A METHODOLOGY FOR COMPUTER-SUPPORTED COLLABORATIVE LEARNING FOR GRADUATE COMPUTING RESEARCH STUDENTS' ARGUMENTATION SKILLS DEVELOPMENT

by

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DEDICATION

To GOD all the glory.

“So, whether I eat or drink, or whatever I do, I do it all to the glory of God.”

1 Cor 10:31 (NIV)

To my husband Johan, whom I love dearly, my mother Nella, my sons Schalk and Rohan, and all my dear friends and family who have supported and encouraged me, every step of the way.

To Deirdre, who supported me with words of wisdom: “if you think you cannot go on anymore, you still can ....”

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DECLARATION

I declare that, **A METHODOLOGY FOR COMPUTER-SUPPORTED COLLABORATIVE LEARNING FOR GRADUATE COMPUTING RESEARCH STUDENTS' ARGUMENTATION SKILLS DEVELOPMENT**, is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

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Date:

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ABSTRACT

Presenting a well-formulated research argument is a core competency which a graduate student has to acquire in the course of his/her learning journey. The mere availability of the technology platforms provided in open distance e-learning (ODeL) through computer-supported collaborative learning (CSCL) platforms does not guarantee that graduate students will use such technologies effectively in the development of their argumentation skills. Furthermore, there is little evidence on how a graduate course, offered through a CSCL platform, should be constructed to augment the development of argumentation skills. This study was guided by the research question, *How can CSCL environments be used to augment graduate computing students' argumentation skills development?* The study, conducted according to a design science paradigm, is underpinned by a pragmatic philosophical worldview . In adhering to design science research (DSR) principles, the problem was defined and a conceptual argumentation skills development framework (ASDF) was designed, developed, implemented and evaluated . The disciplinary knowledge was subsequently shared in this thesis and related peer-reviewed publications. The research was conducted in two phases: the first reported on the development and evaluation of a conceptual ASDF, with the literature-based conceptual ASDF being presented to expert participants in online focus groups with expertise in postgraduate supervision and ODeL course development. During online discussions, the participants reflected on the elements that comprised the ASDF and the CSCL affordances, and completed an online questionnaire. The ASDF was then revised based on the findings from the data analysis. In the second phase, the revised ASDF was implemented using CSCL in a computing graduate research course to validate the elements of the ASDF and the CSCL affordances. To measure the graduate students' educational experience whilst engaging with the activities as presented in the ASDF, a survey was distributed to the wider research group of students, and online focus groups were held with a smaller group of students enrolled for the project. The students reflected on their perceptions of educational experiences

in the learning processes in terms of social presence, cognitive presence and teaching presence. The thematic analysis of the online discussions was used to validate the elements in the ASDF . The development of a framework that can be implemented in an ODeL graduate course was compelled by the drive to digitise – a process accelerated by the 2020/21 health pandemic – which has called into question prevailing assumptions on how to use technology effectively in a graduate research course to augment argumentation skills, and how to research and reflect on it . On a theoretical level, the study contributes to the body of knowledge by providing a novel methodology encompassing a philosophy and strategy in the form of an ASDF. The knowledge and experience gained from its implementation and evaluation could provide valuable practical insights to lecturers and course designers alike . The rigour of the DSR process was complemented by an implementation of the ASDF in a graduate computing research course. The researcher recommends that the ASDF be implemented in the larger graduate computing research course, in such a way that argumentation skills development becomes part of the regular curriculum.

Keywords: argumentation skills development; computer-supported collaborative learning; design science research; educational experiences; ODeL; scaffolded learning

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Description
4IR	Fourth Industrial Revolution
ACM	Association for Computing Machinery
ADI	Argument-Driven Inquiry
AIS	Association for Information Systems
ASD	argumentation skills development
ASDF	argumentation skills development framework
Atlast.ti	workbench for the qualitative analysis of large bodies of textual data
CCFOs	critical cross field outcomes
CoI	community of inquiry (framework)
CP	cognitive presence
CSCL	computer-supported collaborative learning
CFGs	confirmatory focus groups
CSF	critical success factors
DHET	South African Department of Higher Education and Training
DSR	design science research
EFGs	exploratory focus groups
HCD	human-centered design
HEI	higher education institution
HEQF	Higher Education Qualifications Framework
ICT	information and communication technology
IS	information systems
LMS	learning management system
ML	machine learning
MOOCs	massive open online courses
NLS	natural language processing
NQF	National Qualifications Framework
ODeL	open distance e-learning
OERs	open educational resources
PRISMA	preferred reporting of items for systematic reviews and meta-analysis
SALSA	search, appraisal, synthesis and analysis
SAQA	South African Qualifications Authority

Acronym	Description
SP	social presence
SWaRM	research methodology semantic wiki
TP	teaching presence
Unisa	University of South Africa
WA	WhatsApp
ZPD	zone of proximal development

CHAPTER 1

INTRODUCTION

The terms “critical thinking” and “academic argumentation” are often discussed concurrently in educational research (Rapanta & Macagno, 2019). Critical thinking entails the analysis of arguments that involve skills such as questioning, analysing, interpreting and evaluating, in order to make a judgement. The development of argumentation skills is seen as a derivative that develops in the course of an academic journey, and includes (amongst others) complex academic and reasoning skills. Andrews (2009, p. 39) defines an argument as “... a claim or proposition, to the evidence cited in support of a proposition, or to the phenomenon of arguing itself”. Argumentation skills development refers to the process of acquiring, improving, and refining the abilities and techniques necessary for constructing and presenting persuasive arguments. It involves the development of critical thinking, logical reasoning, evidence evaluation, effective communication, and the ability to support one’s viewpoint with sound reasoning and evidence (Andrews, 2015; Wambsganss & Rietsche, 2019).

To augment the development of argumentation skills, working on collaborative projects is often deemed to lead to effective learning (Chatterjee & Correia, 2020; Gašević et al., 2019; MacCann-Alfaro et al., 2018), as it allows students to “exercise, verify, solidify and improve their mental models through discussions and information sharing” (Alavi, 1994, p. 161-162). During the early 1990s, the use of technology to facilitate collaborative learning was conceptualised as a new field of knowledge, and has since become a well-established field that has influenced other domains

of research (including computer science and learning analytics), as well as various principles of teaching in an online learning space and pedagogical approaches in computer-supported collaborative learning (CSCL) (Fischer, 2007; King, 2007). CSCL is often used in distance education, where learning takes place via a complex mix of interrelated processes, and the sharing and construction of knowledge are facilitated by using technology as the primary means of interaction, or as the common resource (Yoon & Brice, 2011).

Distance education is not new, and is described in the literature as a mode of learning that has been adopted by higher education to support online teaching and blended modes of learning (Gregory & Salmon, 2013). In distance education, students do not attend classes in person, and are thus often isolated from both their peers and their supervisors. This is even more evident in open distance e-learning (ODeL) – a learning model which endeavours to use CSCL to bridge time and geographical space in providing education to students (Arinto, 2013; Manyike, 2017; Ngubane-Mokiwa, 2017).

Studies conducted in CSCL over the years have enriched the body of knowledge by addressing fundamental questions related to knowledge building, the application of learning in online environments, the development of frameworks and models through various experiments, design-based research, and reflection on lessons learned in practice (Bates, 2015; Salmon, 2013). One of the perceived advantages of the CSCL environment in graduate studies – from both the students' perspective and that of their supervisors – is the "ability to overcome obstacles of distance and time" (Pollard & Kumar, 2021, p. 272), and is often used by graduate students to create an environment in which they can collaborate and develop their argumentation skills (Vasquez-Colina et al., 2017). In this study, graduate students are defined as candidates who have completed their undergraduate qualifications, and are now enrolled for research as part of an honours qualification.

Through CSCL, the University of South Africa (Unisa), an ODeL institution (Letseka, 2021), is progressively providing various solutions and platforms for collaboration. Admittedly, the availability of technology and applicable platforms using CSCL does not, however, imply that graduate students will use these resources to critically engage on the available collaboration platforms in academic argumentation, and consequently develop their argumentation skills (Fatimah et al., 2021; Piki, 2014; Vasquez-Colina et al., 2017). There is also a lack of empirical evidence to confirm that the use of online collaborative tools and environments significantly increases the argumentation skills development of graduate research students (Ellis et al., 2018; Fatimah et al., 2021; Shing et al., 2017).

Admittedly, it often takes considerable time for graduate students in ODeL to develop argumentation skills and demonstrate these successfully in their research outputs (Luna et al., 2020; Rapanta & Macagno, 2019). In a study by Van Biljon et al. (2020), it was noted that graduate research students – even in a cohort supervision environment under the guidance of supervisors – are reluctant to use the available collaboration platforms to critically engage in argumentation with their peers. As identified by Järvelä and Rosé (2020, p. 146), more empirical research is required on the "design of the technological settings for collaboration and how people learn in the context of collaborative activity", along with how CSCL can be used to augment argumentation skills development (Kirschner & Erkens, 2013).

Despite various empirical research studies into online learning environments, "the development and acceptance of theoretical frameworks unique to online learning environments are still relatively lacking" (Arbaugh, 2019, p. 73). Stahl (2015) warns that teachers and policy-makers do not always understand the complexities relating to offering courses through CSCL, and the development of such a curriculum may require several iterations. These complexities were again emphasised during the 2020/21 health pandemic, when higher education institutions (HEIs) gave renewed attention to CSCL, in implementing and rolling out such environments for teaching

and learning (Czerniewicz et al., 2020; Fatimah et al., 2021; Jandrić et al., 2020). Of specific interest in academic discussions is research on how graduate students' argumentation skills can be augmented in distance learning (Fatimah et al., 2021; Luna et al., 2020), specifically by using CSCL (Gašević et al., 2019).

Furthermore, scaffolded activities in collaborative learning are often associated with the augmenting of argumentation skills (Gensowski, 2016; Oh & Kim, 2016; Tsai & Tsai, 2014) and, in that regard, course developers should take cognisance of the technology available in CSCL environments (Ali, 2020) that allow for a scaffolded learning journey in the development of argumentation skills. Despite conducting a comprehensive literature review, the researcher could not find sufficient evidence on the guidelines, methodologies and structures which are specific to the development of a framework that can be implemented to augment argumentation skills development for graduate students using CSCL in ODeL contexts. This then points to a need to rethink the development of a framework to support a technology-collaborative online environment that will facilitate the development of argumentation skills in graduate students.

The research reported on here, set out to develop a methodology that can provide a philosophy and a strategy of scaffolded procedures and techniques to implement in graduate studies, using CSCL, that augments students' argumentation skills development.

This chapter provides a conceptual overview of the research reported on in this thesis. Section 1.1 offers a background to the study, followed by a statement of the research problem in Section 1.2, the research questions in Section 1.3, and the research design, methodology and data-gathering methods in Section 1.4. The delineations, limitations and assumptions are presented in Section 1.5, followed by a conclusion and an outline of the study as a whole.

1.1 BACKGROUND

1.1.1 Argumentation skills development

citeAAndrews2009 describes argumentation as core to learning by describing the balance between two perspectives on argumentation: namely that on the one end, there is the perspective that argumentation is a fundamental skill that can be taught to all university students from the beginning of their education, and on the other end there is the view that argumentation is so deeply integrated into specific disciplines that lecturers assume students possess it, and it is not subject to generic instruction. Rapanta and Macagno (2019, p. 129) further elaborated on this view to indicate that the "argumentation skills of students are neglected" and concluded that argumentation schemes may "serve as generic mechanisms for learning how to apply argumentative reasoning, which can be used in different cases and settings" [p. 140]. From these two perspectives, the balance can not be seen as a stagnant midpoint, but rather a combination of practices that offer both generic argumentation skills development and discipline-specific guidance.

Sound argumentation skills in academic discourse require a student, as a researcher, to deal with academic content in order to reach an understanding thereof and reflect on material, before providing information that will either support or refute a given argument. It requires the researcher to respond to existing knowledge derived from the literature, and to formulate a justified opinion or argument. The argument should either confirm or defend a specific point of view, based on supporting evidence (Toulmin, 2003).

CHAPTER 1: INTRODUCTION

Argumentation skills, which include complex problem-solving skills, are seen as part of lifelong learning, thus mastering argumentation skills will allow a person to thrive and be productive in the era of the Fourth Industrial Revolution (4IR) (Liu, 2017). This aligns with the requirements of the South African Department of Higher Education and Training (DHET), to deliver more research outputs at the graduate level (DHET, 2015). The South African Qualifications Authority (SAQA)[1] is the oversight body of the National Qualifications Framework (NQF) and it guides teaching and learning in higher education in South Africa. SAQA identified critical cross-field outcomes (CCFOs) and development outcomes which are regarded as key competencies for any employee or worker to be effective in the workplace of the 21st century. These outcomes are important, as they identify key terminology that is required when building an argument. Included are concepts such as identifying, working, organising, collecting, communicating, using technology, demonstrating and contributing. Furthermore, the outcomes represent the generic, core, employable, graduate and transferable competencies required of each graduate student during his/her learning journey, but also the skills that have to be taken into, and transferred in, the real world (Van Staden, 2016). Embedded in these CCFOs and development outcomes is the development of argumentation skills (Gensowski, 2016; Rapanta & Macagno, 2019).

Numerous research studies have focused on developing argumentation skills. Amongst these studies, is the study by Luna et al. (2020) that addressed the challenges of writing augmentations on controversial issues in higher education and designed virtual training to improve argumentative writing. The training, using online tools, enhanced organisation, counterarguments, and integration of perspectives. Rapanta and Macagno (2019) explored teaching critical thinking through academic writing, emphasising an argumentative approach and advocating for explicit argumentative reasoning mechanisms and constructing solid arguments with evaluated evidence. Both studies emphasised integrating different perspectives

[1] https://www.saqa.org.za/

and the need for ongoing support in constructing robust arguments based on critically evaluated evidence.

Various models exist that can be applied in the development of argumentation skills. Argument-Driven Inquiry (ADI), as proposed by Sampson et al. (2011), and Toulmin's model of argumentation (2003), are most often applied in higher education (Kneupper, 1978; Luna et al., 2020; MacCann-Alfaro et al., 2018; Metaxas et al., 2016; Rahayu & Widodo, 2019; Sampson et al., 2011; Scheuer et al., 2014; Songsil et al., 2019; Stegmann et al., 2012; Vogel et al., 2016; Weinberger & Fischer, 2006). Toulmin's model – despite being traditionally reported in research studies in classrooms and among undergraduate students – is now applied and reported in research amongst graduate students and in graduate studies, to augment the development of argumentation skills (Kneupper, 1978; Luna et al., 2020; MacCann-Alfaro et al., 2018; Metaxas et al., 2016; Rahayu & Widodo, 2019). Toulmin's (2003) model provides for a style of argumentation that breaks down the argument into six components, namely the claim, grounds, warrant, qualifier, rebuttal and backing. The student, in an attempt to formulate an argument, can then evaluate each part individually, to ensure that the logic is sound. In studies where Toulmin's model was used to augment the argumentation development of a researcher, a scaffolded approach was followed (Hasnunidah et al., 2019; Oh & Kim, 2016), allowing the students as researchers to develop their argumentation skills through "scaffolding, planning and sequencing" (Andrews, 2009, p. 121).

1.1.2 Computer-supported collaborative learning

CSCL can be described as a pedagogical approach in which learning takes place by using technology in an online environment that encourages collaboration among the participants (Buchal & Songsore, 2019; Tiruwa et al., 2018). CSCL is an interdisciplinary research field that focuses on how technology can support and facilitate collaborative learning, by enhancing interaction between participants and working in groups, typically by means of tools such as computers, tablets or

mobile devices, through the internet or a digital cloud environment, often while including additional technology such as video conferencing and a range of multimedia platforms (Koschmann, 2011; Stahl, 2015; Zheng et al., 2017). Such advances in the technologies that support CSCL offer new ways of communicating, and have great potential to connect more students, through various technologies, both faster and more efficiently. As the literature confirms, CSCL, when designed in accordance with cognitive principles (Anderson et al., 2018; Klieger & Rochsar, 2017), offers a suitable environment for facilitating argumentation skills development, as it provides technology-mediated platforms that allow for the conceptualisation and negotiation of meaning and the building of knowledge through community discourse (Dragon et al., 2012; MacCann-Alfaro et al., 2018; Stahl, 2015).

Relying on collaboration through computer-supported technology in ODeL has become increasingly important during the past few years (Eustace, 2013; Toming & Lamas, 2012; Van Staden, 2016), and the very notion of learning through CSCL has called into question prevailing assumptions around not only how to use CSCL effectively in teaching and learning, but also how to research and reflect on it (Huang, 2011; Letseka, 2021; Salmon, 2019; Yang, 2016). Although CSCL holds promise for enhancing collaborative learning in graduate research, it is not without challenges: not only is access to the technologies limited, there is also a lack of methodologies and frameworks to implement in CSCL environments, when developing effective online courses aimed at enhancing discourse through collaborative learning (Bates, 2015; Lipponen, 2002; Paul et al., 2015). In studies where educators' feedback is reported, the time required to create an online classroom, monitor student discourse, conduct formative and summative assessment, and deal with the complexity of setting up CSCL, were identified as areas of concern in developing an environment which will support collaborative work (Alharbi et al., 2014; Kaendler et al., 2015; Robinson et al., 2017). Researchers concur that the mere availability of technology

and various platforms does not necessarily lead to the creation of a successful CSCL environment (Czerniewicz et al., 2020; Wright, 2015; Zhu et al., 2009).

The development of an online environment that can assist in augmenting argumentation skills has not been fully investigated or reported on in higher education institutions (HEI) contexts (Luna et al., 2020; Ma, 2013), and is specifically lacking as it pertains to graduate studies (Rapanta & Macagno, 2019). While many academic books and courses exist for the purpose of ameliorating academic writing, these tend to focus on addressing academic writing concepts, the structure of a study, academic language and the use of references, without focusing on the development of an argument (Irish, 2003). In summary: there is a dearth of literature studies and reported research on developing a CSCL environment to foster graduate students' argumentation skills.

In Section 1.2 the research problem is identified, while Section 1.3 defines the research question which addresses the research problem. In Section 1.4, the research design, methodology and methods applied in answering the research question are presented, while Section 1.5 focuses on the related delineations, limitations and assumptions.

1.2 RESEARCH PROBLEM

Students in graduate research often experience problems in not being able to develop and present a well-formulated argument, identifying counter-arguments, considering alternative viewpoints, and removing their own perspectives from the process of articulating an argument (Noroozi et al., 2018). As reported in the literature, students in ODeL need more explicit guidance and support to overcome difficulties when formulating and writing argumentative texts (Cotos et al., 2020; Tsai & Tsai, 2014).

In ODeL, CSCL plays an important role in creating an environment that will augment the development of argumentation skills. Therefore, in order to solve the

problem, the solution has to be viewed from two sides: on the one side is the presentation of a well-formulated argument, which is seen as a core ability that all individuals should develop in their lifetime (Rapanta & Walton, 2016) as it aids in "transforming, clarifying, changing ideas, [fostering] personal growth and identifying [. . .] information" (Andrews, 2009, p. 50). On the other side is using CSCL to provide affordances that can, through the use of technology, be applied in a graduate course to augment the development of argumentation skills.

The inclusion of the theoretical concepts of argumentation in a graduate course, along with skills related to academic writing, is not new – in fact, positive results have been reported by Rapanta and Macagno (2019, p. 139) in that the "students were able [...] to produce academic texts [which were] argumentatively more sophisticated". Worryingly, unless supervisors (as e-moderators and material developers in graduate courses using CSCL) actively start to implement structures within graduate offerings that will address the learning experiences of their students and augment argumentation skills development (Luna et al., 2020), the latter may find themselves in a situation where they either take a very long time to develop argumentation skills, or are incapable of presenting a well-formulated argument in their academic writing.

The problem is that the researcher could not find theorisation in the literature for a framework that can be adhered to, in implementing argumentation skills development alongside course content in graduate research studies using CSCL in ODeL. Järvelä and Rosé (2020, p. 146) corroborate the finding that more empirical research is required on the "design of the technological settings for collaboration and how people learn in the context of collaborative activity".

1.3 RESEARCH QUESTION

The current research sought to answer the following primary research question:

How can CSCL environments be used to augment graduate computing students' argumentation skills development?

The primary research question is supported by the following research sub-questions:

RSQ1: What trends, drivers and barriers influence the use of CSCL in ODeL?

RSQ2: What methodologies and frameworks exist that support argumentation skills development using CSCL in ODeL?

RSQ3: What are the key elements required of a CSCL framework that could contribute to the development of argumentation skills in a graduate course?

RSQ4: How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?

1.4 RESEARCH DESIGN, METHODOLOGY AND METHODS

Following the research process presented by Pilkington and Pretorius (2015, 2019) (refer to Figure 1.1), pragmatism was selected as a philosophical worldview. As a paradigm, pragmatism offers an experience-based, action-oriented framework where the research assists in addressing the issues of dealing with how we experience the world, and come to know it in a practical sense (Goldkuhl, 2012). As a research paradigm, it allows the researcher to choose a methodological approach that works best for the research problem under investigation, and is often associated with mixed methods (Ormerod, 2006).

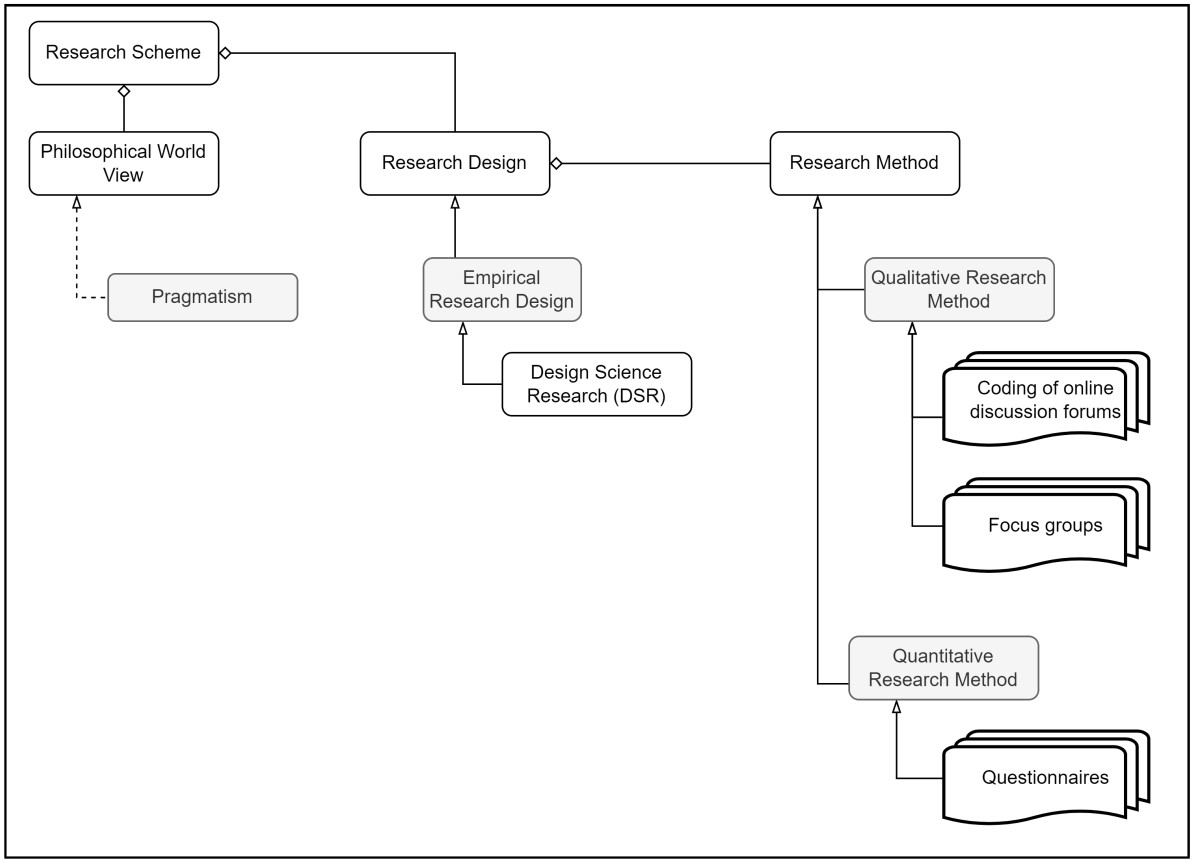


Figure 1.1: Research process guided by the Research Methodology Semantic Wiki (SWaRM) (Pilkington & Pretorius, 2015,2019)

Design science research (DSR) for information systems research, as presented by Mullarkey and Hevner (2019) and Peffers et al. (2007), was followed in the design and development of a novel artefact instantiation as a methodology for CSCL learning for graduate computing research students' argumentation skills development. Design science supports the pragmatic philosophical paradigm, as it provides a framework for problem solving and seeks to offer solutions to problems, by developing and building theories and artefacts (de Villiers & Harpur, 2013; Matthew & Hirschheim, 2012). The iterative process activities of DSR allowed for the development and building of the artefact, justification of the artefact through demonstration and evaluation, in addition to making a contribution to the body of knowledge through the reporting of methodologies and theories.

Based on the DSR activities, the research was conducted in two phases: the first phase reports on the development of an argumentation skills development

framework (ASDF). The elements required in a CSCL framework that may facilitate the development of argumentation skills in a graduate research course were tested in focus groups that comprised experts in the field of post-graduate supervision and ODeL course development. The conceptual ASDF was presented and discussed in the focus groups. The thematically analysed discussions (data) and findings from the online survey were subsequently used to revise and update the ASDF.

The second phase of the study reports on the implementation of the revised ASDF using CSCL in a computing graduate research course. In this phase, students' educational experiences whilst engaging with the activities, as presented in the ASDF, were measured through thematic analysis of the discussions in a focus group. The thematic analysis of the online discussions was used to confirm the elements and affordances of the ASDF, and contribute to CSCL in identifying the "cross-disciplinary application of skills" as a fourth pillar alongside pedagogy, collaboration, and technology (Jeong et al., 2019).

1.5 DELINEATIONS, LIMITATIONS AND ASSUMPTIONS

The study was delineated by the DSR paradigm and underpinned by a pragmatic philosophical worldview. The study was limited to using CSCL at the University of South Africa (Unisa), an ODeL institution. An inherent limitation of this study relates to the generalisability of the research, since only one project was selected from a range of computing research projects. To advance the generalisability of the research, iterative steps were followed that included the presentation of the framework to a group of postgraduate experts prior to its implementation, and an evaluation of the approach in a graduate course. The assumption was that the computing graduate students would be familiar with the technology used in CSCL.

In some instances in the study, the researcher refers to graduate students/courses, and in others to graduate computing students/courses. This, to respond to the

research sub-questions in the context of discussion: in the first instance the research refers to the wider community of graduate students/courses and in the second, to the more focused group of graduate computing students/courses.

1.6 SUMMARY

Developing and presenting a well-formulated research argument is a core competency which a graduate student must acquire during his/her learning journey. In ODeL, CSCL plays an important role in providing a platform for graduate students to engage in academic discourse that will help to develop their argumentation skills. Although the literature indicates that there is a need for a methodology using CSCL that will contribute to the development of argumentation skills in graduate students, the initial review of the literature could not identify such a methodology or artefact. For that reason, it is important to develop a methodology that can provide an ASDF and technology infrastructure affordances to guide courseware developers and e-moderators in the implementation of a model in an academic course that will augment argumentation skills development. The rationale of this study, then, is to develop an evidence-based ASDF that can be followed when implementing an argumentation model in a graduate course using CSCL. This led to the formulation of the main research question: "*How can CSCL environments be used to augment graduate computing students' argumentation skills development?*".

The research seeks to contribute to the extant body of knowledge, by providing a methodology that will offer a philosophy and strategy of scaffolded procedures and techniques to implement in a course using CSCL, to augment the argumentation skills development of graduate students.

At a theoretical level, the research contributes to the body of knowledge pertaining to evidence-based approaches using CSCL that can be applied in graduate courses, with a view to augmenting students' argumentation skills. On a methodological level, the ASDF provides a methodology that courseware designers and e-moderators can

use in designing a graduate course using CSCL, and embedding argumentation models that will improve students' argumentation skills. On a practical level, the ASDF makes a contribution in that it has been tested in practice by being implemented in a computing graduate course. Although the ASDF designed and presented in this study was intended for a research course in Computer Science, the concepts should be transferable to similar studies. The findings are expected to influence the development of modules using CSCL with a specific focus on argumentation skills development, by taking an inclusive approach to the outcomes of the modules and the use of technology-mediated collaboration tools. The structure of the thesis is presented in Section 1.7.

1.7 STRUCTURE OF THE THESIS

The structure of this research study (see Table 1.1) follows the publication schema for a DSR study, as presented by Gregor and Hevner (2013), namely introduction, literature review, method, artefact description, evaluation, discussion and conclusion.

To enhance the reader's understanding of the phenomenon under investigation, in Chapter 2 the researcher describes the systematised literature review approach, in addition to identifying the themes that emerged and are perceived as key when using CSCL in ODeL to augment graduate students' argumentation skills.

Table 1.1: Adapted publication schema for DSR study (Gregor & Hevner, 2013) mapped to the DSR phases and chapters in this study

Section	Contents	Chapter	RQ
Introduction	Problem identification, motivation, key concepts, research questions/research objectives, scope of the study, overview of methods and findings, theoretical and practical significance and structure of the remainder of the thesis Problem definition and research objectives specify the goals required to develop the artefact Claims about the contribution to practice and knowledge	Chapter 1: Introduction	
Literature review	Prior work that is relevant to the study, theories, empirical research and findings from practice Literature includes prior design theories and artefacts already designed relating to the class of problems to be addressed	Chapter 2: Systematised literature review Chapter 3: A literature review on themes identified in Chapter 2	RSQ1, RSQ2, RSQ3
Method	The methods used, and an explanation of the rigour of the research approach	Chapter 4: Research design, methodology and method	
PHASE I:			
Development of the artefact Evaluation of the approach	A concise description of the artefact at the appropriate level of abstraction Evaluation of the artefact from the perspective of the users	Chapter 5: Develop, implement and report on the conceptual ASDF Expert focus groups: Postgraduate supervisors and ODeL courseware developers Online questionnaire: Experts	RSQ4
PHASE II:			
Implementation of the artefact Evaluation of the approach	Evidence provided of the implementation of the artefact Evaluation of the artefact from the perceived educational experience of the users	Chapter 6: Implementation of the revised ASDF Users: Students enrolled for the HRCOS82-P19 project Student focus groups Survey: Educational experience	RSQ4
Discussion and conclusions	Interpretation of the results Research contributions are highlighted Broad implications of the results for research and practice, are discussed Concluding paragraphs restating the important findings and contributions	Chapter 7: Conclusion and recommendations	

CHAPTER 2

SYSTEMATISED LITERATURE REVIEW APPROACH

2.1 INTRODUCTION

In this chapter, guided by the main research question, *"How can CSCL environments be used to augment graduate computing students' argumentation skills development?"*, the researcher endeavours to set out, through a systematic and methodological literature review, to enhance the reader's understanding of the phenomenon being researched, establish the context and rationale for this study, and confirm the applicability of the first three research questions:

> RSQ1: What trends, drivers and barriers influence the use of CSCL in ODeL?
>
> RSQ2: What methodologies and frameworks exist that support argumentation skills development using CSCL in ODeL?
>
> RSQ3: What are the key elements required of a CSCL framework that could contribute to the development of argumentation skills in a graduate course?

For the literature review to be valid, reliable and repeatable (Xiao & Watson, 2019), the processes followed in identifying, selecting and critically appraising the findings from the literature review, are described in Section 2.2. The key stages of the literature search are described in Section 2.2.1, followed by a description of the use of the Preferred Reporting of Items for Systematic reviews and Meta-Analysis (PRISMA) (Moher et al., 2009). Section 2.2.2 reports on the literature research phases. The themes emanating from the literature review are listed in Section 2.3, and further explored in Chapter 3.

2.2 LITERATURE REVIEW PROCESS

A literature review is a rigorous and systematic process undertaken to identify, select and critically appraise relevant research, and summarise the applicable literature and "constructively inform the reader about what has been learned" (Webster & Watson, 2002, p.xviii). A literature review entails a systematic literature search and process in reporting on study findings.

Studies in Information Systems (IS) employ a range of literature review types and diverse terminology to reflect and describe the literature review process followed (Levy & Ellis, 2006; Okoli & Schabram, 2010; Snyder, 2019). Okoli and Schabram (2010) and Snyder (2019) argue that literature reviews, for theoretical backgrounds and graduate theses, do not always follow rigorous processes, and often lack thoroughness and rigour. Snyder (2019) and Cooper et al. (2018) propose that descriptive phases or key stages guide the literature review, and that these be clearly described in the research study.

In a typology of overviews on the different types of literature reviews, Grant and Booth (2009) label the major literature review types and associated methodologies, and indicate which methods tend to be used most frequently. Although the review by Grant and Booth (2009) was done from the viewpoint of research in healthcare it is deemed to be important, as studies conducted in IS often refer to the literature review types described by those authors.

Grant and Booth (2009) group the literature reviews used in the studies under review according to the manner in which the search, appraisal, synthesis and analysis (SALSA) were conducted. Some of the most significant literature reviews that can be conducted in a thesis are critical review, systematic review, systematic search review and systematised review. These methods allow for completeness through

comprehensive searching, and characterise both the quantity and the quality of the literature.

Grant and Booth (2009) and Okoli and Schabram (2010) differentiate between three types of literature reviews that are frequently implemented when conducting research in IS: the first type is often found in a section in an article that provides a theoretical foundation and context to the research question; the second refers to the literature review chapter in a graduate thesis or dissertation; and the third is the stand-alone literature review which is often presented in a journal-length article for the purpose of reviewing the available literature in a field. In a graduate thesis, the role of the literature review is to give an overview of existing research, and to justify the research questions by identifying a gap in the literature – to that end, a chapter in the study is often dedicated to the literature review (Okoli & Schabram, 2010).

Snyder (2019) stipulates the design phases that can be followed in a literature review, in guiding the researcher to perform a rigorous literature search and report on the process and outcomes. The design phases, as described by Snyder (2019), include an initial phase, where the researcher should ask whether the review has to be conducted, and needs to decide on an appropriate literature review process. During the follow-up phase a pilot test, as preparation, should be done to determine the relevance of the literature review process, as well as the protocols that will be adhered to. This should be followed by a formulation of the research strategy, to outline an appropriate process and the theoretical perspectives to follow in analysing the data extracted from the literature review. The final phase recommends the use of existing standards, such as PRISMA (Moher et al., 2009), for reporting on the literature review.

As is the case in the design phases (Snyder, 2019) Cooper et al. (2018) describe the key stages in the literature review process. During the first stage, the researcher should ask who will conduct the literature search, and determine the expertise of

that researcher. During the second stage, the aims and purpose of the literature search should be defined, followed by a preparation stage for a scoping review. After the scoping review, the key terminologies, synonyms and search terms should be defined, before the researcher undertakes a comprehensive bibliographic database search. To complement the literature review, the researcher has to identify supplementary literature beyond the bibliographic search. An important stage that should be run concurrent with all the other stages, is to manage the references, using applicable software. The final stage involves using existing standards, and following the stipulated reporting guidelines.

In an attempt to include the elements of a systematic review process (Grant & Booth, 2009), whilst stopping short of conducting a systematic literature review, the key stages in literature review, as identified by Cooper et al. (2018), and the literature review phases, as identified by Snyder (2019), are applied in this study and also described as key stages. These stages include describing the expertise and competency of the researcher who is conducting the literature search, the aims and purpose of the literature search, an initial scoping exercise to determine the scope of the literature search, the research strategy followed, the databases searched, and the handling of the references using appropriate software – see Section 2.2.1 for more details.

2.2.1 Key stages of the literature search

The stages followed in the literature review are underpinned by the key stages of a literature search (Cooper et al., 2018). Importantly, a literature review can be iterative in nature, as the researcher may glean fresh insights or experience unforeseen problems during the process (Xiao & Watson, 2019). Table 2.1 links the key stages of the literature search to the research actions applied here.

Table 2.1: Adapted key stages of literature search (Cooper et al., 2018)

Key stages	Application	Evidence
Identify the researcher(s) who will conduct the literature review	Researcher(s) are identified who will conduct the literature search Determine whether the researchers have the required literature search skills and access to a range of databases	The researcher, under the guidance of the supervisors, with relevant expertise in literature search: PhD candidate, information specialist, access to the institutional library (see Section 2.2.1)
Define the aims and purpose of the literature search	Literature search aims and purpose are described	A thorough and comprehensive literature search was conducted to define the aim of a literature search (done during the proposal phase of the study [see Section 2.2.2.1])
Do exhaustive preparation to determine the scope of the literature search	Conduct an initial scoping exercise to determine the scope of the literature search Identify the bibliographic databases applicable in the field of study	An initial scoping exercise was done to determine the scope of the literature search Databases were searched and conference proceedings applicable to the field of study were identified Databases accessed: Association for Computing Machinery (ACM), Emerald, IEEE Xplore, Science Direct, Elsevier, JStor, Sabinet, Scopus, Web of Science, EBSCO and ProQuest
Define the key terminology and search strings	Key terminology, synonyms, search terms, language and date limits were identified The search string to be used in the different databases, was determined	Key terminology, synonyms, compilation of search terms and Boolean search strings, language and date limits were identified (see Section 2.2.2.2)
Conduct bibliographic database searches	Database searches included journals, articles, conference proceedings and reports, government publications and books	Bibliographic searches were done in the identified databases and conference proceedings Applicable government papers were sourced, as well as relevant books and chapters
Conduct a supplementary search	Supplementary literature beyond the bibliographic database searches, was identified	Applicable additional literature was identified and added
Manage the literature by using a reference management tool	An applicable reference tool was identified	Mendeley was used as referencing software Downloaded literature was added The software allows for the identification and removal of duplicates
Report the search process	Identify existing standards and reporting guidelines to follow	The PRISMA reporting guidelines were followed (Moher et al., 2009)

The first key stage required that the competence of the researcher, in terms of conducting a literature search, be confirmed. This was followed by the second stage, which involved describing the aims and purpose of the literature search. During the preparation and research strategy stages, an initial scoping exercise was conducted to identify relevant databases and conference proceedings deemed applicable to the study.

The researcher in question is a doctoral candidate with the appropriate literature search skills, and access to the Unisa online library and research databases. Furthermore, to strengthen the search during the scoping exercise, a request was made to the college librarian to assist in identifying applicable databases and literature. The aims and purpose of the literature search were clarified during the proposal phase of the thesis. An initial scoping exercise was done to determine the key terminology, synonyms, search terms, language and date limits. This was followed by the researcher defining the search strings to use in the literature searches. The applicable bibliographic databases were identified and confirmed with the college librarian for both ease of access and relevance.

The bibliographic database search, and supplementary search stages, were done using the identified databases, conference proceedings and additional literature, with the downloaded literature being added by means of a reference management tool. The final stage required the reporting of the search process in line with existing standards and guidelines.

In this study, the researcher accessed the bibliographic database through Unisa's online library portal. Conference proceedings, which were not found in the databases, yet were deemed applicable to the literature search, were sourced from the relevant conference websites and proceedings. Government publications, books and chapters were either downloaded from the relevant internet sites or sourced

through the library and other relevant repositories. Using Mendeley[1] as a reference tool, the material was added to the pool of downloaded literature. The software made provision for the retrieval of the metadata, and the removal of duplicate articles. During the last stage, the PRISMA reporting guidelines were followed, to report on the processes adhered to (Moher et al., 2009) (see Table 2.1). For more information on the reporting process, see Section 2.2.2, which describes the different phases defined by PRISMA (Moher et al., 2009).

2.2.2 Reporting the searching process

For the purpose of this study, the reporting of the literature research was done in accordance with the diagram and phases defined by PRISMA (Moher et al., 2009) (see Figure 2.1). The diagram outlines the process of article selection, as described by Moher et al. (2009) , and maps out the number of records identified, included and excluded. PRISMA accommodates an identification phase, a screening and an eligibility phase, and also a final phase, reporting on the final number of articles selected for inclusion in the literature review.

For the purpose of this study, article identification was split into two stages: the first identification process was done during the proposal stages, with the number of articles indicated by *n1*. By the time the proposal had been accepted, some time elapsed, during which the ethical clearance documentation was drafted and submitted for approval. As additional insights were gained in the course of reading a range of materials, the researcher continued in the thesis stage to expand the literature search and included keywords that were not considered during the initial search, yet were deemed valuable for contributing to the study. The articles identified in the thesis stage, are indicated by *n2*. The same process was followed of screening, determining eligibility and finally including texts into the final pool of articles. The articles and resources from the library search are indicated by *n3*. To complement

[1] https://www.mendeley.com/search/

the PRISMA phases (Moher et al., 2009), a “referenced phase” was added, for the purpose of indicating the final number of articles referenced in this study.

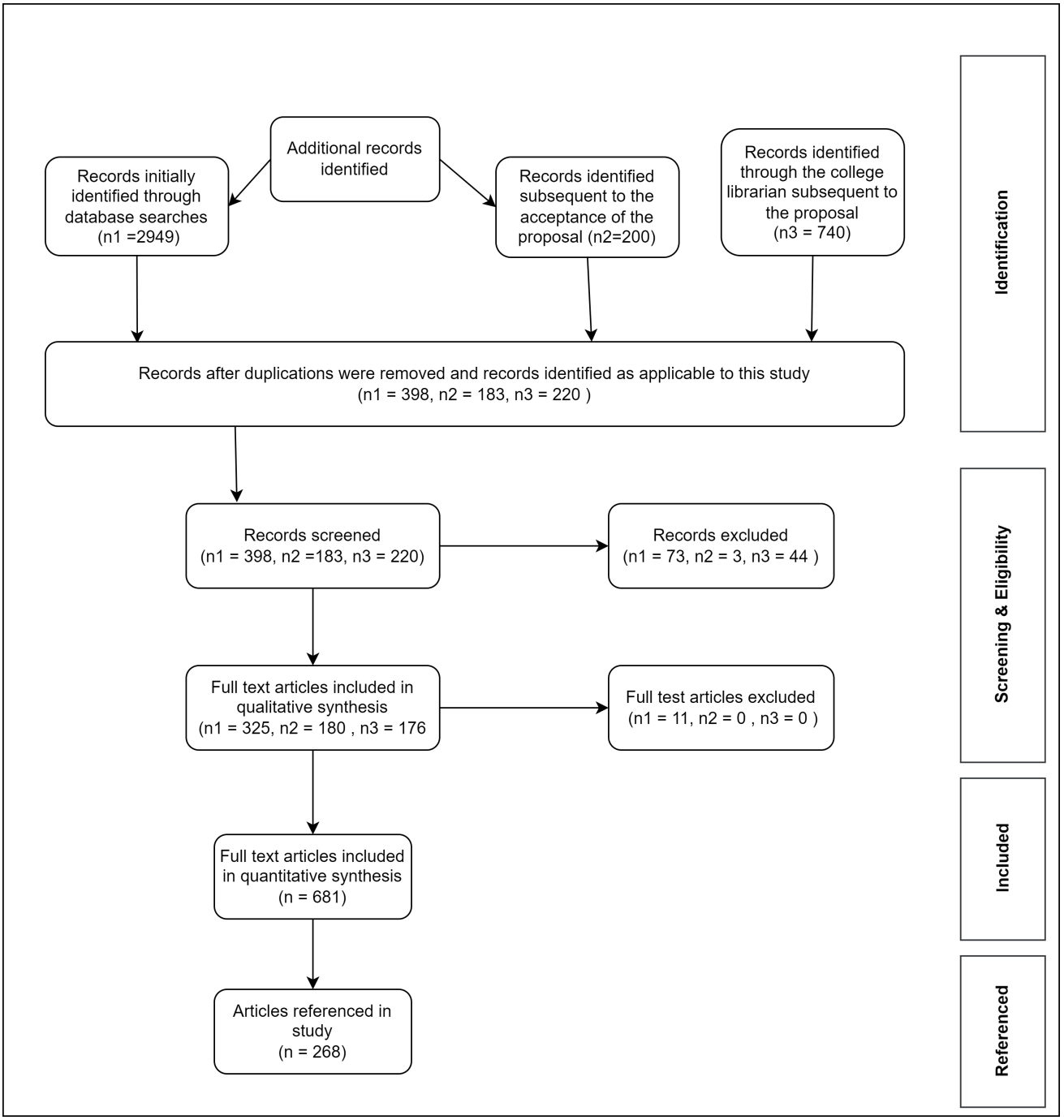


Figure 2.1: Adapted PRISMA (Moher et al., 2009)

2.2.2.1 Identification phase

The following keywords were used in the database searches during the identification phase:

computer supportive collaborative learning

graduate research

argumentation

distance education

computer-supported collaborative learning

A broad search was done to extract and identify as many publications as possible, which address any or all of the keyword combinations. The databases used in this study included ACM, Emerald, IEEE Xplore, Science Direct Elsevier, JSTOR, Sabinet, Scopus, Web of Science, EBSCO and ProQuest, as the researcher has access to these databases through the online library resource of the university. For the purpose of the proposal, an initial search was done for publications spanning the period 2010–2020. The document types included chapters in books, journal papers, conference papers (excluding keynotes), dissertations and theses. In the process, the researcher became aware of seminal research, specifically pertaining to research design, pedagogy and argumentation skills development, and subsequently set out to source the original documents, leading to the inclusion of articles and books published prior to 2010.

During the initial search, a combination of the keywords was used in the database search, using the following Boolean search string:

> “computer supportive collaborative learning” *and*
>
> “argumentation” *or* ”critical reading” *or* ”critical writing” *and*
>
> “open distance e-learning” *or* ”distance education”

Admittedly, the combined Boolean search returned limited results (see Figure 2.2 for an example of a search in Scopus, using all the keywords in the search.) Given the limited results emanating from the combined Boolean searches, the search algorithms applied in the search strings had to be adapted to include a search for any of the Boolean search strings, which resulted in the return of numerous records. The results were ordered according to the “relevance” option in the different databases. See Figure 2.3 for an example of a search in Scopus, using ANY of the keywords in the search and applying the “relevance sort on” option.

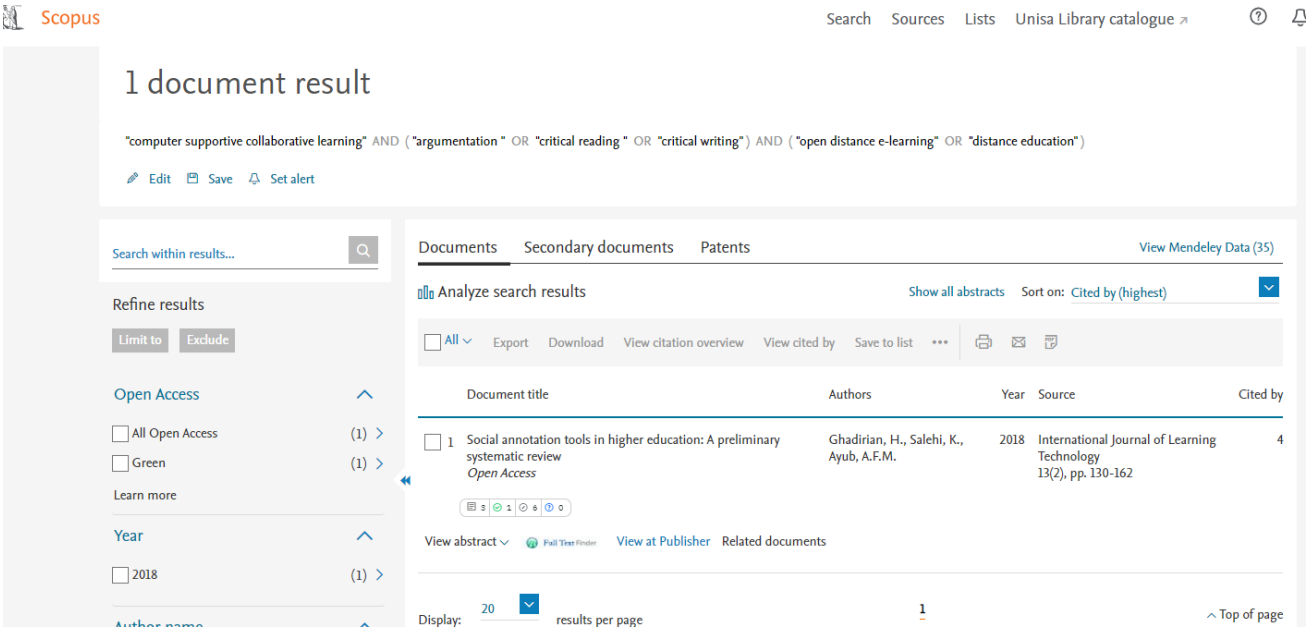


Figure 2.2: Boolean search returning limited record

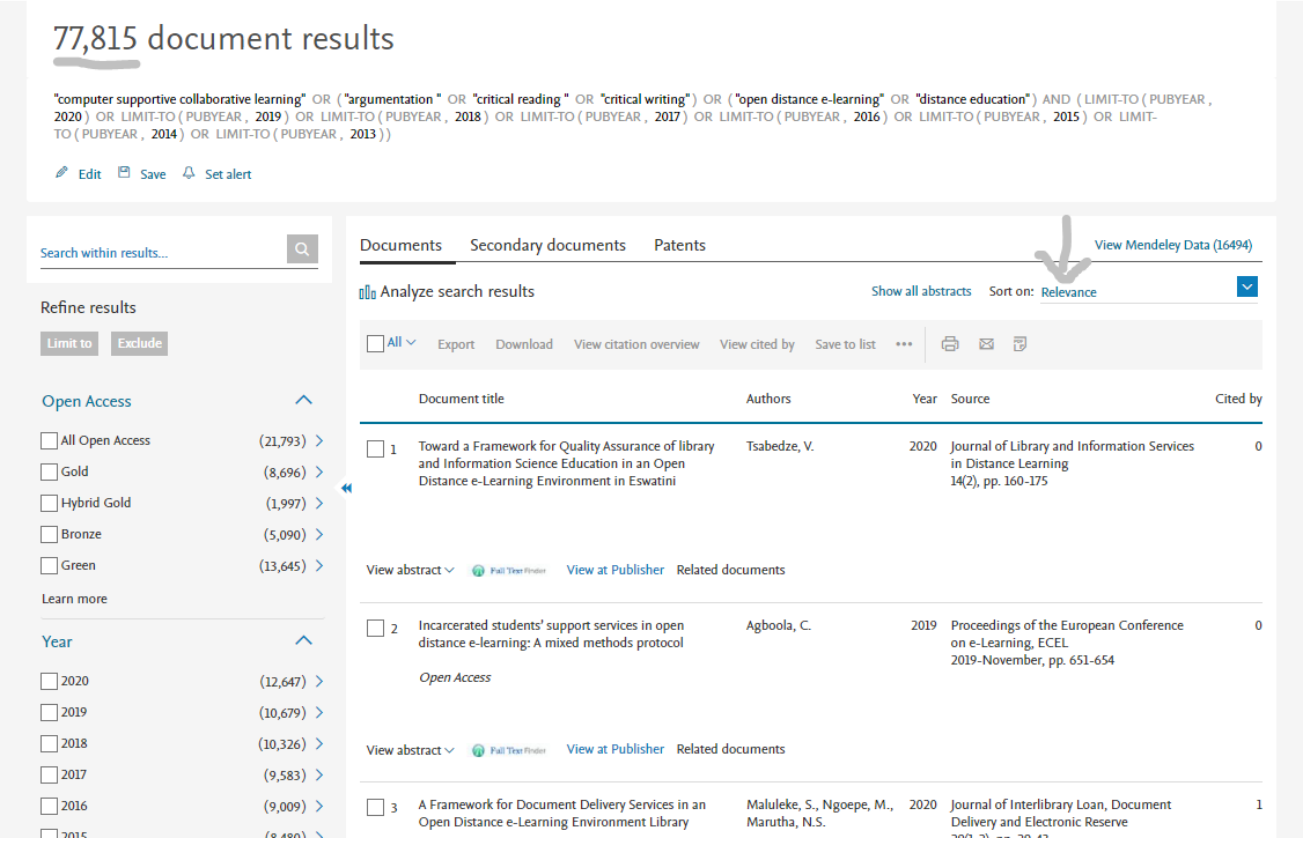


Figure 2.3: Boolean search returning many records

2.2.2.2 Screening phase and eligibility phase

As some database searches returned hundreds of articles (records), only the top selection of each database was chosen for screening. That selection was determined by the "relevance" option in the database (i.e., a statistical calculation that indicates how well text in the documents returned as search results, reflect the terms and criteria executed in a search query)[2]. The top 30 returned results were downloaded for further analysis, with the understanding that, should more data be required, the researcher could repeat the query and download additional articles. This process was repeated for all the databases.

Once the articles had been downloaded, they were added to the reference management tool. The abstract and keywords of each article were read to determine a text's inclusion or exclusion from the pool of eligible records. The following types

[2]https://service.elsevier.com/app/answers/detail/a_id/14182/supporthub/scopus/kw/relevance/

of articles were excluded: texts not written in English, short papers and keynote speeches, and research focusing on industry experiments, or which did not contribute to this undertaking (e.g., research on verbal debates). Articles that did not address higher education or CSCL or a variation thereof, were also excluded.

Although some articles included research done in traditional classrooms, they were included if their content was deemed to contribute to the body of knowledge which this research encompasses. Articles that referred to models and frameworks relating to CSCL, and that were not initially part of the selection of literature (e.g., research and publications describing the "five-stage model of online learning" by Salmon (2013)), were sourced and added to the pool of academic literature. The same applied to the "argumentation model" as described by Toulmin (2003).

The identified full-text articles were saved to a folder in the reference management tool, to assist in documenting them. Duplicates were removed and the metadata for the articles were verified and updated in Mendeley.

2.2.2.3 Qualitative and quantitative synthesis of literature during proposal stage

As regards the qualitative synthesis of the texts, full-text articles were imported and added to a workbench for the qualitative analysis of large bodies of textual data (Atlas.ti). To assist in the qualitative synthesising of the eligible full-text articles, the stages in the descriptive coding method of Saldaña (2013), as summarised by Onwuegbuzie et al. (2016), was used. The stages in the coding method can be summarised as follows:

1. Identifying and extracting the literature by following the steps in the identification phase, as described in sections 2.2.2.1 and 2.2.2.2
2. Adding the literature to the Mendeley reference tool

3. Determining the subset of data to be coded (i.e., determining which components – whole work vs. part – of the selected data would be coded)

4. Deciding which of Saldaña (2013) coding methods would be applied. For example, in this study, the descriptive coding method was used, as it permits the addition of descriptive nouns as codes to the data, and allows the researcher to determine word frequency using tools such as Word Clouds and Atlas.ti

5. Coding the data, using descriptive coding principles.

Following the descriptive method, coding principles (Saldaña, 2013) were applied in Atlas.ti to arrive at a qualitative synthesis of the data. Through descriptive coding, labels were assigned to data to summarise the basic topic of a passage of qualitative data (see Figure 2.4 for an example where labels were added to a document in Atlas.ti). The addition of labels provided an inventory of topics that could be used for indexing and categorising. This permitted the researcher to identify research trends and gaps, to illuminate research opportunities, and find a way of synthesising the concepts emerging from the literature review process.

To perform a quantitative synthesis of the literature, the researcher used the tools available in Atlas.ti to extract a list of codes created on the full-text documents – a code in Atlas.ti being a tag which is attached to a segment of data that depicts what the segment is about. The co-occurrence coefficient table used to perform a quantitative analysis on qualitative data in Atlas.ti can be used to represent the strength of the relationship between various codes and, in turn, may be used to identify a gap in the literature.

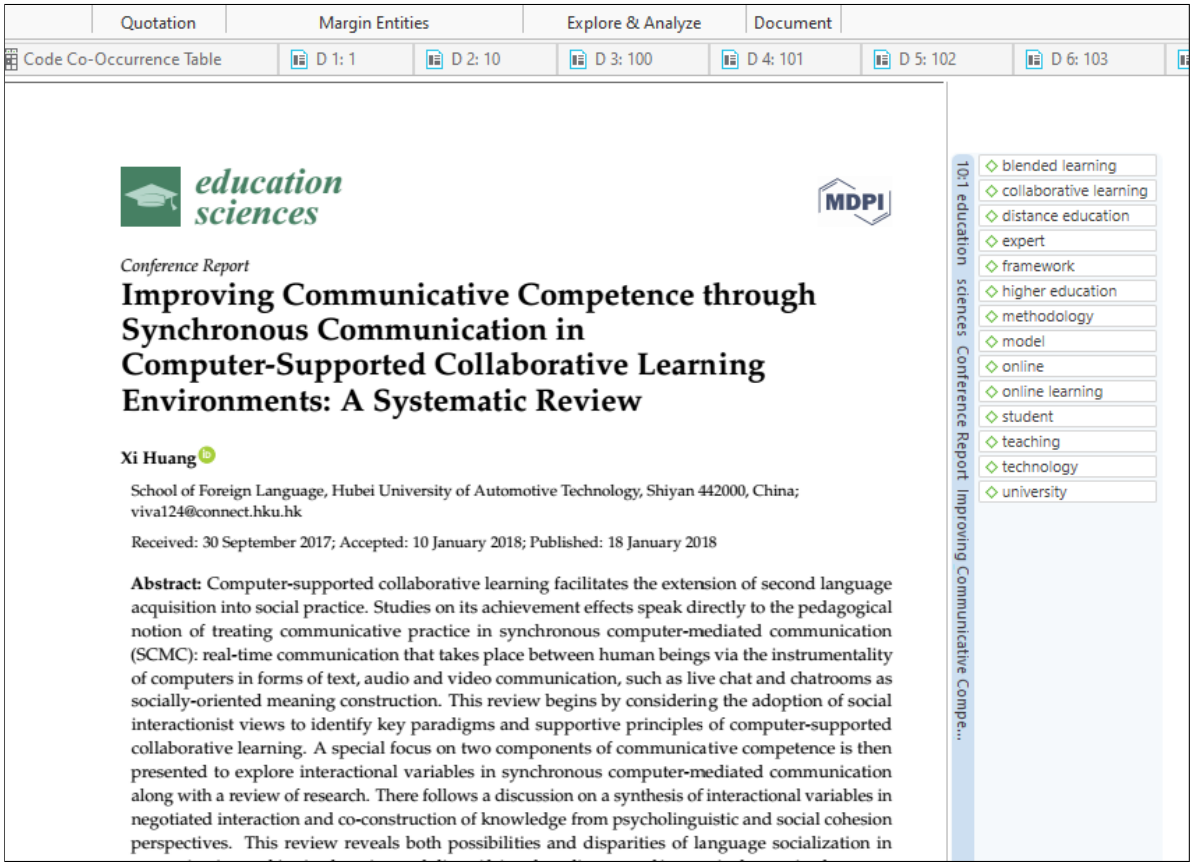


Figure 2.4: Example: Labels as codes added to a document in Atlas.ti

The codes were divided into two groups and presented in a co-occurrence coefficient table, as seen in Table 2.2. The codes *higher education, post-graduate, student, and university*, refer to a student in higher education, and are displayed in vertical column. By contrast, the codes, *argumentation, collaborative learning, distance education and online learning* displayed in the horizontal row.

The first number in the table, *count*, indicates the total number of co-occurrences, while the second represents the coefficient – the coefficient being similar to a correlation coefficient in statistics, without obtaining a p–value, where the value of the coefficient is always between zero and 1. The closer the number is to 1, the stronger the relationship between the codes. The count indicates the number of times the two sets of keywords (or the synonyms thereof) were found jointly in the articles. The *Gr* indicates the number of articles in which the keyword appeared.

The co-occurrence coefficient table, presented in Table 2.2 was used to identify a gap in the literature. The highlighted row indicates that the term “post-graduate” had a low count in respect of appearing in articles where the terms “argumentation”, “collaborative learning”, “distance education” and “online learning” occurred. Using this information, the researcher identified a gap in the coded literature, as regards reported studies on postgraduates and argumentation, with only eight articles being found where both keywords were used. In terms of “post-graduate” and “collaborative learning”, both keywords were used in ten articles; “post-graduate” and “distance education” were used seven times; and “post-graduate” and “online learning” ten times. The findings were used to formulate the proposal for the thesis, and indicated that further research opportunities exist in the field of postgraduate research which is specific to argumentation, collaborative learning, distance education and online learning.

Table 2.2: A co-occurrence coefficient table to determine gaps in the literature

	argumentation Gr=811		collaborative learning Gr=310		distance education Gr=86		online learning Gr=314	
	count	coefficient	count	coefficient	count	coefficient	count	coefficient
higher education Gr=184	83	0,09	183	0,59	63	0,30	184	0,59
post-graduate Gr=10	8	0,01	10	0,03	7	0,08	10	0,03
student Gr=266	126	0,13	264	0,85	76	0,28	266	0,85
university Gr=308	132	0,13	305	0,97	85	0,28	308	0,98

2.2.2.4 Qualitative and quantitative synthesis of literature during thesis stage

After the proposal stage of the study, and having identified a gap in the literature, as described in Section 2.2.2.3, the researcher continued to add literature to the pool of articles, repeating the processes as described in the preceding sections. The databases accessed included ACM, Emerald, IEEE Xplore, Science Direct Elsevier, JSTOR, Sabinet, Scopus, Web of Science, EBSCO and ProQuest, and the search was broadened to include publications from 2010–2022.

The following keywords and Boolean strings were used in the searches:

"computer supportive collaborative learning" *or*

"argumentation" *or* "critical reading" *or* "critical writing" *or*

"open distance e-learning" *or* "distance education" *or*

"scaffolded learning" *or*

"Toulmin" *or* "argumentation models"

During this stage, additional articles (n2=200) were identified and, after screening, 183 of the 200 articles were included in the qualitative synthesis (n2=183). The literature search request that was forwarded to the college librarian, resulted in a long list of articles that matched the search criteria (n3=740). The library search included the databases National ETD Portal: SA theses and dissertations, ProQuest, Sabinet African Journals, EBSCOhost and Google Scholar. The articles were screened by reading the abstracts. The full text of the articles, identified through a screening process as applicable, were downloaded and added to Mendeley, with any duplicates being removed (n3=220). Following a similar process, as described in Section 2.2.2.3, the full-text articles were imported into Atlas.ti, and the descriptive method proposed by Saldaña (2013) was applied.

The following main keywords were used as labels to code the data:
"argumentation skills development", "elearning", "collaborative learning", "learning approaches" and "infrastructure"

The following sub-codes were identified whilst coding the data:
"models for argument", "taxonomies for learning", "frameworks [for collaborative learning]" "collaborative [learning]", "higher education", "LMS", "distance learning", "post-graduate", "scaffolded [learning]", "CSCL", "Vygotsky".

2.2.2.5 Referenced phase

The referenced phase is not part of the stages described in PRISMA (Moher et al., 2009), however, to add value, this phase was added. The referenced phase represents the final number of articles to be referenced in the literature review of the study (see References).

In Section 2.3, the themes that emerged from the systematised literature review, are listed.

2.3 THEMES IDENTIFIED

Refer to Figure 2.5 for a diagram that illustrates the clustering of the themes identified in Atlas.ti after applying descriptive coding principles. The themes, which will be explored in Chapter 3, are grouped as follows:

1. **Argumentation skills development** in higher education
2. **Collaborative learning** as an approach to involve students in working together
3. **Pedagogical (learning) approaches** in collaborative learning to augment argumentation skills development (ASD)
4. Human capacity: the student as a researcher in an **e-learning** environment
5. **Infrastructural resources** required for the implementation of an ASDF.

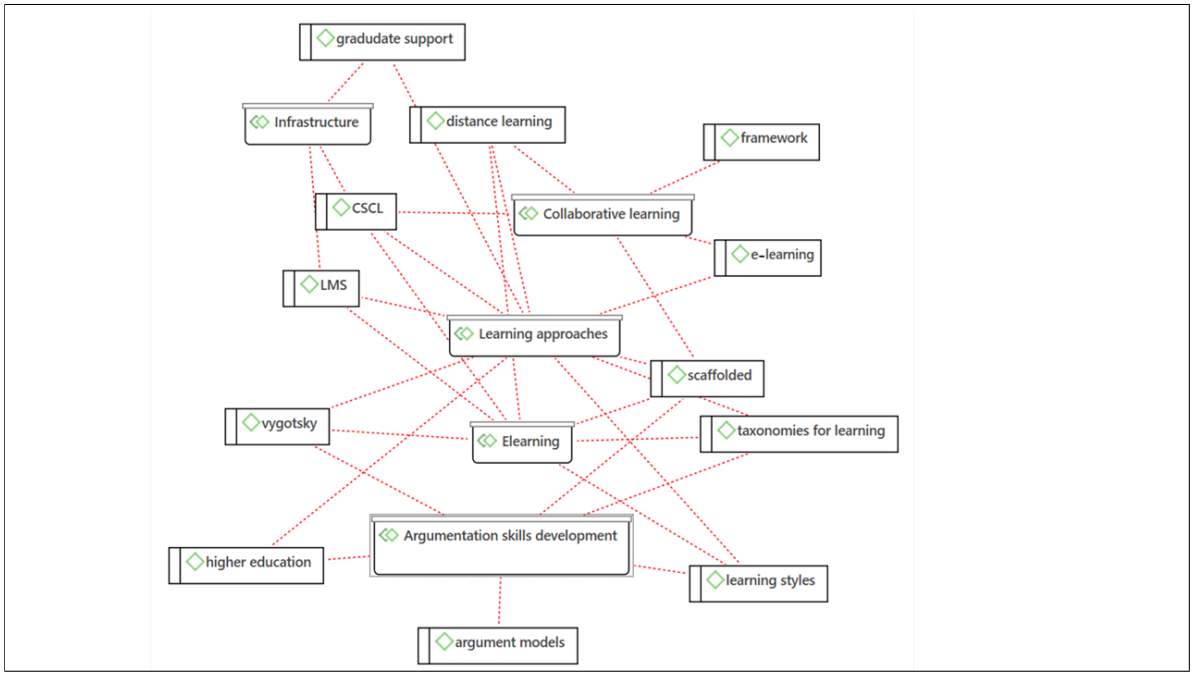


Figure 2.5: Clustering of themes, as identified using Atlas.ti

2.4 SUMMARY

In Section 1.2, the research problem was identified, namely that there is not sufficient theorisation in the literature to put forward a methodology that can be implemented in ODeL using CSCL to augment argumentation skills development in a graduate course. This chapter described the systematic and methodological literature review approach followed in identifying applicable literature to establish the context and rationale for this study, by identifying themes that can answer the research question, *How can CSCL environments be used to augment graduate computing students' argumentation skills development?* The literature review was conducted following the process of adapted key stages (Cooper et al., 2018) as presented in Table 2.1 and Section 2.2.1. Sections 2.2.2.1–2.2.2.5 described the stages followed. During the initial stages, the researcher identified the aims and purpose of the literature search and conducted an initial scoping exercise to determine the scope of the literature search and identify the bibliographic databases applicable to this study. Following the preparation stage (see sections 2.2.2.1 and 2.2.2.2), the key terminology, synonyms, search terms, language and date limits were identified, and Boolean strings were formed and used in the bibliographic searches. In sections 2.2.2.3 and 2.2.2.4, the

qualitative and quantitative syntheses of the literature were explained. Eligible full-text articles were added to Mendeley and Atlas.ti, with the latter being used to assist in the qualitative synthesis and identification of research gaps in the literature. The reporting of the research process was described following the PRISMA guidelines (Moher et al., 2009). Applying descriptive coding principles, themes were identified (see Section 2.3).

The exploration of the literature, as indicated by the themes, are elaborated on in Chapter 3, and were deemed to elucidate and answer the research sub-questions (see Table 2.3):

Table 2.3: Aligning the research sub-questions with the identified themes

Research sub-questions	**Themes**
RSQ1: ”What trends, drivers and barriers influence argumentation skills development in graduate students’ in ODeL?”	1. Argumentation skills development in higher education
RSQ2: ”What methodologies and frameworks exist that support CSCL in ODeL?”	2. Collaborative learning as an approach to involve students in working together 3. Pedagogical approaches in collaborative learning to augment ASD
RSQ3: ”What are the key elements required in a CSCL framework that could contribute to the development of argumentation skills in a graduate course?”	4. Human capacity: the graduate student 5. Infrastructural resources required to implement an ASDF

CHAPTER 3

LITERATURE REVIEW

3.1 INTRODUCTION

In this chapter, the themes, as identified in the course of the systematised literature review and presented in Section 2.3, are presented. The themes are expected to contribute to answering the research sub-questions, namely RSQ1: *What trends, drivers and barriers influence the use of CSCL in ODeL?*, RSQ2: *What methodologies and frameworks exist that support argumentation skills development using CSCL in ODeL?* and RSQ3: *What are the key elements required of a CSCL framework that could contribute to the development of argumentation skills in a graduate course?*

The remainder of the chapter is structured as follows: In Section 3.2, argumentation skills development and literature-based argumentation models are discussed. Collaborative learning maturity is discussed in Section 3.3, by describing the roots of collaborative learning, and in Section 3.4 collaborative learning approaches to augment argumentation skills development (ASD) are identified, with a specific focus on scaffolded learning. Section 3.5 focuses on the collaborative learning environment from the perspective of the student, and in Section 3.6, the infrastructural requirements, as identified in the literature, are discussed. Several challenges, which are informed by the trends, drivers and barriers that influence the development of CSCL practices in ODeL, are discussed in Section 3.7. Table 3.3 conceptually

summarises the themes discussed in this chapter, by linking the identified themes to the research sub-questions. The conceptual summary can be used to identify the key elements required for the presentation of a conceptual ASDF (see Chapter 5).

3.2 ARGUMENTATION SKILLS DEVELOPMENT

Constructing an academic argument which is grounded in, and backed by, academic literature and resources, is essential in graduate studies (Andrews, 2009; Bitchener, 2017). Although there is no formal definition for argumentation skills, it is understood in the literature that it is a thought process used to develop and present arguments, and is often described together with concepts related to critical thinking, reasoning, rhetoric and higher-order thinking skills (Andrews, 2015).

The presentation of an argument, developed through the process of argumentation, is seen as fundamental to learning for any student, from the primary phase to university, as well as in everyday life (Noroozi et al., 2018; Rahayu & Widodo, 2019; Rapanta & Walton, 2016). From a higher education perspective, academic argumentation is considered core to learning in the construction of knowledge, and includes not only complex academic skills but also sound proposal preparation, the choice of an appropriate methodology, referencing and presenting a body of work in a formal structure (Gensowski, 2016). Andrews (2015) identifies key elements that, in combination, augment argumentation skills development in higher education. Summarised, these elements include the student being aware that knowledge is required regarding the theories and models of argumentation, and being willing to study and apply them. Thus, both the student and the supervisor understand that the development of such argumentation skills will take time to develop, and will proceed along a number of stages.

Using a diagram (see Figure 3.1), Andrews (2009, p. 11) explains the “place” of argumentation in various modes of communication, thought, rationality and critical thinking, defining the role of argumentation as a process through which “higher

mental functions operate socially, and cognitively" towards "clarification, exploration, persuasion, logical and quasi-logical connection, [the] provision of evidence" and so forth. Critical thinking in developing sound argumentation in academic discourse requires a student to deal with academic content, to reach an understanding and reflect on it, and to provide information that will either support or refute a stated position (Andrews, 2009; Hasnunidah et al., 2019). This means the student, as a researcher, needs to respond to existing knowledge derived from the literature, and to formulate a justified opinion or argument. The argument should either confirm or defend a specific point of view based on supporting evidence, and the researcher should be able to communicate his/her arguments both orally and in written format (Booth et al., 2015; Gensowski, 2016; Hasnunidah et al., 2019; Toulmin, 2003). As reported in the literature, students receiving training in skills to augment their capacity for argumentation were found to have improved their abilities, when presenting a formulated argument to others (Dawson & Venville, 2009). Wingate (2012), in a study amongst undergraduate students, confirms that although the development of argumentation skills is often intrinsic, an effort should be made to teach these skills explicitly to students. Wingate (2012, p. 147) concedes that many students experience difficulties in transferring argumentation skills learned in one discipline to another, as the "nature of argumentation" is often discipline-specific. As Noroozi et al. (2018, p. 170) report, there is no systematic evidence that the acquired "argumentation competence can be transferred for dealing with new comparable tasks".

Of interest to this study are various processes and models that have been reported on in the literature, and can be used to develop argumentation skills. In this research, the argument-driven inquiry (ADI) instructional model (Sampson & Gleim, 2009) (see Section 3.2.1.1), the triangle model of argumentation (Mitchell & Riddle, 2000) (see Section 3.2.1.2), the core of a research argument flow as described by Booth et

al. (2015) (see Section 3.2.1.3) and the seminal argumentation model presented by Toulmin (2003) (see Section 3.2.1.4), are reported on.

Other frameworks and models that contribute to the understanding of argumentation, but that are not discussed in this study, include Walton's dialogue theory (Walton, 1989) and Bayesian probabilistic models (Chipman, George, & McCulloch, 2001). Walton's dialogue theory (Walton, 1989) focuses on analysing and evaluating arguments within dialogues, considering different types of moves and their strategic functions. It emphasises rational persuasion, information exchange, critical questioning, burden of proof and fallacy detection.

Bayesian models (Chipman et al., 2001) are probabilistic frameworks used in statistics and machine learning. The Bayesian models are applied in natural language processing and dialogue systems to model conversations and employ probabilistic inference to estimate the likelihood of interpretations or intents based on observed data or dialogue context. The Bayesian models integrate prior knowledge and evidence to infer the most probable meanings behind user utterances, aiding tasks like intent recognition for informal argumentation. Studies by Hahn and Oaksford (2007) and Hahn and Hornikx (2016) demonstrate the productive use of Bayesian reasoning in normative models of argument quality and the broader context of human argumentation, respectively.

Overall, the argumentation models emphasise the importance of teaching and developing argumentation skills, the benefits of virtual training, and the ongoing need for improvement in argumentative writing in higher education.

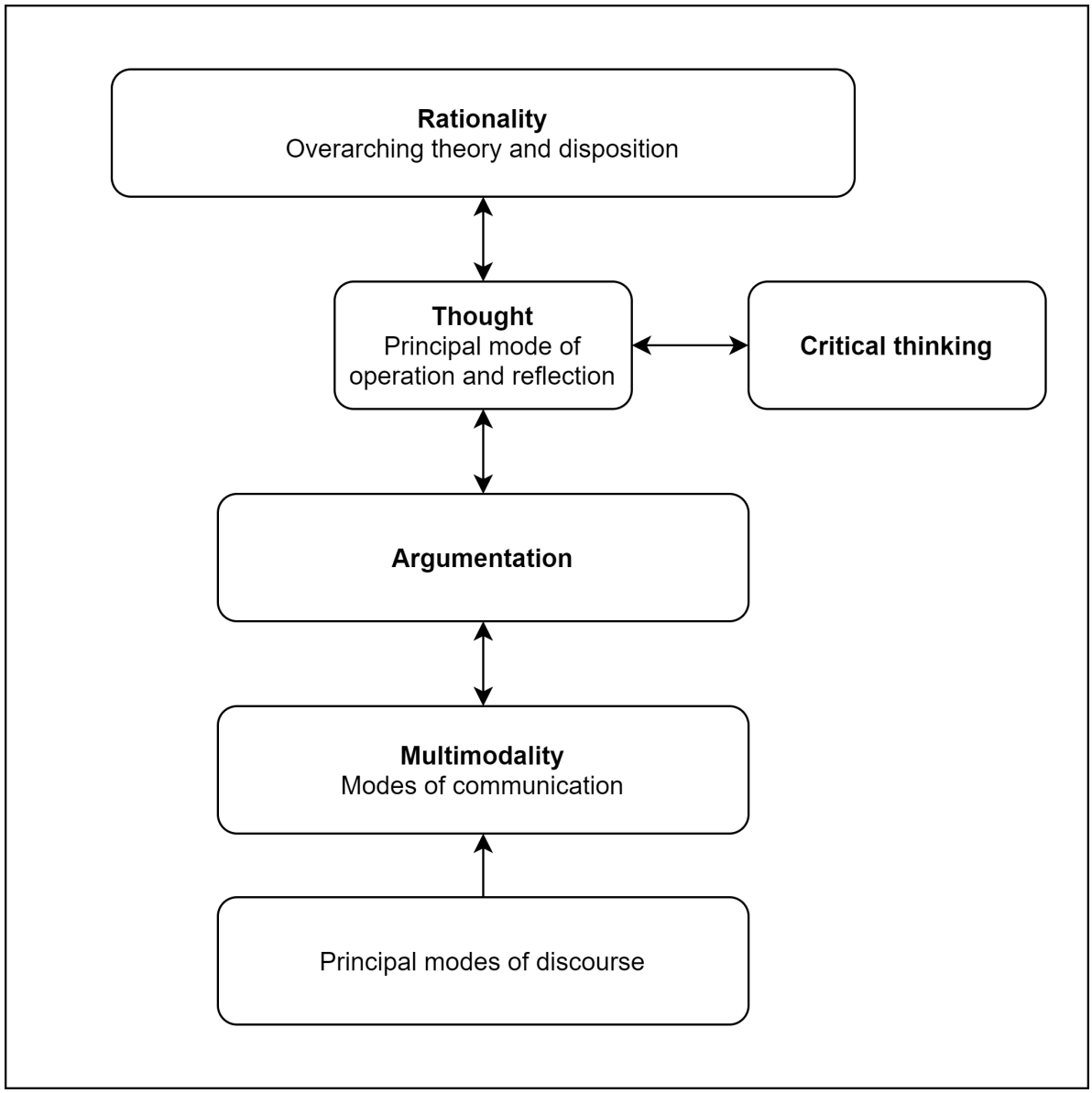


Figure 3.1: The place of argumentation (Andrews, 2009)

3.2.1 Argumentation models

3.2.1.1 The ADI instructional model

Although the ADI instructional model was designed for secondary school learners, it is employed in this study, as it allows for augmenting argumentation skills to be integrated into academic discourse. The augmentation of argumentation forms part of the scaffolded steps outlined in the ADI instructional model, and affords students an opportunity to be exposed to the ideas of others, to respond to questions

and challenges, to articulate substantial warrants, and to evaluate competing ideas (Sampson & Gleim, 2009).

In argumentation development, the ADI instructional model (Sampson & Gleim, 2009) supports activities unfolding in the classroom, to allow students to develop, understand, and/or formulate scientific explanations for problems. The model further encourages students to “generate an argument that articulates and justifies an explanation for a research question as part of the inquiry process” (Sampson & Gleim, 2009, p. 465). The steps in the ADI instructional model include those identified by Sampson and Gleim (2009), as illustrated in Figure 3.2:

1. Identifying a task set by the teacher
2. Formulating an experiment in which students have an opportunity to gather and analyse data
3. Creating an argument that justifies arriving at, and sharing, findings with the rest of the group
4. Hosting an argumentation session, where the group members share their argumentation, and critique and learn how to use the received critique to refine their arguments
5. Writing individual investigation reports by following argumentation guidelines
6. Doing double-blind peer review and inviting feedback from the participants in the groups
7. Granting a student an opportunity to refine the report, based on the results of the peer review
8. Inviting an explicit and reflective discussion of the findings.

Hasnunidah et al. (2019) invited a group of undergraduate students to apply the model, and reported that steps in the ADI instructional model assisted them in developing, amongst others, critical thinking skills.

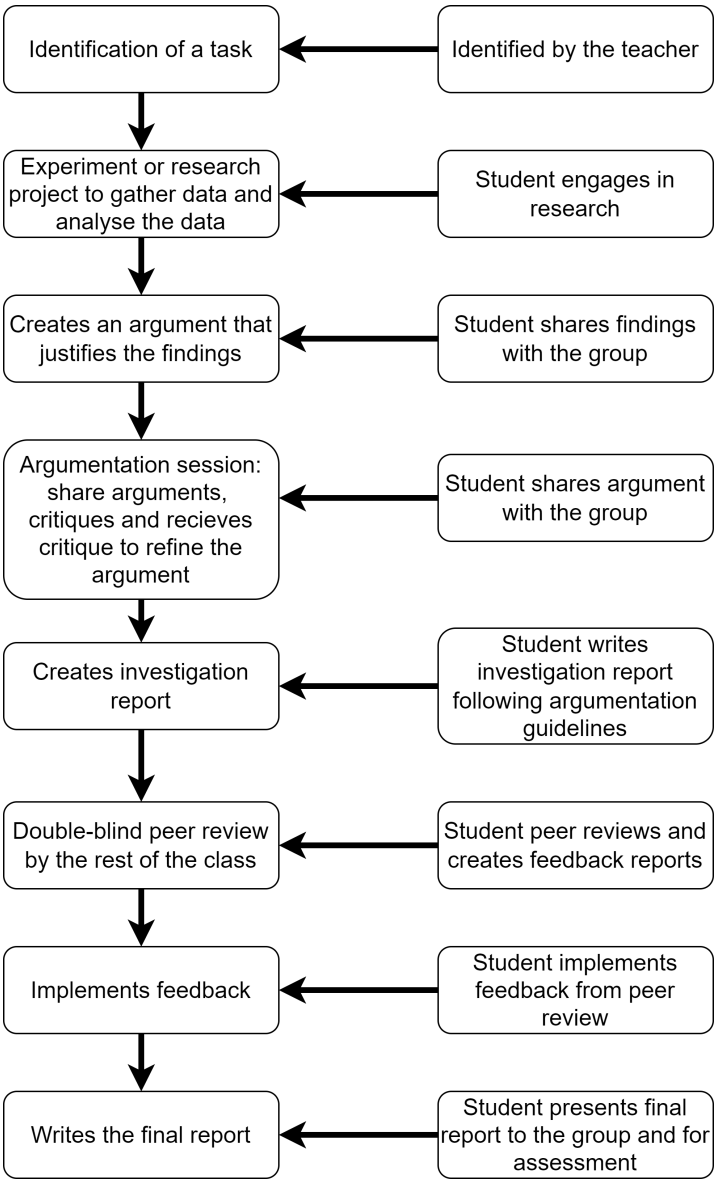


Figure 3.2: Steps in the ADI instructional model

3.2.1.2 Triangle model of argumentation

The triangle model (Mitchell & Riddle, 2000, as cited in Andrews, 2009) can be used as a tool for planning and composing arguments, as illustrated in Figure 3.3. The everyday terminology of SINCE, BECAUSE and THEN can be applied by students to start planning and composing an argument, with the justification element being required to indicate that evidence or support is required for that argument. Although this model can be used as an analytical tool to assess the structure and nature of an argument, the syntactic conjunctions SINCE, BECAUSE and THEN might be confusing, and do not always operate as the words indicate. Andrews (2009, p. 46) suggests that although the model is useful and "accessible", the terminology does not contribute to an accessible argumentation model. The researcher could not find additional references in the literature to support the triangle model of argumentation (Mitchell & Riddle, 2000).

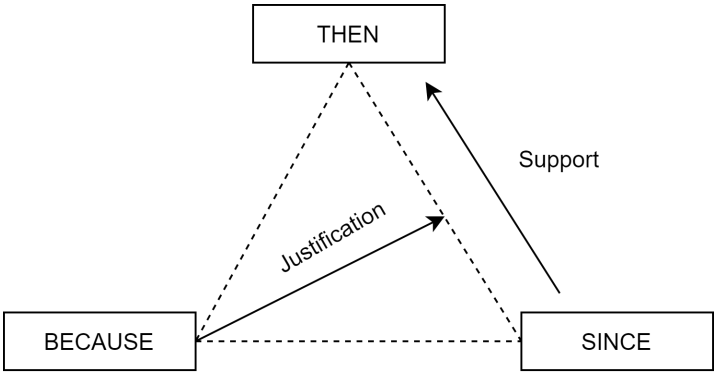


Figure 3.3: Triangle model of argumentation (Mitchell & Riddle, 2000)

3.2.1.3 Booth's core of a research argument

Booth et al. (2015) present an argument flow that illustrates and explains the research process. The process of constructing an argument is reflected in the "core of a research argument" Booth et al. (2015, p. 134) (see Figure 3.4), adding the component of acknowledgements and responses to existing literature, and even to questions that may arise in the future.

Where *claim* is seen as an assertion and requires support (*because of*), the *reason* is an assertion that supports the claim (*because of these reasons*) and the *evidence* supports the reason (*which I base on this evidence*) (Booth et al., 2015, p. 132). As Booth et al. (2015) further note, in complex claims there could be multiple reasons to support a claim, and that in itself can lead to the acquisition of multiple instances of evidence. Further, *warrants* are explained as those "general principles that connect reasons to claims" (Booth et al., 2015, p. 179).

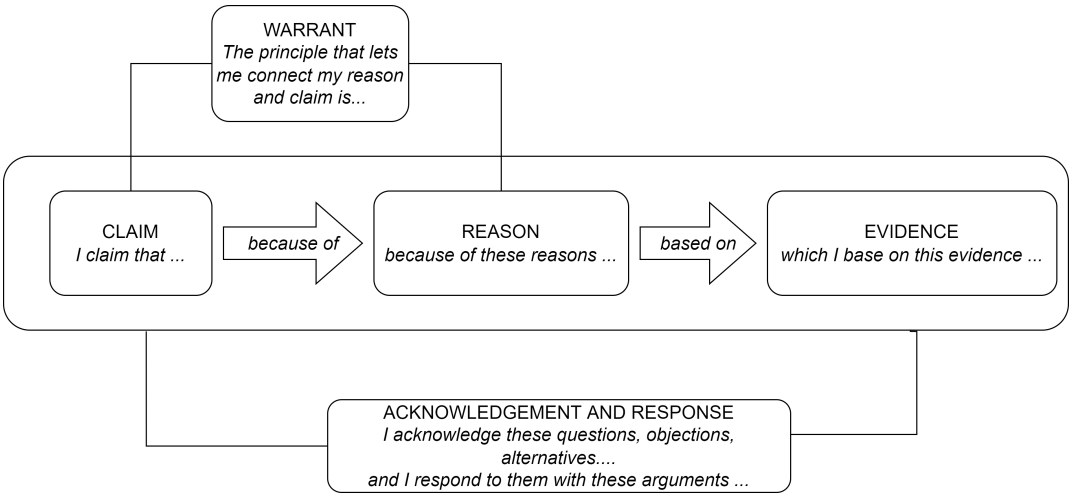


Figure 3.4: Core of a research argument (Booth et al., 2015)

3.2.1.4 Toulmin's argumentation model

The argumentation model proposed by Toulmin (2003) is an approach that breaks an argument into six components, as seen in Figure 3.5. These components are the claim, the grounds, the warrant(s), the qualifier, rebuttal(s) and backing(s). Within this method, every argument comprises three fundamental parts, namely the claim, the grounds and the warrant. Following an explanation of the terminology, as described by Toulmin (2003), the *claim* is the main argument which represents the assertion the author would like to convince others of, or prove to the audience; the *grounds* of an argument are the evidence and facts that support the claim; the *warrant* (often not stated explicitly, yet it should be part of the argument) is the assumption that links the grounds to the claim. The *backing, qualifier* and *rebuttal* are not always present in an argument, but are usually required to assist the author with the nuance of his/her

argument. The *backing* refers to any additional support of the warrant; the *qualifier* limits the study to a specific content or time, or makes the reader aware that the claim may not be true in all circumstances. Finally, the *rebuttal* acknowledges other views derived from similar studies.

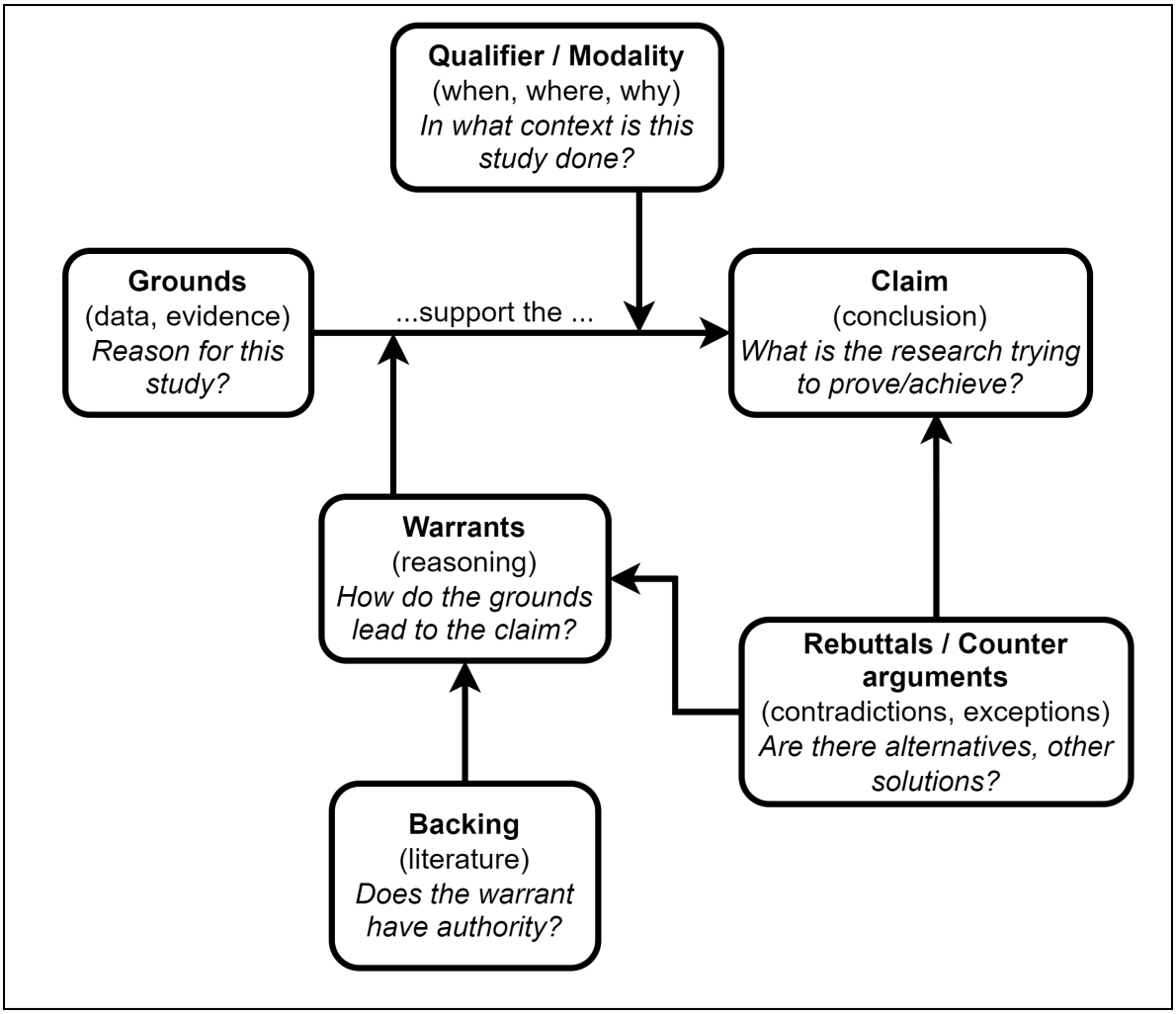


Figure 3.5: Toulmin's (2003) model of argumentation

For practical implementation in this study, the seminal argumentation model presented by Toulmin (2003) will be followed in respect of augmenting the argumentation skills of graduate students, as it is a mature model which has been implemented and reported on in various studies (Kneupper, 1978; Luna et al., 2020; MacCann-Alfaro et al., 2018; Metaxas et al., 2016; Rahayu & Widodo, 2019; Scheuer et al., 2014; Stegmann et al., 2012; Vogel et al., 2016; Weinberger & Fischer, 2006).

Research shows that the social and cognitive experiences of students in collaborative learning lead to deeper learning (Khoo et al., 2012; Tegos et al., 2017), and will benefit a student in respect of developing his/her higher-level cognitive skills. In Section 3.3, collaborative learning is discussed as a learning context that can support higher-level cognitive skills, including argumentation skills development in ODeL.

3.3 COLLABORATIVE LEARNING

The term "collaborative learning" has been used across various disciplines and fields. Although there is no consensus on a definition for this concept, collaborative learning in this study can be seen as involving activities where knowledge can be created between two or more individuals who are actively interacting by sharing and engaging, to take advantage of resources, skills and experience (Li, 2015; Stahl, 2015) with a view to solving a problem, completing a task, or creating a product (Laal & Laal, 2012). According to Bates (2015), interactions in collaborative learning can happen either via face-to-face interaction or through computer-supported scenarios, where the outcome depends on a "well-constructed" classroom in which "discussion-based" teaching principles are implemented (Bates, 2015, p. 176). Such activities include, amongst others, collaborative writing, joint projects and problem-solving tasks. Environments that support cognitive development create learning environments and structures that allow students to bridge the "distance between the performance of independent learning and the potential of development with the aid of peers" (Chew et al., 2016, p. 248). In Section 3.3.1, Vygotsky's cognitive development theory, as described by Langford (2005) and Zavershneva and van der Veer (2017) is discussed. Section 3.3.2 focuses on the zone of proximal development (ZPD) (as described by Warford (2011)), and on its importance for collaborative and scaffolded learning. The ZPD posits that students' problem-solving skills will enhance through collaboration with more capable peers, rather than them relying on their own abilities (Kuo et al., 2017). Embedded in collaborative learning are the CCFOs of identifying problems; doing effective teamwork; organising, collecting, analysing

and critically evaluating information; effective formal and informal communication using science and technology; and contributing to the body of knowledge through demonstration and argumentation. In Section 3.3.2.1, CCFOs are described as measurable outcomes that can be used to determine whether learning took place in a collaborative learning environment.

3.3.1 Vygotsky's cognitive development theory

The roots of collaborative learning can be found in Vygotsky's cognitive development theory (Langford, 2005; Zavershneva & van der Veer, 2017). Key to collaborative learning is Vygotsky's notion that social interaction is fundamental to cognitive development, and the belief that learning is fundamentally a holistic approach, rather than the traditional process of the teacher initiating, the student responding, and the teacher evaluating (Wass et al., 2011; Zavershneva & van der Veer, 2017). Vygotsky's theory comprises concepts such as culture-specific tools, language and thought interdependence, and the ZPD (Warford, 2011; Zavershneva & van der Veer, 2017).

3.3.2 Zone of proximal development

The ZPD refers to a range of tasks that are too difficult for individual participants to complete on their own, but which they should be able to master within a bigger group in which one (or more) of the participants/members is more skilled. Figure 3.6 depicts the participant (or student) in the inner circle, who is capable of solving a problem or completing a task on his/her own, which is scaffolded to the outer circle, where the requirements of the task are beyond the capabilities of the participant, even with the assistance of a more skilled participant.

Within this inner circle, an individual is likely to draw on previous experience or academic skills, and to use the available resources as well as the experience and skills of more skilled participants. Between these two circles lies the ZPD, within a community of practice, as the student is learning and making meaning through

the process of sharing perspectives (Kuo et al., 2017). In a CSCL environment, the actions required for a student to complete a task or solve a problem using the community of practice, will be realised by using information and communication technology (ICT) and online platforms (McLeod, 2018). To measure whether goals have been reached and learning took place, CCFOs (discussed in Section 3.3.2.1) can be used.

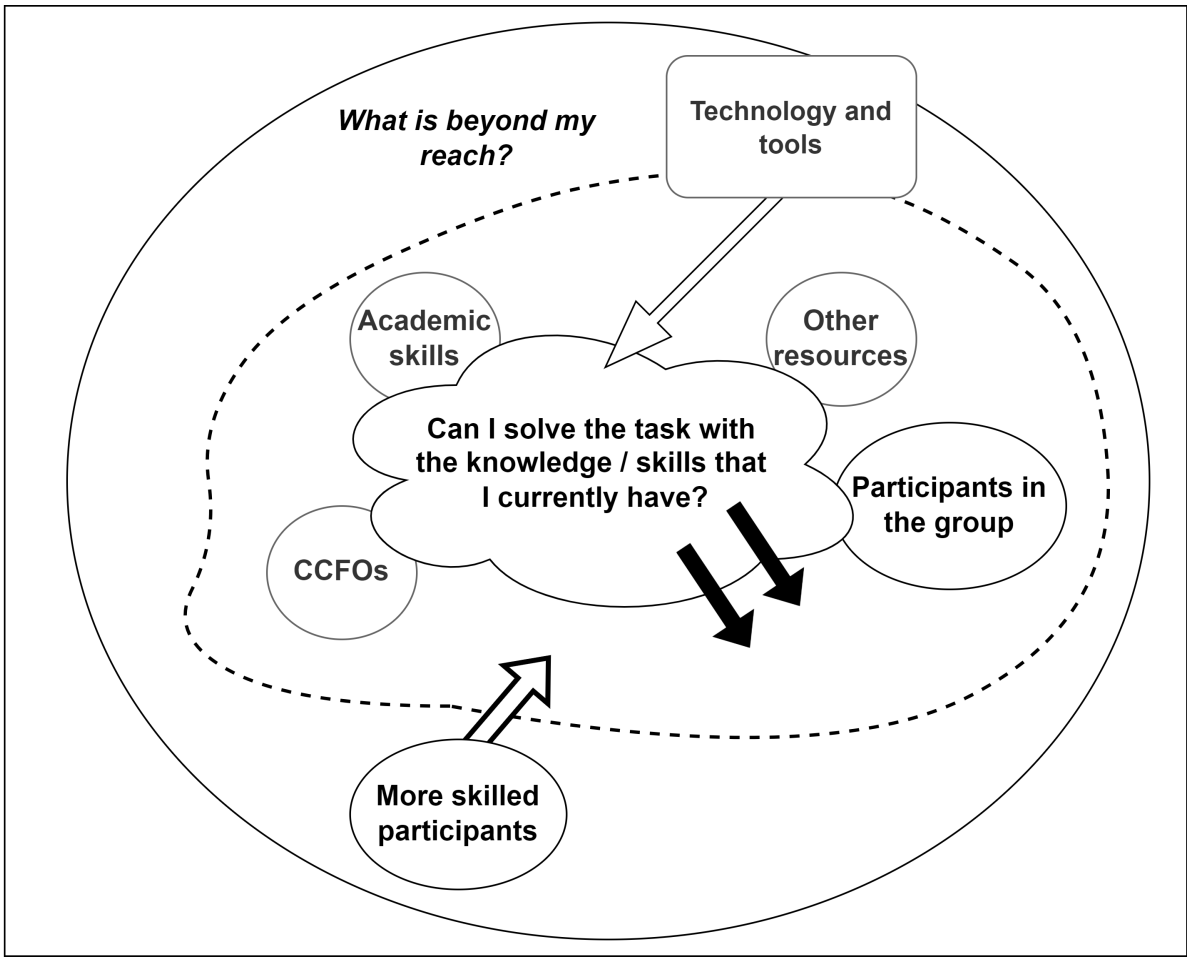


Figure 3.6: Vygotsky's zone of proximal development (adapted from McLeod (2018))

3.3.2.1 Critical cross-field outcomes

CCFOs describe those measurable statements that can be used to determine whether goals have been reached as a result of the learning that took place (Van

Staden, 2016). (See Table 3.1 for a list of CCFOs, as defined by SAQA[1] and a short description of each outcome.)

Table 3.1: SAQA critical cross-field outcomes

CCFO	Description
1. Identifying	Identify and solve problems: done by using context to decode and make meaning individually and in groups in oral, reading and written activities
2. Working	Work effectively with others in a team: done by using interactive speech in activities, discussions and research projects
3. Organising	Organise and manage oneself and one's activities: done by responsibly and effectively by using language
4. Collecting	Collect, analyse, organise and critically evaluate information: this is fundamental to the process of developing language capability across language applications and fields of study
5. Communication	Communicate effectively: done by using visual, mathematical, and/or language skills in formal and informal communications
6. Science	Use science and technology effectively and critically: done by using technology to access and present texts
7. Demonstration	Understand the world as a set of interrelated parts of a system: done by using language to explore and express links and exploring a global range of contexts and texts
8. Contributing	Contribute to the full development of self: done by engaging with texts that stimulate awareness and development of life skills and the learning process.

Examples using CCFOs, include working effectively with others as a member of a team, and/or collecting, analysing, organising and critically evaluating information. Although CCFOs are not specifically developed to measure argumentation skills development in a scaffolded learning environment, the outcomes are relevant, since they include the identification and solving of problems by working effectively in teams, and the use of argumentation skills through collecting, analysing, organising and critically evaluating information. Group work and communication using science and technology form part of the CCFOs, in addition to contributing to the body of knowledge through communication and demonstration.

[1] https://www.saqa.org.za/

In Section 3.4, pedagogical approaches that augment ASD in a collaborative learning environment to support the ZPD (Langford, 2005; Zavershneva & van der Veer, 2017) are discussed. This is followed by the unpacking of the scaffolded learning approach in Section 3.4.1.1, and a description of the five-stage model of Salmon (2013). For a structure that can be applied in assessment in a collaborative scaffolded teaching and learning environment, Bloom's revised taxonomy (Anderson & Krathwohl, 2001) is presented in Section 3.4.1.2.

3.4 PEDAGOGICAL APPROACHES AUGMENTING ASD USING CSCL

Bitchener (2017) notes that for students to augment their argumentation skills, collaboration is required, in addition to space where they can demonstrate the development of their argumentation skills in a scaffolded approach through practice, training and the presentation of their arguments. Various researchers emphasise that students will benefit from using CSCL environments, when scaffolded approaches are implemented to stimulate higher cognitive thinking (Maor & Currie, 2017; Pifarre & Cobos, 2010; Stahl, 2015; Strang, 2016). From a pedagogical perspective, it is important to look at existing literature that supports the use of CSCL environments in the learning management systems (LMSs) of higher education institutions, where the aim is to augment the development of argumentation skills. Gašević et al. (2019) report that the networking and social interaction among the participants, as well as the topics discussed, should be monitored to ensure that optimal learning takes place. Kwet and Prinsloo (2020, p. 13) warn that the technology applied in CSCL should be constructive, rather than resorting to "surveillance and control", which will infringe on the privacy of the students.

Table 3.2 presents extracts from studies reporting on the implementation of scaffolded learning in higher education to augment critical thinking and argumentation skills, using CSCL. The first column reports on aspects identified

in the literature that support ASD. This includes developing the vocabulary of argumentation (Liu & Lan, 2016; Liu et al., 2016), developing argumentation skills whilst working in groups (Chew et al., 2016; Eustace, 2013), socially oriented activities to allow for the augmentation of ASD (Eustace, 2013; Huang, 2018), and gradually moving to higher-order thinking and reflecting skills (Huang, 2011; Kuo et al., 2017; Wass et al., 2011). The CSCL infrastructures identified in the literature, that can be used to support the aspects identified in ASD, are listed in the third column.

The last column lists the e-tivities identified using CSCL in the studies, with "e-tivities" referring to a framework for "active and interactive online learning by individuals and groups" (Salmon, 2013, p. 1). The elements identified in these studies include the development of argumentation vocabulary through scaffolded learning and e-tivities that encompass the sharing of work using online tools, such as Google Docs and wikis (Liu & Lan, 2016; Liu et al., 2016). The augmenting of argumentation skills in groups is supported in all of the cited studies, with specific reference to peer assessment and peer tutoring (Chew et al., 2016; Eustace, 2013; Liu et al., 2016). The CSCL infrastructure has to cater for a diverse learning environment that should include scaffolded activities, peer assessment and tutoring, the promotion of online dialogue, student-centred pedagogy and a diverse learning environment. Using CSCL for autonomous and online assessment, the socio-cultural factors and individual characteristics of the student should be considered, as well as online space for dialogue and collaborative tools.

Regarding critical thinking and reflection skills, the use of interactive online space for dialogue is required in the CSCL environment. As reported, students should be trained on how to use technology and e-tivities such as icebreakers, and case-based and real-life exercises (Huang, 2011; Kuo et al., 2017; Wass et al., 2011).

Table 3.2: Extract of studies implementing scaffolded learning using CSCL

Aspects of ASD	**References**	**Infrastructures identified in CSCL to support ASD**	**E-tivities identified using CSCL**
Argumentation vocabulary gain	Liu & Lan (2016) Liu et al. (2016)	Gradual release of activities (scaffolded)	Sharing of work using online tools (e.g. Google Docs, wikis)
Development of an argument in groups	Eustace (2013) Chew et al. (2016) Liu et al. (2016)	Peer assessment Online dialogue Peer tutoring Student-centered pedagogy Diverse learning environment	Group activities which support the augmentation of ASD Peer assessment using CSCL
Socially oriented activities to augment ASD: articulate and communicate a well-formulated argument	Eustace (2013) Huang (2018)	Online assessment Provide for socio-cultural factors, individual characteristics of the student, autonomous learning	e-Portfolios Scaffolded learning integrated using CSCL Synchronous CSCL
Critical thinking and reflecting skills: higher-order thinking	Kuo et al. (2017) Wass et al. (2011) Huang (2011)	Interactive online space for dialogue Collaborative tools	Activities to train students who are not ICT literate Students take responsibility for own and peer work Scaffolded activities (ZPD applied): use small icebreaker activities, prior skills, factual knowledge and background, case-based and real-life experience exercises Activities included in the formal learning journey: formal start - topic discussion and research discussion, exploration - reading, field trips, discussion - in smaller groups and the larger group, conclusion - make a final conclusion and review

Specific to scaffolded learning, examples of e-tivities suggested in the literature include the use of small ice-breaker activities and taking into account the prior skills and factual knowledge required, before commencing with the actual learning journey (Huang, 2011; Kuo et al., 2017; Wass et al., 2011). Activities which form part of the formal learning journey should follow a structured format, including e-tivities with a formal start where the topic is introduced, an exploration of the topic is done through reading, a discussion takes place in small and large groups, and finally an e-tivity is undertaken in which the student can present a conclusion and review the contributions of others.

In Section 3.4.1, scaffolded learning in online learning environments is discussed. Section 3.4.1.1 focuses on the key concepts of the five-stage scaffolded model, as described by Salmon (2013), which can be implemented using CSCL. In Section 3.4.1.2, Bloom's revised taxonomy descriptors (Anderson & Krathwohl, 2001) are presented and used to describe the scaffolded levels of thinking (Oh & Kim, 2016).

3.4.1 Scaffolded learning in online learning environments

A scaffolded learning approach allows a student to gradually progress from receiving assistance to complete a task, to a state where s/he can solve the task with knowledge and skills acquired during the learning process. This implies that the student can contribute to the discussions (indicated by the two black arrows in Figure 3.6) until s/he becomes one of the more skilled participants, and can make a contribution by assisting others. In this learning journey, elements of the educational experience, such as social, cognitive and teaching presence, are addressed (Garrison & Arbaugh, 2007; Garrison et al., 2010). In the literature, a revised version of Bloom's taxonomy (Anderson & Krathwohl, 2001) is employed to describe the learning behaviour of a student, and his/her increased cognitive skills as the learning journey unfolds. While Bloom's taxonomy provides descriptors, Andrew and Arnold (2011); Gregory and Salmon (2013); Yeh (2010); Zhao and Jiang (2010)

applied the constructivist design approach suggested by Salmon (2003; see also Salmon & Wright, 2014), to provide structure using CSCL for a scaffolded learning journey. The scaffolded learning journey which Salmon refers to as the five-stage approach, is discussed in greater depth in Section 3.4.1.1, followed by an overview of Bloom's taxonomy, as a scaffolded approach, in Section 3.4.1.2.

3.4.1.1 Unpacking the scaffolded learning approach

An exploration of the grounded five-stage model developed by Salmon (2013), reveals key concepts that can be used in the development of CSCL environments that are both student-centred and facilitate quality digital learning. Figure 3.7 provides a diagrammatic representation of the model.

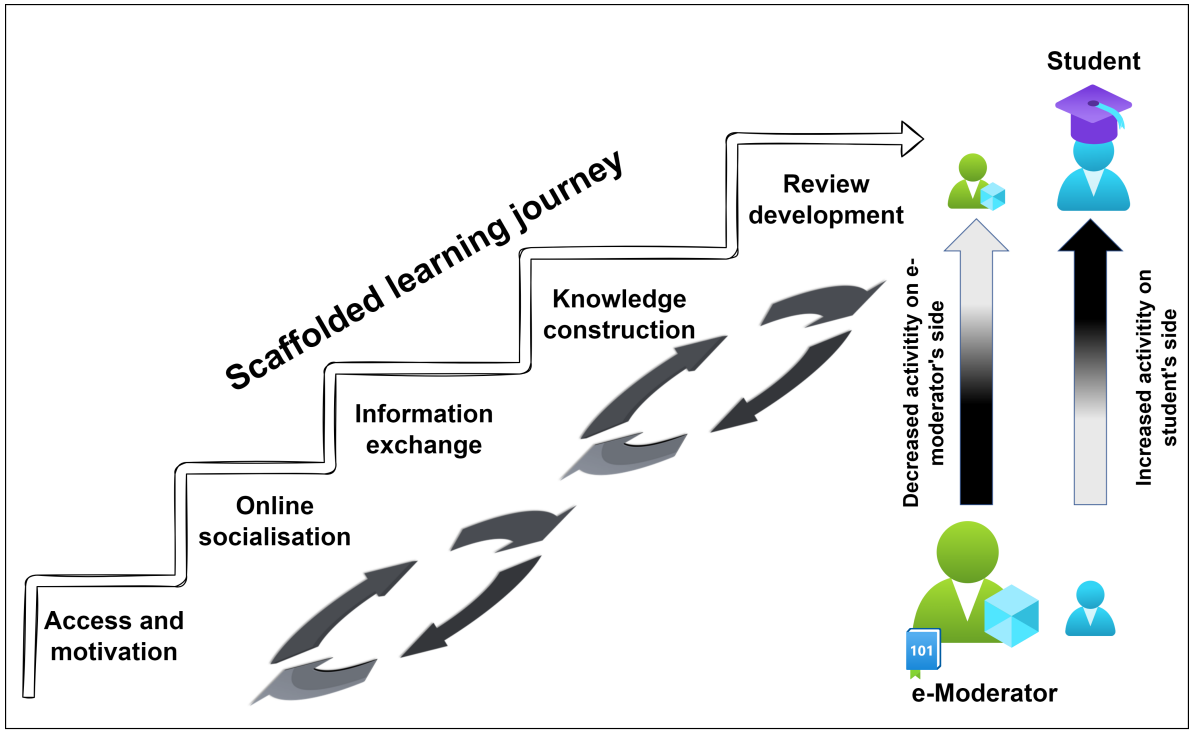


Figure 3.7: Model of teaching and learning online (Salmon, 2003, p.10)

In a scaffolded learning environment, the supervisor as an e-moderator facilitates the processes and engages the participants in discussions. Here, the role of the e-moderator is pivotal for effective discourse to unfold. S/he guides the student through the different stages, providing the pedagogy at each stage. The technical

support across all the stages is provided by ICT, however, it is important that the e-moderator be aware of the technical aspects, and understand the affordances available using the CSCL. The role of the student is to accept and engage with the tasks and challenges in the different stages, by actively participating in collaborative discussions, posts and academic writing assignments.

The structured learning scaffold offers essential support and development to students at each stage, as they gain expertise in learning online. This is done by designing and developing concrete e-tivities in each stage of the model. Through carefully constructed e-tivities, the student starts taking responsibility for learning, by working more collaboratively from an early point in the scaffolding model. Furthermore, well-structured, paced and carefully constructed e-tivities reduce the amount of e-moderator time required, and directly affect satisfactory learning outcomes and CCFOs, adding value to the experiences of the student (Salmon, 2013).

Each stage comprises three components: (i) the pedagogy/learning journey, (ii) the e-moderating component that refers to the educator (the supervisor, in this study) who works with the graduate student in this environment, and (iii) ICT technical support. Each stage in the model builds on the preceding, and each stage requires the student to master certain skills. During each stage, different e-moderating skills are at play, as depicted in the two bars on the right of the model (see Figure 3.7). The arrow on the left shows decreasing activity on the part of the e-moderator, and the arrow on the right, increased activity on the part of the student, as s/he progresses along the scaffolded learning journey. During stages one and two, the students are orientated and introduced, and online socialisation occurs, including getting to know the CSCL environment. In terms of productive and constructive learning, stages three to five (information exchange, knowledge construction, and review and development) are deemed the most important. During the last three stages, there is more interaction and discussion amongst the students. During the review and development stage, students may return to more individual pursuits, and

apply the skills gathered during earlier stages in their own work. From stages three to five, the role of the e-moderator changes from facilitating and supporting (i.e., proactively providing support) to providing support only when requested to do so.

Depending on the learning journey for a specific course, the stages within the five-stage model (Salmon, 2013) can be repeated. The depth and complexity of each stage will also depend on the course outcomes and the progress of the students. Also, the five-stage model, in its entirety, can be repeated with a view to achieving specific learning outcomes. As the learning journey progresses, confidence is built. Once students start becoming familiar with the process in stages one and two, access, motivation and online socialisation will merge. As is the case with earlier phases of the learning journey, the final stages of the five-stage model (Salmon, 2013) may not all be reached. Not reaching the final stages does not mean that the process has failed, but rather reflects on the depth and complexity of the course outcomes.

During the first stage, *access and motivation*, the role of the e-moderator is to welcome the student, provide the required initial training, and explain the purpose of the CSCL. The e-moderator will outline the structure of the course or learning outcome, the expectations s/he has of the student as a participant, and the engagement required. The role of the student includes gaining access to the CSCL environment, navigating the online environment, and familiarising him/herself with the different components. Students' initial collaboration could include posting a message to introduce themselves to the group.

During stage two, *online socialisation*, students should be encouraged to start working with the different online socialisation tools available in the CSCL. This includes becoming familiar with the resources in the CSCL environment, such as sending posts, accessing applicable software, registering for relevant sites, viewing appropriate multimedia, and engaging with peers. The role of the e-moderator is

to encourage the student, and determine whether there are any resources that the student is not comfortable using. This can be accomplished by the e-moderator facilitating the process and monitoring the student, while the latter completes a smaller and more manageable task. The role of the student will be to engage in the tasks and identify areas with which s/he is not comfortable.

It is the responsibility of the e-moderator during the third stage, *information exchange*, to ensure that the students actively participate, and that the CSCL is set up to encourage collaboration. The tasks should guide and motivate the student to participate in the activities provided, and, in turn, the student should start to exchange information with his/her or her peers.

During the *knowledge construction* stage, the role of the e-moderator becomes less that of an “instructor” and more that of a facilitator to the cohort of students. The student should now contribute actively to the group by providing information, posting new threads in the posts, critiquing posts and adding to the body of knowledge.

During the final stage, *review and development*, students should already be familiar with using CSCL, and require less e-moderator support. Individual students, or the entire cohort, should by now be in a position to start contributing to their ongoing development, by enhancing the activities and resources. The role of the e-moderator is now less instructive and more facilitative in nature, preparing the students for evaluation. The role of the student changes from stages one to five, from being a recipient of information to becoming a contributor to the body of knowledge.

Lee et al. (2016) support the notion of a scaffolded learning journey using CSCL, as it allows the student (as a participant), the supervisor (as e-moderator) and fellow students (as peers), to offer support and transfer information in a scaffolded manner, as the levels of challenge and competence grow. In a study by Altebarmakian and Alterman (2019), it was found that working in a collaborative online environment

allowed students to collaborate at their convenience, however, the e-moderator should keep in mind that responding to discussions in a disjunctive way, will complicate engagement in in-depth discussions.

3.4.1.2 Bloom's taxonomy level descriptors

Bloom's revised taxonomy (Anderson & Krathwohl, 2001) provides descriptors that can be applied in teaching and assessment. The taxonomy, which is widely used and reported on in the literature (Bates, 2015; Krathwohl, 2002; Zainuddin & Halili, 2016), includes frameworks for collaborative learning (Serrano-Cámara et al., 2012) and for developing critical thinking skills in higher education (Daud, 2012).

Figure 3.8 illustrates the seven scaffolded level descriptors, with several of the verbs used to describe each level. The levels identified in the taxonomy assist in the development of learning outcomes. The level descriptors facilitate a scaffolded approach to the student's cognitive learning journey, and are identified as *remembering* and applying prior knowledge from long-term memory, *understanding* by demonstrating comprehension through explanation, *applying* by using the information or skill in a new situation, *analysing* the relationship between parts and relating how the parts constitute to the overall structure, validating and *evaluating* based on criteria and standards and, finally, contributing to the body of knowledge (*creating*) (see Anderson & Krathwohl, 2001).

In Section 3.3, collaborative learning was considered from the perspective of cognitive development theory and the ZPD. In Section 3.4, the pedagogical approaches that can be applied using CSCL to augment ASD, were discussed. In Section 3.5, the role of the student in the collaborative learning environment is presented from the perspectives of the social, cognitive and teaching presences, respectively.

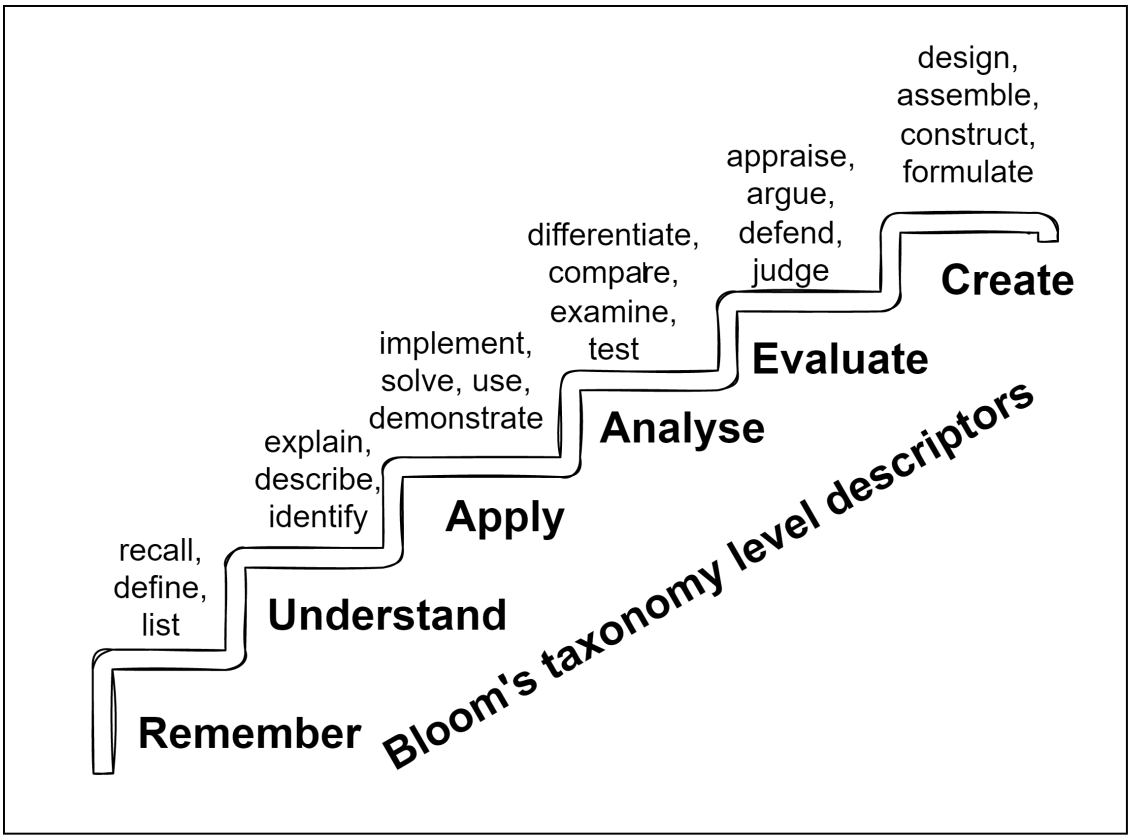


Figure 3.8: Bloom's revised taxonomy descriptors (Anderson & Krathwohl, 2001)

3.5 THE GRADUATE STUDENT IN A COLLABORATIVE LEARNING ENVIRONMENT

Creating collaborative learning environments on computer-supported platforms in higher education for graduate students, in an ODeL environment, requires unique skills from both the e-moderator and the graduate student (Swan & Shih, 2019). In Section 3.5.1, the requirements for a meaningful educational experience in collaborative learning are discussed.

3.5.1 Requirements for meaningful collaborative learning

In as early as 1990, Johnson et al. (1990) identified the five elements – which are still relevant today – that are required in collaborative learning, as seen from the perspective of the social and cognitive presence of the student. In this instance, cognitive presence is taken to refer to the extent to which a student is able to

construct meaning through sustained reflection and discourse (Garrison et al., 1999), while social presence pertains to the student's personal characteristics that s/he projects through emotional expression, "open communication" and "group cohesion" (Garrison et al., 2010, p. 7).

The five elements, as identified by Johnson et al. (1990), that are required in collaborative learning are:

1. Positive interdependence, as participants are obliged to rely on one another to achieve set goals (social presence)
2. Considerable interaction, as participants encourage one another by sharing knowledge through feedback, discussion, reasoning and academic argumentation (social and cognitive presence)
3. Individual accountability, as participants are held accountable for delivering their share of the work (social presence)
4. Interpersonal and social skills, as participants have to develop skills in practising trust-building, communication and conflict management (social presence)
5. Group processing and evaluation, as participants have to set goals and periodically do self- and group assessment, thereby identifying changes and implementing strategies to work more productively in the future (cognitive presence).

In a study by Swan and Shih (2019), the presence of the e-moderator, the course design and the students are identified as being of importance. This need to be fostered through not only the presence of the e-moderator, but also through explicit training for the students on social presence. Here, social presence refers to the ability of the students to identify with the group as a community, to purposefully

communicate and develop academic relationships within the group, and in turn, to develop their own personalities (Akyol et al., 2009).

In addition to the elements identified by Johnson et al. (1990), Anderson et al. (2001, p. 5) describe the element of teaching presence as “the design, facilitation and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes”. Annand (2011) further describes teaching presence as having an indirect effect on cognitive presence through its effect on social presence.

In summary, to create a collaborative learning environment that contributes to a meaningful educational experience, the teaching, cognitive and social presences should be considered. Furthermore, to establish a collaborative learning environment in ODeL that supports pedagogical approaches using CSCL to augment ASD, infrastructural requirements should be taken into account. In Section 3.6, these requirements are discussed from three viewpoints: Section 3.6.1 focuses on the institutional resources for collaborative learning, Section 3.6.2 on the external resources that support the use of CSCL, and Section 3.6.3 on the e-moderator as a supervisor and resource.

3.6 INFRASTRUCTURAL REQUIREMENTS

Infrastructural requirements include the resources that are required to use CSCL in ODeL. These are identified as (1) institutional, (2) external and (3) human supervision resources, which students can access and make use of, as part of the learning community.

From an institutional resource perspective, the LMS is presented in Section 3.6.1 as the centre of the educational experience in a CSCL environment. Important are the technological affordances of using CSCL, which are presented in Section 3.6.1.1

from the perspective of human-centred design (HCD). The external resources supporting CSCL are presented in Section 3.6.2 and in Section 3.6.3, supervision as a resource is discussed.

3.6.1 Institutional resources for collaborative learning

Institutional resources include access to those resources that the university provides to students as part of their enrolment. Included are the university's online library, its reference management software, statistical analysis software, webinars, and academic integrity and similarity tools, to name a few. Since these resources are part of the institution, governance thereof is the responsibility of the university, which provides training and support to both the e-moderator and the student.

In ODeL, information technology platforms provide the infrastructure in CSCL for the development of an online learning community. The LMS supplies the technological infrastructure for CSCL resources and includes, among others, the structure for the learning path, e-tivities, assessment and learning approach (Rubin et al., 2013; Zanjani et al., 2017). Figure 3.9 is a diagrammatic presentation depicting the LMS as the centre that provides the technology for the educational experience in a CSCL environment, where that experience can be described in terms of the cognitive, teaching and social presences of the student, within the learning environment (Garrison & Arbaugh, 2007).

3.6.1.1 Technology affordances using CSCL

Gibson (1979) coined the term "affordance", which refers to all the action possibilities of an object, depending on the user's capabilities. Norman (2002) elaborates on those affordances by including the *perceivable* action possibilities which come with using technology. Norman (2013) adds that affordances can be described from the perspective of HCD, where such an approach not only considers the technological aspects that CSCL can provide, but also primarily takes into account

the human requirements, such as human needs, capabilities and behaviours, prior to considering the technological aspects.

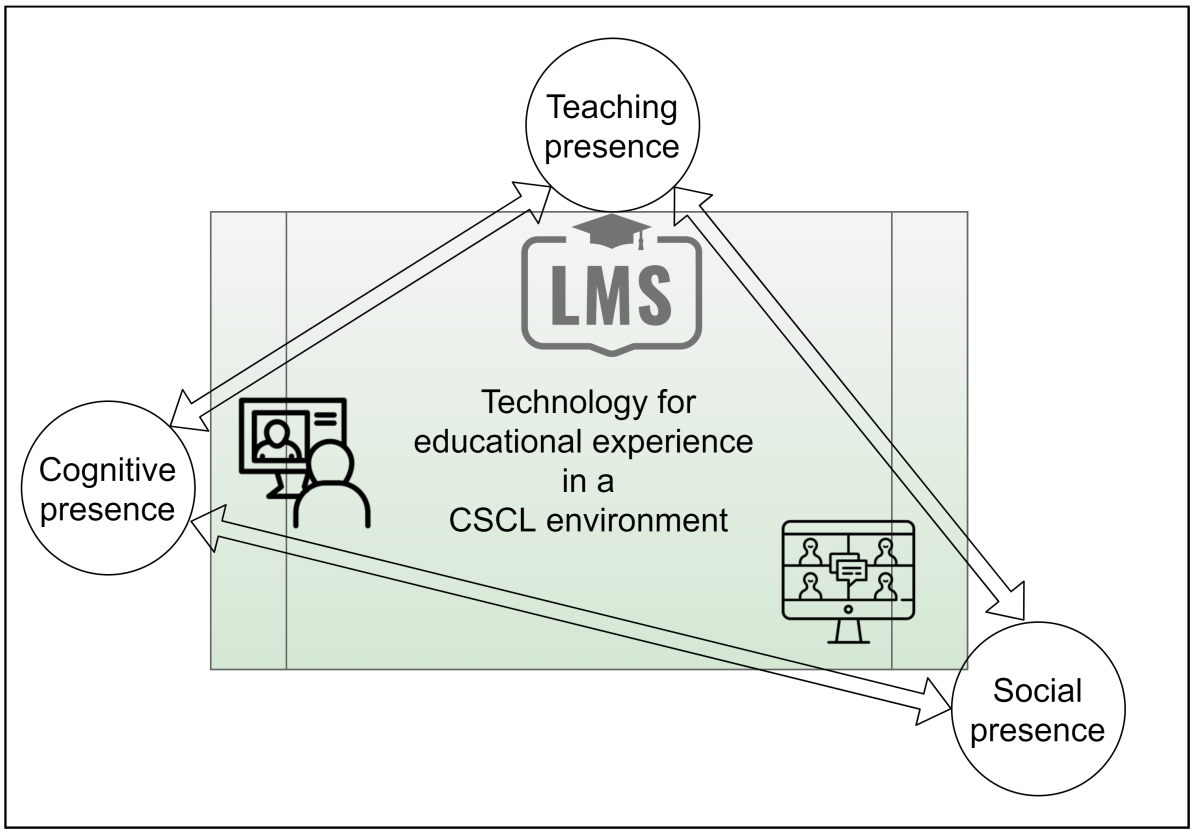


Figure 3.9: Technology providing infrastructure in CSCL

While individual and collaborative learning share general principles and mechanisms, the affordances required in collaborative learning are unique (Jeong & Hmelo-Silver, 2016; Suthers, 2006). In this study, affordances are expressed from the perspective of practical HCD, as described by Gibson (1979), as the action possibilities of an object, based on the user's physical capabilities and in turn, incorporating the description by Norman (2013, p. 8) that HCD as a solution where "human needs, capabilities and behaviour are put first, then the technology designs are done to accommodate those needs, capabilities and ways to behave". In this context, using CSCL, affordances are key to usability, where the user maps the possibility of the object according to his/her conceptual model of what the object should be able to do.

Suthers (2006), and Jeong and Hmelo-Silver (2016), propose CSCL affordances that will grant students opportunities to (1) engage in learning through joint tasks, (2) communicate, (3) share resources, (4) participate in collaborative learning processes, (5) undertake co-construction, (6) monitor collaborative learning, and (7) build groups and communities. As Jeong et al. (2019, p. 3) report, the ability to take advantage of the affordances of technology "critically depends on the pedagogy", in providing students with a structure to collaborate, using CSCL. In their meta-analysis synthesised research, Chen et al. (2018) found that using CSCL offers a favourable environment for facilitating collaborative learning which envisages knowledge gain, and the acquisition of skills through collaboration with peers (something which may not have been possible when solving problems in isolation). In addition, Chen et al. (2018) report that studies are shifting from examining *whether* using CSCL is effective, to *how* the affordances that technology provides, can be used to improve the use of CSCL to address more complex pedagogical approaches – as is the case in this study, augmenting the development of argumentation skills, by means of CSCL.

3.6.2 External resources supporting CSCL

The use of external resources, in this instance, includes the adoption of cloud computing services which encompass open educational resources (OERs), massive open online courses (MOOCs), and open data resources (Arinto, 2013). External resources may also include popular multimedia platforms for communication and collaboration, such as WhatsApp, Facebook, Instagram and others (Manca, 2020; Veytia-Bucheli et al., 2020). Notably, the inclusion of these resources is often left to the judgement of the e-moderator (Jung & Lee, 2020). Access to external resources is largely dependent on accessibility and availability, and in some instances are mobile device-dependent. Furthermore, a need for policies to govern privacy, security and ethics, along with cost and scalability, are important factors to consider

(Van der Merwe & Van Biljon, 2018) before adopting external resources as part of the curriculum (Eneje, 2020). In this regard, further research is required into the affordances of external resources.

3.6.3 Supervision resources

An e-moderator is appointed by a department within the university as a supervisor for students enrolled in the honours research course. The role of the e-moderator differs from that of a traditional face-to-face supervisor, in that s/he has to deal not only with a student studying in an online environment, but also has to manage challenges related to technological infrastructure and the availability of resources when "working from home" (Pollard & Kumar, 2021). From a graduate student's perspective, the e-moderator has to deal with the former's pedagogical expectations, while adopting his/her supervisory methods to adjust to the infrastructure using CSCL (Charoensukmongkol & Phungsoonthorn, 2021).

In higher education contexts, many of the collaborative platforms which students use to engage with their peers and supervisors are technology-enabled, and constitute a complex mix of interrelated processes and systems that include, among others, online discussion forums, instant messaging applications, assessment platforms and various institutional resources (Gašević et al., 2019; Hmelo-Silver & Jeong, 2021; Sun et al., 2018; Tsai & Tsai, 2014; Vasquez-Colina et al., 2017). As Fatimah et al. (2021) emphasise, from a courseware developer's perspective, course requirements should take cognisance of the available technology, and provide guidance on the integration of the courseware and technology using CSCL.

A unique benefit of CSCL is that, given proper facilitation (Ma, 2013), users can employ technology to build learning foundations with their peers (Prapinpongsakom et al., 2017). This allows for an escalation of the difficulty level of the tasks presented,

and permits the e-moderator to make informed decisions about the extent of the scaffolding required (Kilis & Yıldırım, 2018).

In sections 3.2 - 3.6 the themes identified in Section 2.3 were discussed. This includes the topics of ASD, collaborative learning, pedagogical approaches using CSCL to augment ASD, the graduate student in a collaborative learning environment, and infrastructural requirements based on the resources available. Although CSCL holds promise for enhancing collaborative education, it is not without its challenges: Section 3.7 highlights the barriers encountered in using CSCL in ODeL from both a theoretical and a practical perspective.

3.7 BARRIERS IN USING CSCL IN ODeL

CSCL has been studied and reported on from various angles, from a pedagogical perspective on the roots of CSCL integration (Koschmann, 1996) to interdisciplinarity in CSCL (Hmelo-Silver & Jeong, 2021). Others have studied CSCL from a pragmatic approach, using it as a platform for teaching online (Singh & Thurman, 2019). In recent studies, the socio-cultural and cognitive perspectives of using CSCL have received renewed attention (Dado & Bodemer, 2017; Fatimah et al., 2021; Gašević et al., 2019). In a meta-analysis undertaken by Chen et al. (2018), the researchers note that integration in CSCL practices is required to support the range of affordances available using CSCL. Furthermore, researchers warn that using CSCL as a platform for augmenting ASD in ODeL will lose its effectiveness if it is done without a proper methodology and guidelines (Arbaugh, 2019; Damm, 2016; Manyike, 2017; Maor & Currie, 2017; Rolim et al., 2019; Rueter et al., 2019; Sutton, 2017). In what follows, the barriers to using CSCL are considered – in Section 3.7.1 from a theoretical perspective, and in Section 3.7.2 from a practical perspective.

3.7.1 Using CSCL barriers from a theoretical perspective

Theoretically speaking, CSCL emerged from the interdisciplinary fields of collaborative learning, technology in the form of computational objects (Hmelo-Silver & Jeong, 2021) and the social interactions made possible via social media (Stahl, 2015). In ODeL, CSCL allows for engagement amongst students around the world, meaning the "classroom" is no longer bounded by space and time (Brady et al., 2010; Gill et al., 2020). Interaction and collaboration using CSCL are made possible courtesy of a range of available computational artefacts, online tools, online social interactions and technologies (Hmelo-Silver & Jeong, 2021).

Some have warned that the interaction between the technology, pedagogy and socio-cultural sides of CSCL, can cause tension and conflict (Hmelo-Silver & Jeong, 2021). While educators and courseware developers see CSCL as the new way of promoting learning, technological readiness is not always adequate on either the institutional or the student side - that includes psychological readiness, the requisite technology-related skills, and access to technology (Khalifeh et al., 2020). Similarly, socio-cultural aspects and challenges tend not to be addressed in the pedagogy that makes use of CSCL, nor are courseware developers always aware of the socio-cultural norms and standards involved (Hung, 2016; Montebello, 2017; Prasad et al., 2018).

3.7.2 Using CSCL barriers from a practical perspective

From a practical perspective, it is vital to address access to CSCL technologies, and the lack of methodologies and frameworks that the educator can implement in an CSCL environment (Bates, 2015; Paul et al., 2015; Strijbos et al., 2006). The barriers identified in the literature include socially related barriers, and those related to language and digital literacy, as some students who are already comfortable with online communication often choose to interact casually, while others may find the interaction with CSCL problematic due to cultural differences (Fatimah et al., 2021; Khine & Santos, 2014). E-moderators should pay special attention to making

students aware of their expectations for formality online, and establish a space for an emerging synergy (Vasquez-Colina et al., 2017). While some students have frames of reference for online communication, many do not have the necessary skills to solve problems by themselves. Furthermore, the availability of technology and diverse platforms does not automatically mean a successful CSCL environment has been created (Czerniewicz et al., 2020; Kirschner & Erkens, 2013; Wright, 2015; Zhu et al., 2009).

In summary, the barriers encountered in using CSCL in practice can be classified as a lack of methodologies and frameworks that will guide the e-moderator and courseware developer to:

1. identify CSCL affordances that will support collaborative learning in ODeL,
2. build a scaffolded learning journey to support the pedagogy, and the academic and cognitive development of the graduate student, and
3. address challenges related to socio-cultural, language and technology skills.

3.8 SUMMARY

This chapter reported on the themes identified in Section 2.3, which aided in answering the first three research sub-questions. Table 3.3 offered a conceptual representation of the themes identified in Section 2.3 (and elaborated on in sections 3.2 - 3.7). The sections to which the themes relate in the chapter are indicated in brackets, while the clustering indicates where the first three research sub-questions were addressed in the chapter.

RSQ1: *What trends, drivers and barriers influence the use of CSCL in ODeL?*

RSQ1 was answered in Section 3.3 with the discussion of collaborative learning maturity and in Section 3.7, the barriers in using CSCL in ODeL were discussed from a theoretical and a practical perspective.

In Section 3.3, CSCL maturity was discussed, focusing on Vygotsky's cognitive development theory (Section 3.3.1) and the ZPD (Section 3.3.2). In discussing the significance of the ZPD, the CCFOs as defined by SAQA were presented. In discussing the ZPD, the pedagogical approach of collaboration was addressed. Table 3.2 provides a summary of selected literature that identifies the elements of ASD, the CSCL infrastructure required to support the ASD, and the e-tivities that can be used when implementing CSCL. These e-tivities – as identified in the literature – can be used as minimum requirements in identifying which e-tivities are applicable in the ASDF.

In presenting an overview of Section 3.7, the barriers can be summarised as a lack of methodologies and frameworks to guide the e-moderator and courseware developer with respect to (1) identifying CSCL affordances that will support collaborative learning in ODeL, (2) providing infrastructure to build a scaffolded learning journey for the graduate student, and (3) addressing challenges (related to socio-cultural, language and technology-based literacy skills).

RSQ2: *What methodologies and frameworks exist that support argumentation skills development using CSCL in ODeL?*

RSQ2 was answered in sections 3.2 and 3.4 respectively, by discussing the pedagogical approaches which make use of CSCL to augment ASD. Table 3.2 offers an extract from studies that report on implementing scaffolded learning in higher education to augment critical thinking and argumentation skills, using CSCL.

The table lists research that addresses ASD and the infrastructure identified in that research, that supports ASD. Also, the e-tivities using CSCL are listed there.

In Section 3.2, ASD was described from the viewpoint that the development and presentation of an argument are fundamental to learning. Furthermore, in higher education, the presentation of a formal argument is deemed core to learning, and it may take time to develop and present a sound argument, even more so in graduate studies in ODeL. To complement the research, four argumentation models were discussed, namely the ADI instructional model (Sampson & Gleim, 2009), the triangle model of argumentation (Mitchell & Riddle, 2000, as cited in Andrews, 2009), Booth's core of a research model (Booth et al., 2015) and the seminal argumentation model of Toulmin (2003). For practical implementation in this study, the argumentation model presented by Toulmin (2003) was followed to augment the ASD of graduate students, as it is a mature model which has been implemented in various studies.

Scaffolded learning in an online learning environment was discussed in Section 3.4.1, with a specific focus on Salmon's (2013) five-stage approach in Section 3.4.1.1 and Bloom's revised taxonomy (Anderson & Krathwohl, 2001) for level descriptors in Section 3.4.1.2. The framework and e-tivities presented by Salmon (2013) offer a useful structure for scaffolding the learning experience in an CSCL environment, while engaging in research and developing students' argumentation skills. Bloom's revised taxonomy (Anderson & Krathwohl, 2001) allows, alongside the CCFOs, for approaches that can be followed in evaluating the outcomes of the ASD.

RSQ3: *What are the key elements required of a CSCL framework that could contribute to the development of argumentation skills in a graduate course?*

RSQ3 was answered in Section 3.5, by discussing the human capacity requirements from the graduate student's perspective in a collaborative learning environment and, in Section 3.6, discussing the infrastructural requirements from the perspective

of the institution, the external resources supporting CSCL, and the supervisory requirements.

In Section 3.5, the requirements for a meaningful educational experience in collaborative learning were addressed. The educational experience was considered from the perspectives of social, cognitive and teaching presence. In Section 3.6, the infrastructural requirements along with the resources required to use CSCL in ODeL, were stipulated. These were identified as institutional, external and supervision resources, as discussed in sections 3.6.1 - 3.6.3 respectively.

In Section 3.6.1, the institutional resources for collaborative learning came under the spotlight, and they include the resources provided by the university. The LMS as core provider of technology for the educational experience was discussed (see Figure 3.9) as the pivotal point for students' educational experience when using CSCL. The technology affordances of using CSCL were discussed in Section 3.6.1.1, described from the perspective of HCD, as the affordances of CSCL not only consider technological aspects but take into account the requirements of the human, first and foremost, rather than the technological aspects.

In Section 3.6.2, the external resources which support CSCL were discussed, while Section 3.6.3 focused on supervision as a resource that employs CSCL to deal with the pedagogical expectations of the student.

In Chapter 4, the research design, methodology and methods applied in this study to address the research problem, will be discussed.

Table 3.3: Conceptually clustered matrix

RSQ1		RSQ2	RSQ3			
What trends, drivers and barriers influence using CSCL in ODeL?		*What methodologies and frameworks exist that support ASD using CSCL in ODeL?*	*What are the key elements required in a CSCL framework that could contribute to the development of argumentation skills in a graduate research course?*			
Themes identified from the literature review influence the use of CSCL in ODeL (2.3)			**Pedagogical approach for ASD**	**ODeL technology infrastructure requirements**	**Infrastructural requirements**	**Evaluation of educational experience elements**
Argumentation skills development (3.2)	ASD in higher education develops intrinsic or through course (3.2)	ADI (3.2.1.1), Triangle model (3.2.1.2), Booth's argumentation flow (3.2.1.3) Toulmin's model (3.2.1.4)	Course requirements Student as researcher (3.5)	CSCL resources (3.6.1)	Supervision requirements (3.6.3)	Evaluation of cognitive presence (Output: well-structured argument)
	Students transfer skills through collaboration and across disciplines (3.3)	Collaborative learning (3.3)	Student as a researcher (3.5)	CSCL environment and resources (3.6.2)		Evaluation of social presence
Collaborative learning (3.3)	Vygotsky's cognitive development theory (3.3.1)	ZPD (3.3.2) CCFP (3.3.2.1)	Pedagogical approach (3.4)	CSCL resources (3.3)		
Pedagogical collaborative learning approaches (3.4)	Scaffolded learning approaches in online learning environments (3.4.1)	Salmon's 5-stages approach (3.4.1.1) Bloom's taxonomy (3.4.1.2)	Pedagogical approach (3.4)	CSCL environment and resources (3.3)	Institutional resources (3.6)	Evaluation of teaching presence
Barriers in using CSCL in ODeL (3.7)						

CHAPTER 4

METHODOLOGY, RESEARCH DESIGN AND METHODS

In this chapter, the research philosophy, research design and methodology applied to address the research problem, are presented. The study adopted pragmatism as a philosophical worldview (see Section 4.1). In Section 4.2, the use of the DSR process model (Peffers et al., 2007) is discussed as an appropriate method for interrogating the problem at hand. Section 4.2.1 focuses on the research stages, as illustrated in the adapted DSR process model (Peffers et al., 2007) for the ASDF (see Figure 4.3).

There is a responsibility, on the part of the researcher, to demonstrate that the research methods applied in a study are applicable, trustworthy, reliable and valid (Creswell & Miller, 2000; Rose & Johnson, 2020). It includes acknowledging the viewpoint of the researcher, by identifying the different lenses used in the study (Creswell & Miller, 2000), and contextualising the research by describing the techniques used to ensure validity and reliability. The validity and reliability of research methods are discussed in Section 4.3, and the chapter concludes in Section 4.4 with a summary of the motivation for selecting the chosen methodology.

4.1 RESEARCH PHILOSOPHY

The study adopted pragmatism as a philosophical worldview. Pragmatism offers a factual and practical approach to solving problems, and takes the view that the most suitable research paradigms, approaches, methods and techniques are those that help to effectively answer the research question (Creswell & Plano Clark, 2017; Deng & Ji, 2018; Ormerod, 2006). Furthermore, pragmatism recognises the constructive

and indispensable roles that researchers play in the research process (Deng & Ji, 2018), offering an experience-based, action-oriented framework where the research assists in addressing issues related to how we experience the world, and come to know the world in a practical sense (Goldkuhl, 2012). Pragmatism focuses on the research questions and the consequences of research as an innovative artefact, rather than on the methods (Goldkuhl, 2004; Kaushik & Walsh, 2019). In Section 4.4, the appropriateness of adopting pragmatism as a philosophical worldview in this study comes under the spotlight.

4.2 RESEARCH DESIGN

Information Systems (IS) is seen as a multi-faceted complex discipline, and researchers apply different methods to study various phenomena in this field (Alturki et al., 2012). In keeping with pragmatism as philosophical worldview, the study presents an argument for the use of DSR as an appropriate method for addressing the problem at hand, namely "*How can CSCL environments be used to augment graduate computing students' argumentation skills development?*". The process will include the steps of problem identification, defining the objectives of the solution, designing and developing, demonstrating, evaluating the approach and communicating the process and findings (Peffers et al., 2007), as illustrated in Figure 4.1. By selecting and applying a methodology, the researcher provides structure to the process and ensures that the research will uncover knowledge and deliver answers – in line with the questions being asked – in a rigorous, systematic way.

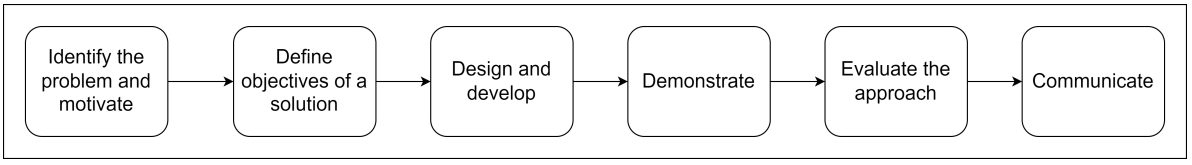


Figure 4.1: DSR steps (Peffers et al., 2007)

In IS, design – albeit implicitly being a component of the design process of IS artefacts – is in itself not considered to be the topic of study (Kuechler & Vaishnavi, 2008). The framework for IS research, as presented by Hevner et al. (2004), provides a framework for DSR in IS, with guidelines for understanding, executing and evaluating the research and emphasising relevance in the selection of an appropriate environment, designing and justifying the theories and artefacts, and ensuring rigour in adding to the knowledge base. In developing the artefact, the IS research framework associates the environment of the IS with the knowledge base of related theories and methods. In this regard, Hevner et al. (2004) present a set of guidelines for the discipline of IS, as regards the artefact created in DSR. The guidelines include:

1. **Design as an artefact**: The artefact should be viable and can be in the form of a construct, model, method or instantiation.
2. **Problem relevance**: The technology-based solution should be relevant and has to solve a business problem.
3. **Design evaluation**: The artefact should demonstrate rigorous utility, quality and efficacy.
4. **Research contributions**: These should be clear and verifiable.
5. **Research rigour**: Rigorous methods should be evident in both the construction and evaluation of the artefact.
6. **Design as a research process**: The search for an effective artefact requires the use and implementation of means that will satisfy the problem.
7. **Communication of research**: The research should be presented to the academic research audience, as well as technology and management audiences.

Following the four-cycle model as presented by Alturki et al. (2012), and elaborated on by Drechsler and Hevner (2016), the application in the appropriate environment is extended to accommodate the sociotechnical system context and the immediate

application context as part of the change and impact cycle. (For a diagram depicting the four cycles identified in the DSR, see Figure 4.2.) Adding the change and impact cycle allows for continuous evaluation of the approach, and enables the researcher to determine the long-term effects on the organisation, the environment and the society (Drechsler & Hevner, 2016). DSR provides, through the IS research framework, a structure that can be used to develop and evaluate the artefact through sound research.

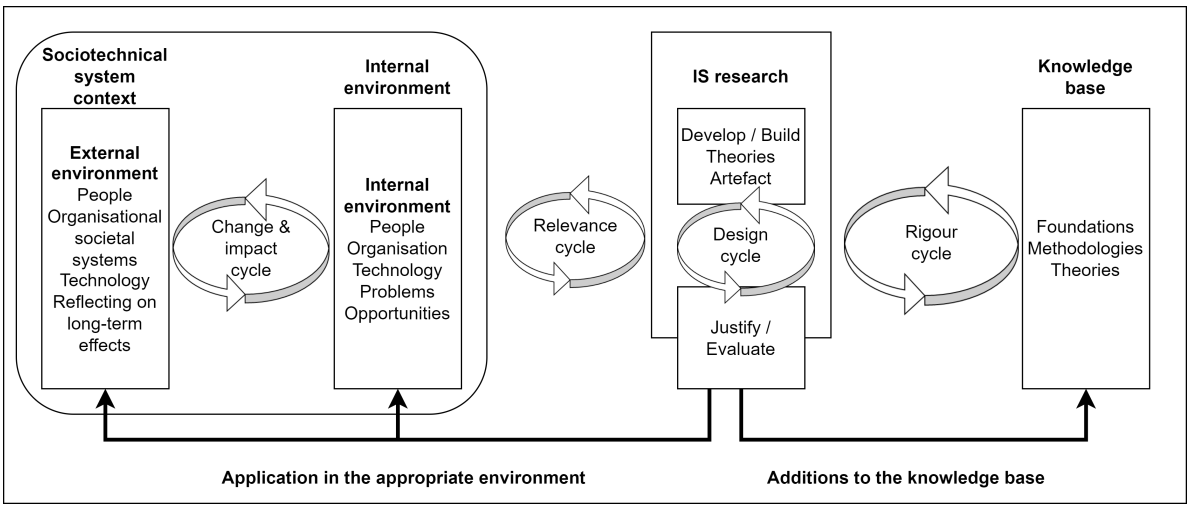


Figure 4.2: Four-cycle DSR for information systems research (Hevner et al., 2004; Drechsler et al., 2016)

The approach followed in the process allows for a recognition of the complex sociotechnical systems that exist in the organisation, that include the external and internal environments. Furthermore, the process acknowledges that the application of IS research will have an effect on the interaction between the people and the technology obtained in the organisation, in the short as well as the long term (Drechsler & Hevner, 2016). The relevance cycle allows for the bridging of the "contextual environment of the research project with the design science activities" (Hevner, 2007, p. 2). During the development and building of the theories and the artefact, the design cycle allows for iteration through justification and evaluation. In this context, design becomes both a "noun and a verb" (Gregory, 2010, p. 3), in that there is a "design process" but also a "designing of the artefact" (Hevner et al., 2004). The rigour cycle addresses the way in which the research is conducted, and

requires both rigorous methods in the design, the evaluation of the approach, and the reporting on the research to add to the body of knowledge (Dresch et al., 2015).

Following the DSR process for IS, the development of the ASDF in this study can be described as an iterative process, starting with the literature review, the IS iterative research stages were followed (designing, developing, demonstrating and evaluating, communicating the findings, and contributing to the body of knowledge). The research was conducted in two phases: a theoretical evidence-based conceptual ASDF was developed during the first phase, then presented in focus groups to expert participants in postgraduate supervision and ODeL courseware development. The input received from the focus groups was used to update the framework, and then presented in a revised ASDF. During the second phase, the revised ASDF was implemented using CSCL in a computing graduate research course. To measure the graduate students' educational experience while engaging with the activities using CSCL, an online survey was distributed to a wider research group of students enrolled in the honours course (HRCOS82). To measure the students' educational experience and perceived ASD, online focus groups were held with a smaller group of students enrolled for one of the projects (HRCOS82-P19). The input received from the focus groups and online survey was used to update and present the final ASDF. To help execute the phases following the DSR processes, more detailed activities and stages were defined (see Figure 4.3). The different stages and the process are elaborated on in Section 4.2.1.

4.2.1 IS research activities and stages

The construction and evaluation of the ASDF went through a number of stages, each of which included tasks and activities that the researcher carried out. The iterative processes in the DSR are presented as activities and stages (discussed in sections 4.2.1.1 - 4.2.1.4). This commences with the setting of the environment, by identifying the problem and motivation for the research, the literature review and the development of the conceptual ASDF (Section 4.2.1.1). In Section 4.2.1.2, stage 2 represents the demonstration and evaluation of the conceptual ASDF, followed by the implementation of the feedback from stage 2 in updating the ASDF, the implementation of the ASDF and the evaluation of the approach in stage 3 (Section 4.2.1.3). To complete the DSR process, the findings of the research are presented in articles and relevant academic publications (Section 4.2.1.4).

4.2.1.1 Setting the environment and stage 1 - design and development of a conceptual ASDF

In this study, the environment was set with the identification of the problem and the motivation to define objectives, to find a solution (described in Section 1.2). The research problem was identified as students in graduate research often experiencing problems in not being able to develop and present a well-formulated argument. The main research question was subsequently formulated as follows: "*How can CSCL environments be used to augment graduate computing students' argumentation skills development?*". To support the main research question, the research sub-questions were formulated as follows:

RSQ1: What trends, drivers and barriers influence the use of CSCL in ODeL?

RSQ2: What methodologies and frameworks exist that support argumentation skills development using CSCL in ODeL?

RSQ3: What are the key elements required of a CSCL framework that could contribute to the development of argumentation skills in a graduate course?

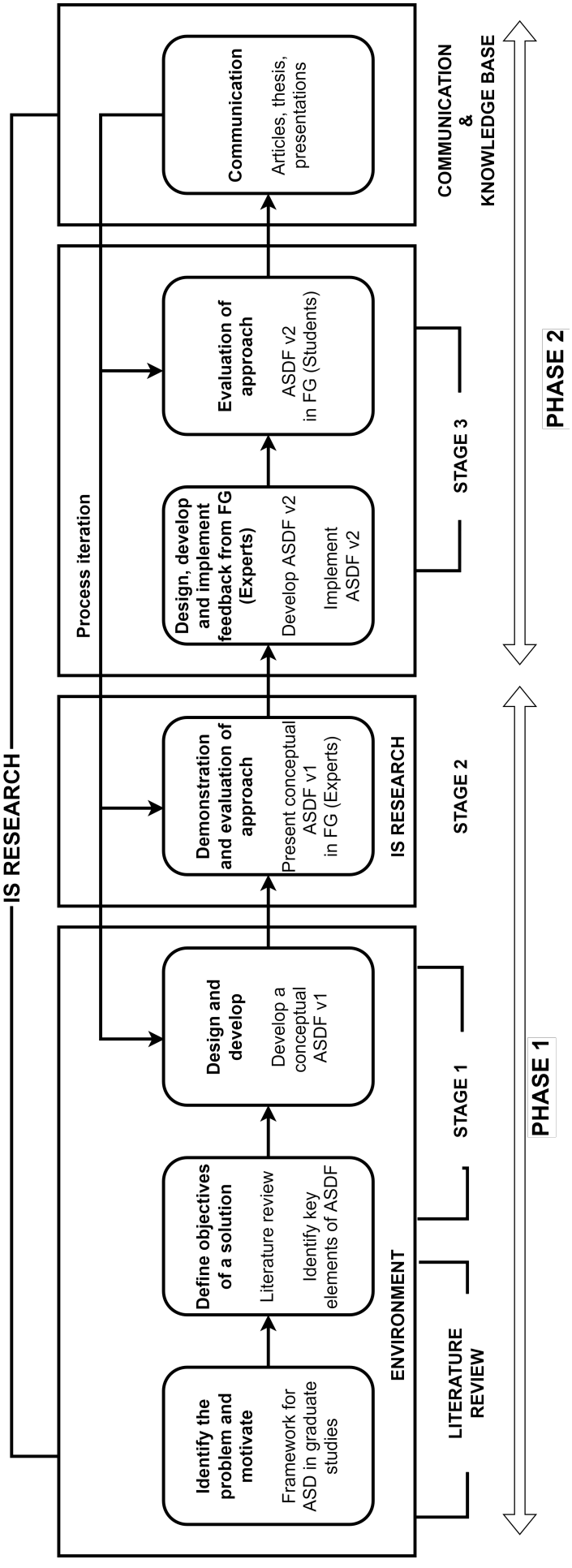


Figure 4.3: DSR process model for the ASDF (adapted from Peffers et al., 2007)

RSQ4: How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?

Commencing the process by identifying the problem and the motivation, allowed the researcher to explore the design options based on the project objectives. During the initial investigation of the problem, the research showed that a limited number of frameworks are available when implementing ASD in ODeL graduate courses using CSCL. After an initial investigation and literature review, it was determined that there is insufficient theorisation in the literature to address a methodology that can be adopted for implementing ASD alongside course content in graduate studies using CSCL in ODeL. Furthermore, after the initial investigation and literature review, the researcher identified a need for an ASDF to follow when implementing a framework in graduate research studies, to augment ASD.

The outcomes of the systematised literature review allowed the researcher to answer RSQ1, RSQ2 and RSQ3, and identify key elements required in an ASDF in ODeL using CSCL (Section 2.3). The information from the initial stage was subsequently applied in the first stage, and a conceptual framework was designed and developed (see Section 5.2 and Figure 5.2).

RSQ4 is answered through the implementation of the key elements identified in RSQ3, in a conceptual ASDF and the evaluation of the approach. Demonstration, evaluation, refinement and the implementation of the ASDF are presented in stages 3 and 4 of the DSR process.

4.2.1.2 Stage 2 - demonstration and evaluation of the conceptual ASDF

RSQ4 is answered through the implementation of the key elements identified in RSQ3 in the ASDF. To demonstrate and evaluate the approach presented in the ASDF, the conceptual ASDF (as described in Section 5.2) was presented to nine focus groups (see Section 5.3.1) consisting of experts in postgraduate research and

ODeL courseware development. Reporting on the presentation of the conceptual ASDF from the experts' perspective, is discussed in Section 5.3.2. The focus groups were held online, using MS Teams. The discussions were recorded, transcribed and thematically analysed (see Section 5.3.2). In order to enhance the understanding of the phenomena under investigation, the researchers employed a triangulation approach (Goldkuhl, 2004) by combining the responses gathered from online surveys with the thematic analysis of online discussions conducted in the focus groups. Triangulation allowed for a comprehensive examination of the identified key elements in the responses. The findings were then utilised to update the conceptual ASDF and presented as a revised version in Section 6.2.

4.2.1.3 Stage 3 - revised ASDF and evaluation of the approach

The revised ASDF was implemented in a graduate research course in Computing. The implementation of the course, applying the structure of the conceptual ASDF, is discussed in Section 6.3. For the purpose of this study, one of the projects in the honours research course, HRCOS82 - Honours Research Report, was chosen. HRCOS82 serves as a fundamental building block in equipping students with the necessary knowledge and competencies to conduct research in the computing field, while giving them an opportunity to undertake a small research project under the supervision of a lecturing team in Computing. Students enrolled for HRCOS82 can choose between a number of projects, based on their area of study. In this case, we refer to the project as HRCOS82-P19.

The graduate students' perceived educational experience, as a combination of social, teaching and cognitive presence, was measured and described from the perspective of a community of inquiry framework (CoI) (Garrison & Arbaugh, 2007) in Section 6.4, while engaging with the activities presented in the ASDF. A CoI survey was distributed to the wider HRCOS82 group, for input on their educational experiences whilst engaging in academic activities using CSCL.

Two online focus groups were held in which the HRCOS82-P19 students reflected on the elements of social, cognitive and teaching presence, while using CSCL to augment their argumentation skills. A thematic analysis of the online focus groups was used to evaluate the elements and affordances of the ASDF, to which updates were subsequently made. The feedback received from the students was thematically analysed using Atlas.ti. The thematic analysis and process followed the process as described by Braun and Clarke (2006, 2020). The implementation thereof will be discussed in Section 5.3.2.

Chapter 6 offers a more comprehensive discussion of the implementation of the ASDF and the participating students' educational experiences, to reflect the insights gained.

4.2.1.4 Communicating the research and contributing to the knowledge base

The rationale for this study was to develop an ASDF that can be followed when implementing an argumentation model in a graduate course using CSCL. The findings of the study – apart from being reflected here – will be communicated in scholarly articles and presentations. The contribution at a methodological level involves the strategies that courseware designers and e-moderators can utilise when designing a graduate course. These strategies involve the use of CSCL and the integration of argumentation models to enhance students' argumentation skills. At a theoretical level, the research contributes to the body of knowledge pertaining to evidence-based approaches using CSCL that can be applied in graduate courses, to augment candidates' argumentation skills. On a practical level, the concepts presented in this study can be transferred to similar studies, even though the ASDF that is designed and presented here, was for a research graduate course in Computer Science.

Having set out how the research was carried out and what contributions were made to the knowledge base, the validity and reliability of the research methods are discussed in Section 4.3.

4.3 VALIDITY AND RELIABILITY OF RESEARCH METHODS

There is a responsibility, on the part of the researcher, to demonstrate that the research methods applied in a study are applicable, trustworthy, reliable and valid (Creswell & Miller, 2000; Rose & Johnson, 2020). It includes an acknowledgement of the researcher's viewpoint by identifying the different lenses used in the research (Creswell & Miller, 2000), and contextualising the research by describing the techniques used to ensure validity and reliability. Rose and Johnson (2020) report that, although numerous reliability and validity techniques can be incorporated into research, it is often not a single-event occurrence and should rather be reported on throughout a study. Validation in qualitative research, which was done extensively in this undertaking, represents "an attempt to assess the 'accuracy' of the findings" Creswell and Poth (2013, p. 249), where "accuracy" refers to the validation of the qualitative research, as best described by the researcher and the participants. From the reliability perspective, specifically in this study, "intracoder" reliability is vital (O'Connor & Joffe, 2020), referring to consistency in terms of how the same researcher codes data at multiple points in time. In this regard, the researcher kept detailed records of the discussions, for example, by transcribing them (Creswell & Poth, 2013), and reporting on participants' utterances in this thesis and subsequent research articles.

In Section 4.3.1, the validity and reliability of the processes followed are discussed in more detail. Section 4.3.2 presents the characteristics of the data-collection methods, while Section 4.3.3 addresses the ethical issues arising.

4.3.1 Validity and reliability of the process

The research in this study unfolded in an iterative manner, through the DSR processes described in Section 4.2 and the IS research stages described in Section 4.2.1. The validation of the process is measured through the extensive time spent in the field and the description of the study, the methods applied, and the findings reported on. Creswell and Poth (2013, p. 50) suggest that validation in qualitative research should validate the "accuracy" of the study, placing less emphasis on distinct validation approaches. Accuracy refers to a rigorous approach to data collection, analysis and report writing. To validate the accuracy of the findings reported on, Creswell and Poth (2013) suggest using peers to check the process, confirm the accuracy and triangulate the sources of data.

In this study, the data capturing was done during stages 2 and 3 of the research (see sections 4.2.1.2 and 4.2.1.3), and as discussed in Section 5.3. In stage 2, the study participants contributed by taking part in extensive discussions in focus groups, and completing an online survey. The focus group discussions, during which the ASDF was evaluated, were done online using MS Teams, recorded and thereafter transcribed for thematic analysis. The focus groups allowed the participants to connect in a group and discuss the conceptual ASDF, by sharing their personal experiences of augmenting argumentation skills in graduate students. Furthermore, it allowed for the generation of new knowledge, and facilitated the capturing of the existing knowledge in the recording and thematic analysis of the discussions (Fernández & Valverde, 2014; Manyike, 2017; Rueter et al., 2019). (See Section 5.3.1 for an in-depth discussion on the focus groups.)

The method followed to conduct data capturing can be described as contextualist in nature, as it acknowledges the ways in which individuals make meaning of their experience that is influenced by their broader social context, while being aware of the limits of their reality (Braun & Clarke, 2006, 2020). In Section 5.3.2, the thematic

analysis process is described as it enables the reporting of complex conversation analysis, by "identifying, analysing and reporting patterns (themes) within data", while acknowledging the researcher's own "theoretical positions and values in relation to the qualitative research" (Braun & Clarke, 2006, p. 6-7). Furthermore, the thematic analysis process allowed for thematic analysis at the latent level, and enabled the researcher to examine the "underlying ideas, assumptions and conceptualisations" (Braun & Clarke, 2006, p. 13) contained in the data.

The identification of the themes was done by transcribing the data corpus (the recordings made during the MS Teams meetings), as described in Section 5.3.2. The surveys, used during the focus group with the experts, were designed to measure the key elements identified in Section 2.3, as required for the ASDF, and are discussed in Section 5.3.5 and presented in Figure 5.2. The findings derived from the online surveys are used to confirm the themes emerging from the group discussions (Section 5.3.3).

In stage 3 of the research, the updated ASDF was implemented in the HRCOS82-P19 project, and the graduate students' perceived educational experiences were measured through the lens of CoI (Garrison & Arbaugh, 2007). As in stage 2, the participants contributed extensively to the discussions unfolding on MS Teams. During the focus group sessions, the participating students reflected on the elements of social, cognitive and teaching presence. They shared their personal experiences in respect of their ASD, while enrolled in the HRCOS82 course, in addition to applying their argumentation skills across disciplines. The recordings were transcribed for thematic analysis, and used to evaluate the elements and affordances of the ASDF, after which updates were made to the latter (see Section 6.4.3.1 for a discussion of the results).

4.3.2 Mixed-method data collection

According to Oates (2005), data collection is the means by which empirical data or evidence is produced. Data collection methods allow researchers to systematically collect information about the context under study (Miles et al., 2014) and to report their findings. The main methods of collecting data include surveys, interviews, focus group interviews, observation, document review, critical incidents and portfolios (Oates, 2005).

In the study reported on here, a mixed-method approach to data collection was followed. Mixed-methods research is defined as "an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks" (Cresswell, 2014, p. 32). This method was selected as it offered a "useful strategy [for gaining] a more complete understanding of the research problem" (p. 266).

During stage 2 (see Section 4.2.1.2), the qualitative data are explained with quantitative follow-up data collection and analysis. During stage 3 (see Section 4.2.1.3), the quantitative data are explained with qualitative follow-up data collection and analysis, to ensure a more complete understanding of the need for, and impact of, the ASDF using CSCL in a graduate research course.

4.3.2.1 Qualitative data collection using focus groups

In the social sciences, focus groups or focused interviews are understood to enable the researcher to (1) gather qualitative data from participants who share experiences of a particular situation, and/or (2) allow him/her to observe any group dynamics that affect the "individual's perception, information processing and decision making" (Stewart & Shamdasani, 2014, p. 10).

For the purposes of this study, the description of focus groups by Tremblay et al. (2010) was deemed suitable as they discuss the use of focus groups for artefact refinement in design research in IS, and define *focus* as referring to a limited number of issues under discussion. Furthermore, Gundumogula (2020) predicts that focus groups that are carefully predetermined and well-planned will allow for more in-depth interviews with the study participants. Tremblay et al. (2010) distinguish between two types of focus groups, namely exploratory focus groups (EFGs) and confirmatory focus groups (CFGs). EFGs are mostly used in design research, where rapid incremental improvements in artefact design are required, while CFGs demonstrate the utility of the design. For the purpose of this study, the roles of EFGs were deemed helpful, in respect of (a) providing feedback to be utilised for design changes to the artefact and focus group scripts, and (b) refining the scripts and identifying constructs for future focus groups, in addition to refining the artefact (Tremblay et al., 2010).

In this study, focus groups with experts and with students were held. The process for selecting the participants in the focus groups with experts is discussed in Section 5.3.1 and with the students in Section 6.4.3.

Following the focus group steps (see Figure 4.4), the research problem was formulated, the focus group dynamics were determined, a moderator was identified to facilitate the process, the questions that would lead the discussions were defined, the participants were selected based on their experience and knowledge of the matter and their ability to contribute to discussions around the research problem, the focus group was conducted, the data was analysed and interpreted, and the results reported (Tremblay et al., 2010). As for the dynamics, focus groups can be conducted either individually or in groups, in a venue or online via the internet, according to Gundumogula (2020).

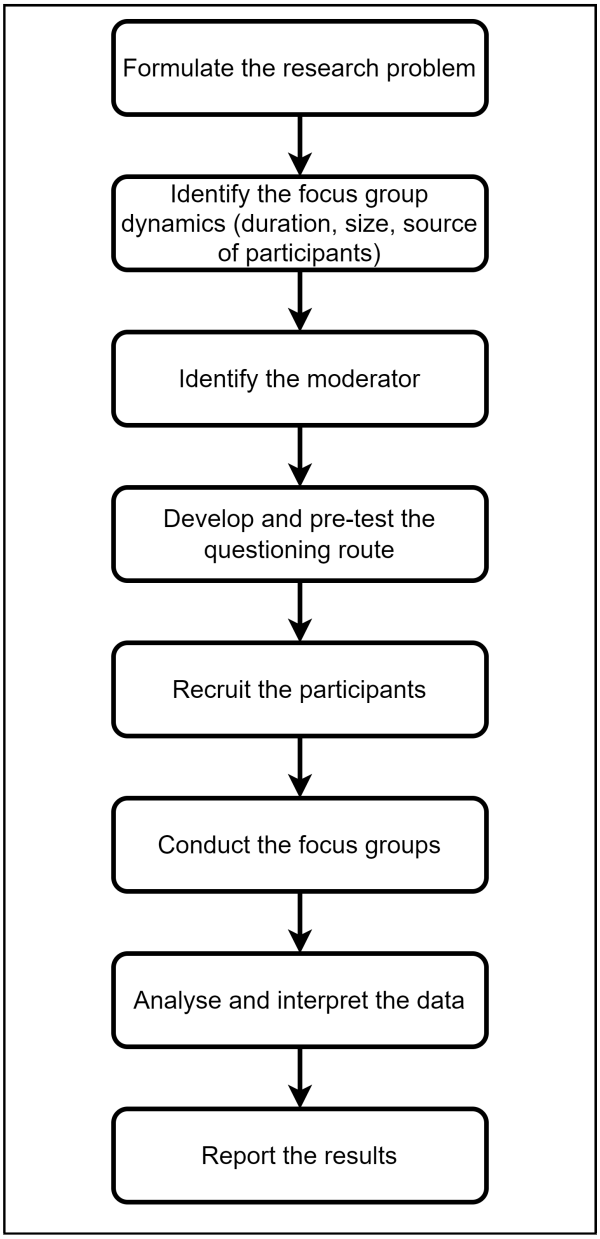


Figure 4.4: Focus group steps (adapted from Tremblay et al. (2010))

An advantage of using focus groups is that it allows for a carefully planned series of discussions, with the purpose of gleaning the perceptions of the participants in a defined area of interest (Krueger, as cited in Gundumogula, 2020). Amongst the limitations of focus groups are manipulation by dominant or domineering participants, biases related to the topic under discussion, difficulty interpreting and analysing the data task (Braun & Clarke, 2006, 2020), and preventing the presence of the researcher from having an effect on the discussions (Gounder, 2004). Furthermore, there may be issues related to anonymity and confidentiality when the findings are discussed and presented in scholarly articles (Gounder, 2004).

4.3.2.2 Quantitative data collection using cross-sectional surveys

Surveys, as research tools, are used for collecting data from a predefined group of respondents, to gain information on, and insights into, various topics of interest. Data are collected and statistically analysed to draw meaningful research conclusions. Surveys can have multiple purposes and can be conducted in many ways, depending on the methodology chosen (Creswell & Poth, 2013; Dresch et al., 2015).

The advantages of using a survey include the ability to arrive at generalisations – from a sample to a population – in order to make inferences about certain characteristics, attitudes or behaviours which are prevalent amongst this cohort. Where surveys are distributed online, that makes them easy and cost-effective to administer, distribute and collect (Cresswell, 2014). During stage 2, to allow an individual to contribute his/her opinion to the survey, open-ended questions were included. The procedures followed in identifying the participants for the focus groups are discussed in more detail in Section 5.3.1 and Section 6.4.3.

4.3.3 Ethical considerations

The application forms in respect of ethical clearance were completed and submitted to the ethical clearance committee of the School of Computing at Unisa. The application included the research proposal and data-collection instruments (surveys and focus group questions).

Ethics approval was received from (1) the Unisa College of Science, Engineering and Technology's (CSET) ethics review committee as well as from (2) the research permission sub-committee (RPSC) of the Senate Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC). (See APPENDIX E: Ethical Clearance Documentation).

4.4 MOTIVATING THE CHOICE OF METHODOLOGY

The study adopted pragmatism as a philosophical worldview, as it enables the researcher to solve a real-world problem and "recognise that there are many ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities" (Saunders et al., 2019, p. 151). Pragmatist research affords the researcher an understanding of the social world and the development of IS, to recognise the actions of others and their role in causing or addressing a real-world problem (Goldkuhl, 2004).

To answer the research question, "*How can CSCL environments be used to augment graduate computing students' argumentation skills development?*", selecting DSR as research design, provided a structure for the processes followed in the study, and presented answers to the identified research questions. In this regard, the pragmatic research in IS asks questions first on the environment to be studied, then on the design, development and evaluation; and finally reflects on what was learned through these actions (Goldkuhl, 2004).

The application of DSR in IS research, across the various stages, recognises the complex social and technical systems that exist in implementing a conceptual ASDF using CSCL (as discussed in Section 4.2). The practical implementation of the DSR (illustrated in Figure 4.3) describes the environment in terms of the identification and motivation of the problem, and defines the objectives of a solution. The IS research stages were illustrated by the iteration process of designing and developing (Section 4.2.1), demonstrating the ASDF as an artefact and evaluating the approach (chapters 5 and 6). To conclude the research design and methodology, the validity and reliability of the methods used were discussed in Section 4.3. In this respect, the objectives of describing the validity and reliability of the research methods, were met.

CHAPTER 5

REPORTING ON THE CONCEPTUAL ARGUMENTATION SKILLS DEVELOPMENT FRAMEWORK

5.1 INTRODUCTION

Following the DSR stages, as described in Section 4.2.1, this chapter represents stages 1 and 2 as the researcher reports on the development of the conceptual ASDF and the evaluation of the approach. The development of the ASDF using the key elements identified in RSQ3, and presented in Section 2.3, was expected to assist in answering RSQ4: *"How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?"* (See Table 5.1 for a list of the key elements.) This question could not be answered without input from experts in postgraduate research supervision and ODeL courseware development, or the educational experiences of graduate research students' development of argumentation skills, through ASDF.

The remainder of the chapter is structured as follows: in Section 5.2, the design and development of a conceptual ASDF are presented as a diagram (see Section 5.2.2). In Section 5.3, the focus is on an evaluation of the conceptual ASDF in focus groups, where the participants included supervisors as experts in graduate supervision and research, and ODeL courseware developers.

5.2 DEVELOPMENT OF THE CONCEPTUAL ASDF

In the design and development of a conceptual ASDF, the themes identified in the literature review (see Section 2.3) and discussed in Chapter 3, informed the requisite key elements. The key elements identified, are listed in Table 5.1, with references to the literature review indicated in brackets. The references in the last column refer to Section 5.2.1, where the elements are discussed, while in Section 5.2.2 a graphic representation is given of the conceptual framework for ASD.

Table 5.1: ASDF key elements

Theme identified (2.3)	**Elements required in an ASDF**	**Section**
Argumentation skills development	Argumentation models (3.2.1) Output as a well-structured argument	5.2.1.2 5.2.1.9
Collaborative learning as an approach to involve students in working together	**CSCL resources**: Identify e-tivities to support collaborative learning **Learning approach**: Toulmin's argumentation model (3.2.1.4) Scaffolded learning approach (3.4.1) **Assessment taxonomies**: Bloom's taxonomy(3.4.1.2) CCFOs (3.3.2.1)	5.2.1.8 5.2.1.3
Pedagogical approaches	Course requirements (4.2.1.3) Pedagogical approaches using CSCL (3.4)	5.2.1.1 5.2.1.5
Human capacity: research graduate students in e-learning	Graduate student in collaborative learning environment (3.5) Requirements for meaningful collaborative learning (3.5.1) Meets course requirements (4.2.1.3)	5.2.1.4 5.2.1.1
Infrastructural resources	Institutional resources for collaborative learning (3.6.1) External resources supporting CSCL (3.6.2) Supervision resources (3.6.3)	5.2.1.7 5.2.1.6

5.2.1 Elements of the conceptual ASDF

In Section 5.2.1.1, the requirements for the graduate research course used in this study, are discussed. Section 5.2.1.2 describes the argumentation model used here to augment argumentation. Section 5.2.1.3 describes the scaffolded learning environment and Section 5.2.1.4 human capacity from the student's perspective as a researcher, followed by a description of the pedagogy of collaborative learning

in Section 5.2.1.5. Infrastructural requirements, as applied in this study, are discussed in Section 5.2.1.6. The ODeL technology infrastructure and the design and affordances of CSCL are discussed in sections 5.2.1.7 and 5.2.1.8 respectively.

5.2.1.1 Course requirements

For the purpose of this study, one of the honours courses offered at Unisa, was chosen. The HRCOS82 course lends itself to ASD being implemented alongside the course content through a scaffolded learning approach, as the course seeks to "serve as a fundamental building block in equipping students with the knowledge and competencies to conduct research in the computing field". It also gives students an opportunity to conduct a small research project under the supervision of a lecturing team in Computing, and has as an outcome the following: "the qualifying student has mastered scientific writing, literature references and can complete an acceptable written research report"[1]. Students enrolled for HRCOS82 choose from amongst a range of research projects, one which is based on their area of study. One such course is Project 19 (referred to as HRCOS82-P19 in this study), in which the ASDF will be implemented. A further assumption is that students have passed the prerequisite research methodology course, as well as one or more courses with academic content that is required for conducting research on the topic presented in HRCOS82-P19.

5.2.1.2 Argumentation skills model

In Section 3.2, existing processes and models that are suitable for developing argumentation skills, are discussed. In this instance, to augment students' argumentation capabilities, the argumentation model of Toulmin (2003) (see also Andrews (2009)) was chosen, to support ASD while covering course content in the graduate course (HRCOS82-P19).

[1] https://tinyurl.com/HRCOS82Course

Table 5.2 presents a practical example of the different components in an argument, as presented in Toulmin's (2003) model. Section 3.2.1.4 provides a more in-depth discussion of the model, within which every argument has three fundamental parts – the claim, the grounds and the warrant.

Table 5.2: Example of identifying elements of Toulmin's argumentation model

Elements of Toulmin's model	
Claim	Graduate students have a problem with argumentation in research
Grounds	Own experience. Other supervisors. Literature
Warrant(s)	Assuming that graduate students will need to use argumentation skills to present their argument in their final report
Backing(s)	Based on last three years of research projects The literature identified it as a problem area
Rebuttal(s)	Alternative research on addressing argumentation skills development English literacy contributes to poor academic argumentation E-skills are not what they should be Students' grasp of course content is insufficient
Qualifier/Modality	ODeL. Graduate research. Computing

The claim is the main argument, and it represents the assertion that the author would like to convince or prove to the audience/readership. In this example, the author claims that "graduate students have a problem with argumentation in research". For these grounds, the author provides evidence from his /her own experience, or from that of other supervisors, and may even include evidence from the literature. "Assuming that graduate students will need to use argumentation skills to present their argument in a final report", serves as a warrant for this research. The warrant, which is often not stated explicitly, should form part of the argument, as the assumption links the grounds to the claim. As backing, the author can provide evidence from real-life scenarios and literature reviews. The rebuttal, which is either implied or stated explicitly, acknowledges other views of similar studies. In this example, the author reviewed alternative research and findings on efforts to address ASD, and took into account factors such as English literacy skills, e-skills and course content proficiency. The qualifier limits the study to a specific context, time or makes

the reader aware that the claim may not be true in all circumstances, as in this example the author explicitly states that the research is in an ODeL context, in the domain of computing, and specifically pertains to graduate research.

5.2.1.3 Scaffolded learning environment

To present the scaffolded learning environment in terms of the development of ASD, (see Figure 5.1), the different levels of competencies can be demonstrated, showing the scaffolded categories as presented in the revised version of Bloom's taxonomy (Anderson & Krathwohl, 2001). A student's level of competence is mapped on the horizontal axis, and this represents his/her learning journey as an individual. The vertical axis represents an improvement in the student's level of competency as s/he progresses. The e-moderator, as the supervisor, facilitates the learning journey by establishing the group, introducing the knowledge domain and the learning approach, and inducting students into the ASD learning environment (Salmon, 2013).

In the scaffolded learning journey, the role of the e-moderator changes as the student progresses. Initially starting as an instructor, the supervisor provides the requisite training and instruction, using Toulmin's (2003) model, by identifying the various elements of claim, grounds, and so forth. As the students progress in their learning journey, so the role of the instructor gradually changes to that of facilitator (dotted line 1), allowing students to build their competencies in respect of developing their argumentation skills from a low level of competence to a place where they can create and present a well-formulated argument.

Each stage requires the student to master argumentation skills in the scaffolded learning journey. The scaffolded levels of skills are presented in the categories of the revised version of Bloom's taxonomy (Anderson & Krathwohl, 2001), and include competencies ranging from remembering and understanding, to applying and analysing, and finally to the categories of evaluating, creating and implementing.

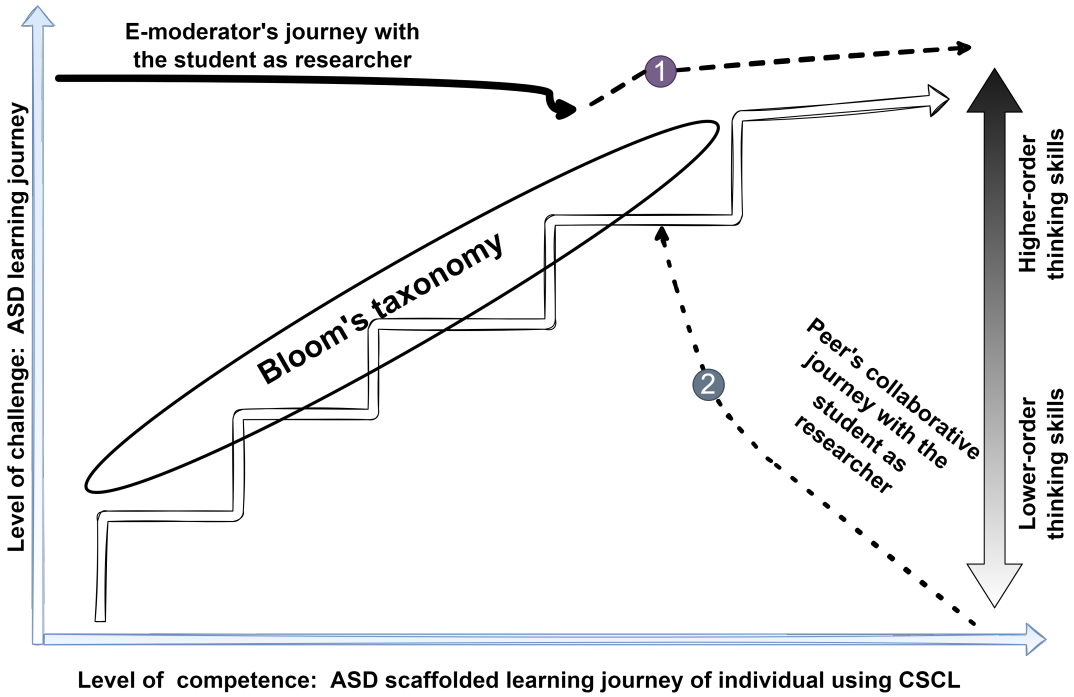


Figure 5.1: ASD through a scaffolded learning journey

In this scaffolded learning journey, the students (as peers) form part of discussion groups and have an opportunity not only to present their arguments, but also to give and receive critique. As peers who are travelling on the same learning journey, students collaborate in the space provided in the LMS by sharing, presenting, evaluating, critiquing, and applying the terminology of Toulmin's (2003) model (presented by the dotted line labelled 2). The scaffolded learning journey presents the student with the opportunity to move in and out of their comfort zones, as described in the ZPD (Langford, 2005).

5.2.1.4 Human capacity: the student as a researcher

Students enrolled for HRCOS82-P19, meet the course requirements as discussed in Section 5.2.1.1. As participants in the community of collaboration (through scaffolded e-tivities), these students progress on a path of learning by augmenting their argumentation skills alongside the course content. They also contribute to the community by applying and using their competencies and contributions to attain a collaborative goal. Each student's development as a researcher can be described according to the ZPD (Langford, 2005). Important are the results reflected in studies

by Oh and Kim (2016) and Van Staden (2019), who emphasise that students will benefit from scaffolded argumentation activities using CSCL, as long as the activities are compulsory and group sizes are kept small.

5.2.1.5 Pedagogy of CSCL

Pedagogy, collaboration and technology are seen as the three pillars of CSCL (Jeong et al., 2019) and the pedagogy of collaborative learning can be adopted in most learning environments (Chelliah & Clarke, 2011; Maor & Currie, 2017). In the literature, scaffolded activities in collaborative learning are often associated with the augmenting of argumentation skills (Gensowski, 2016; Oh & Kim, 2016; Tsai & Tsai, 2014) and, in that regard, course developers should take note of the technology available in the CSCL environment (Ali, 2020) that facilitates scaffolded learning on the road towards the development of argumentation skills.

5.2.1.6 Infrastructural requirements

Success in a collaborative learning environment often relies on the practices of CSCL and the practical demands of real-life situations (Jeong & Hmelo-Silver, 2016). Using technology in CSCL serves not only as a digital platform via which the course is delivered, but also provides the context in which the learning journey is constructed and presented (Eryilmaz et al., 2013; Jeong & Hmelo-Silver, 2016).

5.2.1.7 ODeL technology infrastructure

ODeL technology infrastructure is well suited to the CSCL environment and collaborative learning (Jeong & Hmelo-Silver, 2016). The ODeL technology infrastructure provides resources that support different learning approaches, including scaffolded learning (see Section 3.4.1). In this regard, the student as a researcher (see Section 3.5), the course requirements (see Section 5.2.1.1) and the infrastructural requirements (see Section 3.6) should be considered to provide inputs not only into the resources that can be used to augment ASD alongside academic

content but also in the affordances that the CSCL infrastructure can provide. The CSCL resources (design practices and affordances) are discussed in more detail in Section 5.2.1.8.

5.2.1.8 CSCL resources: design practices and affordances

CSCL resources refer to the various online resources and scaffolded e-tivities that can be used and applied in ODeL (Salmon, 2013). In the learning path, e-tivities allow students to participate and commit to working with the rest of the group, as a team, to reach a joint goal. Arinto (2013) proposes a framework that will assist course developers in making decisions when it comes to selecting the applicable CSCL resources for a specific course. To complement Arinto's (2013) proposal, the framework put forward by Jeong and Hmelo-Silver (2016) can be used to determine which needs will be met by the affordances that technology can provide for collaborative learning.

Course design is influenced by an e-moderator's personal constructs, which are a combination of his/her personal experiences in teaching and learning (Arinto, 2013). The course design practices proposed by Arinto (2013) provide guidelines for the development of a comprehensive range of ODeL competencies, following a systematic process. The areas identified in the framework address (1) content development, using applicable resources to cater for the different needs of the students, (2) the design of online collaborative learning activities that promote knowledge generation, (3) the adoption of co-construction teaching strategies to promote participatory pedagogies and allow for cohort teaching and learning, and (4) the design of flexible summative and formative assessments.

CSCL is based on the premise that the technology available will support the collaborative learning process (Jeong et al., 2019; Pretorius et al., 2019). The core affordances, identified by Jeong and Hmelo-Silver (2016), can be employed in this study to verify that the technologies and e-tivities used in CSCL will address the

CCFOs, be applicable in a scaffolded learning environment, and serve to augment students' ASD. The affordances, according to Jeong and Hmelo-Silver (2016), should provide students with opportunities to

- engage in co-construction through joint tasks
- communicate the results of the learning attained in the course of the learning journey, using online communication platforms
- use technology to share resources amongst the group
- work effectively in groups by engaging in productive processes aimed at augmenting their argumentation skills
- engage in co-construction using technology and online platforms
- find groups and build communities with similar interests, and
- define guidelines on monitoring and regulating collaborative learning.

Using the framework developed by Arinto (2013), CCFOs and a list of CSCL affordances presented by Jeong and Hmelo-Silver (2016), guidelines are provided in Table 5.3 that can be followed when selecting applicable resources and e-tivities using CSCL that will augment ASD. The guidelines include the CCFOs, mapped to the core affordances identified by Jeong and Hmelo-Silver (2016) in the second column. To assist in choosing course design practices, Arinto's (2013) examples are listed. The table is complemented by mapping ASD activities to e-tivities that can be applied using CSCL. The table is not exhaustive, and the e-tivities may differ in each group, as may the maturity level of the students, and the experience of the e-moderator in using CSCL.

Table 5.3: CCFOs, affordances and course design practices in implementing ASD using CSCL

CCFOs	(Jeong & Hmelo-Silver, 2016) Affordance	(Arinto, 2013) Course design practice	Mapped to ASD	E-tivities using CSCL
1. Identify and solve a problem by making meaning, individually and in the group, through oral, reading and writing activities	Engage in co-construction.		Identify a problem and use elements of an argument to describe it	Find articles using an online library Identify the arguments in the article and describe the elements of the argument Let the e-moderator guide the process by leading discussions, allowing students to work on articles, and sharing information with the rest of the group
2. Work effectively in a group using interactive speech and discussions	Work in groups		Work in a group to critically engage in discussions by using argumentation terminology	Present the findings from the previous step to the group Critically engage in the discussions and peer evaluation
3. Organise activities responsibly and effectively, using language	Define guidelines on the forming of groups	Online collaborative knowledge- generation learning activities	Work in a group, define the rules and guidelines, and identify how knowledge will be shared	The students identify platforms, shared online resources, and space to share information Examples: Mendeley, Dropbox Formulate rules Protect intellectual property Discourage plagiarism
4. Collect, analyse, organise and critically evaluate information in the process of developing language capability	Engage in productive processes		Collect, analyse, organise and critically evaluate information by presenting the information using the elements of an argument to describe it	Present the findings in a formal way to the group, using argumentation elements to describe their findings Example: using presentation software
5. Communicate effectively, both in formal and informal contexts	Participate in online communication		Present a well-formulated argument	The e-moderator provides guidelines on how the argument should be presented in an academic paper Students share by presenting their arguments to the group Examples: mini-conference or workshop
6. Use science and technology effectively and critically to present text	Share resources	Select external and institutional resources to cater to different sets of students	Use technology to present arguments to the group	E-moderator assists in selecting resources students can use to augment argumentation skills in a scaffolded learning journey Example: decide on steps in the learning journey that require repeating, identify additional resources
7. Demonstrate an understanding of the world as a set of interrelated parts of a system, through language, to explore a global range of contexts and texts	Establish a joint task	Online collaborative knowledge-generation learning activities	Present a well-formulated argument to the group	Extend the e-tivities to include external academics to join in the discussions Students present their work in the discussion groups
8. Contribute to the full development of the individual by engaging with the text and thereby stimulating awareness and development of life skills and the learning process		Adopt participatory pedagogies (students as co-creators)	Collaborate by evaluating the arguments of peers, using the argumentation model as a guide	Students participate in evaluating and critiquing the work of peers Students participate in evaluating the ASD approach

5.2.1.9 Output as a well-structured argument

The course requirements define the outcomes – in terms of the HRCOS82-P19 project, the course requirements are described in Section 5.2.1.1.

The implementation of the pedagogy of CSCL, the infrastructural requirements, ODeL technology infrastructure and CSCL resources are presented in Table 5.3 and a practical implementation will be discussed in Section 6.3

5.2.2 Conceptual ASDF as a diagram

Figure 5.2 is a representation of Table 5.1, illustrating the elements required in a framework to support the augmentation of ASD in graduate research. The conceptual framework illustrates the relationship among the different elements, indicated by numbers (1) to (7). The course requirements (1) have an impact on the choice of the pedagogical approaches (2), and the pre-requisites for the student as a graduate researcher (human capacity - student) (3). The course requirements, pedagogical approaches and human capacity of the student determine the ODeL technology infrastructure (5). The infrastructural requirements (4) are accessed and used in the ODeL technology infrastructure. The output of the ASD (6) is the research problem presented by the graduate student as a well-structured argument. And finally, the approach (7) is evaluated from the perspective of expert postgraduate researchers and the educational experience of the graduate research student.

Before implementing the conceptual ASDF alongside course content in a graduate course, the input of supervisors and ODeL courseware developers, as experts, is key (Anderson et al., 2018; Arinto, 2013; Wright, 2015). Section 5.3.1 focuses on the presentation of the conceptual ASDF to experts in focus groups.

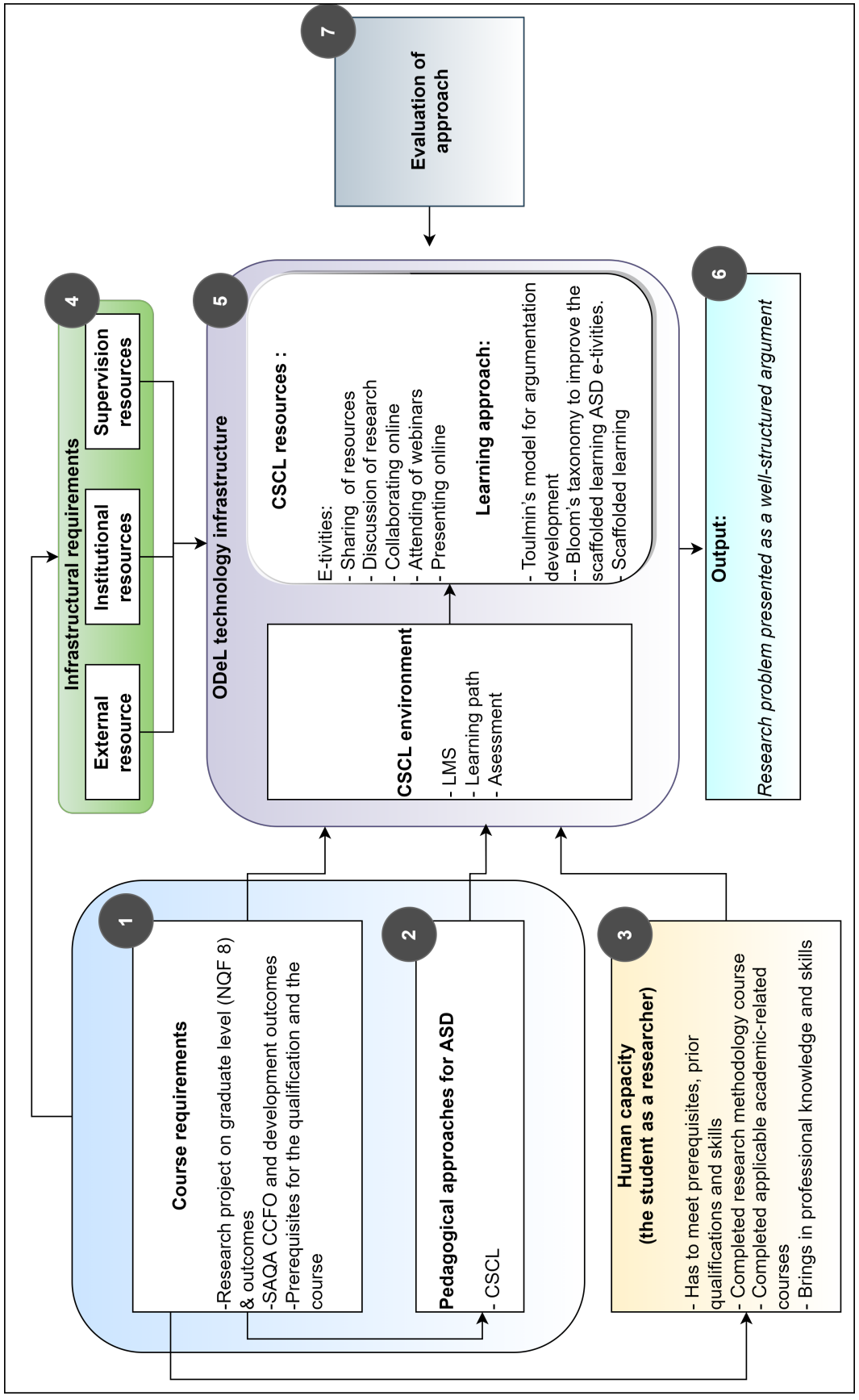


Figure 5.2: Conceptual argumentation skills development framework (ASDF)

5.3 EVALUATION OF THE CONCEPTUAL ASDF

To obtain input from experts, the evaluation of the conceptual ASDF was done in focus groups, with postgraduate supervisors and ODeL courseware developers serving as participants. In Section 5.3.1, the presentation of the conceptual ASDF to the focus groups, is discussed. A discussion of the findings of the focus groups is presented in Section 5.3.2 where the thematic analysis process is described. In sections 5.3.3 and 5.3.4 respectively, the themes emerging from the focus group discussions and general feedback received in the focus groups, are discussed. The findings of the online survey are presented in Section 5.3.5.

5.3.1 The focus groups with experts

The conceptual ASDF, presented in Figure 5.2, was presented to the focus groups. By means of purposive sampling and snowball sampling, the researcher contacted 20 potential participants, ten of whom agreed to participate in a focus group. They nominated 15 more experts to contact, and ten of those invitees accepted an invitation to participate. In total, 19 expert university researchers with experience in postgraduate supervision, and one ODeL curriculum designer, participated in the focus groups. These supervisors hailed from universities across South Africa, and at the time were responsible for postgraduate supervision in different subject disciplines. Although the experts varied in respect of their years of postgraduate supervision, they had experience in either ODeL, distance education or blended learning. Furthermore, due to the pandemic, more traditional residential universities in South Africa relied on e-learning environments to engage with their graduate students, therefore the supervisors could relate to the online learning environment presented in this study. In total, nine focus group sessions were held via MS Teams. The number of participants varied between one and three experts per focus group, allowing 19 participants to contribute. After the ninth focus group session, data

saturation was reached and enough data has been collected to draw necessary conclusions, and any further data collection will not produce value-added insights.

The question which guided the discussions in the focus groups, was this: *How can CSCL environments be used to augment graduate computing students' argumentation skills development?*

A summary of the research study and copies of figures 5.1 and 5.2 and tables 5.2 and 5.3, presented during the focus groups, were distributed in advance to the participants. Each focus group session lasted an hour. During the first 20 minutes, the purpose of the focus group was explained and the conceptual ASDF, as described in Section 5.2, was presented. During the remainder of the session, the participants engaged in discussions (see Appendix A: Focus group discussions) on usefulness, feasibility and ethics, and completed an online survey (see Appendix B: Online survey).

5.3.2 Discussing the findings

The data capturing in this study was done by employing a contextualist method (Braun & Clarke, 2006), which acknowledges the ways in which individuals make meaning of their experience, as influenced by their broader social context, albeit being aware of the limits of their reality. The thematic analysis process as described by Braun and Clarke (2006, 2020) was followed, as it allows the reporting of complex conversation analysis by "identifying, analysing and reporting patterns (themes) within data", while acknowledging the researcher's own "theoretical positions and values in relation to the qualitative research" (2006, pp. 6-7). Notably, the thematic analysis process allows for thematic analysis at the latent level and permits the researcher to examine the "underlying ideas, assumptions and conceptualisation" (p. 13) in the data. The identification of the themes was done from

the transcribed data corpus (i.e., the recordings made during the online MS Teams meetings).

The complete data set was coded in Atlas.ti using a “codebook”, which established a more structured coding framework (Braun & Clarke, 2020). The inductive contextual coding approach (Braun & Clarke, 2006) of reading and re-reading the data allowed the researcher to identify themes that grouped data which may otherwise not have been grouped (Braun & Clarke, 2020). The “keyness” of a theme (Braun & Clarke, 2006, p. 10) was identified based on its importance in relation to the overall research question, and grouped and labelled according to coherent patterns. The researcher acknowledges that the collected data were read through the lenses of her social, cultural, historical and disciplinary position, and she was involved in the discussions unfolding during the focus group sessions. Being involved in the study can influence the way in which a researcher interprets the participants’ accounts and how s/he reflects on the results (Clarke & Braun, 2019, as cited in Braun & Clarke, 2020). For this reason, rigour and record keeping of the process are of vital importance, as addressed in the ethical documentation of this study.

5.3.3 Themes emerging from the focus group discussions with the experts

The themes that emerged from the thematic analysis process are presented in Figure 5.3. In the diagram, the critical success factors identified from the thematic analysis process that links all the elements in the ASDF, were human capacity, collaboration, infrastructural requirements, argumentation model, and a framework for use when implementing ASD alongside coursework in graduate studies (ASDF benchmark). These critical factors as themes emerging from the focus group discussions with the experts are addressed in sections 5.3.3.1 - 5.3.3.6. In Section 5.3.3.1, the responses obtained from the focus group participants, on the presentation of a framework to augment argumentation skills, is presented. In Section 5.3.3.2, the spotlight falls on the choice of argumentation model. In

Section 5.3.3.3, the comments, feedback and suggestions from the focus groups on the infrastructural requirements are presented, and in Section 5.3.3.4, feedback on collaboration is discussed. From the thematic analysis, human capacity is discussed from two viewpoints, namely in Section 5.3.3.5, that of the student as researcher, and in Section 5.3.3.6, that of the supervisor as e-moderator.

5.3.3.1 ASDF

The presentation of a framework that can be used to augment ASD was well received, as was evident in the responses of the participants as the ASDF being "*relevant in teaching and learning*", *"comprehensive"* and *"timewise in addressing the need for argumentation as this is a general concern, not only for studies but also when one needs to publish"*. One participant mentioned that [he] is *"already following the scaffolded learning path in M and D supervision, but I am going to present Toulmin argumentation to the students"*. Concerns expressed, included comments such as *"the person [who] will implement it will have to understand the environment"* and *"buy-in is required, as the framework may be difficult to implement"*.

5.3.3.2 Argumentation model

The presentation during the focus groups focused on the students' lack of argumentation skills. It became apparent to the participants that additional factors should be taken into consideration, as mentioned by one participant who believed that *"...problem could be rather understanding English... [it] doesn't even get to argumentation as they don't have the language skills. [It is] a hurdle for non-English-speaking students"*. One participant commented that *"students coming from previously advantaged schools may have more input during collaboration sessions"*. This was confirmed by a statement that *"no essay writing in undergraduate studies may have a negative impact on their language skills, specifically in unemployed youth"*.

The participants in the focus groups agreed that *"Toulmin is a good model"*, but warned that *"Toulmin is not an easy model to use and apply"*. Another participant mentioned that the model can be used *"when searching for quality articles rather than quantity,"* and labelled the search for articles as a kind of *"detective story"*. Of particular interest was the comment that *"students can be taught to make the elements [terminology of Toulmin] explicit by giving evidence ahead of time. This may address the problem of people evaluating the proposal [argument] from different world-views and backgrounds of education, thus preventing 'red-herrings'"*. Several participants mentioned that at their residential institution, argumentation skills and analytical thinking were presented to students in undergraduate courses.

5.3.3.3 Infrastructural requirements

From the discussions and themes emerging from the thematic analysis, it was clear that the initial presentation of the infrastructural requirements (that included external, institutional and supervision resources) were problematic (see Figure 5.2). In a revised version of the ASDF, the supervision resources were removed and grouped with the human capacity element (thereby representing both the supervisor and the student), as discussed later in Section 6.2. The participants further commented that students should be taught, on each level in the scaffolded learning, *"technical academic skills"* and receive *"life skills training on the use of the external and institutional resources"*. This was emphasised in a comment that *"presentation is a good idea to help them articulate their arguments, but they need to be first trained how to do a presentation"*.

Although few participants commented on access to external and internal resources, utterances referred to the *"extended registration periods [due to the Covid-19 pandemic], [meaning] students are not in the same space [some enrolled much earlier than others]"*. A suggestion was made to *"divide the students into smaller groups as they register, to counter the [current] problem"*.

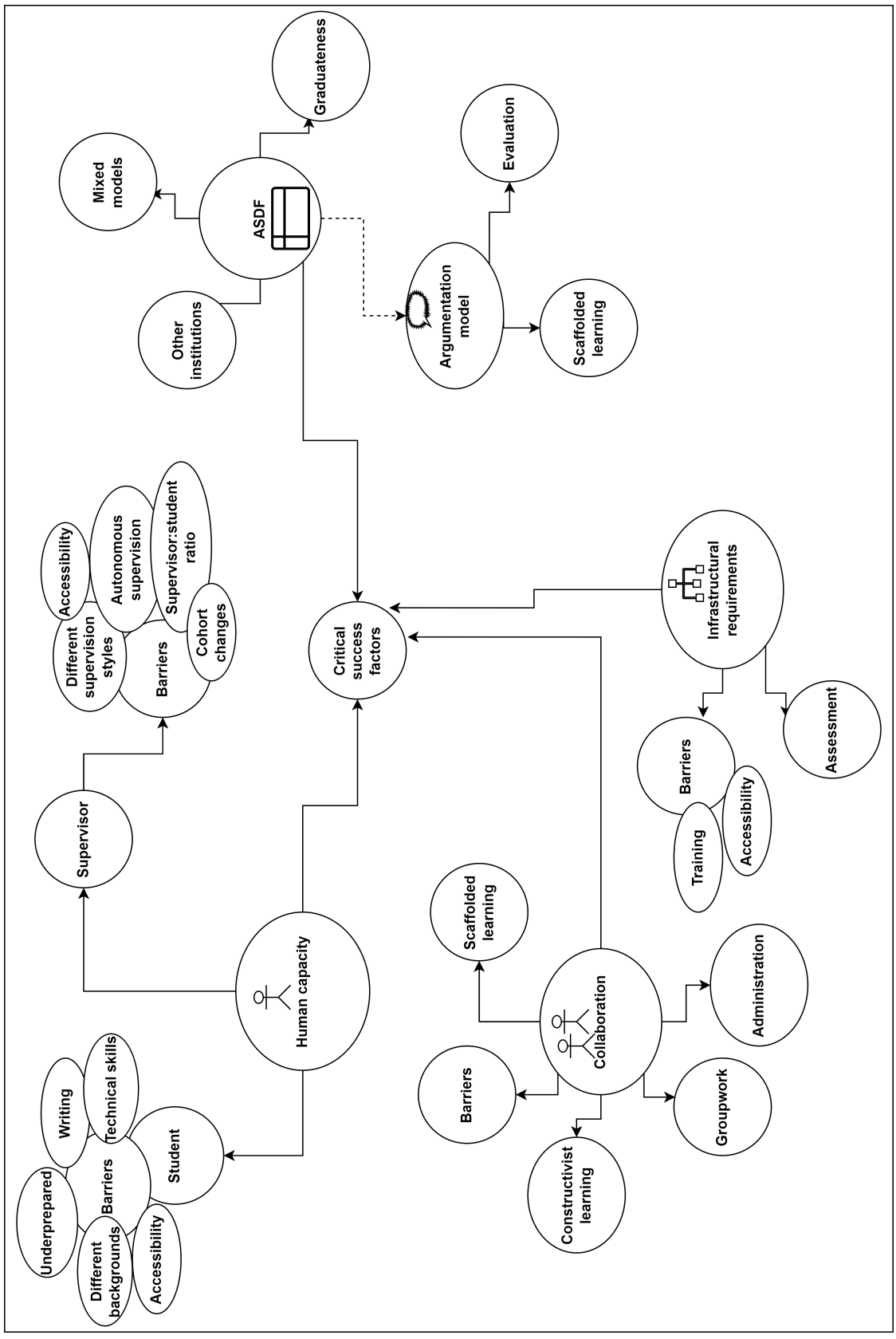


Figure 5.3: Themes emerging from the thematic analysis identified in expert focus groups

5.3.3.4 Collaboration

From the focus group discussions, it emerged that students can be categorised into three distinct groups, namely (1) those who do not want to work in groups, (2) competitive students who are prepared to work in a group to gain information, but are unwilling to share, and (3) students who use the group to share and collaborate in order to grow and contribute. One participant suggested that students should be trained on how to *"peer-review and contribute to the rest of the group, specifically when thinking of advancing to a Masters [degree]"*.

A recommendation was to always keep in mind *"the golden thread"* that should be present, even in a collaborative framework. This comment led to further discussions, with participants arguing that the *"same model [can] be applied to cover the complete project, and not only to the presenting of an argument"*.

Another viewpoint that emerged on the theme of collaboration, dealt with the*"socio-technical perspective and social factors and cultural factors that will come into the interactions"* and influence the behaviour of students in a group, amongst themselves, and with the supervisor[2].

Further comments and discussions pertained to constructive learning, with questions such as the following: *"Will the learning be structured and facilitated?" " How [do we] keep the students active in the learning process during the year as students are often eager to start but then wander off"?*. One participant suggested that the collaborative platform not be restricted to a specific module, but be constructed such that it will allow *"students to move in and out of the group as they progress through their learning journey. As students are from different groups of academic environments,*

[2]The researcher took note of this observation, and plans to explore the factors of social and cultural interactions in future research

they have to formulate their questions and post their questions in such a way that all can understand [them]".

Since one of the study participants had already implemented group work among postgraduate students, the comments on the administrative part are insightful: *"The admin behind it [group work] is a lot"* and *"assignments fail because the admin is not sorted and students were never educated how to do group work"*. This sentiment was shared by another participant, who recommended that administration be kept to a minimum, if the space for group work is initiated by students rather than the supervisor: *"[It] wasn't [created by the] supervisor, but the students actually did [create it]"*, which allowed the students to *"eventually bec[o]me free and very comfortable as they discussed problems together"*.

5.3.3.5 Human capacity: the student as researcher

From the focus group discussions, a reminder that *"students are not all the same"* and *"from the students' perspective, look at aspects regarding literacy, language understanding and knowledge"*. These remarks resonated with other comments relating to providing support to the group and the individual student along the learning path. For instance, *"the first [article] should be chosen by the supervisor – well-defined and explained. . . "*.

5.3.3.6 Human capacity: the supervisor as e-moderator

Discussions in the focus groups regarding the capacity of the supervisor pointed out that the *"supervisors have their own views on argumentation and their pedagogical approach, and [these] may not align with [the] ASD presented."* Further discussions on this aspect related to alternative argumentation models (other than Toulmin). One participant provided information and links to alternative argumentation models. An important contribution on contingency plans indicated that *"the group dynamics and*

cohort from year to year [may change], and have an impact on the whether the framework will be successfully used or not". This comment referred to the allocation of supervisors to a project, which may change annually.

5.3.4 General feedback on the focus group discussions

Although many participants indicated that the focus group discussions were well organised and presented, some comments relating to the feedback required on the ASDF were merely "*theoretical*" at this stage, as the ASDF has not yet been implemented and tested.

5.3.5 Online survey findings

In addition to the discussions in focus groups, the respondents were asked to complete an anonymous online survey, which also served as their consent to participate in the study (see Appendix B: Online survey). In the survey, using MS Forms, seven characteristics presented in the ASDF relating to simplicity, comprehensiveness, generality, exactness and clarity (Olivier, 2013, p. 49), usefulness (Li, 2015) and feasibility (Jung et al., 2016), were used to measure the extent to which the conceptual ASDF contributed to the CSCL environment in providing a context that will augment the development of argumentation skills in graduate researchers. The seven survey questions were based on a five-point Likert scale: (1) strongly disagree (2) disagree (3) neither agree nor disagree (4) agree and (5) strongly agree. Following each of the seven questions, a space was provided in which the respondents could respond in their own words. A final space was provided where the respondents could list any additional suggestions.

Figure 5.4 presents the results of the online survey. The values on the vertical axis represent the characteristics presented in the ASDF. The bars indicate the number of respondents who selected the specific item on the Likert scale. No respondents chose 1 in any of the categories, thus it is not indicated in the figure.

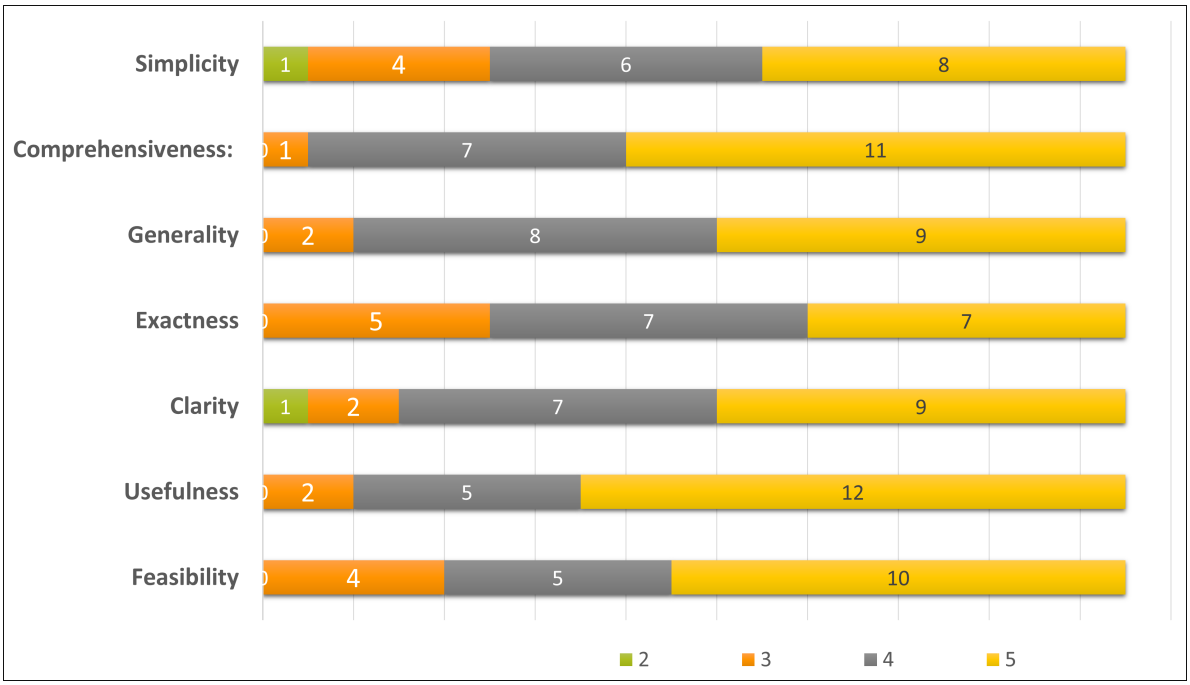


Figure 5.4: Evaluation of the characteristics presented in the ASDF

Simplicity

In respect of the question relating to simplicity, six respondents agreed and eight strongly agreed that the quality of the conceptual framework is uncomplicated in form and design, and encompasses the essence of the modelled concepts. Written comments stated: *"It is sufficiently simple [...] with 7 stages – with some broken down into sub-tasks. The components and how they lead to other components, [are] intuiti[ve]"* and *"I found it well explained"*. However, one respondent wrote that it was *"not completely clear what the central focus is – should the contents of the conceptual framework itself be evaluated, or is it about how the actual framework works?"* This last comment was in relation to the presentation of the ASDF, and was made by a respondent who was unsure whether the ASDF had already been implemented, or whether it had to be evaluated from the perspective of the key elements. This was addressed in follow-up focus groups, where it was pointed out that the focus should be on evaluating the ASDF as a guideline for use in the implementation of a graduate course.

Comprehensiveness

As regards comprehensiveness, seven respondents agreed and 11 strongly agreed that the conceptual ASDF includes and addresses most requirements in CSCL that can be used to enhance the argumentation skills of graduate researchers. Amongst the written comments were the following: *"The framework is (very) comprehensive, but it may need to accommodate social and cultural differences and affordances, on [the] part of both lecturers/supervisors and students."* There were specific comments relating to human capacity critical success factors (CSFs). Those pertaining to the supervision point of view, stated: *"...the factor that needs to be considered is the supervisory capacity and competency which is probably assumed, yet is often a key factor"* and *"There are different supervisory styles – and this model will probably appeal to a certain type of supervisor. Identifying the ideal supervisor for whom this model works, will probably make it more comprehensive."* From the student's point of view, comments on group size included: *"The smaller the group size, the easier the interaction and assessment and feedback are."* In terms of language barriers, comments included: *"If the argumentation is done in English, but the student's (or even the supervisor's) first language is not English, then it could impact on the successful outcome of argumentation skills."* One participant specifically mentioned benchmarking against existing frameworks and guidelines such as *"alignment with SAQA/HEQF's [South African Qualifications Authority/Higher Education Qualifications Framework] guidelines for graduateness."*

Generality

On the question relating to generality, most participants either strongly agreed or agreed that the conceptual ASDF can be implemented in similar scenarios in CSCL environments to augment argumentation skills in graduate researchers. In the comments section, the respondents noted that it can be implemented in most graduate and postgraduate courses, writing: *"... the discussion groups are a great idea. I advocate certain discussions that have minimal facilitator intervention."* One participant indicated that it may be difficult to implement *"the natural sciences, using*

a single epistemological framework (e.g., empiricism), may find it more difficult to apply the framework in their fields."

Exactness

In respect of exactness, five respondents were not in complete agreement that the conceptual ASDF is as accurate as possible, and addresses the perceived requirements for a CSCL environment for augmenting graduate researchers' argumentation skills. Notable is this comment: *"As far as possible, the framework addresses the requirements for CSCL, but it is not easy to tell how accurate it is at this stage."* The accuracy of the framework, in terms of the success rate of the students' final outcomes, falls outside the scope of this study. This is emphasised by the comment: *"The framework does appear to be rigorous in addressing the requirements of CSCL and argumentation at a graduate level. But this will only be clear when it is implemented and evaluated!"*

Clarity

Although 16 respondents agreed or strongly agreed that the ASDF was clear, their comments were quite diverse. Some observed that although the flow is evident and correct, it is not clear what the purpose of the course represented in the ASDF is: *"Thought the subject matter was argumentation; [I] did not gather that it was [a] topic of own choice in which they APPLIED argumentation."* This comment was addressed in the follow-up focus groups and is discussed in more detail in sections 5.2.1.2 and 5.2.1.3.

Usefulness

On the question of usefulness, the majority of respondents concurred that the conceptual framework is applicable in establishing an environment that will augment the development of argumentation skills in graduate researchers. As one respondent

mentioned, the ASDF should be *"more 'packaged', so that it becomes useful in a practical academic setting."*

Feasibility

As for feasibility, although ten participants indicated that they strongly agreed and five agreed that the conceptual framework is feasible in terms of providing a CSCL environment that will augment the development of graduate researchers' argumentation skills, four respondents were unsure that this would be the case – complexity clearly was an issue: *"The model may be too complex to comprehend in one go"*. Human CSF may affect the implementation of the ASDF, and that concern resonates with those comments pertaining to clarity and simplicity.

Additional comments and feedback

In the additional comments and feedback space, the respondents were in agreement that the ASDF is well designed and useful, adding that *"it will enhance the students' argumentation"*. As some observed, *"measuring"* the efficacy of the framework, will be difficult. The respondents recommended that the process be recorded *"from beginning to end in an LMS or tool such as WA [WhatsApp]; the qualitative data will be automatically recorded and can be used to show how the arguing skills of students improved – whether they are top students or those who struggle. The idea is to improve this skill, as I understand it."* Other feedback included a broader approach to ASD, namely the hermeneutical cycle and benchmarking the ASDF against the Association for Computing Machinery (ACM)[3] and Association for Information Systems (AIS)[4] computing/IS curricula. Valuable links to academic articles and books were shared (see Appendix C).

[3]https://www.acm.org
[4]https://aisnet.org

5.4 SUMMARY

This chapter reported on the input received from postgraduate research supervisors and ODeL courseware developers who contributed in answering RSQ4: *"How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?"* This was done by presenting the conceptual ASDF, as described in Section 5.2.1, to focus groups whose participants consisted of expert postgraduate supervisors and ODeL courseware developers. The relevant course requirements were described in Section 5.2.1.1, and the argumentation skills model of Toulmin (2003) was presented in Section 5.2.1.2, with a practical example. The scaffolded learning environment that can be used in augmenting ASD, was presented in Figure 5.1 and discussed in Section 5.2.1.3. Human capacity, from the viewpoint of the student as a researcher, was discussed in Section 5.2.1.4. Using the framework of Arinto (2013), CCFOs and a list of CSCL affordances presented by Jeong and Hmelo-Silver (2016), a list of guidelines was provided in Table 5.3, for implementation in selecting applicable resources and e-tivities using CSCL that will augment ASD. The table is useful, as it allows the courseware developer and e-moderator to map the argumentation skills to design practices and affordances using CSCL.

An evaluation of the conceptual ASDF was done in focus groups, whose participants included supervisors (as experts in the supervision of postgraduate research) and ODeL courseware developers – see Section 5.3. The conceptual framework was discussed with the participants, who had an opportunity to complete an online survey. The themes that emerged from the thematic analysis process, as presented in Figure 5.3, were identified as human capacity, collaboration, infrastructural requirements, the argumentation model and ASDF benchmarking – see sections 5.3.3.1 - 5.3.4. The findings of the online survey were discussed in Section 5.3.5.

The theme relating to the use of the argumentation model, with specific reference to Toulmin (2003), was widely discussed. Although there were suggestions that other models be considered, the participants all agreed that Toulmin's (2003) is an effective and well-researched model to implement.

As to the theme of collaboration, the participants concurred that the scaffolded pathway and collaboration would benefit students' research development. The mapping of Bloom's taxonomy and the SAQA CCFOs in the learning path was commended, although as a number of participants noted, some students may have to go back a step or two, before proceeding to the next level. This is an important finding, which complements the theory of the ZPD (Langford, 2005): (1) through collaboration, students will expand their argumentation skills and (2) the e-moderator has to take cognisance of factors that may influence progress and allow students to develop their argumentation skills while moving between the zones in the ZPD.

The focus group discussions highlighted that the ASDF does not fully encompass the perspective of human capacity. Recommendations were put forth to incorporate a distinct component into the framework, specifically addressing the human-capacity aspect of the supervisor. Based on the thematic analysis, it was determined that separate human capacity groups should be established for both the student (in the role of the researcher) and the lecturer (in the role of supervisor). This has been taken into account and is addressed in Chapter 6.

The study findings confirm the need for a framework, using CSCL, that can be implemented in a graduate course to augment the development of students' argumentation skills. Collaboration among students is important for fostering their sense of working together to reach a higher goal – in this instance, the acquisition of skills which will help them to develop a well-formulated argument.

Implementing the ASDF in a graduate course using CSCL, and measuring the perceived educational experience from the students' perspective, in terms of social, cognitive and teaching presence, will serve to answer RSQ4: *"How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?"* The implementation of a revised ASDF, and the capacity to measure a student's perceived educational experience, are discussed in Chapter 6.

CHAPTER 6

REPORTING ON THE MEASURING OF THE ASDF EXPERIENCE FROM THE STUDENTS' PERSPECTIVE

6.1 INTRODUCTION

Following the DSR stages described in Section 4.2.1, this chapter represents stage 3 as the researcher reports on the design, development and implementation of the revised ASDF, by implementing the feedback obtained from the focus groups (see Chapter 5), the evaluation of the approach from the perspective of the perceived educational experience of the students, and feedback received from a 2022 Computing Conference (Van der Merwe et al., 2022).

The Computing Conference 2022 was held online and the presenters were requested to provide a video feed that was aired at a specific time during the conference. The presentation could be viewed by the conference attendees, even after the initial viewing. Only two conference attendees made comments. The comments from the first attendee are of note, as the attendee was not sure when the argumentation skills "training" will be conducted in the course. This will be further discussed in Chapter 6 by the presentation of a storyboard (Table 6.1) where the activities relating specifically to argumentation and the related ASD e-tivities, will be presented.

The outcomes of this chapter are expected to contribute to answering RSQ4: *"How can the key elements be coordinated to provide a CSCL framework that could*

contribute to the development of argumentation skills in a graduate computing course?"

The remainder of the chapter is structured as follows: in Section 6.2, the revised ASDF is presented and in Section 6.3 the practical implementation of the ASDF in a graduate research course is discussed. Section 6.4 reflects on graduate students' perceived educational experiences. In Section 6.5, a schematic presentation of the ASDF is given as a summarised version of the ASDF.

6.2 REVISED ASDF

From the thematic analysis, the researcher identified that there should be separate human capacity groups for both the student (as the researcher) and the lecturer (as the supervisor) (see Figure 6.1, where the supervision resources have been removed from the infrastructural requirements element, and presented as a separate node). The human capacity element then consists of the student-researcher and the supervisor, to accommodate the recommendations of the focus group, namely that the role of the supervisor cannot only be seen from the viewpoint of institutional resources. The role of the supervisor, as an e-moderator, should be emphasised by adding a component in the ASDF that will represent the supervisor's human capacity.

The revised ASDF presents a framework for the implementation of ASD, using CSCL in ODeL. It comprises the course requirements that influence the choices in pedagogical approaches for ASD, the entry requirements for the student and the minimum requirements for the e-moderator. The pedagogical approach is applied in the ODeL environment, and is dependent on the technology available in a CSCL milieu. Access to the institutional resources occurs through the available ODeL technology infrastructure, while applicable external resources are identified by the e-moderator.

The scaffolded e-tivities that augment ASD are accessed using CSCL. The evaluation of the approach is done by measuring a student's perceived educational experience while engaging in e-tivities. The output is the presentation of a well-formulated argument as an academic report.

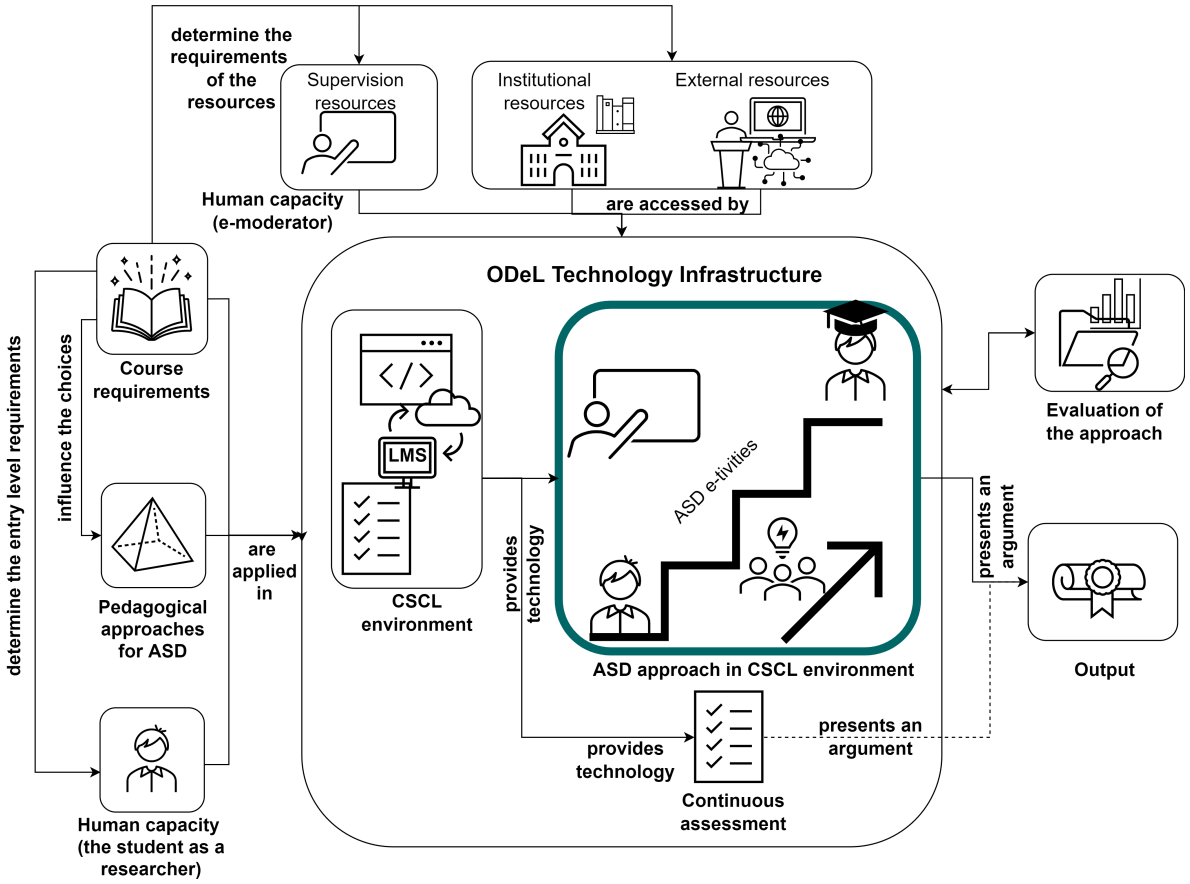


Figure 6.1: Revised ASDs framework (ASDF)

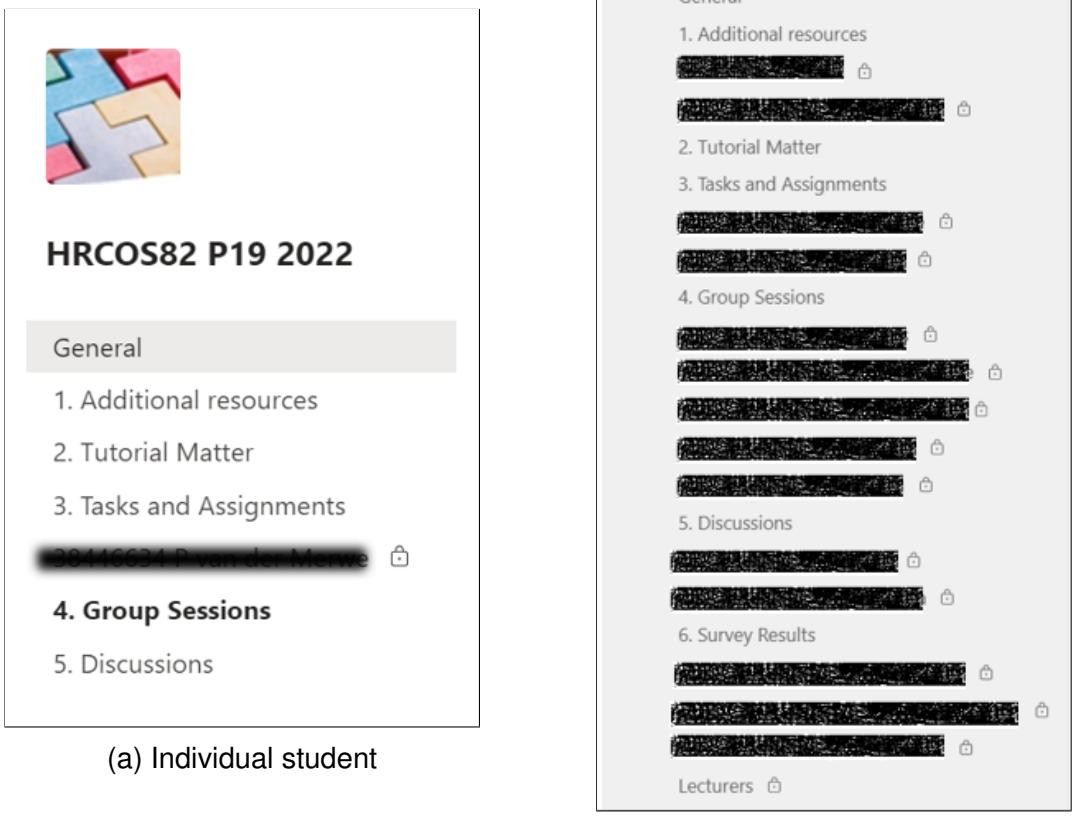
6.3 IMPLEMENTATION OF THE ASDF USING CSCL

The ASDF is implemented in an MS Teams environment. Prior to 2022, the LMS used at Unisa was built on SAKAI[1], before being changed to Moodle[2] in 2022. For HRCOS82-P19, MS Teams was chosen as CSCL environment for implementing the ASDF. At Unisa, all enrolled students have access to MS Teams and are governed by the university's policies in accessing this platform via their institutional email addresses. Furthermore, driven by the Covid-19 pandemic and discussions in courses being presented online, graduate students are familiar with the MS Teams milieu, having been exposed to it in many of their other courses.

6.3.1 Practical example: HRCOS82-P19

The participating students were linked to the HRCOS82-P19 MS Teams group and to individual private channels (see Figure 6.2a for a view of MS Teams from the perspective of an individual student, and Figure 6.2b for a view of MS Teams from the perspective of the e-moderator). The channels with locks, shown in Figure 6.2b, were private, being accessible only to the e-moderator and the individual student. The rest of the channels were "open" and accessible to all members of the MS Teams group.

[1] https://www.sakailms.org
[2] https://moodle.com



(a) Individual student

(b) E-moderator

Figure 6.2: MS Teams group, channels and private channels

A storyboard, as seen in Table 6.1, was created as a practical example, taking into account the elements in the ASDF. The elements in the storyboard were mapped to the different tools and functionalities in the MS Teams site, as seen in the organogram in Figure 6.3. Also, in the storyboard, the ASDF elements were mapped to the CSCL affordances and the needs to be addressed. By providing examples of ASD e-tivities, appropriate design strategies and the role of the e-moderator and the student in this learning journey, the storyboard is important and can be applied not only to this HRCOS82-P19 group, but also in similar graduate courses using CSCL. For practical examples of resources, the last column indicates whether the resource was available as an internal institutional resource (I), or selected by the e-moderator as an external resource (E).

Table 6.1: Storyboard: applying the ASDF using CSCL

				Human capacity			
ASDF Element	**CSCL Affordances**	**Needs addressed**	**Design strategies**	**E-moderator**	**Student**	**ASD e-tivities**	**Resources: (I)nstitutional (E)xternal**
Course requirements ODeL technology infrastructure Pedagogical approach: Implementing scaffolded learning using CSCL Institutional resources				E-moderator attends relevant training in institutional resources and using CSCL environment affordances	Passed required prerequisites Completed research methodology course Access to internet and LMS	Complete MOOC on Writing Skills	I
Pedagogical approaches for ASD Institutional resources External resources	1 Establishing a joint task	Joint project is presented to the group Instructions on how to use institutional and external resources	Students presented with task that is outside their area of confidence	The research project is discussed with students	Attend the online discussion Add comments in discussion forum	Videos: Toulmin model of argumentation Installing of Mendeley and integration with MS Word	I E
Institutional resources CSCL environment	2 Communication	Group communication using tools in the LMS	Using the communication platform and applications available in the LMS Timeous feedback	Toulmin model of argumentation discussed with applicable examples Feedback to the student in the private channel regarding first attempt at argument in his/her own project	Analyse at least three articles and identify the elements of an argument Share with e-moderator in private channel Share with the group in the discussion channels	Chats, webinars, threaded discussions available using CSCL Present work to the group	I
Institutional resources CSCL environment External resources	3 Sharing resources	Group shares resources	Sharing of relevant links, channels and resources	E-moderator monitors and provides guidelines	Student identifies additional resources that can be used in searching for articles towards the literature review	Videos: Using Google Scholar effectively Identify additional resource platforms	I E
ASD approach using CSCL Institutional resources	4 Engaging in productive processes	Scaffolded learning journey Focus on the development of argumentation skills	Structured tasks Group work Feedback given	Give feedback to the student by referring to the elements of an argument	Students identify elements of an argument in their proposals Submit proposals	Peer assessment by applying argumentation tools	I
ASD approach using CSCL Output as a well structured argument Institutional resources	5 Engaging in co-construction	Co-construction by providing input and feedback Presentation of work	Keeping the shared goals and problems in context	Keeping the shared goals and problems in context	Give feedback by presenting work in the group Provide comments by referring to the elements of an argument Present work as a well-structured argument	Discussion channels Present online	I
ASD approach using CSCL Evaluation of the approach Institutional resources	6 Monitoring and regulation	Evaluation of approach	Self- and group-evaluation Evaluation of the approach	Evaluation of the approach	Self-evaluation by the individual student Evaluation of the approach within the group	Discussion channels Sharepoint / OneDrive	I
ASD approach using CSCL Institutional resources External resources	7 Finding and building groups and communities	Space provided in the LMS for students to join in communities with similar interests	Through a scaffolded learning approach, the student identifies relevant communities and use applicable resources	Create awareness of external resources	Student identifies relevant communities	Additional resources	I E

Following the organogram structure in Figure 6.3, the channels in MS Teams were designed for access to additional resources, tutorial matter, tasks and assignments, groups sessions and discussions, and access to the infrastructural requirements (Section 5.2.1.6) and ODeL technology infrastructure (Section 5.2.1.7) that should contribute to scaffolded learning in support of ASD using CSCL (see Table 5.3 for guidelines and examples). The channels are further discussed in sections 6.3.1.1 - 6.3.1.5.

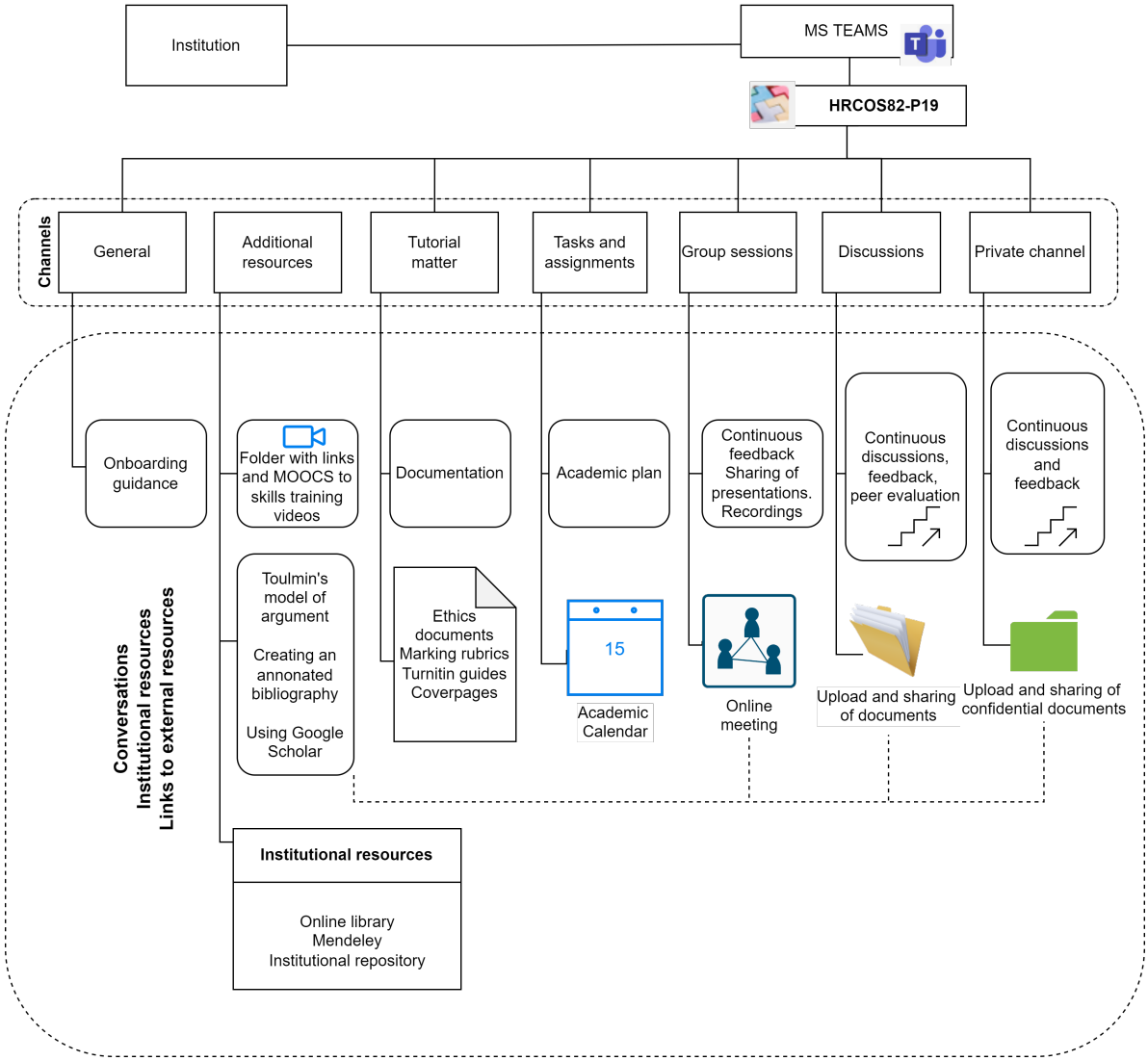


Figure 6.3: Organogram of an implemented ASDF

The LMS provided the necessary technology and access to institutional resources. Using CSCL, access to the relevant institutional resources was provided through links and the main HRCOS82 project site. As advocated by Jung and Lee (2020), access

to external resources was carefully planned and assessed by the e-moderator to determine their contribution and value, before being introduced into the course.

The facilitation of the learning journey was accomplished through carefully constructed e-tivities, which were chosen to not only allow for a scaffolded learning journey, but also to augment the development of argumentation skills (for examples of e-tivities using CSCL, see Table 5.3). The e-tivities addressed the different levels of human cognition, as described in Bloom's revised taxonomy, and in the process followed the scaffolded learning journey as advocated by Salmon et al. (2010). In addition, the e-tivities allowed the students to move in and out of the ZPD as they progressed in the learning journey, and to become more confident in applying their course knowledge and argumentation skills. As the students progressed, the role of the e-moderator changed from that of an instructor or teacher to that of a facilitator in the learning journey.

6.3.1.1 Additional resources

After the students in the HRCOS82-P19 project had completed the MOOC on Academic Writing and Integrity Fundamentals offered by the university, the Toulmin (2003) model of argumentation, as described in Section 5.2.1.2, was presented to the students. The students accessed an online video created by the e-moderator on Toulmin's model, and then in an interactive session had an opportunity to discuss and apply it in real-life situations and also to an article sourced by the e-moderator. This was supplemented with online material and discussions on creating an annotated bibliography and using Google Scholar to search for scholarly literature. Links were provided to the institutional resources, such as the institutional online library, reference management (software and training) and institutional repository. For an example of additional resources implemented in MS Teams, see Figure 6.4.

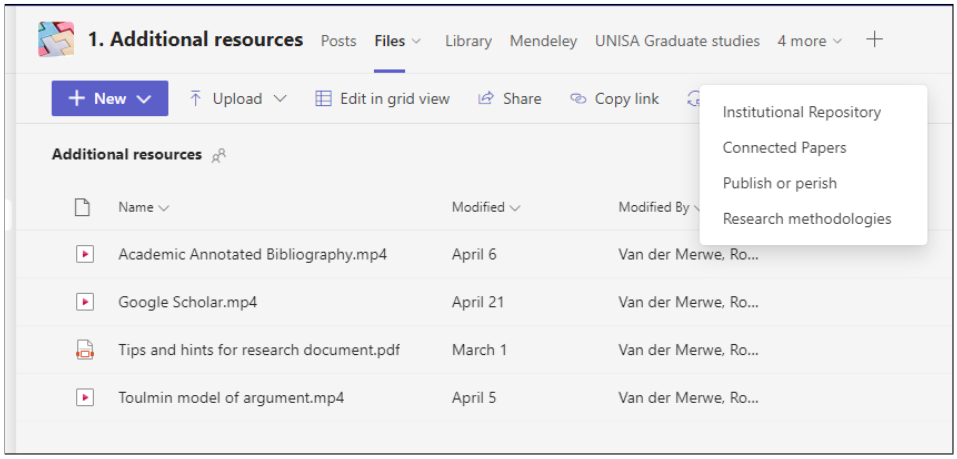


Figure 6.4: Example of additional resources

6.3.1.2 Tutorial matter

The tutorial matter included access to documentation relating to ethics, rubrics used in assessment, and originality report software (Turnitin)[3].

6.3.1.3 Tasks and assignment

In this channel, the academic plan, with the specified e-tivities for this project, were shared with the group.

6.3.1.4 Group sessions and discussions

The technology core affordances of shared tasks, communicating, sharing resources, collaborative learning, co-construction and the building of groups, were facilitated by the e-moderator during the group sessions and subsequent online discussions. During these sessions, the continuous progress of the graduate students' argumentation development, was monitored. This was done by means of formative assessments and additional work as and when deemed necessary by the e-moderator. Each channel offers resources that can be accessed by the student, as seen in the example in Figure 6.4. Figure 6.5 is an example of a resource uploaded by a participant in the MS Teams group.

[3]https://www.turnitin.com

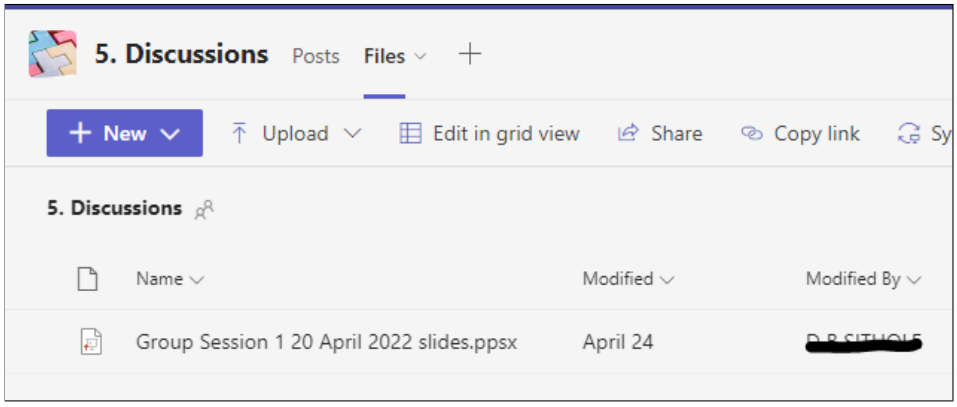


Figure 6.5: Example of a resource uploaded by a student in an open channel

6.3.1.5 Private channels

These channels allowed for private and continuous discussions and feedback, as well as the uploading and sharing of confidential documentation (see Figure 6.6 for an example of resources which were uploaded and shared in a private channel).

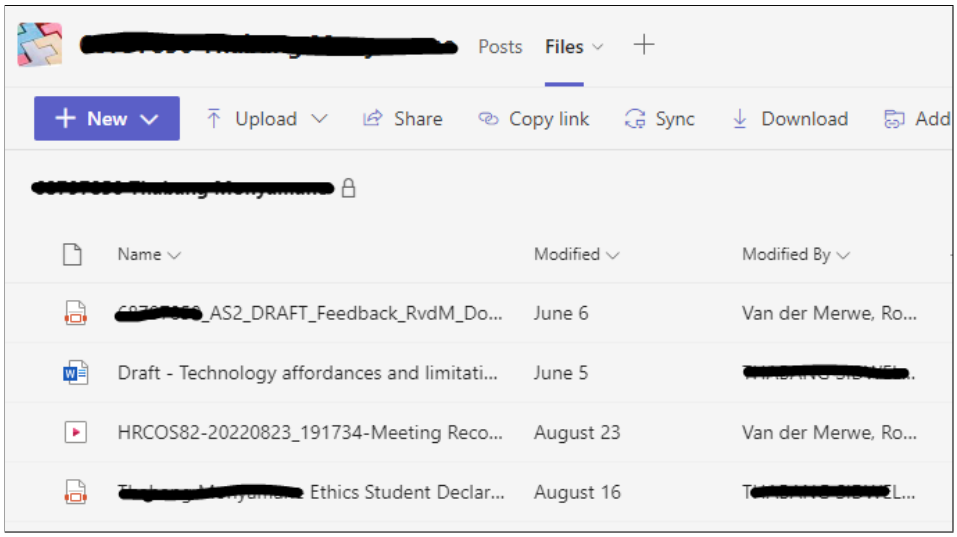


Figure 6.6: Example of resources uploaded in a private channel

6.4 GRADUATE STUDENTS' EDUCATIONAL EXPERIENCE

Incorporating students' educational experiences into the ASDF is an important component of a sustainable framework that can be implemented to augment argumentation skills in a graduate course using CSCL. In this regard, measuring the students' educational experience as a combination of social, teaching and cognitive presence (Demuyakor, 2020; Jung & Lee, 2020) was imperative. As Garrison

(2016) and Fiock (2020) advocate, these three presences are required in distance education to create meaningful educational experiences. In Section 6.4.1, the three presences are discussed from the perspective of the Community of Inquiry (CoI), as advocated by the framework Garrison et al. (1999). Section 6.4.3 focuses on the implemented ASDF, which is evaluated from the graduate students' perceived educational experience thereof, in terms of the ASDF augmenting their ASD.

6.4.1 Elements required in the measurement of a meaningful educational experience

Following a collaborative constructivist approach to teaching and learning, Garrison et al. (1999) introduced the CoI framework which provides a structure that allows for the articulation of the educational experience of a student using CSCL (Shea & Bidjerano, 2010). The CoI framework is also significant in that it focuses on the development of an online learning community, by emphasising that individuals do not learn in isolation (Garrison, 2016). Notably, the importance of learning scaffolds in online learning in the educational experience of a student has been reported on in the body of literature (Feng et al., 2017; Fiock, 2020; Sutton, 2017).

The three elements of educational experience (social, cognitive and teaching presences), as described in the CoI, can be applied in evaluating the educational experience of graduate students in the ASDF, as those elements represent their perceived educational experiences while using CSCL (Annand, 2011; Kozan & Richardson, 2014). The elements further permit the researcher to measure the development of "critical inquiry and the collaborative construction of personal meaning and shared understanding" (Garrison, 2016, p. 24), from the perceived educational experience of the graduate student.

Figure 6.7 illustrates the elements of an educational experience in a CoI, as presented by Garrison and Arbaugh (2007). The three presences – teaching presence (TP), social presence (SP) and cognitive presence (CP) – are discussed in

more detail in sections 6.4.1.1 - 6.4.1.3, to provide context for the CoI and why these presences are important when measuring the educational experience of a student using CSCL. The intersection of the presences includes the educational experience of support, which refers to the setting of the academic climate, supporting discourse, and the selecting of relevant content.

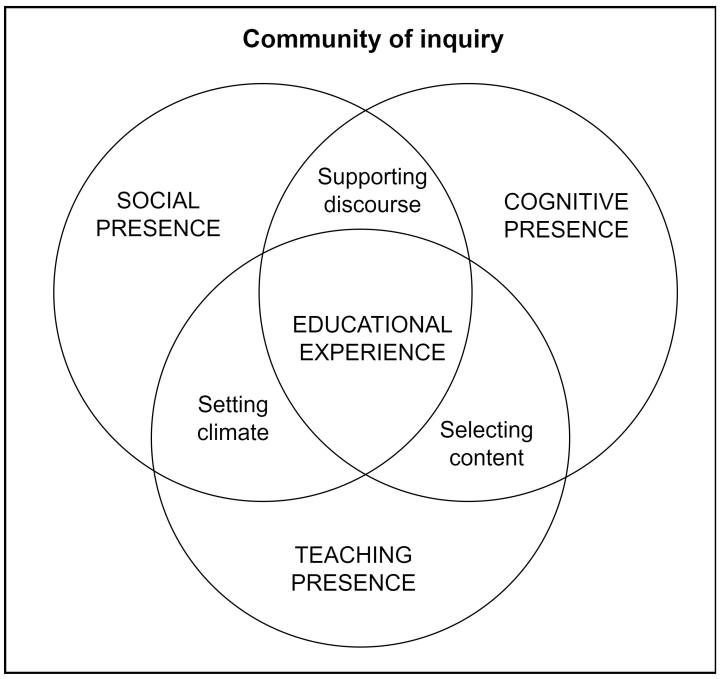


Figure 6.7: Elements of an educational experience in a community of inquiry (Garrison & Arbaugh, 2007)

6.4.1.1 Teaching presence

Teaching presence is defined as "the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (Anderson et al., 2001, p. 5). It occurs when the e-moderator and courseware designer "design, support and direct student activities to provide a powerful learning experience" (Rubin et al., 2013, p. 50). In the learning experience, the student and the e-moderator have joint responsibility in the learning interaction experience, using CSCL (Rueter et al., 2019; Shea & Bidjerano, 2012). Studies sourced from the literature agree that the learning interaction between students involves the co-construction of knowledge by allowing them to use the

affordances in the CSCL to develop their argumentation skills (Chi 2009; Chi & Wylie, 2014). Furthermore, this co-construction and use of the affordances available in the CSCL will happen online, if CSCL environments are designed in such a way that they support the teaching presence element – that requires the professional development of online teaching skills in educators (Gregory & Salmon, 2013)

In the evaluation of the approach pertaining to teaching presence, three main categories are identified, namely (1) *instructional design and management*, which refer to pedagogy, (2) *facilitation of discours*e, which refers to the design and implementation of the discourse, and (3) *direct instruction*, which refers to the e-moderator's responses to students (Jaffer et al., 2017; Rourke et al., 1999).

6.4.1.2 Social presence

Social presence is defined as "the ability of learners to project themselves socially and emotionally in a community of inquiry" (Rourke et al., 1999, p. 3). The categories presented in the social presence are: *affective expression*, which refers to students sharing personal expressions and values; *open communication*, which refers to students developing aspects of mutual awareness and recognition; and *group cohesion*, which refers to students building and sustaining a sense of group commitment (Garrison & Archer, 2000). In a study by Swan and Shih (2019), the design and presentation of the course and the social presence of the students were found to be vital and deemed important to foster, not only through the presence of the e-moderator, but also through explicit training for students on social presence.

6.4.1.3 Cognitive presence

Cognitive presence is defined as the "exploration, construction, resolution and confirmation of understanding through collaboration and reflection in a community of inquiry" (Garrison, 2007, p. 65). It describes the progressive phases of practical inquiry that will lead to the development of a solution to a problem (Akyol & Garrison, 2011). The categories presented in the cognitive presence include the *triggering*

event, which refers to problem identification for further inquiry; *exploration*, which refers to an individual exploring the issue; *integration*, which refers to students forming meaning from ideas shaped during the exploration phase; and *resolution*, which refers to students' ability to apply the new skills and knowledge learned in real-world applications (Garrison & Archer, 2000).

6.4.2 Student input on social, teaching and cognitive presence

A survey (see Appendix D.1: CoI survey) was distributed to the wider HRCOS82 student group and the quantitative data obtained, was subsequently analysed. A CoI survey is used to measure the three core elements of cognitive, social and teaching presence, as the presences that are required to create a meaningful educational experience in distance education (Garrison et al., 1999). The distribution of the CoI survey to the wider HRCOS82 group of students and the interpretation of the outcomes is not directly linked to any of the research questions but has relevance in providing context to the students in the HRCOS8-P19 project. The findings will be presented in future research. (See Appendix D.2: HRCOS82 CoI survey data)

A Pearson product-moment correlation coefficient was calculated to evaluate the relationships between the participating graduate students' social, teaching and cognitive presences (N=82). The preliminary analysis showed no violations in the assumptions of normality, linearity or homoscedasticity. The correlation probability showed statistically significant relationships between all the elements (teaching, social and cognitive presences) of the CoI survey ($\rho < 0.05$), thus all three elements were relevant. There is significant evidence to conclude that there was a strong, positive association between teaching presence and cognitive presence ($r = .580$), but a weak association between social presence and cognitive presence ($r = .330$).

Multiple linear regression was applied to predict the cognitive presence (dependent variable), by looking at teaching presence and social presence (as independent variables). Multiple linear regression allowed the researcher to determine the

variation of the model and the relative contribution of each independent variable contribution to the total variance. It was found that teaching presence significantly predicted cognitive presence, while social presence did not significantly do so.

The results of the multiple linear regression confirmed the findings of a study by Rolim et al. (2019), that teaching presence in CoI has stronger links with cognitive presence, specifically with the two high levels of cognitive presence, namely integration and resolution. This is pertinent to the current thesis, indicating that teaching presence is still important in a student's learning journey towards higher levels of cognitive presence, which includes the development of argumentation skills in the academic context.

6.4.3 Measuring the perceived educational experience from graduate students' point of view

Initially, one focus group session was planned with the student participants in this research study. During this session, nine students attended and opted to participate in the research. After this session, one of the students who had not attended, asked to be interviewed, on the basis of having something to contribute to the discussions. Another session was subsequently held with this individual. All students who attended the group sessions, were enrolled for HRCOS82-P19. The focus group sessions lasted 45 minutes, and during that time the student participants were allowed to share their educational experience of the ASDF, from the perspectives of teaching presence, social presence and cognitive presence, respectively.

In the focus groups, the following main question was discussed: *To what extent did the use of a CSCL environment augment the development of your argumentation skills in the graduate research course?* To guide the discussions, sub-questions were used, which addressed the categories presented in each of the presences identified as significant in the educational experience (see Table 6.2).

Table 6.2: Measuring educational experiences from a student's point of view

EDUCATIONAL EXPERIENCE	**Leading question(s)**
TEACHING PRESENCE	
STRUCTURE (DESIGN AND ORGANISATION)	1. Was the structure of the course well communicated with you?
FACILITATION OF DISCOURSE	2. How did the supervisors help you to identify problems in your thinking?
DIRECT INSTRUCTION	3. How did the supervisors help you to focus on the relevant issues in your writing?
SOCIAL PRESENCE	
EFFECTIVE EXPRESSION	4. Did you get a sense of belonging to the project?
OPEN COMMUNICATION	5. Did you feel comfortable conversing in the discussion forums?
GROUP COHESION	6. Did you feel comfortable sharing your opinion and disagree with the rest of the participants when necessary?
COGNITIVE PRESENCE	
TRIGGERING EVENT	7. Did the project increase your interest in developing a well-constructed argument?
EXPLORATION	8. Which of the resources did you use in MS Teams to overcome barriers and problems presented in the project, specific to the development of a well-constructed argument?
INTEGRATION	9. How far were you able to integrate the model of argument in your project? Did you feel that you were academically growing in this project?
RESOLUTION	10. How did you apply the knowledge of developing an argument, beyond this project?

6.4.3.1 Discussing the findings from the focus group discussions

The data-capturing followed the contextualist method advocated by Braun and Clarke (2006, 2020), as described in detail in Section 5.3.2. The dataset was coded using a codebook (Braun & Clarke, 2020). *Keyness* was identified based on the importance of the theme in relation to the overall research question, and grouped and labelled according to coherent patterns. The researcher acknowledges that the

data were read through the lenses of her social, cultural, historical and disciplinary position, and that she was involved in the focus group discussions.

In those discussions, organisation, facilitation and direct instruction were emphasised as important, and two of the students agreed that the well-designed **structure** of the course was one of the reasons why they managed to remain focused on the course. This was supported by the use of a well-structured rubric that offered them clear guidance. Feedback included that they were aware of the **scaffolded learning** that took place – this is evident from comments such as the following:

> *...so step by step, starting from assignment 1 and then assignment 2, and then the next assignment, meaning that in the final report, it is going to be everything that we have gone through. I think that it has been structured in a way that I could see how far I've gone through the module.*

One participant commented that they were all

> *at the same level because it happens that, in some instances, some people would tend to take a little bit longer to understand some concepts, but then with the structure of the module, I think it enabled everyone to be at the same level, as much as others are quicker to understand some concept[s].*

As for **direct instruction**, the participants were in agreement that the constructive feedback received from the e-moderators helped them to identify their strengths and weaknesses relative to the argument in their projects.

The importance of informing the group of the design and organisation of a course was mentioned. The constructive feedback in the formative assessments and discussion forums was indicated as being core to the development of not only their research skills, but also their ASD, as mentioned by one participant:

> *... when I started, I didn't know what I was doing, but as you kept on explaining and leading us, guiding us, really... all of a sudden everything was clear. I was excited. I understood what I was doing and I believe from now on, I can do it [research].*

The students indicated that the recordings of the different group sessions were accessible afterwards, and that assisted them in reinforcing their understanding of concepts. It also assisted those who could not attend the discussions due to other commitments.

Open communication was mentioned throughout the discussions as being central to the course. This emerged from the discussions as unfolding between the individual and the e-moderator, but also during the online discussions. One participant reported feeling

> *comfortable and [it] was actually interesting to have people not only just disagreeing for the sake of disagreeing, but actually why they thought their opinion was the correct one.*

The participants referred to the **additional course resources** and **links to institutional resources** available in the dedicated MS Teams channel. Specific mention was made of the availability and accessibility of the resources that allowed them access to information and resources for the discussions during the group sessions. Also, the use of dedicated channels for sharing files between the student and the e-moderator was found to be useful, with the students mentioning that it allowed them to share information without sharing with the main group. Specific mention was made of the first formative assessment, where they had an opportunity to share a draft version with the e-moderator. The general feedback was subsequently shared with the group during group session.

On a question from the interviewer about their preference for **MS Teams as the platform** for this course, the overall experience was positive, yet there were

participants who indicated that the structure of MS Teams could be confusing for a first-time user, as *"it was sometimes a challenge to know where the different topics and resources were".*

The role of the **e-moderators** in the course was emphasised on various occasions as being of importance. This was confirmed by students indicating that they experienced *"a sense of belonging"*, as their communication with the e-moderators was acknowledged and responded to.

Although the **building of groups** was addressed, the sense from the discussions was that the participants did not form individual groups to discuss the project outside of the formal discussion classes.

As to the **development and application of argumentation skills**, four participants indicated that they were better able to articulate their thoughts and ideas and use the elements of the argument model when formulating an argument, as indicated by one of the participants who stated: *"When we discuss, I don't feel scared of being wrong, because I do know that I will [be allowed to] give reasons [. . .] why I should consider other options".* During the discussion, a number of participants indicated that they had applied argumentation skills not only to the HRCOS82-P19 project, but also managed to transfer it to their everyday lives and work environment. One participant mentioned having to write performance reviews, and stated that s/he was able to present a more carefully constructed report and apply the elements of argumentation in his/her writing. The participant added that s/he used the additional resources when explaining how to search for credible articles, and did not only use wikis when searching for grounds and warrants. Another participant mentioned that

> *"putting my reasoning in a way that, people would understand what I'm talking about and having to make them see what I'm talking about. [. . .] The module*

made it possible for me to [...] structure my arguments and reasoning". Another study participant shared that his/her project in another course *"was picked out in the writing class as a good example of a well-constructed portfolio".*

6.4.3.2 Themes emerging from the focus group discussions with the students

The themes that emerged from the thematic analysis are presented in Figure 6.8. Presented as interlocking pieces, it was clear from the discussions that the teaching, social and cognitive presences are integrated, and it was evident in the focus group that the students integrated all of these presences when discussing their educational experience. Four main categories that emerged from the discussion were:

- Cross-disciplinary applications: mentioned twice. Students applied knowledge from multiple disciplines, such as business, economics, and sociology, which facilitated a holistic understanding of their research topic.
- Use of technology: mentioned three times. Students utilised online databases and research tools to access a wider range of sources and find information more efficiently. For instance, one student mentioned using online databases for researching the impact of climate change on the economy, enabling access to scholarly articles and reports.
- Collaborative learning: mentioned twice. Students engaged in collaborative work with peers, fostering learning from each other and enhancing teamwork and communication skills.
- Comments on course structure: mentioned twice. Students found the course structure clear and well-organized, appreciating the feedback provided by their supervisors.

The themes that emerged from the focus group discussions mirrored the three pillars of CSCL which Jeong et al. (2019) identified as pedagogy (course structure), collaboration and technology. In addition to the three pillars, the results from the thematic analysis in this study identified a fourth pillar, namely "application", in which

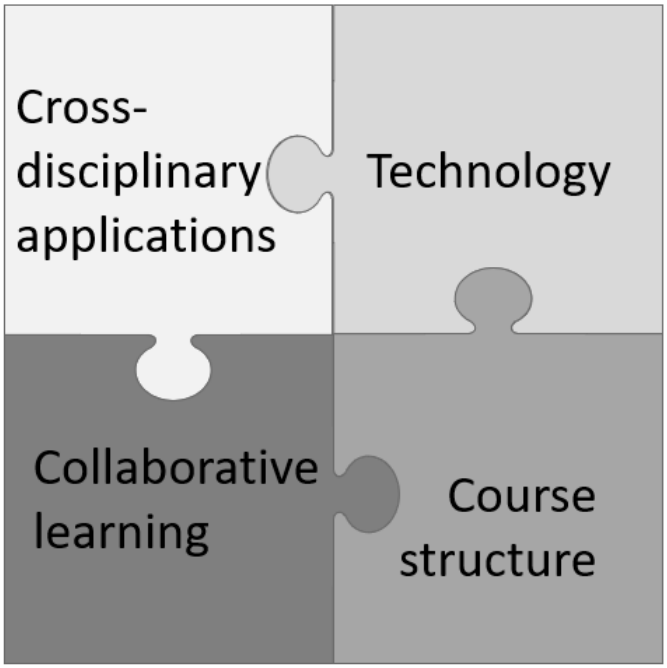


Figure 6.8: Themes emerging from the thematic analysis identified in focus groups with students

the student uses CSCL to apply skills in cross-disciplinary fields. These themes are discussed in Section 6.4.4, where the researcher reflects on the group discussions specific to the perceived educational experiences of the students in the ASDF.

6.4.4 Reflection on the group discussions with the graduate students

Incorporating the students' educational experiences into the ASDF was deemed a vital component of a sustainable framework that can be implemented in augmenting argumentation skills in a graduate course, using CSCL. In this regard, measuring the participating students' experiences as a combination of social, teaching and cognitive presences provided insight into their perceived educational experience of the role of the ASDF in augmenting their argumentation skills. From the discussions in the focus groups, two of the students emphasised that teaching presence is core for them, as not only the physical presence of the e-moderator, but also a well-structured pedagogical environment that can guide them throughout the academic course. Cognitive presence equally played an important role in the student's educational experiences, specifically in discussions relating to ASD and the application thereof in

multi-disciplinary fields. This is confirmed by Annand (2019, p. 12), who states that "sustained communication in the educative process cannot be assumed", and that subsequent representations of learning need to be developed that are not built on the instructional design.

Based on the responses, it was apparent that social presence had a limited influence on the educational experience. For instance, none of the students mentioned forming independent groups for project discussions outside the formal discussion classes. When prompted, the group specifically mentioned relying solely on the online group sessions facilitated by the e-moderator. This is in line with findings reported by Swan and Shih (2019), that in graduate studies, the presence of the e-moderator often has a greater influence in determining student satisfaction, than the presence of peers does. This was confirmed in a study that the researcher did amongst the larger HRCOS82 group of students (see Section 6.4.2).

6.5 SCHEMATIC PRESENTATION OF THE ASDF

Figure 6.9 presents a schematic presentation of the argumentation skills development framework (ASDF) that constitutes the elements required in a framework, using CSCL, that will augment the development of argumentation skills in graduate research, whilst the graduate student is engaged with academic activities (*e-tivities*) in the learning journey and progresses to the presentation of a well-developed argument.

The diagram (Figure 6.9) summarises the elements that were discussed in detail in Section 5.2.1, and the discussion and presentation of a revised ASDF, as presented in sections 5.3.1 and 6.2 respectively. It further illustrates the dependencies between the different elements using CSCL. These elements are the *course requirements* that determine the *pedagogical approaches for ASD*, which in turn determine the affordances in the *ODeL technology infrastructure*.

The *course requirements* also inform the requirements for the *e-moderator*, who supervises or facilitates the *scaffolded learning journey* of the *student as a researcher*. The *ODeL technology infrastructure* provides technology and access to *resources*, by the e-moderator and the student alike. As part of the course development, the e-moderator, can access, use and contribute to the resources in the technology infrastructure. Similarly, the student as a researcher can contribute to the resources for the course (Wenger-Trayner & Wenger-Trayner, 2011). The e-tivities, shown as steps on the learning path, represent the scaffolded learning journey as described by Salmon (2003; see also Salmon & Wright, 2014). In this regard, students progress from an academic space with little or no skills in presenting a well-structured argument, to a place where they can present a well-formulated argument. This supports the zones outlined in the ZPD (Langford, 2005) as discussed in Section 3.3.2, through which students will progress in the learning journey to reach a space where they can contribute to the body of knowledge, or, - as in this case in this study -, to arrive at a well-presented argument.

6.6 SUMMARY

This chapter reported on the development and implementation of the revised ASDF in Section 6.2, as presented in Figure 6.1. The practical implementation of the revised ASDF in the HRCOS82-P19 project, was discussed in Section 6.3. The graduate students' educational experiences came under the spotlight in Section 6.4, while in Section 6.5, a schematic presentation of the ASDF was presented in Figure 6.9.

The required elements for measuring a meaningful educational experience, namely social, cognitive and teaching presence, were presented in Section 6.4.1. The evaluation of the approach was reported from the perspective of the educational experience of the students in the wider HRCOS82 course (see Section 6.4.2), the students enrolled for the HRCOS82-P19 project (see Section 6.4.3) and the feedback from the Computing Conference 2022, in answering *RSQ4: How can the*

key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?

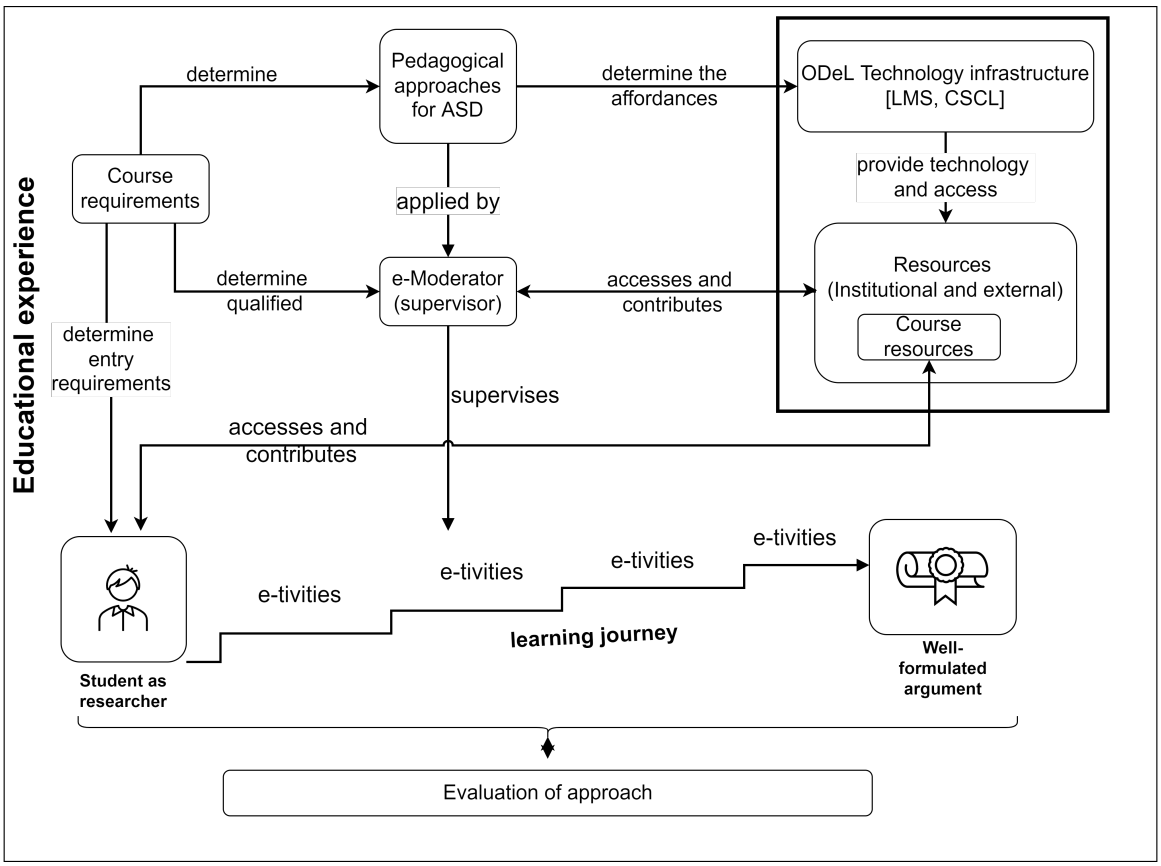


Figure 6.9: Schematic representation of the ASDF

Measuring the educational experience of the students in the wider HRCOS82 project (see Section 6.4.2) was done by distributing the CoI survey to all the participating students. Thereafter, the quantitative results were analysed to determine the association between the teaching, cognitive and social presences. The findings revealed statistically significant relationships between all the elements (teaching, social and cognitive), yet there was a strong, positive association between teaching presence and cognitive presence, but a weak association between social presence and cognitive presence. The results confirmed the findings of a separate study (Rolim et al., 2019), that teaching presence in CoI has stronger links with cognitive presence, specifically with the two high levels thereof, namely integration and resolutions.

The perceived educational experience from the point of view of graduate students enrolled for the HRCOS82-P19 project, on the development of their argumentation skills through the revised ASDF, was described in sections 6.2 and 6.3 respectively. The participants reflected on their perceived educational experiences relating to the three elements of social, cognitive and teaching presence. The findings confirmed that teaching presence is core for graduate students, not only the physical presence of the e-moderator, but also a well-structured pedagogical environment to guide them throughout their academic course. Cognitive presence equally played an important role in the students' educational experiences, specifically in discussions relating to ASD and the application thereof in multidisciplinary fields. From the discussions, it was also evident that social presence did not play a major role in the educational experience, and confirmed that the presence of the e-moderator had an influence in terms of determining student satisfaction, more so than the presence of their peers.

To conclude this chapter, the researcher offers a representation of the ASD in Figure 6.10. Here, argumentation skills are embedded in the learning journey of a graduate student. The upward "spiral" illustrates an individual's life-long building blocks that contribute to the development of the cognitive presence of the student as a researcher. Using technological affordances to engage in learning using CSCL, the e-moderator, through scaffolded learning, provides a pedagogy that will augment the ASD for graduate students, while engaging with the academic course content.

Finally, an evaluation of the proposed approach is discussed in Chapter 7, as part of the researcher's conclusions and reflections on this research.

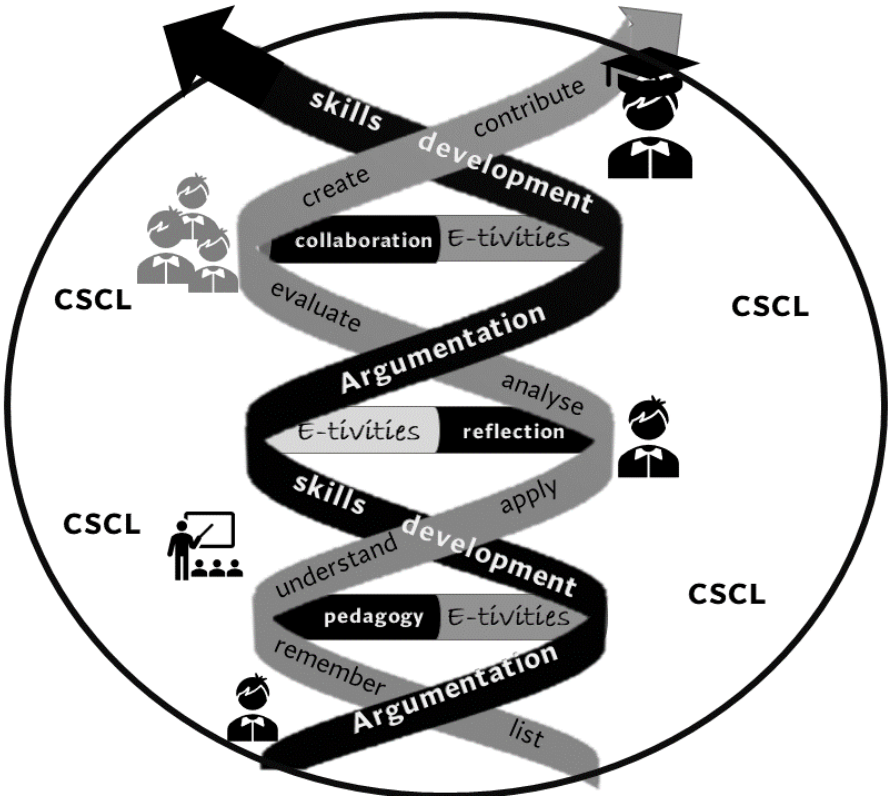


Figure 6.10: Argumentation skills embedded in the learning journey of the graduate student

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 INTRODUCTION

This chapter concludes the study reported on here, by presenting a critical view of the research, guided by the DSR stages. This is undertaken in light of DSR guidelines pertaining to relevance and rigour (Hevner & Chatterjee, 2010), whereby core decisions regarding the research and outputs are evaluated. The value of the research is discussed by mapping the contributions to the DSR knowledge contribution framework (Gregor & Hevner, 2013, p. 345), where the maturity of the solution is plotted against the application domain maturity, to substantiate the impact of the contribution. To further substantiate the contribution, the questions identified by Gregor and Hevner (2013), drawn from questions proposed by Wilson (2002), are presented with an explanation of the application in this study.

The chapter is organised as follows: In Section 7.2, the research overview is presented by mapping the core elements of DSR onto this study, to demonstrate the alignment with DSR as the research approach. In Section 7.3, the questions identified by Gregor and Hevner (2013), drawn from Wilson (2002), are used to evaluate this contribution by stating the question(s) with an explanation of the application thereof in this thesis. In Section 7.4, the limitations of the study are presented, while Section 7.5 contextualises the findings by reflecting on research developed in the space of CSCL, ODeL and ASD in higher education, since the start of this study. Section 7.6 concludes with recommendations for future research.

7.2 MAPPING RESEARCH QUESTIONS TO RESEARCH ACTIVITIES FOR DSR

Hevner and Chatterjee (2010, p.20) formulated a checklist with eight essential questions that DSR should address. Table 7.1 maps these essential questions to the research questions and research activities in this study, and the corresponding chapters, with specific sections and figures indicated in brackets.

Table 7.1: Checklist: questions DSR research should address in the study (adapted from Hevner & Chatterjee, 2010)

Questions	**Research questions / Research activities**	**Chapters**
1. What is the research question (what are the design requirements)?	RQ: How can CSCL environments be used to augment graduate computing students' argumentation skills development?	Chapter 1: Background Research problem Research question Rationale
2 What is the artefact? How is the artefact represented?	RSQ4: How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?	Chapter 6: Schematic representation of the ASDF (Fig.6.9) Schematic representation of argumentation skills embedded in the learning journey of the graduate student (Fig. 6.10)
3. What design processes (search heuristics) will be used to build the artefact?	RQ: How can CSCL environments be used to augment graduate computing students' argumentation skills development?	Chapter 4: Methodology, research design and methods
4. How are the artefact and the design processes grounded by the knowledge base? What, if any, theories support the artefact design and the design process?	RSQ1: What trends, drivers and barriers influence the use of CSCL in ODeL? RSQ2: What methodologies and frameworks exist that support argumentation skills development using CSCL in ODeL? RSQ3: What are the key elements required of a CSCL framework that could contribute to the development of argumentation skills in a graduate course?	Chapter 2: A systematised literature review (2.2.1) PRISMA (Moher et al., 2009) phases followed Themes identified (2.3) Chapter 3: Literature review: themes discussed and key elements identified (Table 3.3)

Questions	Research questions / Research activities	Chapters
5. What evaluations are performed during the internal design cycles? What design improvements are identified during each design cycle?	ASDF went through two phases of iteration and improvement. For the execution of the phases, detailed activities and stages were followed (4.2.1) Phase 1: Conceptual ASDF (5.2.2) evaluated in focus groups (thematic analysis of discussions and online survey) Survey metrics: simplicity, comprehensiveness, generality, exactness, clarity Phase 2: Conceptual ASDF (6.2) revised and implemented in HRCOS82-P19 project (6.3). The perceived educational experience was measured in focus groups (HRCOS82-P19) (thematic analysis of discussions) and a wider HRCOS82 group of students (online survey). Metrics: teaching, social and cognitive presence	Chapter 4: Methodology, research design and methods Chapter 5: Conceptual ASDF Evaluation of conceptual ASDF (5.3) Peer-reviewed conference (van der Merwe et al. 2022) Chapter 6: Revised ASDF Evaluation of revised ASDF (6.4.3)
6. How is the artefact introduced into the application environment and how is it field tested? What metrics are used to demonstrate artefact utility and improvement over previous artefacts?	Phase 1: Conceptual ASDF developed Conceptual ASDF presented to focus groups with experts Phase 2: ASDF revised Revised ASDF implemented using CSCL in HRCOS82-P19 Focus groups with students to measure the perceived educational experience from the graduate students' point of view (6.4.3)	Chapter 5: Development of conceptual ASDF (5.2) Presented to experts in focus groups (5.3.1) Chapter 6: Revised ASDF (6.2) Revised ASDF implemented (6.3) Measuring the perceived educational experience of the graduate computing research students' ASD, using CSCL
7. What new knowledge is added to the knowledge base and in what form?	RSQ4: How can the key elements be coordinated to provide a CSCL framework that could contribute to the development of argumentation skills in a graduate computing course?	ASD framework (ASDF) Methodology for CSCL for graduate research students' ASD Final ASDF (6.5)

Questions	Research questions / Research activities	Chapters
8. Has the research question been satisfactorily addressed?	RQ: How can CSCL environments be used to augment graduate computing students' argumentation skills development?	A systematised literature review to identify the themes and key elements required for ASDF (Ch 2) Themes and key elements discussed (Ch 3) Evidenced-based conceptual ASDF developed and evaluated (Ch 5) Revised ASDF implemented and evaluated (Ch 6)

7.3 CONTRIBUTION TO KNOWLEDGE

Drawing on the work of Wilson (2002), Gregor and Hevner (2013, p. 338) identify questions that can be used to evaluate the contributions presented in a study. In Table 7.2 the questions are stated, together with a response as it pertains to this study.

Table 7.2: Questions to ask in evaluating a contribution (Wilson, 2002, as cited in Gregor & Hevner, 2013, p. 338)

	Question(s) asked	Applicability to this study
Relevance of the question	Are the problems discussed in the paper of substantial interest? Would the solutions to these problems materially advance knowledge of theory, methods or applications?	Students undertaking graduate research often experience problems in respect of being unable to develop and present a well-formulated argument as evident from extant research and the observations of the researcher and supervisors (with combined 25 years of supervision experience) Theoretical level: a methodology that provides philosophy and strategy, by presenting the ASDF Methodological level: ASDF provides a methodology that can be used by courseware designers and e-moderators in designing graduate courses using CSCL and embedding argumentation models Application level: The ASDF has been tested in practice

	Question(s) asked	Applicability to this study
Relevance of the solution	Does the author either solve these problems or else make contributions toward a solution that improves substantially upon previous work?	Nascent design theory (level 2) - knowledge as operational principles/architecture (Gregor & Hevner, 2013, p. 342). ASDF is presented as a theorisation for guiding implementation in computing graduate research studies
The novelty of the method or solutions and their transferability	Are the methods or solutions new? Can the proposed solutions or methods be used to solve other problems of interest?	Evidence-based ASDF presented, for implementation in ODeL using CSCL. The concepts can be transferred to similar research in ODeL, to augment argumentation skills development The following are novel, original knowledge productions created for use in this study but applicable to related projects: Table 5.3 provides affordances of CSCL that should be considered when developing a graduate course in ODeL Storyboard (Table 6.1): implementation of ASDF elements in a graduate course Figure 6.3: example of implemented ASDF in MS Teams (organogram) Figure 6.9: Final ASDF Figure 6.10: Representation of argumentation skills embedded in the learning journey of the graduate student.
Knowledge mobilisation	Does the exposition of the study help to clarify our understanding of this area of research or application?	The solution maturity of the paper/study can be described as the identification of a research opportunity and a contribution to the body of knowledge (Gregor & Hevner, 2013) Having identified a compelling research study, the study draws on the theory of argumentation models, scaffolded learning, collaborative learning and pedagogical approaches using CSCL, and mobilises that knowledge to develop and implement an ASDF for graduate computing research students in ODeL Having done the research and published one related peer-reviewed paper. Future research will focus on more publications which could lead to expanding the community of practice and eventually influence policy.

7.4 LIMITATIONS IDENTIFIED IN THE STUDY

The phenomenon addressed in this study, namely the lack of ability in graduate students in computing, to develop and present a well-formulated academic argument, stemmed from the researcher's years of experience in the field of ODeL. Thus, the desire to develop a framework that can be implemented in the HRCOS82-P19 project, alongside the coursework, provided structure in respect of implementing affordances, using CSCL to augment the argumentation skills of graduate students. The researcher adopted the research philosophy of pragmatism, and had to keep an open mind, specifically since, as one of the supervisors (e-moderators), she was actively involved in the HRCOS82-P19 project.

In the course of the study, the researcher had to adapt to the scaffolded learning journey of the students, notably because, in practice, a learning journey is not always as predictable as it appears to be when set out in theory. The researcher had to improvise, and deal with institutional issues of late registrations and a lack of support from the ICT department, as well as country-wide problems such as power cuts which plague South Africa on a regular basis – that influenced students' attendance of online webinars and focus groups. To accommodate the students, the online engagements were recorded and, on special requests, repeated. One student who registered towards the middle of the course was accommodated, and additional online sessions were scheduled. To accommodate those students who experienced problems accessing and downloading articles from the institutional library, the college librarian assisted in downloading the relevant articles, which were subsequently shared in Mendeley. In this regard, the ASDF proved useful, as it allowed the students to join the ASD learning journey and progress towards developing and presenting well-formulated arguments, using the CSCL affordances and receiving support from their peers and the e-moderator.

7.5 RESEARCH PUBLISHED DURING THE COURSE OF THIS UNDERTAKING

The researcher acknowledges that research continued in the spaces of CSCL and ASD in higher education, since the start of this study. Notable studies include those of Wambsganss and Rietsche (2019) and Wambsganss et al. (2020), on technology-mediated argumentation learning using Natural Language Processing (NLP), machine learning (ML) and intelligent feedback learning tools for argumentation skills. Wambsganss and Rietsche (2019) and Wambsganss et al. (2020) propose using AI-based adaptive learning tools to actively support students in developing the ability to argue in a structured, logical, and reflective way. That is promising in terms of tapping into the potential of artificial intelligence for scaling, and providing individual feedback. Unfortunately, it is not obvious what argumentation model is being used, and the social components are not mentioned. Having noted those limitations in generalising the work, the use of ML to augment argumentation skills is acknowledged as an aspect to consider in future work.

In a study by Yilmaz and Karaoglan Yilmaz (2020, p. 1356), the importance of developing “group awareness” using CSCL, was studied. Yilmaz and Karaoglan Yilmaz (2020) propose developing tools that will enable users to assess their contribution to, and responsibilities towards, the rest of the group. Further, that study confirms that the use of a pedagogical agent increased the students’ task and group awareness in using CSCL to collaborate, and boosted their self-regulated learning skills. Many pedagogical agents are animated characters that facilitate learning in computer-based learning environments in higher education (Adcock & van Eck, 2005). The use of pedagogical agents which employ CSCL is promising in terms of using agents to assist students in mastering self-regulated learning, either on their own or as part of a group. That study does not contribute insights into the use of technology specifically to bolster ASD, but provides valuable insights into guiding instructional designers and practitioners in developing the CSCL environment. The

use of pedagogical agents in developing argumentation skills in graduate research courses is an aspect to consider in future work.

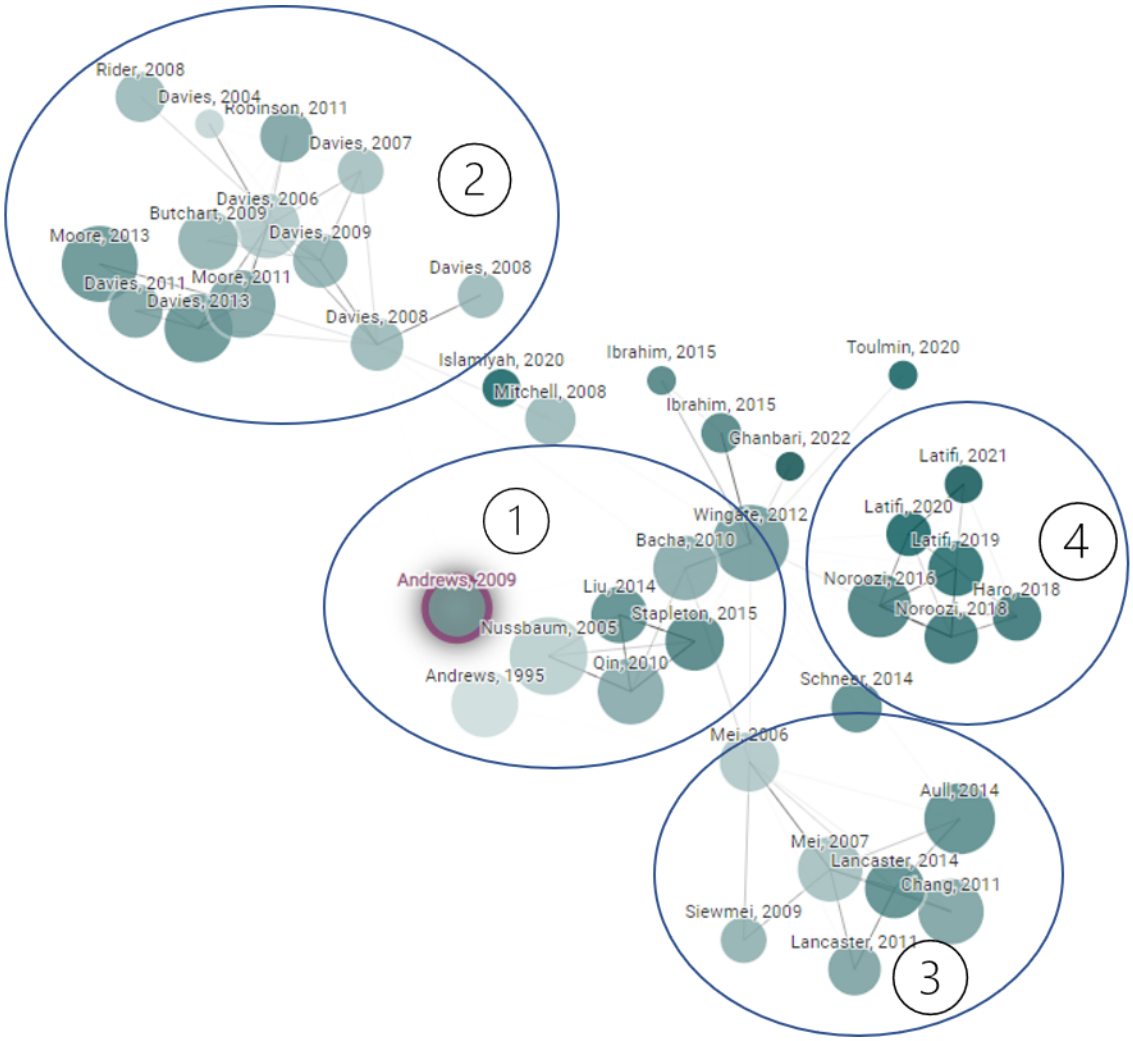


Figure 7.1: Maturity of using CSCL to augment ASD[1]

Recent studies have shown increased research outputs in NLP and artificial intelligence using CSCL to promote collaborative learning and augment ASD. In Figure 7.1[1] the maturity of ASD in higher education is demonstrated with the clustering of articles in four domains. The first cluster represents published work on the theoretical side of ASD, the second represents the work stemming from the first cluster, which applies pedagogy to augment the development of argumentation skills. The third and fourth clusters represent the use of CSCL in pedagogy to develop argumentation skills in online environments. The findings of stage 2 (see

[1]https://www.connectedpapers.com/main/5921913cc013ddc97d321ed2ae39fb7719c7835a/Argumentation-in-Higher-Education%3A-Improving-Practice-Through-Theory-and-Research/graph

Section 4.2.1.2) – as reported at the Computing Conference of 2022 (Van der Merwe et al., 2022) – would reside in the fourth cluster, describing ASD using technology in online collaborative learning environments (Latifi & Noroozi, 2021; Noroozi et al., 2016; Valero Haro et al., 2019). The findings of stage 3 (see Section 4.2.1.3) and the ASDF (see Section 6.5) support the findings in stage 2, and provide an implemented instance of the ASDF.

7.6 RECOMMENDATIONS AND FUTURE RESEARCH

The researcher recommends that the ASDF be implemented in the larger HRCOS82 course, in such a way that ASD becomes part of the regular curriculum. Moreover, ODeL institutional infrastructure should provide affordances that can be utilised by the broader university to support collaborative learning and ASD. In this regard, further research on the affordances of both internal and external resources is required. Where applicable, the use of ML tools, as proposed by Wambsganss et al. (2020), should be studied and considered for their ability to enhance ASD for students undertaking graduate research.

As to the social, teaching and cognitive presences, the data already obtained from the CoI questionnaire in the wider HRCOS82 group of students, should be further analysed and presented to gain insights into the perceived educational experiences of graduate students using CSCL in ODeL.

From the narratives on students' experiences, obtained during the focus group sessions, it became evident that there is a need for research into the strengths and weaknesses of using virtual platforms when conducting such sessions.

Further research into the element of human capacity, specifically from the perspective of the e-moderator as supervisor, is recommended. Specific focus could fall on the role of the e-moderator in facilitating the critical success factors that may influence the success of the ASD.

7.7 CONCLUDING REMARKS

Despite the admitted shortcomings of the study, the researcher is confident that the findings reported on here, will contribute to the development of argumentation skills in computing graduate research courses. Useful insights and knowledge were gained from the experts in stage 2 of the study, and the perceived educational experiences reported by the student participants during stage 3. From the study, the researcher identified that teaching presence is still an important element in the educational experience of graduate students, and that the e-moderator plays a vital role in the students' scaffolded learning journey, while developing their argumentation skills. Furthermore, it was identified that, alongside the three pillars of pedagogy, collaboration and technology (Jeong et al., 2019), application should be considered a fourth pillar in the use of CSCL.

It is clear from the study, that augmenting argumentation skills in graduate research courses is not a once-off event, or remedied through a quick argumentation skills course, but should rather be considered a continuous learning endeavour, until argumentation skills become part of the everyday academic reading, writing and thinking skills of graduate students. To achieve this, the study can be considered to contribute to the body of knowledge in providing a methodology which encompasses a philosophy and strategy in the form of an evidence-based and practice-tested ASDF that can be implemented in graduate research courses using CSCL in an ODeL environment.

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APPENDICES

APPENDIX A EXPERTS: Focus Group

Focus group discussion

CSCL Conceptual Framework for
Argumentation Skills Development (ASD)

The following main question was discussed: *"To what extent does the proposed methodology contribute to the CSCL environment in providing an environment that will augment the development of argumentation skills in graduate research? "*

The proposed methodology was evaluated in terms of feasibility, propriety (ethics) and utility (usefulness) (Jeong & Hmelo-Silver, 2016; Mullarkey & Hevner, 2019)

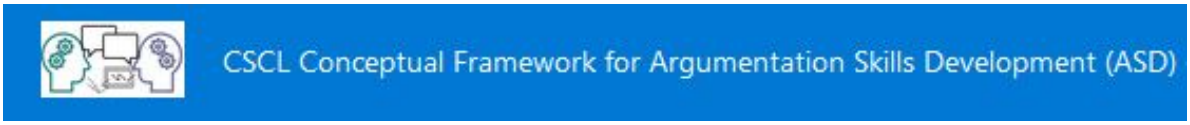
1. Utility (usefulness): To what extent is the proposed methodology applicable in providing an environment that will augment the development of argumentation skills for post-graduate research?

2. Feasibility: To what extent is the proposed methodology feasible in providing a CSCL environment that will augment the development of argumentation skills for post-graduate research?

3. Propriety (ethics): To what extent is the proposed methodology suitable for the academics as supervisors, the student as post-graduate researcher and applicable to be implemented in similar scenarios in ODeL environments?

APPENDIX B EXPERTS: Online survey

Link to an example of the survey in MS Forms: `https://forms.office.com/r/t5tmRYKWKj`.



To what extent do the activities (Stages 1,2,3 and 4 in the Storyboard - see Fig. 5.2) in the proposed conceptual framework contribute to the CSCL environment in terms of simplicity, comprehensiveness, generality, exactness, clarity (Olivier,2013), usefulness and feasibility in providing an environment that will augment the development of argumentation skills in graduate research?

Rate your level of agreement with each of the statements:

1=Strongly disagree and 5=Strongly agree

1	2	3	4	5

SIMPLICITY

The quality of the proposed conceptual framework is uncomplicated in form or design. The model comprehends the essence of the modeled concept.

Comments on simplicity:

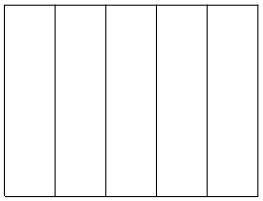
COMPREHENSIVENESS

The proposed conceptual framework includes and addresses most of the requirements in CSCL that can be used in to enhance argumentation skills in graduate research.

Comments on comprehensiveness:

GENERALITY

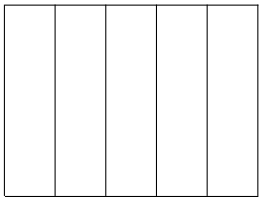
The proposed conceptual framework can be implemented in similar scenarios in CSCL environments that can augment argumentation skills for graduate students in research.



Comments on generality:

EXACTNESS

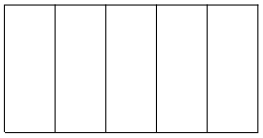
The proposed conceptual framework is as far as possible accurate and addresses the perceived requirements for a CSCL environment for the augmenting of argumentation skills in graduate research.



Comments on exactness:

CLARITY

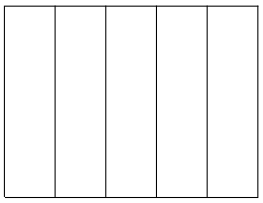
The proposed conceptual framework is coherent and unambiguous. The interaction or flow between the components is evident and correct.



Comments on clarity:

USEFULNESS

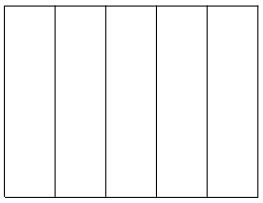
The proposed conceptual framework is applicable in providing an environment that will augment the development of argumentation skills for graduate research.



Comments on usefulness:

FEASIBILITY

The proposed conceptual framework is feasible in providing a CSCL environment that will augment the development of argumentation skills for graduate research.



Comments on feasibility:

ADDITIONAL COMMENTS

Any additional comments or feedback on the CSCL conceptual framework for ASD:

APPENDIX C: List of resources shared in the focus groups

Books and articles of interest

1. The Craft of Research, Fourth Edition by Booth et al. (2015).
2. Communities of practice: learning, meaning and identify by Wenger (1999).
3. Diversity among postgraduate students belonging to a South African community of scholars by Harpur and Cronje (2018)

Alternative argumentation models to consider

1. The Scriven Model of Argumentation: The Logic of Evaluation by Scriven (2007)
2. Walton's Argumentation Schemes [2]

[2] https://www.reasoninglab.com/patterns-of-argument/argumentation-schemes/waltons-argumentation-schemes/

APPENDIX D.1 : HRCOS82 CoI survey

Link to an example of the survey in MS Forms:

`https://forms.office.com/r/02zNvFN7PF`.

TEACHING PRESENCE

Which of the following discussion tools did you use whilst enrolled for the module HRCOS82?

2.1	myUNISA discussion forums				
2.2	MS Teams discussions (e.g. posts, discussions)				
2.3	Other				

1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

DESIGN AND ORGANISATION		1	2	3	4	5
3.1	The instructor clearly communicated important course topics.					
3.2	The instructor clearly communicated important course goals.					
3.3	The instructor provided clear instructions on how to participate in course learning activities.					
3.4	The instructor clearly communicated important due dates/time frames for learning activities.					
FACILITATION						
4.1	The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.					
4.2	The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.					
4.3	The instructor helped to keep course participants engaged and participating in productive dialogue.					
4.4	The instructor helped keep the course participants on task in a way that helped me to learn.					

4.5	The instructor encouraged course participants to explore new concepts in this course.					
4.6	Instructor actions reinforced the development of a sense of community among course participants.					

DIRECT INSTRUCTION

5.1	The instructor helped to focus the discussion on relevant issues in a way that helped me to learn.					
5.2	The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives					
5.3	The instructor provided feedback in a timely fashion					

SOCIAL PRESENCE

AFFECTIVE EXPRESSION

6.1	Getting to know other course participants gave me a sense of belonging in the course.					
6.2	I was able to form distinct impressions of some course participants.					
6.3	Online or web-based communication is an excellent medium for social interaction.					

OPEN COMMUNICATION

7.1	I felt comfortable conversing through the online medium.					
7.2	I felt comfortable participating in the course discussions.					
7.3	I felt comfortable interacting with other course participants.					

GROUP COHESION

8.1	I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.					
8.2	I felt that my point of view was acknowledged by other course participants.					
8.3	Online discussions help me to develop a sense of collaboration.					

COGNITIVE PRESENCE

TRIGGERING EVENT

91.	Problems posed increased my interest in course issues				
9.2	Course activities piqued my curiosity				
9.3	I felt motivated to explore content related questions.				

EXPLORATION

10.1	I utilized a variety of information sources to explore problems posed in this course.				
10.2	Brainstorming and finding relevant information helped me resolve content related questions.				
10.3	Online discussions were valuable in helping me appreciate different perspectives.				

INTEGRATION

11.1	Combining new information helped me answer questions raised in course activities.				
11.2	Learning activities helped me construct explanations/solutions.				
11.3	Reflection on course content and discussions helped me understand fundamental concepts in this class				

RESOLUTION

12.1	I can describe ways to test and apply the knowledge created in this course.				
12.2	I have developed solutions to course problems that can be applied in practice.				
12.3	I can apply the knowledge created in this course to my work or other non-class related activities.				

APPENDIX D.2 : HRCOS82 CoI survey data

Multivariate Correlations:

Presences:	Teaching	Social	Cognitive
Teaching	1.000	0.3199	0.5900
Social	0.3199	1.000	0.5696
Cognitive	0.5900	0.5696	1.000

Partial Correlation:

Presences:	Teaching	Social	Cognitive
Teaching		−0.0243	0.5236
Social	−0.0243		0.4979
Cognitive	0.5236	0.4979	

Partial Correlation Probability:

Presences:	Teaching	Social	Cognitive
Teaching			
Social			
Cognitive			

Partial Correlation Probability:

Presences:	Teaching	Social	Cognitive
Teaching		0.8284	< .0001
Social	0.8284		< .0001
Cognitive	< .0001	< .0001	

APPENDIX E: Ethical clearance documentation

Ethical clearance documentation:

- Ethics approval received from the UNISA College of Science, Engineering and Technology's (CSET) ethics review committee.
- Ethics approval received from the research permission sub-committee (RPSC) of the Senate Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC)

APPENDIX E: Ethical Clearance Documentation

UNISA university of south africa

UNISA COLLEGE OF SCIENCE, ENGINEERING AND TECHNOLOGY'S (CSET) ETHICS REVIEW COMMITTEE

9 September 2020

ERC Reference #: 2020/CSET/SOC/012
Name: Petronella van der Merwe
Student #: 38446634

Dear Mrs van der Merwe

Decision: Ethics Approval from 9 September 2020 to 8 September 2025 (Humans involved)

Researcher: Petronella van der Merwe
School of Computing, 38446634@mylife.unisa.ac.za, 011 471 2929

Supervisors: Prof. Judy van Biljon
vbiljja@unisa.ac.za, 011 670 9182
Mr Colin Pilkington
pilkicl@unisa.ac.za, 011 471 2130

Working title of research:

A methodology for computer supported collaborative learning for post-graduate computing research students' argumentation skills development

Qualification: PhD in Information Systems

Thank you for the application for research ethics clearance by the Unisa College of Science, Engineering and Technology's (CSET) Ethics Review Committee for the above mentioned research. Ethics approval is granted for 5 years.

*The **low risk application** was expedited by the College of Science, Engineering and Technology's (CSET) Ethics Review Committee on 9 September 2020 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment. The decision will be tabled at the next Committee meeting for ratification.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa COVID-19 position statement on research ethics

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attached.

2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College of Science, Engineering and Technology's (CSET) Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
8. No field work activities may continue after the expiry date *expiry date*. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.
9. Permission to conduct research involving UNISA employees, students and data should be obtained from the Research Permissions Subcommittee (RPSC) prior to commencing field work.

Note

The reference number 2020/CSET/SOC/012 should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.

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Yours sincerely,

_____

Prof. A da Veiga
Chair of College of Science, Engineering and Technology (CSET) Ethics Review Committee
E-mail: dveiga@unisa.ac.za
Tel: (011) 670 9175

_____

Prof. E Mnkandla
Director: School of Computing
College of Science Engineering and Technology (CSET)
E-mail: mnkane@unisa.ac.za
Tel: (011) 670 9104

_____

Prof. B Mamba
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College of Science Engineering and Technology (CSET)
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RESEARCH PERMISSION SUB-COMMITTEE (RPSC) OF THE SENATE RESEARCH, INNOVATION, POSTGRADUATE DEGREES AND COMMERCIALISATION COMMITTEE (SRIPCC)

2 November 2020

Decision: Research Permission Approval from 5 March 2020 until 8 September 2025.	Ref #: 2020_RPSC_043 Mrs. Petronella van der Merwe Student #: 38446634 Staff #: 90008162

Principal Investigator:
Mrs. Petronella van der Merwe
Department of Computer Science
School of Computing
College of Science, Engineering and Technology
vdmerwer@unisa.ac.za; 011 471 2929, 082 922 4872

Supervisors: Prof Judy van Biljon, vbiljja@unisa.ac.za; 011 670 9182
Mr. Colin Pilkington, pilkicl@unisa.ac.za; 011 471 2130

A methodology for computer supported collaborative learning for post-graduate computing research students' argumentation skills development.

Your application regarding permission to involve UNISA employees, students and data in regard to the above study has been received and was considered by the Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) on 19 October 2020.

It is my pleasure to inform you that permission has been granted for the study. You may:

1. Recruit academics from the School of Computing, who teach Honours research related modules, to participate in focus group discussions.
2. Gain access to the participants' email addresses via the supervisor's gatekeeping assistance for recruitment purposes.
3. Send an online survey to the students registered for HRCOS82 through ICT over two years. Each cohort will have 250 students.

4. The researcher may also recruit HRCOS82 students who have chosen Project 19 and also participating in the study to:
    - complete an online survey to collect demographics (15 minutes)
    - complete the CoI online questionnaire (30 minutes)
    - partake in a focus group via MS Teams.

You are requested to submit a report of the study to the Research Permission Subcommittee (RPSC@unisa.ac.za) within 3 months of completion of the study.

The personal information made available to the researcher(s)/gatekeeper(s) will only be used for the advancement of this research project as indicated and for the purpose as described in this permission letter. The researcher(s)/gatekeeper(s) must take all appropriate precautionary measures to protect the personal information given to him/her/them in good faith and it must not be passed on to third parties. The dissemination of research instruments through the use of electronic mail should strictly be through blind copying, so as to protect the participants' right of privacy. The researcher hereby indemnifies UNISA from any claim or action arising from or due to the researcher's breach of his/her information protection obligations.

Note:

*The reference number **2020_RPSC_043** should be clearly indicated on all forms of communication with the intended research participants and the Research Permission Subcommittee.*

We would like to wish you well in your research undertaking.

Kind regards,

Dr Retha Visagie – Deputy Chairperson

Email: visagrg@unisa.ac.za, Tel: (012) 429-2478

Prof Lessing Labuschagne – Chairperson

Email: llabus@unisa.ac.za, Tel: (012) 429-6368

APPENDIX F: Participants information sheets

Participants information sheets:

- Focus groups: Experts
- Focus groups: HRCOS82 P19 students

Focus Group: Experts

PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: 2020/CSET/SOC/012

Research Permission Sub-Committee (RPSC): 2020_RPSC_043

May / June 2021

A methodology for computer supported collaborative learning for post-graduate computing research students' argumentation skills development.

Dear Prospective Participant

My name is Ms Petronella van der Merwe and I am doing research with Prof Judy van Biljon and Dr Colin Pilkington. Both these supervisors are in the School of Computing. Prof van Biljon is a full professor and Dr Pilkington a senior lecturer. This study is towards a Doctor of Philosophy in Information Systems in the subject Information Systems at the University of South Africa. We have funding from the NRF SARChI Bursary for developing a methodology that can be used in post-graduate students' argumentation development using a computer supported collaborative learning (CSCL) environment. We are inviting you to participate in a study entitled: *A methodology for computer supported collaborative learning for post-graduate computing research students' argumentation skills development.*

WHAT IS THE PURPOSE OF THE STUDY?

The study aims to describe through empirical research the interrelationships and dependencies of CSCL in graduate research in the development of argumentation. The project involves a case study, over a period of three years, conducted amongst graduate students enrolled for an honours research module (HRCOS82) in the School of Computing in an ODeL environment. A graduate student is a student that has completed his/her first degree and is now enrolled for an Honours qualification.

WHY AM I INVITED TO PARTICIPATE?

You are invited to participate in this study as you are an expert with many years of experience in supervision in graduate and post-graduate research, specifically in the field of Computer Science and/or in the ODeL / CSCL environment.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

As an expert with a background in graduate and post-graduate research and supervision you are invited to participate in a focus group. The outcome of this focus group will be the evaluation of a proposed conceptual framework that we have developed for use in the CSCL platform. This proposed conceptual framework is specifically designed to assist students enrolled for graduate research in the development of argumentation skills. The focus group will be hosted online via MS Teams. The focus group will take approximately 60 minutes. The following question will guide the discussion: "*To what extent does the proposed conceptual framework contribute to the CSCL environment in providing an environment that will augment the development of argumentation skills in graduate research?"*

Should you accept the invitation to be part of the focus group, I will forward you a copy of the proposed conceptual framework, the CSCL affordance to be considered and a link to an online form that we will use during the focus group to record feedback.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Your presence in this study will help us to determine to what extent the proposed framework, when implemented in CSCL, contributes to the development of argumentation skills.

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

The researcher does not see any potential negative consequences should you participate in the study.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

The discussion during the focus group will be anonymous. Your discussions will be given a code number, or a pseudonym and you will be referred to in this way in the data, as well as in any publications, or other research reporting methods such as conference proceedings and journal articles. While every effort will be made by the researcher not to identify you or connect you to the information you share in the focus group, we cannot guarantee that other participants in the focus group will treat the information confidentially. Therefore, we will encourage all participants to do so and not disclose personally sensitive information in any of the discussions.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Any hard copies of data will be stored by the researcher for a minimum period of five years in a locked cupboard / filing cabinet in the office of the supervisors of this research, in the School of Computing or as appropriate.

Further use of the stored data will be subject to further Research Ethics Review and approval if applicable.

After the applicable period, any hard copies will be shredded, and electronic copies will be permanently deleted from the hard drive of the computer through the use of the relevant software programme.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

You will not receive any payment or any incentives for participating in this study.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the School of Computing and Research Permission Subcommittee of the Senate Research and Innovation and Higher Degrees Committee (RPSC), Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Mrs R van der Merwe, vdmerwer@unisa.ac.za.

The findings will be accessible for five years.

Should you require any further information or want to contact the researcher about any aspect of this study, please contact Mrs R van der Merwe, vdmerwer@unisa.ac.za, 011 471 2929.

Should you have concerns about the way in which the research has been conducted, you may contact Prof Judy van Biljon, vbiljja@unisa.ac.za.

Contact the research ethics chairperson of the SoC ERC at SoCethics@unisa.ac.za if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study. Thank you.

Mrs P van der Merwe

PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: 020/CSET/SOC/012

23 November 2022

A methodology for computer-supported collaborative learning for graduate computing research students' argumentation skills development.

Dear Prospective Participant

My name is Ms Petronella van der Merwe and I am doing research with Prof Judy van Biljon and Dr Colin Pilkington. Both these supervisors are in the School of Computing. Prof van Biljon is a full professor and Dr Pilkington is a senior lecturer. This study is towards a Doctor of Philosophy in Information Systems in the subject of Information Systems at the University of South Africa. We have funding from the NRF SARChI Bursary for developing a methodology that can be used in graduate student argumentation development using a computer-supported collaborative learning (CSCL) environment. We are inviting you to participate in a study entitled: *A methodology for computer-supported collaborative learning for post-graduate computing research students' argumentation skills development.*

WHAT IS THE PURPOSE OF THE STUDY?

The study aims to describe through empirical research the interrelationships and dependencies of CSCL in post-graduate research in the development of argumentation. The project involves a case study, over a period of three years, conducted amongst post-graduate students enrolled for a research module (HRCOS82) in the School of Computing in an ODeL environment.

WHY AM I BEING INVITED TO PARTICIPATE?

You are invited to participate in this study as you are currently enrolled for the module HRCOS82 and was allocated to the HRCOS82 Project 19 group of students. The outcome of this HRCOS82 is a research project in which you will demonstrate your research and argumentation skills.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

In this HRCOS82 Project 19 we will use Microsoft Teams (MS Teams) as the CSCL platform. As a student at UNISA you have access to the Office 365 tools and one of those tools is MS Teams. MS Teams is an online collaboration application that helps the team (in this instance, the HRCOS82 Project 19 group) stay organised and have online discussions and conversations.

Towards the end of the HRCOS82 course, you will be invited to partake in a focus group, which will be hosted online in MS Teams. In this focus group, you will have the opportunity to share with us your experiences in both the use of the CSCL environment as a teaching tool for post-graduate research students, as well as the use of the CSCL environment in the development of your argumentation skills. The focus group will take approximately 45 minutes.

Throughout the duration of the course, the researcher will gather data from online discussions in the CSLC environment. The data will be anonymised and tagged with specific tags. Typical information retrieved from this will include: (1) Action items – identify items that require follow-up and to-do. (2) Troubleshooting – identify items where participants reacted to assistance required by other participants, by providing suggestions, ideas or assistance in solving a research-related problem. (3) Deliberation – identify self-designed labelling by the participants to solve, and identify discourse in the discussions, specifically referring to research and argumentation development. (4) Announcements, links, research ideas, etc. – identify announcements, and links relating to research and argumentation development.

The purpose of this information sheet and consent is for you to partake in the gathering of the data from the online discussion in the CSCL environment, which will be in MS Teams. The discussions will be online throughout the academic year.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. Should you decide not to participate, then you will not be disadvantaged in the learning as no undue incentive will be given to students participating in the study. Not participating will have no effect on the overall delivery of the HRCOS82 Project 12 and the

outcome of your assignments and final project. You may at any stage of the project indicate that you do not want to partake in the study and all data that may link to you as an individual will be removed.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Your presence in this study will help us to understand the methodology used in this group to develop your argumentation skills that are required in post-graduate research.

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

The researcher does not see any potential negative consequences should you participate in the study.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

You will not be requested to provide any information that will identify you. Data captured from the discussions in the CSCL environment, through coding (segmenting, categorizing and annotating) will be anonymized and participants will not be identifiable. While every effort will be made by the researcher not to identify you or connect you to the information you share in the discussions or during the focus group, we cannot guarantee that other participants in the online discussions will treat the information confidentially. Therefore, we will encourage all participants to do so and not disclose personally sensitive information in any of the online discussions.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Electronic copies of the answers and the research findings will be stored for a minimum period of five years, password protected in the MS One Drive Cloud account of the researcher for future research or academic purposes; electronic information. Thereafter it will be permanently deleted from the One Drive Cloud account.

Future use of the stored data will be subject to further Research Ethics Review and approval if applicable.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

You will not receive any payment or any incentives for participating in this study.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the School of Computing and Research Permission Subcommittee of the Senate Research and Innovation and Higher Degrees Committee (RPSC), Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Mrs R van der Merwe, vdmerwer@unisa.ac.za. The findings are accessible for five years. Should you require any further information or want to contact the researcher about any aspect of this study, please contact Mrs R van der Merwe, vdmerwer@unisa.ac.za, 011 471 2929.

Should you have concerns about the way in which the research has been conducted, you may contact Prof Judy van Biljon, vbiljja@unisa.ac.za. Contact the research ethics chairperson of the SoC ERC, Colin Pilkington, at SoCethics@unisa.ac.za and pilkicl@unisa.ac.za if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study. Thank you.

Mrs P van der Merwe

APPENDIX G: Article stemming from the research

'A Conceptual Framework for the Development of Argumentation Skills Using CSCL in a Graduate Students' Research Course' (Van der Merwe et al., 2022) was presented at the Computing Conference 2022 and included in Springer Lecture Notes in Networks and Systems, 508, Intelligent Computing, Proceedings of the 2022 Computing Conference, Volume 3.

A Conceptual Framework for the Development of Argumentation Skills using CSCL in a Graduate Students' Research Course

R van der Merwe, J van Biljon, and C Pilkington[1]

[1] University of South Africa,
vdmerwer@unisa.ac.za
[2] vbiljja@unisa.ac.za
[3] pilkicl@unisa.ac.za

Abstract. Developing and presenting a well-formulated research argument is core to the learning journey of a graduate student. In open distance e-learning, computer-supported learning is instrumental in providing a platform for graduate students to develop their argumentation skills. However, there is little guidance on the elements required in using computer supportive collaborative learning (CSCL) to augment argumentation skills development (ASD). This paper reports on elements identified in literature that should be present in a framework using CSCL to augment ASD. The thematically analysed data gathered during the focus group sessions were used to confirm the structure of the argumentation skills development framework (ASDF), and confirmed that there is a need for a framework to provide guidance in using CSCL to augment ASD. The contribution includes the conceptual ASDF using CSCL, comprising seven elements, that provides a strategy of scaffolded learning for implementation in a graduate course to augment ASD.

Keywords: learning, collaboration, computer support, argumentation skills, ODeL, CSCL, scaffolded learning, argumentation skills development

1 Introduction

Argumentation skill is seen as a derivative that develops along the academic route and involves the understanding, managing and formulation of arguments [1] and is of interest to education as it contributes to the individual in "transforming, clarifying, changing ideas, personal growth and identifying of information" [2, p. 50]. The inclusion of the theoretical concepts of argumentation in a graduate course, along with the skills of writing academically, is not new and positive results has been reported in that the "students were able ... to produce academic texts argumentatively more sophisticated" [3, p. 139]. We refer in this study to graduate students as students that have completed their undergraduate qualification and are now enrolled for an honours' qualification.

In open distance e-learning (ODeL) it often takes considerable time for a graduate student to develop argumentation skills and demonstrate it successfully in research outputs [3] as the student is often isolated from both peers and supervisors [4]. The use of technologies available in CSCL platforms are imperative in education [5] and allow students in ODeL to not only join in online discussions, but also to augment their argumentation skills. One of the perceived advantages of using CSCL in graduate studies, is the "ability to overcome obstacles of distance and time" [6, p. 272]. However, the availability of technology and applicable platforms are not sufficient conditions to ensure that it will be utilised by graduate students to critically engage on the available collaboration platforms in academic argumentation and consequently develop their argumentation skills [7, 8]. In a study by Van Biljon et al. [9], it was noted that graduate students, even in a cohort supervision environment with guidance from supervisors, are reluctant to use the available collaboration platforms to critically engage in argumentation with their peers.

The University of South Africa (UNISA) an ODeL institution, [10], is progressively using CSCL to provide various solutions and platforms for collaboration. An example of using CSCL, that is grounded in the Grasp of Evidence (GoE) framework, is the platform presented by Mochizuki et al. [11]. The GoE framework posits five dimensions of evidence evaluation, i.e. evidence analysis, evidence evaluation, evidence interpretation, evidence integration and evidence credibility. The platform, presented by Mochizuki et al. [11], allows users to collaboratively share and read multiple documents, synthesize the contents and resolve disagreements, using the scaffolded environment provided in the CSCL.

Though various research exists in the multidisciplinary field of using CSCL [12], the elements required for a conceptual CSCL framework that will augment argumentation skills in ODeL environment, could not be found. Furthermore, the researchers could not find evidence-based guidance on the elements required in a framework, purposefully designed for the augmenting of argumentation skills using CSCL, that can be implemented in a graduate course. This was also identified as a need by Järvelä and Rosé [13, p. 146] that more empirical research is required on the "design of the technological settings for collaboration and how people learn in the context of collaborative activity".

It is against this background, and with a realisation of the complexity of learning interactions in CSCL between graduate students and supervisor, as e-moderator, that the research question was formulated as: *What are the key elements required in a CSCL conceptual framework that could contribute to the development of argumentation skills in a graduate course?* In response to the research question, the researchers developed and presented an evidence based conceptual argumentation skills development framework (ASDF) to experts in focus groups consisting of supervisors with experience in postgraduate supervision and ODeL courseware developers. Evaluation by students and the institution fall outside the scope of this study, as we believe it is important to develop a mature and robust platform before involving the students in future research.

The remainder of this paper is structured as follows: In Section 2 the theoretical framework that underpins the development of the ASDF, based on the concept of community of practice as presented by Wenger [14] is discussed. The proposed ASDF is presented and described in Section 3. In Section 4 a scaffolded learning approach is proposed for the ASDF and Toulmin's argumentation model [2, 15] is used to augment argumentation skills development. Toulmin's model or method has been used in various studies to augment the development of argumentation skills of students [2, 3, 16] and is discussed in more detail in Section 5. The method of selecting the participants, the qualitative thematic analysis process followed in transcribing the data is explained in Section 6. The revised ASDF, based on the findings, is presented in Section 7, and the paper concludes with the conclusions, limitations and future studies recommendations.

The rationale of this study then was to develop an ASDF that can be followed when implementing an argumentation model in a graduate course using CSCL. At the practical level, the research contributes to the body of knowledge by providing a framework that provides a philosophy and strategy of scaffolded procedures and techniques to implemented in a course using CSCL that augment the argumentation skills development of the graduate student. At a theoretical level, the research contributes to the body of knowledge pertaining to scaffolded approaches that can be applied in graduate courses towards the development of argumentation skills.

2 Theoretical Framework

The theoretical framework that underpins the development of the ASDF is the community of practice concept by Wenger [14, 17]. For a community of practice to exist, the three elements that comprised the theory, 'the domain', 'the community' and 'the practice', need to be develop in parallel to cultivate such a community [17]. The domain element points to a community of practice that is characterised by the participation and commitment of the members towards a collaborative goal. The participants are identified by contributing to the collaborative goal through meaning and identity [14]. We refer to meaning as the way the participants will share their experience of life and the world and how it has brought about change, and identity refers to the way the participants will share how learning changed them in the context of the community.

The second element, the community, refers to the engagement among the participants, through which information and knowledge is shared and relationships are built in order to learn from one another [17]. The practice, the third element, refers to the sharing of resources. The participants build libraries of resources and find ways in which to address problems that may occur periodically [17].

In the evaluation of the ASDF, the community of practice among supervisors and course developers is significant, as it allows amongst others an increased sense of community, the sharing of years of experience, construction of knowledge and experience and critical thinking [18].

3 Proposed ASDF

Universities are adopting learning management systems (LMS) that provide collaboration platforms, using CSCL [19], that allows scaffolding learning and environments that can foster higher order thinking and critical thinking skills [20]. From a pedagogical perspective, the pedagogical approach and course requirements should drive the initiative in the development of the ASDF, and not the technology [21]. Furthermore, the ODeL technology infrastructure should provide the environment that is not only user-friendly, customisable, student centred but also provide the required privacy and anonymity [20]. Within the ODeL technology infrastructure, the affordances of collaborative tasks, ways to communicate using communication technologies, sharing of resources are of importance [22]. The learning approach followed should allow for productive processes, following strategies that allow scaffolded collaborative learning processes [22–24].

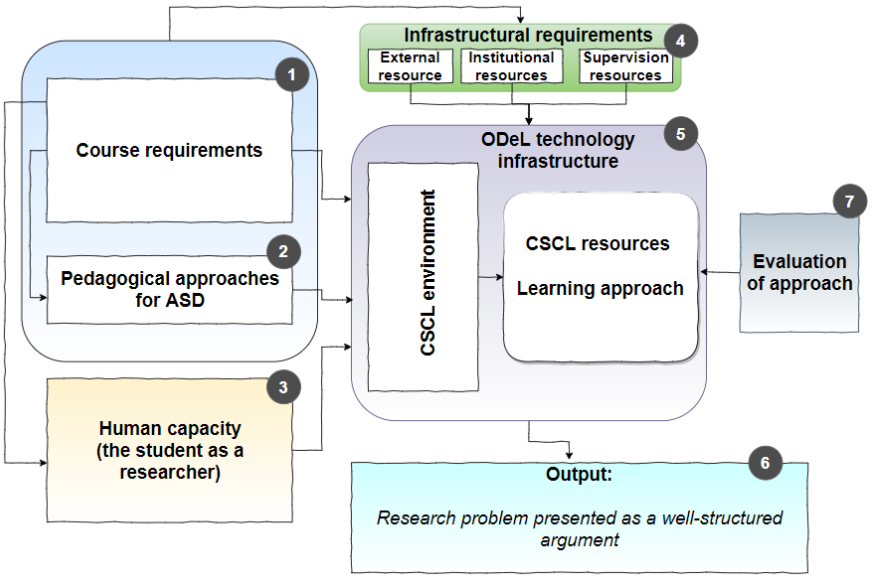

Fig. 1. Conceptual argumentation skills developments framework (ASDF)

A conceptual ASDF, seen in Fig. 1, was presented to the focus groups. The conceptual ASDF comprises seven elements, that include the elements of course requirements, the pedagogical approaches, infrastructural requirements and ODeL technology infrastructure as identified in literature as well as the elements of human capacity from the perspective of the student as a researcher, the

output as a well-structured research problem and the evaluation of the approach. These elements will be explored in the next paragraphs in context of a specific honours research course.

3.1 Course requirements

In this study, one of the honours research courses (HRCOS82), offered at UNISA, is chosen. HRCOS82 serves as a fundamental building block in equipping students with the knowledge and competencies to conduct research in the computing field, as well as giving the students the opportunity to conduct a small research project under the supervision of a lecturing team in Computing. Students enrolled for HRCOS82 choose between a selection of research projects, a project based on their area of study, which we refer to as HRCOS82 P19 in study.

Embedded in the course outcomes are the South African Qualifications Authority[4] (SAQA) critical course field outcomes (CCFO). The CCFOs are of importance as they identify key terminology that is required when building an argument and include terminology such as identifying, working, organising, collecting, communicating, use of technology, demonstrating and contributing.

3.2 Pedagogical approaches for ASD

Collaborative learning is seen as a pedagogy that can be adopted in most learning environments, including CSCL in ODeL [25]. Furthermore, scaffolded learning activities in collaborative learning can be used to enhance argumentation skills development among students [16, 26]. The course developer should take cognisance of the technology available in the ODeL environment [27] that can be used to provide a scaffolded learning journey to assist in the development of argumentation skills.

3.3 Human capacity: the student as a researcher

The student in HRCOS82 P19, contributes by applying and using their competencies and contributions towards the collaborative goal.

3.4 Infrastructural requirements

The infrastructural requirements include the resources that are required to implement the CSCL in an ODeL environment. These resources include the external resources, institutional resources and supervision resources and can be accessed and used by the community. The external resources include the adoption of cloud computing services that include open education recourses (OER), MOOCS and open data resources, as well as the use of popular multimedia platforms for communication and collaboration [28]. The inclusion of external resources is often

[4] https://www.saqa.org.za/

left to the lecturer or supervisor [29]. From the student side, access to these external resources is dependent on accessibility, availability, and in some instances are device dependent. From the institution side, a need for policies that will govern privacy, security and ethics together with cost and scalability are important factors that should be considered [30, 31].

Institutional resources include access to resources that the university provides to students as part of their enrolment and include the university's online library, reference management software, statistical analysis software, webinars, academic integrity and similarity tools, to name a few. As these resources are part of the institution, the governance thereof is the responsibility of the institution. The supervisor, is appointed by the department within the university and the course requirements determine the qualification and capacity of the supervisor. Through institutional university resources, training in supervision and capacity development programmes are provided.

3.5 ODeL technology infrastructure

At UNISA, ODeL is delivered through an online LMS. The LMS provides the technology infrastructure [20] for CSCL resources and includes, among others, the structure for the learning path, e-tivities, assessment and learning approach. CSCL affordances [22] and should include the establishing of a joint task, space for online communication and sharing of resources, online interface for engaging in productive processes, and online technology tools for co-construction towards solving a shared problem. In the development of a course using CSCL, the course developers and e-moderator should keep it mind that, although students have access to technology through the internet, the students "lack the necessary skills and competence to engage fully and efficiently in online learning" [32, p. 18].

3.6 Output

The course requirements define the outcomes for HRCOS82, which in this instance is"... mastering scientific writing, literature references and can complete an acceptable written research report". In this study, following the scaffolded learning journey approach within CSCL and applying the argumentation model of Toulmin [15], the output will be "the presentation of a well formulated argument". The students will submit their final report for assessment, which is externally examined by a panel of examiners. For future studies, the method to evaluate argumentation skills from argumentation records [33] can be considered.

3.7 Evaluation of the approach

The evaluation of the approach following in this study includes learning analytics, gathering of data through questionnaires and expert focus groups. To monitor the students' progress, learning analytics and data will be gathered over the learning journey regarding the elements of the community of practice: 'the domain', 'the community' and 'the practice' [17]. The evaluation of an implemented

ASDF, through learning analytics and questionnaires among students, does not fall within the scope of this study and is considered for further research. The qualitative thematic analysis process followed in the evaluation of the proposed ASDF with experts in focus groups is discussed in Section 6.

4 The scaffolded learning journey

Scaffolded learning refers to the use of a variety of activities in a learning journey that will assist the students in progressing towards a stronger understanding and ultimately to independence in the learning process [26, 34]. In CSCL, a scaffolded learning journey, as presented by Salmon et al. [24] is made up of activities (e-tivities) that promote "active and interactive online learning" and include sharing of resources, online discussions relating to the research, collaborating in the CSCL environment through writing messages, attending webinars and presenting research. The student starts with little or low level of competence in argumentation skills and progresses to a place where a well-formulated argument can be presented. The participants, e-moderator and other students as peers, provide support and transfer of information in a scaffolded manner as the level of challenge and the level of competence grows [34]. Refer to Fig. 2 for a presentation of this scaffolded learning journey.

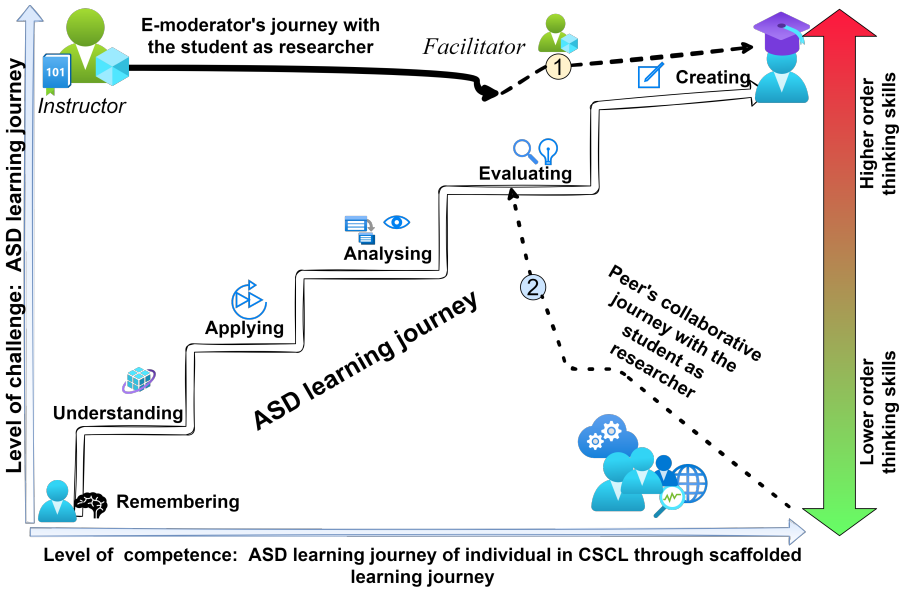

Fig. 2. ASD through a scaffolded learning journey

The level of competence of the student is mapped on the horizontal axis and represents the learning journey of the individual, and the vertical axis represents the increase in the level of competencies as the student progresses. The e-moderator, as the supervisor, facilitates the learning journey by establishing the group, introducing the knowledge domain and the learning approach as well as inducting the students into the ASD learning environment [23, 24]. In the scaffolded learning journey, the role of the e-moderator changes as the student progresses in the learning journey. Initially starting as an instructor, the supervisor provides the required training and instruction in using Toulmin's model by identifying the various elements of claim, grounds, and so forth. As the student progresses in the learning journey, the role of the instructor gradually changes to that of a facilitator (dotted line 1) by allowing the students to build their competencies in developing argumentation skills from a low level of competence to a place where the student can create and present a well-formulated argument. Each stage requires the student to master argumentation skills in the scaffolded learning journey. The scaffolded levels of skills are presented in the categories of the revised version of Bloom's taxonomy [35], and include competencies from remembering and understanding, to applying and analysis, and finally to the categories of evaluating, creating and implementing.

In this scaffolded learning journey, the students (as peers) are part of discussion groups and have the opportunity not only to present their arguments, but also give and receive critique. The peers, travelling on the same learning journey as the individual student, collaborate in the space provided in the LMS. This is done through sharing, presenting, evaluating, critiquing, and applying the terminology of Toulmin's model (presented in the dotted line labelled 2).

Using the technology available in CSCL, allows students to collaborate at their own convenience, however, the e-moderator should monitor the collaboration as responses to discussions may appear in a disjunctive way, making engagement in in-depth discussions difficult [36]. This is of importance, as the storyboard that will be designed for the implementation of the ASDF in a research course should provide guidelines on the e-tivities and the commitments from the students to ensure that argumentation skills development is reached. Refer to Table 1 for an example of a storyboard that represents the CSCL affordances, the needs that should be addressed and design strategies with examples of e-tivities that can be used.

5 Toulmin's argumentation model

Toulmin's argumentation model was chosen as the argumentation model to follow in this study. The model is a style of argumentation that breaks the argument into six components, namely claim, grounds, warrant, qualifier, rebuttal and backing, as seen in Fig. 3.

Within this argumentation model, every argument has three fundamental parts which are the claim, the grounds and the warrant. The claim is the main argument and represents the assertion that the author would like to convince or

Table 1. Storyboard: CSLC affordances map to the needs, design strategies and e-tivities.

CSCL Affordances (Jeong & Hmelo-Silver, 2016)	Needs addressed	Design strategies	E-tivities
1. Establising a joint task	Joint project is presented to the group. Instructions on how to use inernal and external resources.	Students are presented with a task that is outside their area of conficence.	Using LMS collaboration spaces. Toulmin explained to in webinar. Searching and downloading of articles. Sharing work in collaboration space. Assessing in the online space . 
2. Communication	Group communicate using the LMS.	Using the communciation platform and applications available in LMS. Timeous feedback.	Using chats, webinars, threaded discussions available in LMS. Presenting work to the group. 
3. Sharing resources	Group shares resources (internal and external).	Sharing of relevant links, channels and resources.	Identifying and utilizing data repositoris, websites, referencing tools and software.. Accesing and using online library. 
4. Engaging in productive processes	Scaffolded learning journey, taking into account pre-requisited, focus on the development of argumentation skills.	Tasks are structured and students have to perform specific tasks in the group. Timeous feedback.	Continuing peer assessment by applying argumentation tools. 
5. Engaging in co-construction	Co-construction by providing input and feedback. Presentation of work.	Keeping the shared goals and problems in context. Using elements of Toulmin to cirtique. Timeous feedback.	Presenting research in a webinar Peer's critique by applying argumentation elements. 
6. Monitoring and regulation	Evaluation of approach	Self-evaluation, group evaluation. Group evaluation the approach. Data analytics.	Self-evaluation by individual student. Learning analytics by the e-moderator. Evaluating the approach within the group. 
7. Finding and building groups and communities	Space provided in the LMS for students to join in communities with similar interests. Create awareness of external	Through scaffolded learning path the student identify relevant communities and use applicable resources.	Identifying relevant communities that have similar interests. 

prove to the audience. The grounds of an argument are the evidence and facts that support the claim. The warrant, which is often not stated explicitly, but should be part of the argument, are the assumptions that link the grounds to the claim. The backing, qualifier and rebuttal are not always present in an argument but are often required to assist the author to add nuance to the argument. The backing refers to any additional support of the warrant. The qualifier limits the study to a specific content, time or making the reader aware that the claim may not be true in all circumstances. Finally, the rebuttal, which is either implied or stated explicitly, acknowledges other views of similar studies. Table 2 presents a practical example illustrating the different elements in a Toulmin argument.

6 The focus groups

Ethical clearance was received and by means of purposive sampling and snowball sampling, the researchers contacted 20 potential participants. Ten of the 20 participants agreed to participate in a focus group and nominated 15 more experts to contact, of which 10 accepted. In total, 19 expert university researchers that have experience in postgraduate supervision and one ODeL curriculum designer formed part of the focus groups. These supervisors are from universities in South Africa and responsible for postgraduate supervision in different subject disciplines. Although the experts varied in their years of postgraduate super-

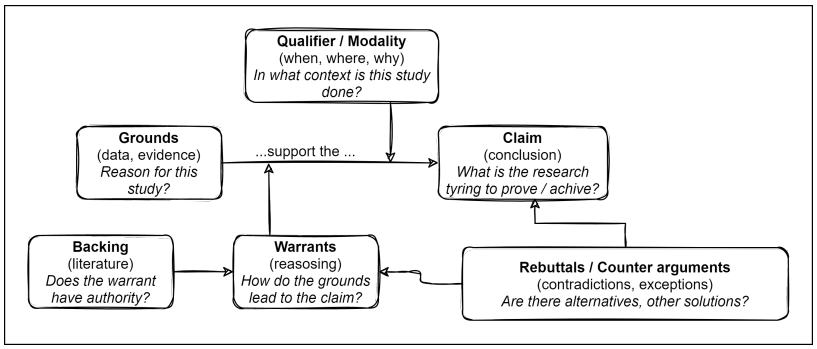

Fig. 3. Toulmin's model of argumentation

Table 2. Example of identifying elements of Toulmin's argumentation model as part of annotation of literature

Elements of Toulmin's Model	
Claim	Graduate students have a problem with argumentation in research.
Grounds	Own experience. Other supervisors. Literature.
Warrant(s)	Assuming that graduate students will need to use argumentation skills to present their argument in the final report.
Backing(s)	Based on last three years of research projects. Literature identified it as problem area.
Rebuttal(s)	Alternative research on addressing argumentation skills development. English literacy contributing to poor academic argumentation. E-skills are not what it should be. Students level of the course content not sufficient.
Qualifier/Modality	ODeL. Graduate research. Computing

vision, the participants all had experience in either ODeL, distance education or blended learning. Furthermore, due to the COVID-19 pandemic, more traditional residential universities in South Africa relied on e-learning environments to engage with their graduate students and could relate to the online learning environment as presented in this study. Nine focus group sessions were held via MS Teams. The number of participants varied between one and three experts in a focus group.

The following question guided the discussions in the focus groups: *What are the key elements required in a CSCL conceptual framework that could contribute to the development of argumentation skills in a graduate research course?* A summary of the research study and copies of the screens presented during the focus groups were distributed in advance to the participants. Each focus group lasted an hour. During the first 20 minutes, the purpose of the focus group was explained and the ASDF presented. During the remainder of the session, the participants engaged in discussions and completed an online questionnaire. In Section 6.1 the findings are discussed in terms of themes that emerged from the discussions and in Section 6.2 the online questionnaires completed by the participants are discussed.

6.1 Focus group discussion findings

The themes that emerged from the thematic analysis process were identified and labelled as *ASDF*, *argumentation model*, *infrastructural requirements*, *collaboration* and *human capacity*. The themes are discussed in the paragraphs that follow. The responses quoted from the participants are indicated in square brackets and refer to the specific focus group, for example, FG2 and the timestamp as recorded in the transcript.

The ASDF: The presentation of the ASDF was well-received and included comments such as [FG2 [00:39:31]] *"... this is really very comprehensive. There's a lot of detail, but the framework is simple enough*" and [FG2 [00:45:18]] *"[the ASDF] is linked to different theoretical frameworks that are already existing on models that support [the ASDF] concepts"* and [FG1 [00:03:58]] *"... timewise in addressing the need for argumentation as this is a general concern, not only for studies but also when one needs to publish*". Concerns expressed included comments such as *"... the person that will implement it will have to understand the environment"* and *"... buy-in is required as the framework may be difficult to implement*".

Argumentation model: As to the theme of the use of an argumentation model that can be used to augment argumentation skills, in this instance Toulmin, the participants in the focus groups agreed that *"Toulmin is an acceptable model"* and [FG 3 [00:48:05]] *"... it empowers them [the students] to make the difference between criticizing an argument and criticizing the person [other students]"* but warned that [FG3 [00:50:39]] *"... having taught Toulmin's to [postgraduate] students at previous university, it's hard. It's a very hard way of reasoning"*.

Although the presentation during the focus groups focused on the lack of argumentation skills and the implementation of the ASDF in a research course, it quickly became apparent from the participants that additional factors should be taken into consideration, such as language skills. As mentioned by the participants [FG 1 [00:04:37]] *"students need this for studies, ..., they are ultimately going to publish.... And if you can't argue, you can't publish. So it's a problem ... made me wondered as to how much of the problem for some students is that they are so much battling understanding English and reading in English and writing in English that they're ... never actually even get to the argumentation skills that they don't have the basic language skills."* This was confirmed by [FG 7: [00:38:59]] *"... the thing is people are not used to argumentation. I mean, they're not critical even though they went through three years of an undergraduate degree"*.

Infrastructural requirements: From the discussions and the themes that emerged from the thematic analysis, it was clear that the initial presentation of the infrastructural requirements to include the external resources, institutional resources and supervision resources were problematic (see Fig. 1). In the revised version of the ASDF, the supervision resources were removed and grouped with

the human capacity element (representing then both the supervisor and the student) This will be discussed in Section 4.

Participants further suggested that the students should receive life skills on each of the levels in the scaffolded learning: [FG 5 [00:37:02]] *"... there is also skills and knowledge attached to each one of those steps, which is admin life skills"*. This was further emphasised in the comment of [FG 5 [00:45:52]] *"So many of these students don't want to present. Not because they don't think their research is good, they just don't have the skills to present. And if you don't figure that out, they cannot present the research"*. Although not many of the participants commented on access to the external and internal resources, there were general comments on the *"extended registration periods [due to the COVID-19 pandemic], students are not on the same space [some students enrolled much earlier than others]"*. Suggestions to counteract this included: *"dividing the students into smaller groups as they register to counter the [current] problem"*.

Collaboration: As to the theme of collaboration, it was observed that students can be categorised into three distinct groups, namely (1) those that do not want to work in groups, (2) the competitive student that will work in a group to gain information, but not willing to share and (3) the student that uses the group to share and collaborate to grow and contribute. Another participant contributed to the three distinct groups of students and added that students should be trained on how to [FG 4 [00:31:41]] *"peer-review and contribute to the rest of the group"* and *"not enough is done in the development of the problem statement ... specifically when thinking of advancing to a Master's"*. Another viewpoint that the participants had in the theme of collaboration was the discussion on sociotechnical perspectives and social and cultural factors that will come into the interactions and influence the behaviour of the students in the group, among each other and with the supervisor. [FG 3 [01:03:38]] "...it would be interesting to see in the first place, what collaborations are coming, is it only between the peers and the lecturer? Are those the only parties involved? What is the nature of those interactions?". The researchers took note of this and will explore the factors of social and cultural interactions in future research. Further comments and discussions related to constructive learning and comments made on *"Will the learning be structured and facilitated? How to keep the students active in the learning process during the year as students are often eager to start but then wander off"* as summarised by one of the participants as [FG 3 [01:03:09]] *"[the researchers should] consider very carefully, the way you craft the interactions [in the collaborative space]"*. As students are from different groups of academic environments, they must be taught how to formulate questions and post questions in such a way that all can understand them. This was confirmed by [FG3 [00:47:23]] *"...in the ODeL environment ... students don't know each other and, it, this focusing on a specific tool helps them to understand that they need to, to engage with a person's argument and then kind of applying that tool to [ask] ... where's your backing?"* As one of the participants had already implemented group work among postgraduate students, the comments on the administration part should be taken note of, specifically in terms of allowing

the students to start the group and thus reducing administration on the side of the e-moderator [FG3 [00:58:58]] *"And then we got the students to contribute to it, ... [this] was simply like one big chat, what made it different was it wasn't supervisor initiated the students actually did"*.

Human capacity- the supervisor as an e-moderator and the student as a researcher: The human capacity theme includes both the student as a researcher and the supervisor as an e-moderator. This is different from the original presentation in Fig. 1, where the supervisor was part of the infrastructural resources. From the discussions, it was clear that the ASDF does not take into consideration the capacity of the supervisor. Comments included [FG 1 [00:11:45]] "Different supervisors, different staff members have different levels of skills and have different ways of doing things". Furthermore, the varying capacity of the supervisor to act as an e-moderator may mean training is required: [FG 6 [[00:43:10]] *"... there must be training for a module leader or a research person [because] we were never trained in any of this"*. Adding to the human capacity theme, comments relating to the uniqueness of individual students are of importance and more specific training relating to argumentation skills should be given in the learning path. For example, [PG 5 [00:41:00]] *"... but you start with an easier one. Generic. So you give them that and they work through the process ... and then you do it on a different example and they have to do it then you can see if they understand it or not"*. Of concern to one of the participants is the attrition rate of students in ODeL [FG3 [00:52:54]] *"... will [the course] be in some way structured ... [and]... facilitated ... because we started off with the number of them excited, energized, and then by the end of the year, they were very few in the discussion groups that we, that we had with them"*.

General feedback and critical success factors: The critical success factors that should be taken into consideration in implementing the framework were highlighted by a participant [FG 9 [00:48:42]] *"From a supervisor perspective, but also from a student [side] ..... [there are] ... some critical success factors ... to make this framework work. So I'm wondering if some of these critical success factors for a supervisor could be something that the supervisor would need to be trained in this framework"*. The participant also commented on the implementation of the framework in a large group and that critical success factors should include the size of the group and the capacity of the supervisor [PG 9 [00:49:16]] *"Extremely large group of students, will this model still be practical and will the outcome still be successful? ... If you have five [students], then it's easy. If you're one supervisor and you have 20 or 30 students, then it might not be as feasible anymore. So ... I'm not sure if it's a critical success factor or a dependability. In that view also, ... is the supervisor's capacity"*.

Furthermore, after the themes were identified the code of "critical success factors" that emerged are identified as collaboration, human capacity and infrastructural requirements. These critical success factors support the list of five factors of the institutional management factors, learning environment factors,

instructional design factors, support factors and course evaluation factors [39]. Though most of the participants indicated that the focus group discussions were well-organised and presented, there were comments relating to the feedback required on the ASDF that are [FG 9 [00:37:34]] *"theoretical" at this stage as the ASDF is not yet implemented and tested"*. The researchers take cognisance of this and the implementation and testing of the ASDF is considered for future research.

6.2 Online questionnaire findings

In addition to the discussions in the focus group, the participants were asked to complete an online anonymous questionnaire, which also served as their consent to partake in the study. In the questionnaire, seven characteristics presented in the ASDF relating to simplicity, comprehensiveness, generality, exactness and clarity [37], usefulness [25] and feasibility [38] were used to measure the extent to which the proposed ASDF contributed to the CSCL in providing an environment that will augment the development of argumentation skills in graduate research. The questionnaire consisted of seven questions based on a five-point Likert scale. Following each of the seven questions, a space was provided in which the participants could respond in their own words. A final space was provided where participants could list any additional suggestions. An example of the online questionnaire can be found at https://forms.office.com/r/t5tmRYKWKj.

Of the question relating to *simplicity*, 31.1% of the participants indicated they agreed and 43.8% indicated that they strongly agreed that the quality of the proposed conceptual framework is uncomplicated in form and design and comprehends the essence of the modelled concepts and included comments such as *"It is sufficiently simple enough with 7 stages - with some broken down into sub-tasks. The components and how they lead to other components is intuiti (sic)"* and *"I found it well explained"*. However, there was a comment that indicated that it was *"... not completely clear what the central focus is - should the contents of the conceptual framework itself be evaluated or is it about the act [should be evaluated]"*. The last comment was made by a participant that was unsure whether the ASDF was already implemented or should the ASDF be evaluated from principles. This was addressed in follow-up focus groups, ensuring that the focus should be on the evaluation of the ASDF as a guideline that can be used in the implementation of a graduate course.

On the question relating to *comprehensiveness*, 31.1% agreed and 62.5% strongly agreed that the proposed ASDF includes and addresses most of the requirements in CSCL that can be used to enhance argumentation skills in graduate research and included comments such as *"...the framework is (very) comprehensive, but it may need to accommodate social and cultural differences and affordances, on the part of both lecturers/supervisors and students"*. Comments on human capacity critical success factors from the supervision point of view included governance from the university on supervisory capacity and different supervisory styles. Comments on group size included *"The smaller the group size the easier the*

interaction and assessment and feedback is" and various comments referred to the problem of English first language and other language barriers as it could impact on the successful outcome of argumentation skills. There was also mention to alignment with existing frameworks and guidelines for graduateness.

On the question relating to *generality*, 56.3% strongly agreed and 37.5% agreed that the proposed ASDF could be implemented in similar scenarios in CSCL environments that could augment argumentation skills for graduate students in research. In the comments section, the participants in general commented that it could be implemented in most graduate and postgraduate courses and mentioned that *"... the discussion groups are a great idea. I advocate certain discussions that have minimal facilitator-intervention"*.

Of the question relating to *exactness*, 43.8% strongly agreed and 37.5% agreed that the proposed ASDF is as far as possible accurate and addresses the perceived requirements for a CSCL environment for the augmenting of argumentation skills in graduate research. The accurateness of the framework, in terms of the success rate of the student's final outcomes, falls outside the scope of this study. This is further emphasised in the comment *"The framework does appear to be rigorous in addressing the requirements of CSCL and argumentation at a graduate level. But this will only be clear when it is implemented and evaluated!"*

Although 50% strongly agreed and 37.5% agreed to the question relating to *clarity*, the comments from the participants were more diverse. Comments included that although the flow is evident and correct, it was not clear as to what the purpose of the course represented in the ASDF was, as reflected by one of the participants as *"Thought the subject matter was argumentation; did not gather that it was topic of own choice in which they APPLIED argumentation"*. This comment was addressed in the follow-up focus groups and is discussed in detail in the section on pedagogical approaches for ASD.

Of the question concerning *usefulness*, 68.8% of the participants strongly agreed and 25% agreed that the proposed conceptual framework is applicable in providing an environment that will augment the development of argumentation skills for graduate research.

Of the question about *feasibility*, 62,5% of the participants indicated that they strongly agreed and 18,8% agreed that the proposed conceptual framework is feasible in providing a CSCL environment that will augment the development of argumentation skills for graduate research. The comments included the complexity as *"The model may be too complex to comprehend in one go"* and human capacity critical success factors that may impact the implementation of the ASDF.

In the *additional comments and feedback section*, the participants agreed that the ASDF is well-designed and will be of use and *"... that it will enhance the student argumentation"*. From the comments, it was also noted that the 'measuring' of the efficiency of the framework will be difficult. The participants recommended that the process be recorded *"from beginning to end in an LMS or tool such as WA [sic-WhatsApp] the qualitative data will be automatically recorded and can be used to show how the arguing skills of students improved - whether they are top students or those*

who struggle. The idea is to improve this skill as I understand it". Other feedback included a broader approach to argumentation skills development, to include the hermeneutical circle works and benchmarking the ASDF against the ACM and AIS Computing/IS curricula. Valuable links to academic articles and books were shared.

7 Revised ASDF

From the thematic analysis, the researchers identified that the human capacity code should encompass the student as the researcher, and the lecturer as the e-moderator. Refer to Fig. 4 where the supervision resources as an element is removed from the infrastructural requirements element and presented as a separate node. The human capacity element then consists of the student as researcher and the e-moderator. The key elements of the revised ASDF include then the course requirements that determine the requirements of the human capacity (consisting of both the student and the e-moderator), infrastructural requirements and the pedagogical approaches used in ODeL. The course requirements, pedagogical approaches, human capacity and infrastructural requirements are applied in the ODeL technology infrastructure. Evaluation of the approach is through learning analytics and evaluation. As for the development of argumentation skills, the scaffolded learning approach within the CSCL environment is provided by the LMS. The assessment of the output – in this study, the presentation of a well formulated argument – is conducted through the technology provided by the LMS.

8 Conclusion

The developing and presenting of a well formulated research argument is core in the learning journey of a graduate student. The use of CSCL in ODeL plays an important role in providing a platform for graduate students to engage in academic discourse that will support the development of their argumentation skills. It was highlighted in literature that there is a need for a framework using CSCL that will contribute to the development of argumentation skills in graduate studies.

From the online discussions, it was clear that the ASDF does not sufficiently focus on the human capacity of both the student as a researcher and the e-moderator. In the revised ASDF, (Fig. 4), this was addressed by removing the e-moderator (as supervisor) from the infrastructural requirements to its own space.

The findings are confirming that there is a need for a framework that can be implemented in a graduate course that will augment the development of argumentation skills. Furthermore, collaboration among students is of importance to foster their sense of working together to reach a higher goal, in this instance, the development of a well-formulated argument.

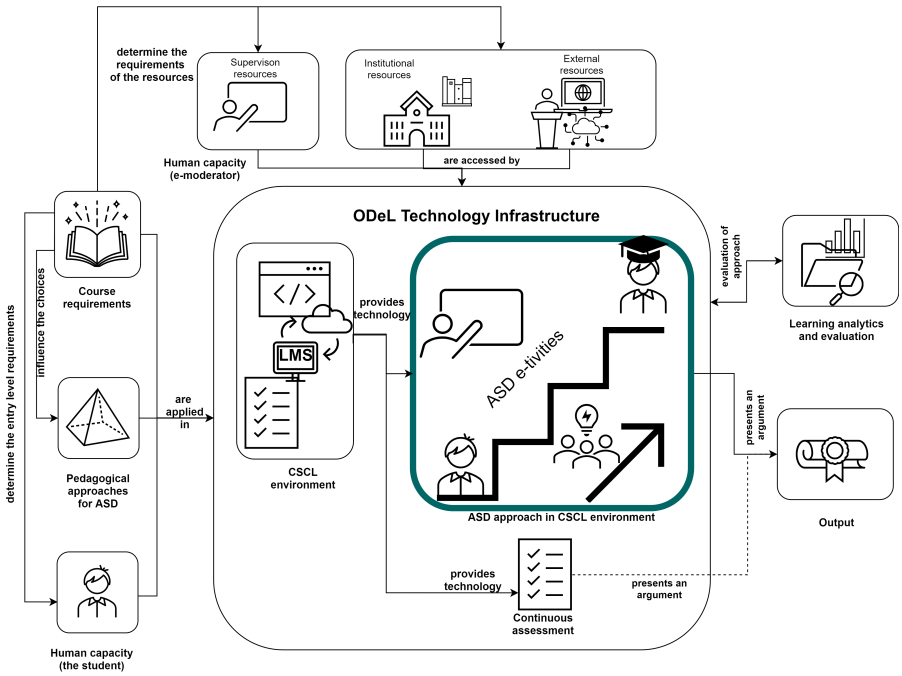

Fig. 4. Revised argumentation skills developments framework (ASDF)

The participants in the focus groups provided valuable insights into the ASDF. Furthermore, the themes that emerged from the discussions suggest that the key elements are required in a CSCL conceptual framework, and the conceptual framework can be used as a guideline when developing a research course with argumentation skills development embedded. From the feedback relating to the element of the human capacity, with the student as a researcher and the e-moderator, the researchers in this study realised that more research should be done to measure the social, cognitive and teaching presence of the learning experience.

The theme relating to the use of the argumentation model, with specific reference to Toulmin, was widely discussed. Although there were suggestions for other models, the participants all agreed that Toulmin is a good and well-researched model to implement.

As to the theme relating to collaboration, the participants agreed that the scaffolded pathway and collaboration are to the advantage of the students' research development. The mapping of Bloom's taxonomy and the SAQA CCFOs in the learning path was commended, although there were participants that mentioned that some students may have to go back a step or two before advancing to the next level.

The researchers acknowledge that there are some limitations to this study in that the ASDF is developed for incorporation into graduate courses in ODeL. Furthermore, the study included a relatively small number of participants in the various focus groups.

To complete this paper, the researchers identified topics for further research, that include the research into the element of human capacity with specific focus on the critical success factors that may influence the success of the ASDF. Measuring of the educational experience from the students' perspective in terms of social, cognitive and teaching presence has been identified as an area of further studies as well as research into determining whether the arguments presented by the students that were part of this graduate course improved their final project and final results. The learning analytics concerning the experience of the elements of the community of practice, namely practice, domain and community from the student's perspective, falls outside the scope of this study and is considered for future research. Reflecting on the use of MS Teams as a platform for conducting focus group sessions, the researchers propose a need to identify the strengths and weaknesses of using virtual platforms for a comparative research study.

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