting on their own team's recorded video and rating comments made by other team members following their project meetings. These activities were well received by participants, who stated that they were very useful for identifying points they may have missed during meetings and for understanding how well team members communicated and performed in order to improve their face-to-face meeting experiences with more efficient outcomes. Face-to-face communication has been proven as the best mode of communication (Ambler, 2002), particularly in software engineering, where engineers regularly share information in order to ensure a successful project and a high-quality product (Prenner et al., 2018). Meetings are viewed as a facilitator of intense and effective face-to-face communication since they bring together a large number of team members and enable them to get a large amount of information with less effort (Schneider et al., 2015). However, team meetings are frequently less successful than anticipated because teams lose concentration, people interrupt one another, and meetings run too long (Kauffeld & Lehmann-Willenbrock, 2012), resulting in dissatisfaction with the meeting's outcome and a feeling of frustration (Rogelberg et al., 2010). To alleviate feelings of frustration and dissatisfaction with team meetings, Lehmann-Willenbrock et al. (2016) recommended frequently assessing meetings by determining their success, as the success suggests if the meeting was useful for the participants. In response, our experiment sought to prevent team members from becoming frustrated or unsatisfied with the outcomes of team meetings by delivering online training via AVW-Space to teach software engineering students critical meeting communication skills. Also, we assessed the meeting success by videotaping team meetings for reflective learning in order to prepare participants as communicators who are efficient at getting to the point when expressing ideas during team meetings; listening to others calmly and seriously while they speak without interruption; providing feedback to others about their strengths and weaknesses in contributing to the topic of discussion; and receiving feedback from others.

Video-based self-evaluation improves retention of knowledge, develops analytical thinking, and encourages learners to become more active in their studies (Boateng et al., 2016). Video-based self-evaluation has also been described as a useful tool for healthcare workers who want to reflect on their interpersonal abilities (Mazor et al., 2007; Zick et al., 2007). According to some research in the field of psychology, video is commonly utilized to provide support and feedback to students studying the more complex components of therapeutic communication (Epstein et al., 2003; Pinsky & Wipf, 2000; Travale, 2007). This research reveals that these methodologies are effective transferable skills teaching methods with high student satisfaction. Epstein et al. (2003) studied learner satisfaction with video projects in a medical-surgical nursing course and found the same thing. Students said that using video was a 'wonderful' and 'dynamic' experience. The scholars further noted that video-based self-reflection could encourage self-improvement by assisting learners in identifying their strengths and flaws and gaining insights into the impacts of their behaviors (Epstein et al., 2003).

5.5 Chapter Summary

This chapter presented the discussion of findings from the online training (AVW) on meeting communication skills we conducted and cited relevant prior research to support our findings. The ICAP framework was used to study students' engagement behaviours in AVW-Space, and the students' learning experience with AVW was assessed using conceptual knowledge scores and perception of learning gain scale. Further, this chapter discussed the effectiveness and challenges associated with commenting on videos and rating comments in AVW-Space. Finally, the overall benefits of participating in the AVW experiment for meeting communication skills training were discussed, as well as the usefulness of watching and commenting on one's own team meeting recording and rating comments made by other team members.

CHAPTER 6

IMPLICATIONS AND CONCLUSIONS

6.1 Introduction

The preceding chapters discussed the rationale for this thesis, the experimental designs, and the analytical techniques used in this thesis. The quantitative and qualitative data obtained were used to address the research questions, mainly focusing on the effectiveness of AVW on participants' meeting communication skills and the participants' experiences with AVW-Space. This concluding chapter discusses the study's practical implications. Following, it highlights the study's limitations and makes recommendations for future research. Finally, this chapter provides conclusions for the thesis and chapter summary.

6.2 Practical Implications

The meeting communication skills online training provided to students using AVW-Space appeared to be quite useful in terms of participants' soft skills development, particularly face-to-face meeting communication skills, which is the thesis's focal communication skills domain. It is evident that the AVW approach could enable students to access video materials by simulating their interaction with videos on widely used social platforms, such as YouTube, in order to keep them active and engaged in the acquisition of soft skills with very little intervention from teachers. This thesis contributes to literature by confirming the effectiveness of AVW in enhancing students' communication skills, particularly among software engineering students. Thus, this thesis validates and supports the usage of AVW-Space as a scalable tool for supporting learners in increasing their knowledge through video watching (Dimitrova & Mitrovic, 2021). It has been demonstrated that videos can pique students' interest and boost their learning engagement (Sablić et al., 2021). However, video creation is a time-consuming process that demands meticulous preparation and a well-defined execution methodology (Sablić et al., 2021). On the other hand, in AVW-Space, teachers can easily select publicly available videos rather than creating and/or editing them, while also requiring little work on the teacher's part to build means of interacting with students in the platform. As a result, AVW should be adopted across Universities as a flexible and time saving approach for soft skills training in order to facilitate students' active and reflective learning processes.

It is indeed worth noting that students appreciate the flexibility of AVW-Space which enables them to pause a video to write comments, review and rate comments from other students on learning outcomes, and promotes reflective and social learning (see Section 4.7.2). Additionally, by watching recorded videos of their meetings, students are able to identify their contributions during meetings and how well all the team members communicated (See Section 4.7.3). Simultaneously, commenting on and rating comments from other team members, enable students to gain insights into some of their communication approaches' shortcomings and strengths from a variety of viewpoints, so making them more mindful of their interactions with others (See Section 4.7.3). When considering AVW as a reflective learning strategy, it is critical to remember that students do not appreciate a restrictive learning space that limits them from expressing their thoughts more freely for their own and others' learning gains (See Section 4.7.2: usefulness of indication aspects). Accordingly, students' willingness to improve their communication skills increases as a result of their participation in the online training. According to our findings, AVW is capable of building more self-conscious students who become more considerate of their own and others' feelings and communication styles during team meetings.

In addition, this study fills a significant gap in the literature by performing rigorous scale development procedures to confirm the validity and reliability of measures for face-to-face meeting communication skills (see Chapter 3). Adapting known measures from credible sources, assessing the content validity of the measures, and conducting EFA and reliability analyses constituted the procedures. This thesis established the validity and reliability of a 23-item measure that is suitable for the current study and applicable to a variety of populations and contexts.

6.3 Study Limitations

Even though we have made every effort to perform this research in a robust and reliable manner, we recognise that it still has some limitations that require further research. The small sample size of this study limits the generalizability of the findings. The findings are representative of 49 students in their second year of bachelor in software engineering at the University of Canterbury. Additional research is needed to determine the impact of AVW on a larger sample size of students. Comparative studies are also required to see whether students' experiences with AVW vary across universities and disciplines. Furthermore, this study relied on self-reporting of the students, and this can have an influence on the reliability and generalization of the results obtained.

One drawback of our study is that the ICAP engagement categories were used just to assess students' learning experiences using AVW-Space in terms of commenting on videos and rating comments, with no apparent structure to the comments based on the participants' level of engagement. It is required to investigate how participants' comments can be classified into many quality categories (see Section 4.6.5) in AVW-Space and how participants' level of engagement influences the comments they view first. This is to ensure that participants' quality comments are captured first, alleviating the frustration expressed by students about having too many comments to view and rate, the majority of which are irrelevant. Moreover, the large volume of comments available in Social-Space demonstrates the need for some type of intelligent filtering for individual students. One possible solution to this problem is to analyze learner comments on videos in order to identify relevant comments to include in the Social-Space. This may be determined by the learner's opinions, the concepts considered, or the number of reflection words mentioned.

During our AVW experiment in the AVW-Space, we did not provide specific explanations for the aspects and how to use them. Additional analysis is required to determine whether a structured way of providing explanations for each aspect and how to apply them during video watching, which can be easily scaled in a variety of informal learning contexts for soft skills, would provide a means for user engagement, can trigger self-awareness, and would provide means for user engagement.

Due to time constraints, participants received no prior training on how to use the AVW-Space features. To get the best learning outcomes, users should first be trained on the system's key features. This is because high-quality comments from knowledgeable users can significantly be considered for enhancement of the overall AVW-Space's interactive features.

6.4 Directions for Future Research

In general, students appeared positive and enthusiastic about the Personal-Space, describing it as a tool that enables them to write their comments on videos, view personal summaries to help them make sense of the video, and generally keeps them active and engaged. However, they considered the AVW-Space to be restrictive due to the platform's limited number of available aspects for video annotation; as a result, the indication of aspects was not perceived as particularly useful, as some participants were discouraged from submitting any comments. Additional analysis of the interaction with the videos is necessary to determine what proportion of the comments needs more aspects and what aspects could have been omitted to more accurately reflect the participants' ideas. Furthermore, future study may broaden the selection options for aspects by including additional terminology based on the targeted concepts in order to facilitate users' learning processes.

We previously stated in Chapter 2 (Section 2.11) that AVW-Space does not support the ICAP framework's Interactive mode. Future research should focus on increasing support for inter-learner interaction, which allows learners to make their own decisions, solicit feedback from others, and take charge of their learning, while also improving their overall social learning.

AVW-Space offers a practical and well-designed approach of transforming videos into interactive learning experiences. Additional research is needed to investigate more intelligent personalised interventions that may be implemented in AVW-Space to motivate students to write high-quality comments and to engage in more active and constructive learning behaviours when interacting with videos. To develop effective strategies for personalised interventions, we recommend conducting additional analysis on individual learner comments to gain a better understanding of their engagement and to determine whether individual differences affect their ability to actively engage with the learning materials and write high-quality comments. Dimitrova and Mitrovic (2021) assert that students who write high-quality comments gain more knowledge than students who submit low-quality comments.

6.5 Conclusions

Over the last decade, the usage of video in higher education has increased exponentially, and this trend is certain to continue (Sablić et al., 2020; Yousef et al., 2014a). The advancement of the "Net" generation of students through higher education, the introduction of new teaching methods (and video's role in influencing some of these), a changing university environment, the development of digital media, and increased awareness of the benefits of video in higher education will all contribute to this ongoing development. It has been demonstrated that videos are particularly effective for teaching soft skills (Conkey et al., 2013; Mitrovic et al., 2016). Facilitating student engagement with videos demands a significant amount of effort on the part of the teachers during video production or in complex learning environments. This thesis utilised AVW-Space, a platform that requires very little effort on the part of teachers to set up and interact with students for soft skills training (Dimitrova & Mitrovic, 2021). Our thesis contributes to an increasing body of research on communication skills methodologies by examining the effectiveness of AVW in teaching soft skills to university students. We studied software engineering students' experiences with AVW-Space and the extent to which the AVW approach was effective in teaching the students how to communicate effectively in face-to-face meetings. The results of our AVW experiment reveal that when learners actively participate in commenting on videos and rating the comments of others (constructive learning approach), their conceptual understanding of face-to-face meeting communication skills increases. We offered several recommendations based on our study's limitations on ways to improve AVW-Space features for a better user experience and to minimize the level of frustration connected with the high number of comments available for evaluation and rating in the Social-Space. The recommendations emphasise the importance of encouraging students to write high-quality comments. Future research could examine the use of AVW-Space to teach other soft skills to undergraduate and postgraduate students from a variety of academic disciplines. As a result, this thesis concludes that reflective video-based (AVW) online training effectively enables students to reflect constructively on their prior experiences, attitudes, and communication practises during face-to-face meetings.

6.6 Chapter Summary

This chapter discusses the study's implications, including the usefulness of employing the AVW technique to teach face-to-face meeting communication skills and further confirming that, in general, students have positive views of the AVW activities provided to them via AVW-Space. It demonstrated that students valued the opportunity to participate in the experiment and believed that participating in AVW improved their ability to communicate effectively and efficiently in meetings. This chapter discussed the study's limitations and suggested further research directions. Finally, the conclusions of this thesis were presented.

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APPENDICES

Appendix A: UC Human Ethics Committee Approval Letter

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2020/30/LR-PS

7 May 2020

Ja'afaru Musa
Computer Science and Software Engineering
UNIVERSITY OF CANTERBURY

Dear Ja'afaru

Thank you for submitting your low risk application to the Human Ethics Committee for the research proposal titled "Reflective Experiential Learning: A Novel Approach for Improving Face-to-Face Communication in Software Development Meetings of Inexperienced Software Engineers Using Active Video Watching".

I am pleased to advise that this application has been reviewed and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 5th May 2020.

With best wishes for your project.

Yours sincerely

Dr Dean Sutherland
Chair, Human Ethics Committee

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand. **www.canterbury.ac.nz**

F E S

Appendix B: Pilot Study Email

Hello FirstName,

I am Ja'afaru Musa (jaafaru.musa@pg.canterbury.ac.nz), a PhD student in the CSSE department. I am looking for volunteers to participate in a study. If you agree to participate, you will be asked to complete a questionnaire on communication in group meetings. It should take around 5-10 minutes to complete. At the end of the study, there will be a lucky draw for a $100 voucher.

You can access the survey here:
http://canterbury.qualtrics.com/jfe/form/SV_8v5dLhfmruRaCu9

It would be great if you could assist a fellow student!

The study has been approved by the UC Human Ethics committee.

Thanks,
Ja'afaru

Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

Appendix C: Information Sheet for Students

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Department of Computer Science and Software Engineering
Telephone: Ext. 94269
Email: jaafaru.musa@pg.canterbury.ac.nz
Date: 20th of July 2020
HEC Ref: HEC 2020/30/LR-PS

Improving face-to-face communication in software development meetings using Active Video Watching

Information Sheet for Participants

I am Ja'afaru Musa, a PhD student in the Department of Computer Science and Software Engineering. This research aims to investigate the effectiveness of active video watching in improving face-to-face communication skills during software development project meetings.

You have been approached to take part in this study because you are currently enrolled in SENG202. If you choose to take part in this study, your involvement in this project will be to 1) fill in a profile survey; 2) watch and make comments on videos; 3) review and rate anonymized comments made by others; 4) record one team meeting; 5) watch and make comments on your team video; 6) review and rate anonymized comments made by your team members, and 7) complete the exit survey. The total time is estimated at 2-3 hours.

Please note that the video recordings of team meetings will only be available to the team members and the SENG202 teaching team (not to the whole class) and will be uploaded to a private video sharing platform. Participation is voluntary and you have the right to withdraw at any stage without penalty. You may ask for your raw data to be returned to you or destroyed at any point. If you withdraw, I will remove information relating to you.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: your identity will not be made public. To ensure anonymity and confidentiality, the collected data will be stored using unique identifiers generated for this study. Any identifying information (names and UC user codes) will be kept separate from the collected data. The data will only be accessible by the research team working on AVW-Space, and will be destroyed 10 years after the completion of the project. A thesis is a public document and will be available through the UC Library. Please email me if you would like to receive a copy of the summary of results of the project.

The project is being carried out as a requirement for PhD in Computer Science by Ja'afaru Musa under the supervision of Professor Tanja Mitrovic (tanja.mitrovic@canterbury.ac.nz), Associate Professor Matthias Galster (matthias.galster@canterbury.ac.nz), and Associate Professor Sanna Malinen (sanna.malinen@canterbury.ac.nz). They will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Appendix D: Pre-Questionnaire (Survey 1)

SECTION A: DEMOGRAPHIC AND PROFILE INFORMATION	
Instruction: Please tick at the appropriate box.	
S/N	Demographic Information
1	What is your age? □ 18 – 23 □ 24 – 29 □ 30 – 35 □ 36 – 40 □ 41 years and above
2	What is your gender? □ Male □ Female □ Other □ Prefer not to answer
3	What is your first language? ________________________
4	How much formal training have you had on communication in face-to-face meetings? □ No training □ Some training □ Quite a bit □ A lot □ Extensive training
5	Select the type(s) of training on communication in face-to-face meetings you have had: □ Training at high school □ Training at University □ Training at community/volunteer group □ Professional development training □ Other (please specify) _______
6	Over the last year, how frequently would you attend face-to-face formal meetings with more than two people? □ Never □ Occasionally □ Once a month □ Every week □ Every day
7	Please specify the type(s) of meetings you have had that involved more than two people: □ Group assignment in high school □ Group assignment in university □ Meeting with lecturers □ As part of an internship □ Part-time job related to software development □ Part-time job not related to software development □ Other (please specify) _________
8	How much experience do you have working in software development teams outside the university? □ None □ Some experience (less than a week) □ Quite a Bit (a month) □ A lot (several month) □ Extensive experience (more than a year)
9	How often do you watch YouTube? □ Never

	☐ Occasionally ☐ Once a month ☐ Every week ☐ Every day	
10	How often do you use YouTube for learning? ☐ Never ☐ Occasionally ☐ Once a month ☐ Every week ☐ Every day	
	SECTION B: CONCEPTUAL KNOWLEDGE ASSESSMENT	
1	[You have max 3 minutes to answer] Write all words/phrases (one per line) that you associate with effective communication in software engineering meetings. ___________________________ ___________________________ ___________________________ ___________________________ ___________________________	

SECTION C: MEETING COMMUNICATION SCALE

Please rate on the scale 1-7, the level that describes your typical behaviour during face-to-face team meetings:

1=Never	2=Rarely	3=Sometimes but infrequently	4=Neutral	5=Sometime	6=Usually	7=Always

	Verbal Communication	
1	I express technical ideas clearly, so that every meeting participant can understand them.	1 2 3 4 5 6 7
2	I express non-technical ideas clearly, so that every meeting participant can understand them.	1 2 3 4 5 6 7
3	I vary language and expression to suit different situations during team meetings.	1 2 3 4 5 6 7
4	I make eye contact with meeting participants during discussions.	1 2 3 4 5 6 7
	GIVING AND RECEIVING FEEDBACK	
5	I provide constructive feedback to other meeting participants.	1 2 3 4 5 6 7
6	I am respectful to other meeting participants.	1 2 3 4 5 6 7
7	I am mindful of other meeting participants' feelings when providing feedback.	1 2 3 4 5 6 7
8	I get defensive when receiving other meeting participants' negative feedback.	1 2 3 4 5 6 7
9	I receive other meeting participants' feedback as a constructive contribution.	1 2 3 4 5 6 7
10	I use the team's feedback to improve my participation during team meetings.	1 2 3 4 5 6 7
	ACTIVE LISTENING	
11	I often begin to talk before the other meeting participants finish talking.	1 2 3 4 5 6 7
12	I begin arguing with the other meeting participants before I have heard their entire idea.	1 2 3 4 5 6 7
13	When I want to say something, I talk about it, even if I interrupt the other meeting participants.	1 2 3 4 5 6 7
14	I listen to the other meeting participants, putting myself in her/his shoes.	1 2 3 4 5 6 7
15	I pay attention to the other meeting participants' body language.	1 2 3 4 5 6 7
16	I am aware of my feelings while I'm listening to other meeting participants.	1 2 3 4 5 6 7

17	If I do not understand what another meeting participant said, I seek clarification by asking questions.	1	2	3	4	5	6	7
	MEETING PARTICIPATION							
18	I contribute my ideas and suggestions during team meetings.	1	2	3	4	5	6	7
19	When other meeting participants are hesitating to contribute, I encourage them to contribute their ideas and suggestions.	1	2	3	4	5	6	7
20	I express my personal feelings when I agree with other meeting participants.	1	2	3	4	5	6	7
21	I express my personal feelings when I disagree with other meeting participants.	1	2	3	4	5	6	7
22	I encourage other meeting participants to express their personal feelings.	1	2	3	4	5	6	7
23	I check my mobile, emails or notifications during meetings.	1	2	3	4	5	6	7

Appendix E: Post-Questionnaire (Survey 2)

SECTION A: CONCEPTUAL KNOWLEDGE ASSESSMENT	
1	[You have max 3 minutes to answer] Write all words/phrases (one per line) that you associate with effective communication in software engineering meetings. ____________________________ ____________________________ ____________________________ ____________________________ ____________________________

SECTION B: MEETING COMMUNICATION SCALE

Please rate on the scale 1-7, the level that describes your typical behaviour during face-to-face team meetings:

1=Never	2=Rarely	3=Sometimes but infrequently	4=Neutral	5=Sometime	6=Usually	7=Always

	Verbal Communication							
1	I express technical ideas clearly, so that every meeting participant can understand them.	1	2	3	4	5	6	7
2	I express non-technical ideas clearly, so that every meeting participant can understand them.	1	2	3	4	5	6	7
3	I vary language and expression to suit different situations during team meetings.	1	2	3	4	5	6	7
4	I make eye contact with meeting participants during discussions.	1	2	3	4	5	6	7
	GIVING AND RECEIVING FEEDBACK							
5	I provide constructive feedback to other meeting participants.	1	2	3	4	5	6	7
6	I am respectful to other meeting participants.	1	2	3	4	5	6	7
7	I am mindful of other meeting participants' feelings when providing feedback.	1	2	3	4	5	6	7
8	I get defensive when receiving other meeting participants' negative feedback.	1	2	3	4	5	6	7
9	I receive other meeting participants' feedback as a constructive contribution.	1	2	3	4	5	6	7
10	I use the team's feedback to improve my participation during team meetings.	1	2	3	4	5	6	7
	ACTIVE LISTENING							
11	I often begin to talk before the other meeting participants finish talking.	1	2	3	4	5	6	7
12	I begin arguing with the other meeting participants before I have heard their entire idea.	1	2	3	4	5	6	7
13	When I want to say something, I talk about it, even if I interrupt the other meeting participants.	1	2	3	4	5	6	7
14	I listen to the other meeting participants, putting myself in her/his shoes.	1	2	3	4	5	6	7
15	I pay attention to the other meeting participants' body language.	1	2	3	4	5	6	7
16	I am aware of my feelings while I'm listening to other meeting participants.	1	2	3	4	5	6	7
17	If I do not understand what another meeting participant said, I seek clarification by asking questions.	1	2	3	4	5	6	7
	MEETING PARTICIPATION							
18	I contribute my ideas and suggestions during team meetings.	1	2	3	4	5	6	7
19	When other meeting participants are hesitating to contribute, I encourage them to contribute their ideas and suggestions.	1	2	3	4	5	6	7

20	I express my personal feelings when I agree with other meeting participants.	1	2	3	4	5	6	7
21	I express my personal feelings when I disagree with other meeting participants.	1	2	3	4	5	6	7
22	I encourage other meeting participants to express their personal feelings.	1	2	3	4	5	6	7
23	I check my mobile, emails or notifications during meetings.	1	2	3	4	5	6	7

SECTION C: PERCEPTION OF LEARNING GAIN

The following questions ask you to estimate how much you have learned from this online training.

Please rate, on the scale of 1 -7, to what extent do you agree with each statement, where lower numbers reflect less agreement and higher numbers reflect more agreement:

1=Strongly disagree	2=Disagree	3=Partially disagree	4=Neutral	5=Partially agree	6=Agree	7=Strongly agree

1	I can summarize what I have learnt in AVW-Space for someone who has not learned from AVW-Space.	1	2	3	4	5	6	7
2	I am able to use the effective meeting participation concepts I learnt in AVW-Space in my future meetings.	1	2	3	4	5	6	7
3	I have changed my attitudes about effective meeting participation as a result of AVW-Space.	1	2	3	4	5	6	7
4	I can assess the quality of face-to-face communication in the example videos used in this training.	1	2	3	4	5	6	7
5	I feel more confident in my face-to-face communication skills in meetings as a result of AVW-Space.	1	2	3	4	5	6	7
6	I have not expanded my knowledge of effective meeting participation concepts as a result of AVW-Space.	1	2	3	4	5	6	7
7	I can demonstrate to others the effective meeting participation concepts I learnt in AVW-Space.	1	2	3	4	5	6	7
8	I feel that I am a more effective meeting participant as a result of AVW-Space.	1	2	3	4	5	6	7

SECTION D: FEEDBACK AND USABILITY

The following questions have a Likert scale from 1 (Very easy) to 20 (Very hard)

1 **MENTAL DEMAND – Writing comments**

How **mentally demanding** was to **write comments on videos** in AVW-Space?
For example, how much mental and perceptual activity was required - thinking, deciding, remembering, looking, and searching?

____

2 **EFFORT - Writing comments**

How **hard** did you have to work (mentally and physically) to **write comments on videos** in AVW-Space?

____

3 **FRUSTRATION - Writing comments**

How **discouraged, irritated, stressed and annoyed** did you feel while **writing comments on videos** in AVW-Space?

____

4 **PERFORMANCE - Writing comments**

How successful do you think you were to identify useful points about effective meeting participation when commenting on videos in AVW-Space?

____

5 Based on your use of AVW-Space, what would be the usefulness of **pausing a video to write a comment?**

____

6 Based on your use of AVW-Space, what would be the usefulness of **asking you to indicate what the comments refer to, e.g. for tutorials:** *'I am rather good at this', 'I did/saw this in the past', 'I did not realize I was not doing this', 'I like this point'*;
for examples: *'Verbal communication', 'Feedback', 'Active listening', 'Contribution'*.

____

7 **MENTAL DEMAND - Rating comments**

How **mentally demanding** was to **review and rate comments on videos** in AVW-Space? For example, how much mental and perceptual activity was required - thinking, deciding, remembering, looking, and searching?

____

8 **EFFORT - Rating comments**

How **hard** did you have to work (mentally and physically) to **review and rate comments on** videos in AVW-Space?

____

9 **FRUSTRATION - Rating comments**

How **discouraged, irritated, stressed and annoyed** did you feel while **reviewing and rating the comments on videos** in AVW-Space?

____

10 **PERFORMANCE - Rating comments**

How **successful** do you think you were to **identify useful points about effective meeting participation** when **reviewing and rating of comments** made by others in AVW-Space?

____

11 The AVW-Space system is aimed at **informal learning of soft skills** (e.g. giving presentations, advising, negotiating, managing teams) using selected videos.

The questions below ask how you **perceive the usefulness** of AVW-Space for informal learning of soft skills.

1=Extremely likely	**2=Quite likely**	**3=Slightly likely**	**4=Neutral**	**5=Slightly unlikely**	**6=Quite unlikely**	**7= Extremely unlikely**

i	I think I would like to use AVW-Space frequently.	1	2	3	4	5	6	7
ii	I would recommend AVW-Space to my friends.	1	2	3	4	5	6	7
iii	Using AVW-Space would enable me to improve my soft skills quickly.	1	2	3	4	5	6	7
iv	Using AVW-Space would improve my performance considering the development of soft skills.	1	2	3	4	5	6	7
v	Using AVW-Space would enhance my effectiveness when developing soft skills.	1	2	3	4	5	6	7
vi	I would find AVW-Space useful in my studies/job.	1	2	3	4	5	6	7
vii	I would find AVW-Space easy to do what I want it to do.	1	2	3	4	5	6	7
viii	My interaction with AVW-Space would be clear and understandable.	1	2	3	4	5	6	7
ix	I would find AVW-Space easy to use.	1	2	3	4	5	6	7

x	If I am provided the opportunity, I would continue to use AVW-Space for informal learning.	1	2	3	4	5	6	7

12 **In the second phase of the study, you experienced two additional features of AVW-Space**:
- reviewing the comments on the videos made by other users of AVW-Space;
- rating the comments of other users;

Based on your use of the AVW-Space, what would be the usefulness **of reviewing the comments on the videos made by other people**?

____

13 Based on your use of AVW-Space, what would be the usefulness of **rating the comments of other people**, e.g.
'This is useful for me'
'I hadn't thought of this'
'I did not notice this'
'I like this point'
'I do not agree with this'

____

14 Based on the peer-assessment exercise, what would be the usefulness **of watching and commenting on your team video**?

____

15 Based on the peer-assessment exercise, what would be the usefulness **of reviewing and rating the comments made by other team members on your team video**?

____

Appendix F: Publication (Extended Summary Paper)

Improving Face-to-Face Communication Skills using Active Video Watching

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Abstract: Although communication skills are widely recognized as crucial for effective software development teams, many graduates lack such skills, which are difficult to teach. We adopt the active video watching (AVW) approach to teach face-to-face communication skills to second-year software engineering project course. We conducted an experiment with AVW-Space, an online platform which supports video-based learning. The participants watched and commented on tutorial videos first, and later on provided videos of meetings. In the last phase, the participants commented on the recording of their own team meeting. We found that students who commented and rated others' comments increased their conceptual understanding of face-to-face communication skills.

Keywords: Active video watching, face-to-face communication in software development meetings

1. Introduction

Communication is crucial in software engineering (SE) projects to promote continuous information sharing with various stakeholders (Prenner et al., 2018). Face-to-face communication between team members enables adequate information flow (de Souza Almeida, 2019). In highly incremental and iterative software development planning, review and retrospective meetings and daily "stand-ups" help structure the project and ensure information sharing (Schwaber & Beedle, 2002).

However, teaching these competencies is time-consuming, requires hands-on exercises and regular feedback from instructors (Anthony & Garner, 2016; Galster, Mitrovic & Gordon, 2018). SE education generally fosters soft skills training in group projects (Sedelmaier & Landes, 2018). Exercising soft skills needs real project work with diverse team members and constant feedback and guidance from instructors. However, universities often do not have the resources (time and budget) to support such training systematically.

Video-Based Learning (VBL) supports teaching soft skills, where the process of learning requires contextual experience to retain knowledge (Cronin & Cronin, 1992; Mitrovic et al., 2017). Active Video Watching (AVW) was recently suggested as a VBL approach that encourages self-reflective learning (Mitrovic et al., 2017; Dimitrova & Mitrovic, 2021). AVW-Space allows instructors to embed YouTube videos for students to watch and comment on, using teacher-specified scaffolds for reflection. We investigate using AVW-Space to enhance SE students' face-to-face meeting communication skills.

2. Methodology and Results

Following the ethical approval, this study collected data from a second-year SE project-based course at the University of Canterbury with 56 students. The course runs over one semester. The students worked in teams of 4 to 6, and had weekly face-to-face meetings. In addition, the students were invited to use AVW-Space to learn face-to-face meeting communication skills. We administered Survey 1 consisting of questions on demographic, training and experiences with face-to-face meetings; a question relating to participant's knowledge of face-to-face meetings communication skills; then a self-reported face-to-face meeting communication scale developed for this study. After the survey, the participants watched and commented on ten carefully selected short videos (2 to 5 minutes) on effective communication skills for SE meetings. Six videos were tutorials on communication skills, and four were recordings of real meetings. In phase 2, students rated anonymised comments from phase 1. In the third phase, each team commented on the recording of their own meeting, and subsequently rated comments written by their peers. We administered Survey 2 at the end, consisting of the same questions on participants' knowledge of communication skills and the self-reported scale. Survey 2 also had three other instruments: CAP perceived learning gain scale (Rovai et al., 2009); NASA-TLX (Hart, 2006) cognitive load scale; Technology Acceptance Model (TAM) (Davis, 1989) scale to capture students' overall perception of AVW-Space; and questions on usability of the AVW-Space.

Out of 56 students enrolled in the course, 49 completed Survey 1. Of those, 83.7% were male, and 16.3% were female. Most participants (98%) were in the 18-23 age group, and were native English speakers (78%). We classified students post-hoc based on their observable learning behaviours using the ICAP framework (Chi & Wylie, 2014). ICAP identifies four categories with decreasing level of engagement: *Interactive, Constructive, Active and Passive*. Interactive mode is not relevant for our study as AVW-Space does not support direct interaction between students. We distinguish constructive from active students by observing the number of high-quality comments. High-quality comments are those which show self-reflection, critical thinking about the content of the video, or planning for future performance, while low quality-comments simply repeat video content verbatim or are short (Mohammadhassan et al., 2020). The median number of high-quality comments on tutorial videos was 2. Hence, we described active students as those who wrote up to two high-quality comments. In comparison, students who wrote more than two high-quality comments were categorized as constructive students.

Table 1 presents the summary of students' activities in AVW-Space. There was a significant difference among different categories ($p < .05$) in all activities except the number of comments on their own meeting ($p = .68$), and the number of ratings ($p = .47$). Constructive students watched more videos, wrote more comments, and rated more comments compared to other categories.

Table 1. *Summary of Activities for Students who Completed both Surveys (* means p < .05)*

	Passive (10)	Active (5)	Constructive (15)
Videos *	9.90 (0.32)	7.40 (2.79)	10.0 (0.00)
Tutorial Comments *	0	4.00 (6.16)	17.20 (13.79)
High-quality Comments *	0	0.80 (0.45)	3.93 (2.99)
Example Comments *	3.50 (7.38)	3.00 (6.16)	9.80 (9.79)
Ratings	116.10 (148.99)	108.80 (201.56)	166.67 (195.87)
Meeting Comments	4.30 (3.47)	5.60 (6.66)	7.20 (7.59)
CK1	6.20 (3.61)	6.00 (2.55)	7.13 (5.60)
CK2	8.10 (5.34)	11.20 (5.81)	10.67 (8.20)

Students' responses for the conceptual knowledge questions from Surveys 1 and 2 (CK1 and CK2 respectively) were analysed using an ontology developed by the authors for face-to-face meeting communication. The scores represent the numbers of ontology concepts mentioned by students. Using ANCOVA with CK1 as co-variate, we found a statistically significant difference in the CK2 scores ($F(3, 26) = 10.98$, $p < .001$). The Wilcoxon signed-rank test revealed a significant increase from CK1 to CK2 for constructive students only ($W = 100$, $p = .003$). The number of comments and CK2 were found to be positively correlated, $r(28) = .41$, $p = .025$.

In Phase 3, we asked students to comment on their meeting recordings. We found that students' comments focused on opportunities for improving their meeting behaviour (for example, "*I might be over contributing while not leaving space for others to contribute.*" and "*I need to construct/deliver my ideas clearer.*"). In Survey 2, we asked students about the usefulness of watching their meetings and rating comments written by their peers. Out of 30 responses, only one response was negative (*"Not useful."*), and the remaining were positive (e.g., *"Primarily useful for reflecting on my own behaviour* *in meetings.", "Very useful, it provides me with many of my weaknesses and my improvements." and "... This allowed me to consider things from not just my point of view, but that of my peers, which I feel is very important.")*. Most students found Phase 3 helpful to reflect on their performance during meetings.

3. Conclusions

The increasing emphasis on the value of transferable skills for the success of SE projects requires novel methods to equip students with a broader set of non-technical competencies. We examined the impact of active video watching on SE students' face-to-face meeting communication skills. Our study shows that when learners engage in commenting on videos and rating other's comments, their conceptual understanding of face-to-face meeting communication skills increases.

In this paper, we reported some preliminary results from our study. Data analysis still needs to be completed. The limitation of our work is the small population size. We plan to conduct another study in 2021, in the context of the same SE course. Our future work will investigate the impact of active video watching in SE industry, with the goal of enhancing SE practitioners' learning and professional development training.

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