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Collaborative Learning in Higher Education in the Fourth Industrial Revolution: A Systematic Literature Review and Future Research

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Abstract. The goal of this study is to determine the variables and difficulties that contribute to collaborative learning at tertiary institutions during the fourth industrial revolution and future research gaps. This study employs a systematic literature review to summarise and provide a comprehensive understanding of collaborative learning. The systematic literature review process used the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) technique between 2008 and 2022, supported by NVivo and Microsoft Excel. A systematic literature review, which is an appropriate method for strengthening research issues and gaps, was conducted with 61 papers. It should be noted that this manuscript only presents work from the Scopus database with journal criteria. This study has identified six factors related to collaborative learning in tertiary institutions in the fourth industrial revolution era including Task & Context, Environment, Social, Technology, Teacher, and Learner. This study presents a comprehensive literature assessment of collaborative learning in tertiary institutions during the fourth industrial revolution in order to acquire a clear grasp of its importance and application in higher education. Furthermore, Several higher education models have adopted the online-based collaborative learning paradigm, according to the study's findings.

Keywords: Collaborative learning (CL); Higher Education; Fourth Industrial Revolution (4IR); Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P)

1. Introduction

The 21st century is characterized by its quick technical development and the effects of the so-called fourth industrial revolution (West & Malatji, 2021). The educational innovation landscape has changed as a result of the fourth industrial

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revolution (4IR), requiring people to engage in innovative thought on manufacturing processes, value chains, and customer service procedures (Scepanovic, 2019). Colleges and universities offering continuing and tertiary education have become an integral part of the government's attempts to increase access to historically underrepresented groups and to promote collaboration between institutions of further education and universities (Campbell et al., 2012). In the current online learning environment, particularly during the COVID-19 epidemic, collaborative learning as a teaching and learning technique encourages students to become active participants and engage with one another (Matee et al., 2022). Collaborative learning refers to an instructional paradigm in which students acquire knowledge via collaborative projects. In the setting of collaborative learning, students cooperate towards a common objective in a cooperative attitude, putting aside rivalry (Isaías, 2018).

According to Ming et al. (2021), the perceptions of collaborative learning and the usage of technology can promote autonomous learning among students. In addition, significant consideration must be given to the design of collaborative learning activities to ensure that they are sufficiently difficult to require a high cognitive load tied to students' past knowledge (Goedhart et al., 2019). Opportunities for collaborative learning experiences can increase learning effectiveness (Gamage et al., 2020). However, there is a need to develop and deliver collaborative learning and evaluation methodologies that may be tailored to the talents and capabilities of individual students (Barberà et al., 2022). According to Su and Zou (2020), analysing studies from various dimensions of collaborative learning can become further literature. Furthermore, it is necessary to evaluate the adoption of learning analysis literature by conducting a systematic literature review on collaborative learning (Gasevic, 2019). Consequently, The aim of this study is to identify, through a literature review, the components of collaborative learning in tertiary institutions during the fourth industrial revolution. This article is an attempt to answer three main questions:

- What are the key elements of collaborative learning in higher education in the era of 4IR?
- What are the challenges faced by institutions in Collaborative Learning in Higher Education in the era of 4IR?
- What research gaps can guide future research regarding collaborative learning in higher education in the era of 4IR?

Collaborative learning refers to an instructional paradigm in which student learning results from group effort. In the framework of collaborative learning, students work together rather than competitively towards a common objective (Isaías, 2018) Students can improve their academic performance by engaging in active collaborative learning, chatting with supervisors or lecturers, speaking with group members or peers, and being involved (Alismaiel et al., 2022). It's also crucial to remember that involving children in group activities in the classroom can help them gain the conceptual understanding they need to sharpen their critical thinking abilities (Al et al., 2020). Therefore, exploring additional trends identified from a social perspective, and other dimensions as a mechanism for validating findings and perfecting technological capability sets (Castro, 2019)

complements the existing literature on collaborative learning theory throughout the fourth industrial revolution.

This study uses a systematic review to collect publications on the topic at hand, summarise them, and provide a comprehensive overview of collaborative learning as according to Gupta et al. (2021). This study uses the systematic literature review process suggested by Bodolica and Spraggon (2018) using modified Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) technique, NVivo, and Microsoft Excel. The data used are from the Scopus database between 2008 and 2022.

This research provides several contributions. This study expands our understanding of the factors that influence collaborative learning in universities during the RI 4.0 era according to Gasevic (2019). Second, this study can develop a roadmap for future research and highlight the possibility of developing literature on collaborative learning factors for academics and practitioners by enriching collaborative learning theory through review articles. Third, it poses new research questions, including original discussions about collaborative learning and background knowledge and encouraging discussion of new dimensions of collaborative learning in universities in the RI4 era.

This article consists of several sections. Section two describes the methodology which consists of a systematic literature review, search strategy, selection criteria, study selection, and analysis method. Section three explains the Results & Analysis which consists of descriptive statistics, factors, challenges, gaps, and future research. Section four consists of a conclusion, limitations, and recommendations for future research.

2. Literature Review

2.1. Collaborative Learning

Although collaborative learning is a popular teaching strategy, it is frequently underutilised in actual classroom settings (Scager et al., 2016). Students are more likely to externalise their ideas while participating in peer exchanges and reflecting on those interactions during the collaborative learning process (Hong et al., 2011). Collaborative learning is defined by Rowe et al. (2010) as employed by a group of students to accomplish a common objective as a teaching strategy. A three-dimensional model might be used to implement this kind of learning. The axes in this model are as follows: (1) a group of people, whether they are alone or in more than twos; (2) a reliable source of learning material (such as course material, an activity, and lifelong job experience); and (3) a strategy for learning that involves group members collaborating together. When students work in groups, they engage in collaborative learning (Roberson & Kleynhans, 2019). Students learn from one another through interaction through collaborative learning, which is also described as “an instructional strategy in which students at varying skill levels work together in small groups toward a common goal” (Westbrook, 2012).

Collaborative learning has the potential to enhance learning and achievement as well as motivate students to complete tasks, which raises their self-esteem and

fosters the growth of collaboration skills. Students can learn by exchanging knowledge, helping one another out, and settling disagreements between their own and other people's perspectives (Webb & Mastergeorge, 2003). Students who participate in collaborative learning must communicate and conceptualise their ideas through interaction with other students and learning resources (John-Steiner & Mahn, 1996), To choose the best answer to a problem, people should converse, consider different viewpoints, and draw on prior knowledge (Dewiyanti et al., 2007).

Higher education students who participated in interactive blogs were shown to have a more optimistic outlook on social interaction and academic accomplishment (Davidson & Major, 2014). Students can connect, work together, and participate in a social atmosphere via social media (Alismaiel et al., 2022). The use of social media curricula for teaching and learning in higher education is of interest to the academic community (Pérez-López et al., 2020). Cognitive abilities, motivation for active collaborative learning in higher education, reflection, and metacognition are among the fundamental components of social media (Alismaiel et al., 2022). According to numerous studies, using social media for student tasks promotes higher levels of learning (Roberson & Kleyhans, 2019).

3. Methodology

3.1. Systematic Literature Review

The SLR process suggested by Bodolica and Spraggon (2018) was implemented in this study with several adjustments as proposed by Elmashhara et al. (2022) related to the analysis phase and answering research questions from Usman et al. (2021). First, the topic and research objectives were determined. Secondly, the search through the database was performed based on the predetermined keywords and selection criteria. Third, articles were filtered and sorted out to include only articles that met the inclusion and exclusion criteria. Fourth, relevant materials were extracted to provide quality results. Systematic reviews differ from traditional literature reviews in several significant ways (Riebe et al., 2016). This approach takes the characteristics of research projects that are robustly designed, and replicable and facilitate research interpretation based on research questions (Zhao et al., 2021).

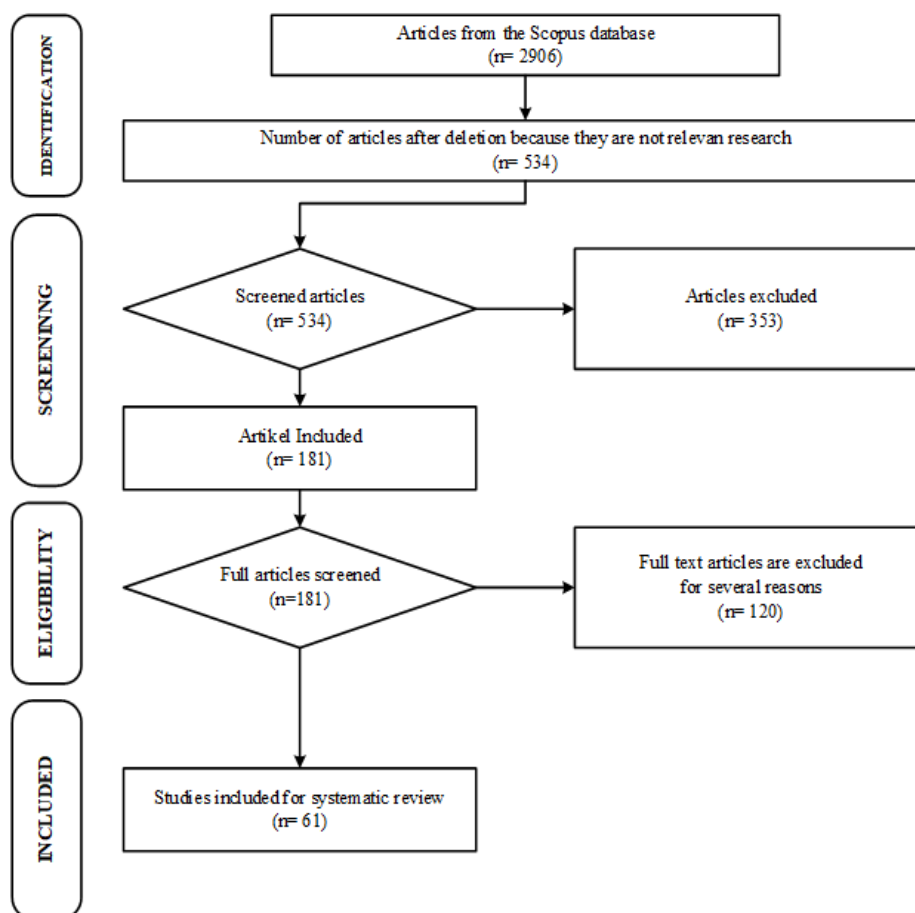


Figure 1. PRISMA diagram on a systematic literature review adapted from Gupta et al. (2021).

To achieve the research objectives and identify relevant research papers, the online database from Scopus was used. Scopus database has been curated by experts and offers higher trust (Bodolica & Spraggon, 2018). In each database, these keywords are analysed individually to broaden the scope of collaborative learning research. As a criterion for study selection, we favour only peer-reviewed publications, as they are a more trustworthy source of scientific knowledge (Salam et al., 2019). This study looks into the elements that affect group work in higher education during the fourth industrial revolution using a modified Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) technique from Männistö et al. (2019), NVivo and Microsoft Excel. This study consisted of articles that were searched using the following queries for the title, abstract and keywords: “collaborative learning”; “higher education”; “online collaborative learning”; “collaborative e-learning”; “collaborative learning process”.

One of the most crucial and significant phases of a systematic literature review is the selection of the studies to be used (Salam et al., 2019). Regarding the rationale for quality assessment (QA), this article selects 61 studies to go through the next step. Any duplicate work was removed using the Mendeley application. To

guarantee that the study met QA standards, irrelevant papers were also excluded. The data extraction process yielded information from each review as described in Table 1. Each study was summarised according to its strategy, methods and conclusions, as well as its scope or area of application. Initially, the Scopus database yielded the identification of 2,906 articles. Following the removal of duplicate entries, 534 unique articles remained. Following a screening of titles and abstracts, 181 papers were retained for full-text examination, of which only 61 matched the inclusion criteria. Figure 1 provides a summary of our search strategy for a systematic literature review, which is modified from Gupta et al. (2021).

3.2. Selection Criteria

To achieve the research objectives, due to the importance of the selection stage in determining the overall validity of the literature review, several inclusion and exclusion criteria were applied (Mikalef et al., 2018). Systematic selection criteria were determined to designate the most relevant studies in collaborative learning. During the initial search process of the Scopus database, we confined the scope of our literature review to the years 2008 to 2022 based on a variety of factors, the language was 'English' and the type of study was 'a peer-reviewed article'. The reason it started in 2008 is that there was a trend towards the development of e-learning in educational research (Valverde-Berrocoso et al., 2020) and the development of collaborative learning.

Table 1. Inclusion and exclusion criteria

Criteria	Review	
	Inclusion	Exclusion
Language	English written	Non-english written
Availability	Only journal	Out of journal
Year Publication	2008-2022	Out of the time
Relevance	Related to research question	Not related to research question
Domain	Collaborative learning; Higher education; Industrial revolution	Duplication

3.3. Analysis Method

The analysis and synthesis of the current evidence is a vital part in any systematic review, depending on the number of studies to be included in the review (Linnenluecke et al., 2020). In this study, unique content data analysis methods are employed for each cluster. For the first cluster, content and topic analysis are conducted to synthesise research that focuses on collaborative learning in higher education as well as the resulting challenges. A comparative evaluation of collaborative learning in higher education was carried out as part of the study to answer the third research question. The remaining 61 publications were inspected thoroughly in line with the coding method, and the necessary material was then extracted, analysed, and synthesised.

4. Result and Analysis

4.1. Descriptive Statistics

The literature study, encompassing academic journal articles published between 2008 and 2022, began in 2008. During a 14-year period, data were collected from a selection of scholarly papers on the research topic. The final sample is comprised

of 61 articles from 45 distinct publications. Table 2 displays the periodicals in which papers on the determinants of collaborative learning in higher education throughout the industrial revolution were published, rated as 4.0 according to the Scopus rating index as recommended by Leijon et al. (2022).

Table 2. List of journal outlets (select) publishing collaborative learning in higher education

Quartile	Journal	SJR	Total
Q1	American Journal of Distance Education	0.898	1 52
	British Journal of Educational Technology	1.87	1 (85%)
	CBE Life Sciences Education	1.297	1
	Computer Assisted Language Learning	1.839	1
	Computers & Education	3.676	2
	Computers & Education journal	0.143	1
	Computers in Human Behavior	2.174	1
	Education and Information Technologies	1.055	2
	Education and Training	0.614	3
	Educational Psychologist	3.537	1
	Educational Psychology Review	3.255	1
	Educational Research Review	3.067	1
	Educational Researcher	3.374	1
	Higher Education	1.729	1
	Innovations in Education and Teaching International	0.76	1
	International Journal of Educational Research	0.923	1
	International Journal of Educational Technology in Higher Education	2.102	1
	International Journal of Emerging Technologies in Learning	0.632	1
	International Journal of Technology and Design Education	0.753	1
	Journal of Computer Assisted Learning	1.491	1
	Journal of Computers in Education	1.039	1
	Journal of Computing in Higher Education	1.387	1
	Journal of Educational Computing Research	1.279	1
	Journal of Information Technology Education: Research	0.628	1
	Journal of Information, Communication and Ethics in Society	0.36	1
	Journal of Music, Technology and Education	0.238	1
	Journal of Network and Computer Applications	2.193	1
	Language Teaching Research	1.64	1
	Learning and Instruction	2.484	3
	Learning Environments Research	0.95	1
	Learning, Culture and Social Interaction	0.685	1
	Malaysian Journal of Learning and Instruction	0.286	1
	Smart Learning Environments	0.9	1

Quartile	Journal	SJR	Total
	Sustainability	0.664	4
	Teaching and Teacher Education	1.945	1
	Technology, Knowledge and Learning	1.138	2
	Technology, Pedagogy and Education	1.162	1
Q2	Education Sciences	0.518	2
	European Journal of Education	0.532	1 (10%)
	Frontiers in Education	0.579	1
	International Journal of Educational Management	0.462	1
	Turkish Online Journal of Distance Education	0.412	1
Q3	Higher education, skills and work-based learning	0.33	1
	Journal of e-Learning and Knowledge Society	0.251	1 (3%)
Q4	International Journal of Learning	0.106	1 (2%)

These articles are scattered in several research journals with varying numbers (Usman et al., 2021). Concerning journals, Sustainability stands out with four publications in total. There are three articles published in the Education and Training, and Learning and Instruction. Computers & Education, Education and Information Technologies, Technology, Knowledge and Learning, Education Sciences all consist of two articles each. Furthermore, each consists of one article from 37 publishers. The distribution of journals according to the name of the journal is presented in Table 2.

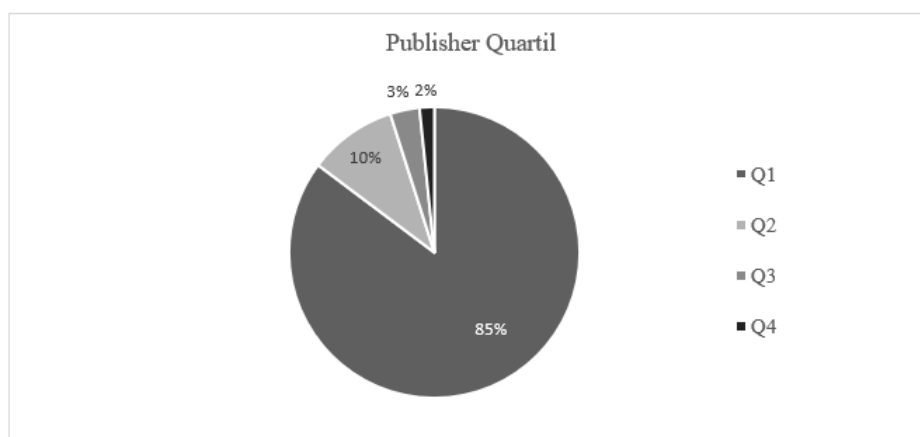


Figure 2. Distribution of selected article quartiles.

In assessing journals, Scopus classifies the quality of journals with the term 'quartiles', consisting of the quartiles Q1, Q2, Q3, and Q4. In this analysis, Q1 is the highest or most significant cluster in terms of journal quality which consists of 52 articles, followed by Q2 (6 articles), Q3 (2 articles), and Q4 (1 article). Overall, 85% of publications appeared in top Q1 journals, 10% in Q2 journals, 3% in Q3 journals, and 2% in Q4 journals as presented in Figure 2. Related research from year to year from 2008 to 2022 showed the highest number of articles in 2019, namely 13 articles. Second, in 2020 there was a total of 11 articles. With 61 articles,

this demonstrates the continued high level of research interest in the area of collaborative learning in higher education during the IR4 era. The distribution of articles included in the study by year is presented in Figure 3.

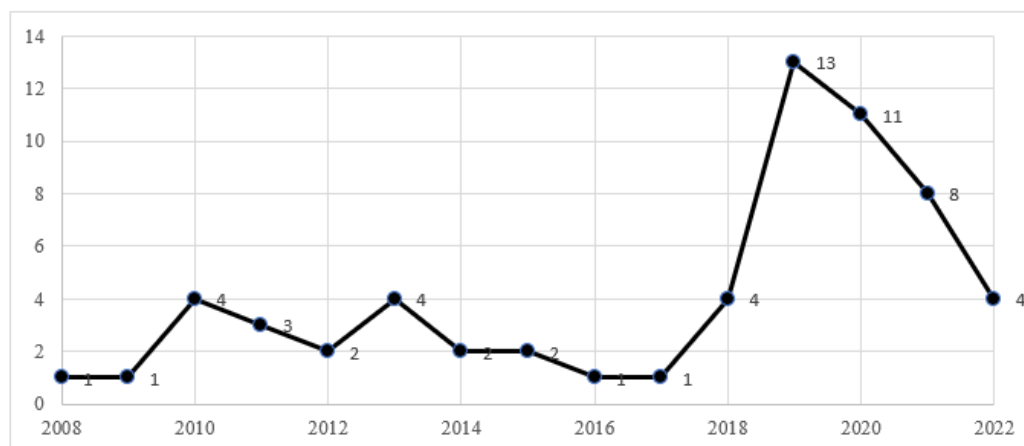


Figure 3. Distribution of articles by year.

4.2. Factors Influencing Collaborative Learning in Higher Education Institutions in the Era of 4RI

This study's primary purpose is to determine the characteristics that promote collaborative learning at universities during the fourth industrial revolution. The 61 researches presented in this paper are multiple pertinent studies given by various writers to discover the characteristics that impact higher education towards collaborative learning. Following completion of the flow of identification, screening, and eligibility to the stages, the information gathered can be analyzed based on methods classified by Sensuse (2019). The analysis is obtained based on the following focus areas: Task and Context, Environment, Social, Technology, Teacher, and Learner.

Table 3. Factors in collaborative learning in higher education in the 4IR era.

Factors	Dimension	References
Task & Context	<ul style="list-style-type: none"> – Online learning – Knowledge and expertise – Ownership of the task – Control of the task – Learning context – Terms of educational context – Encourages collaborative – Collaborative activities – Educational designers – Educational approach – Educational process – Institutional assessment systems 	(Paulsen & McCormick, 2020) (Okolie et al., 2019) (Brindley et al., 2023) (Su & Beaumont, 2010) (Ming et al., 2021; Popov et al., 2014) (Jeong et al., 2019) (Herrera-Pavo, 2021) (ChanLin, 2012; Phuthong, 2021) (Barberà et al., 2022) (Gress et al., 2010) (Näykki et al., 2014) (Kirschner et al., 2011) (Nicolau et al., 2017) (Levin & Avidov-Ungar, 2018) (San-Martín et al., 2020) (Kirschner et al., 2009)

Factors	Dimension	References
		(Hong et al., 2011)
Environment	<ul style="list-style-type: none"> - Online learning environments - Space environment - Resources environment - organisational environment - Learning environment - Computerised environment 	(Chatterjee & Correia, 2020) (Brindley et al., 2023) (Herrera-Pavo, 2021) (Ku et al., 2013; Wang et al., 2020) (Levin & Avidov-Ungar, 2018) (Maqtary et al., 2019) (Ansari & Khan, 2020) (Kolyvas, 2020)
Social	<ul style="list-style-type: none"> - Social interactive - Social engagement - Social media - Social environment - Social skills - Motivation - Social networking - Social presence - Socio-emotional - Social constructivism 	(Järvelä et al., 2010) (Sarwar et al., 2019) (ChanLin, 2012; El Massah, 2018) (Al-Rahmi et al., 2015) (Scager et al., 2016) (Goslin et al., 2016) (Gašević et al., 2018) (So & Brush, 2008) (Näykki et al., 2014) (Tolmie et al., 2010) (Ansari & Khan, 2020)
Technology	<ul style="list-style-type: none"> - 3d virtual worlds - Multimedia technology - Network technology - Collaborative learning technology - Educational technology - Computer-supported - Software architecture - Computer workstation 	(Ibáñez et al., 2013) (Paulsen & McCormick, 2020) (Su & Zou, 2020) (Phuthong, 2021) (Gress et al., 2010; Ku et al., 2013) (Gašević et al., 2018) (Zappatore, 2022) (Hong et al., 2011) (Bjelobaba et al., 2022)
Teacher	<ul style="list-style-type: none"> - Interact in multiple, meaningful ways, - Develop critical thinking, - Communication - High creativity - Course and the structure - Competence and stimulate - Attitude - Interactivity 	(Sarwar et al., 2019) (Awang-Hashim et al., 2019) (Pangestu, 2019) (Oonk et al., 2020) (Ansari & Khan, 2020) (Alismaiel et al., 2022)
Learner	<ul style="list-style-type: none"> - Student engagement - Encourage learners - Learner skill - Students interact - Student perceptions - Student reluctance - Student competences, - Student work evaluation - Participating students 	(Paulsen & McCormick, 2020) (Chatterjee & Correia, 2020) (Awang-Hashim et al., 2019) (Al-Rahmi et al., 2015) (Scager et al., 2016) (Barberà et al., 2022) (So & Brush, 2008) (Wang et al., 2020) (Levin & Avidov-Ungar, 2018) (Zappatore, 2022) (Bjelobaba et al., 2022)

Factors	Dimension	References
		(Alismaiel et al., 2022)

Task & Context

Technological advances are an effective way to connect the online learning environment and provide the benefits of collaborative learning (Paulsen & McCormick, 2020), which focuses on students' knowledge and skills in encouraging collaborative learning (Okolie et al., 2019). Collaborative learning, in an educational context, is a strategy that focuses on groups of students with various levels of performance working together to achieve common goals (Phuthong, 2021). Students work together towards a common goal, in a spirit of cooperation and not competition (Isaías, 2018). Students incorporate group-managed tactics, such as initiating engagement, offering recommendations to improve group interactions, learning by assisting others in their learning, praising group members for their efforts, and reminding others of time and progress (ChanLin, 2012). Social networking sites and social media can be utilised as dynamic tools to help create a learning environment by encouraging student participation and articulation in cooperative learning (Sarwar et al., 2019). Due to technological synchronization, instructors may manage and track their students' participation in online classes and record their exchanges with them (Camilleri & Camilleri, 2022). In online collaborative learning, research has investigated how people collaborate to produce social knowledge in the context of specific learning tasks (Wang et al., 2020). Methods that provide the same detailed information as content analysis in real-time are required to convert the knowledge learned through debate and dialogue. This will allow us to give students immediate feedback on their individual and group learning processes as they take place during group projects (Gress et al., 2010).

Environment

Although there have been advances in technology and efforts to design effective ways in online learning environments, the impact on collaborative learning (Chatterjee & Correia, 2020) with the use of computerised systems to enable or facilitate the learning process can shape various techniques in collaborative learning (Maqtary et al., 2019). Systems learning and transformation methods enhance organisational research and entrepreneurial skills by strengthening important network cooperation and resource-sharing mechanisms (Kumari et al., 2020). Actors are free to customise the workspace, while the online workspace is limited and determined by the resource platform and environment, which refers to the use of cooperative learning resources, forming a collaborative learning concept to expand the reach of resources (Al-Samarraie & Saeed, 2018). Establishing a dynamic and cooperative learning environment allows for active participation, honest dialogue, and the unrestricted exchange of ideas and perspectives, all of which promote learning (Su & Beaumont, 2010).

Social

Collaborative learning (CL) develops social skills necessary for future scientific careers (Scager et al., 2016). CL is used to promote social presence and foster an atmosphere where students feel free to share their thoughts. Students with low levels of social presence are unable to communicate diverse ideas and are unable to receive help from peers and teachers (Phuthong, 2021). Collaboration in the

classroom is critical to social constructivism (Goslin et al., 2016) which emphasises continuous learning through contact, cooperation and group work (Matee et al., 2022). Dealing with technological developments in the field of education can be achieved through the use of collaborative learning and online social engagement strategies (ChanLin, 2012). Active learning literature also supports the influence of positive social interaction approaches on student performance when using collaborative learning strategies (El Massah, 2018). Social networking platforms play an important role in encouraging online collaborative learning by providing more media for students to communicate with their classmates (Ming et al., 2021). In other words, the degree to which students comprehend how to use social media platforms to improve their collaborative learning experiences and the potential of these platforms to make it easier for electronic information sharing and resource sharing (Phuthong, 2021).

Technology

Computer-supported collaborative learning has been used for many years in educational programming and shows that group processes and computer-supported collaboration scripts can facilitate the informed design of meaningful collaboration for learning and teaching (Popov et al., 2014; Silva et al., 2020). The global education industry is being drastically altered by COVID-19. After this epidemic, collaborative and distance learning technologies are anticipated to establish themselves as the "new normal" in education (Phuthong, 2021). Online collaborative learning provides an instructional scaffolding design lens that can encourage active and productive online conversations and is a possible research tool for the future (Wang et al., 2020). Networked technological capabilities can create opportunities for interaction between groups and within entire classes and change the way collaborative learning takes place (Mercier & Higgins, 2013). Future research should focus on how the use of educational technology might enhance students' collaborative learning, particularly when it comes to problem-solving, communication, and finishing assignments (Bond et al., 2020). Therefore, collaborative learning models use client-server tools to build, enabling the specification of learning workflows and setting up collaborative interactions as theatre simulations in a 3D virtual world (Ibáñez et al., 2013) and software architecture-based can be developed to support collaborative learning modules (Ibáñez et al., 2013).

Teacher

Collaborative learning can encourage students to interact in diverse and meaningful ways and develop critical, communication and social skills. The learning methods used by the courses, lecturer plans, and collaborative learning structures are important parts of a Collaborative Learning Design (Pangestu, 2019). Teachers may foster students' creativity by encouraging them to investigate subject matter in more inventive ways (Awang-Hashim et al., 2019). Teachers are required to play a crucial role in the critical interaction of higher education institutions with society by fostering collaborative learning attitudes and mastering cross-border competencies (Oonk et al., 2020). Therefore, interaction with classmates and teachers as well as collaborative learning have a big impact on students' academic success (Ansari & Khan, 2020).

Learner

When students are required to take an active role in learning, encouraging collaboration and discussion with classmates through achieving educational goals in a personalised or self-directed way, is a powerful way to increase student engagement and motivation (Nakajima & Goode, 2019). Appropriate assessment strategies are needed when new educational approaches are introduced, to ensure their effectiveness and feasibility and highlight the importance of addressing student competencies, educational needs, and collaborative learning requirements (Zappatore, 2022). On the one hand, course structure influences students' perceptions of collaboration, social interaction and satisfaction. Utilising social media for educational reasons might enhance students' perceptions of their academic success (Al-Adwan et al., 2020; So & Brush, 2008). Conversely, students' unwillingness to engage in collaborative learning is a factor that influences the design of individual activities rather than collaborative activities, and comparable results were seen with graduate students in online environments (Barberà et al., 2014). The requirement to engage in collaborative learning as part of the educational process encourages students to acquire knowledge in the subject area. Adoption of information about the technology and structures employed, analytical skills, critical thinking and enthusiasm to work on projects, as well as an improvement in the competency of students engaging in collaborative learning can be formed (Bjelobaba et al., 2022).

4.3. Institutional Challenges in Collaborative Learning at Higher Education Institutions

Several challenges are related to students' perceptions of the complexity of economic interactions, and challenges faced as students perceive economic interactions as more complex after participating in simulations in collaborative learning (Sierra & Suárez-Collado, 2021). Several challenges to consider relating to collaborative learning (CL) in higher education in the 4IR era: (a) Experienced educators whose customary practices have been demonstrated to produce positive learning results may not choose to adopt this strategy (Hernández et al., 2019); (b) Time is required to develop activities, and university lecturers with several duties may lack this resource (time) to do something new, and (c) Resistance to change from professors and even from students.

Increasing student diversity and the use of technology in the application of CL are two difficulties that higher education must address (Goedhart et al., 2019). There are difficulties in adopting machine learning (ML) and artificial intelligence (AI) in collaborative learning in universities in middle-income nations (Kuleto et al., 2021). Through more active discussion, sharing, and modification of learning resources, the use of these technologies has unquestionably led to a major increase in student cooperation. Researchers, practitioners, and academics will be able to understand the issues with these technologies from a wider perspective by mapping cloud computing tools in blended learning environments (Al-Samarraie & Saeed, 2018).

In collaborative learning, the majority of faculty members believe that conventional methods of instruction are more useful than online-only ones. The

majority of instructors view student participation as the most difficult aspect of online instruction. When adapting traditional instruction to the online environment, teachers believe it is crucial to modify instructional content to meet students' requirements. Other important aspects that must be changed include teaching delivery methods and classroom policies (Pandit & Agrawal, 2022). A recurring challenge to collaborative learning is to promote student involvement in group activities (Silva et al., 2020).

The idea of a mission-driven institution of higher learning that adopts the University Industrial Park model might be able to handle the challenges brought on by the fourth industrial revolution (Alam et al., 2020). CL's low pass rate impacts university funding; therefore, there is a tremendous amount of pressure to boost pass rates (Roberson & Kleynhans, 2019). Universities throughout the world have turned to online learning as a technique for addressing teaching and learning issues as a result of the globalisation of higher education and economic constraints. However, educating academics and students with the skills necessary for efficient online learning remains a significant difficulty (Thomas et al., 2018).

Although integrating online learning presents a number of challenges, it does allow teaching and learning to continue, lowers the impact on students' academic progress, and enables distance learning for international students who cannot travel abroad to attend classes (Ming et al., 2021). The challenge for teachers is to remain a central figure in supporting collaborative learning, without controlling the moments in which learning opportunities arise for students (van Leeuwen et al., 2019).

4.4. Gaps and Future Research.

Trends in the area of collaborative learning in higher education in the 4IR era are seen based on linked literature, and it is evident that the work studied includes the process of building groups. It is crucial to attempt to re-implement this approach in other situations when individuals must operate in groups. These settings include task and context, environment, social, technological, teacher, and learner. However, there are still a lot of concerns in this area that haven't been fully examined and resolved. These problems are holes and flaws in the literature that are examined and used as a foundation for determining the course of further research, as follows:

(1) Various interactions related to student perceptions (Sierra & Suárez-Collado, 2021) when participating in giving challenges in CL affect the graduation rate (Roberson & Kleynhans, 2019). Therefore, by providing empirical studies related to collaborative learning in higher education, students' perceptions of student graduation rates can become a research gap in the future using a quantitative method approach.

(2) The application of CL in the 4IR era is certainly loaded with the use of technology (Goedhart et al., 2019) including the application of artificial intelligence (AI) and machine learning (ML) (Kuleto et al., 2021). Future research should be geared towards proposing platforms and frameworks for concrete AI and ML projects for higher education, especially in low and middle-income countries. This research is important to bridge this skills gap and provide opportunities for students and professionals to gain hands-on experience.

(3) Various strategies include encouraging students to work together, assessing student participation on online platforms, and using instruction and consulting, which can be used to address challenges faced in using Virtual Collaborative Learning in higher education institutions. To better understand the issues associated with the use of Virtual Collaborative Learning by students and lecturers, future research needs to identify these by including respondents representing all higher education institutions in middle-income countries (Matee et al., 2022).

(4) Some university faculty consider that traditional methods are more profitable than online methods, and changing teaching adaptation modelling, and changing the content as needed is very important (Pandit & Agrawal, 2022). For this reason, a comparative study is needed on how the outcomes of teaching implementation along with its content and methods are from the traditional model and the collaborative online model. Future research can raise this aspect.

(5) Collaborative learning online still encourages the university as a learning strategy. However, good provision is also needed to improve student learning skills online (Thomas et al., 2018). Future research can discuss the paradox in empirical studies between universities, learning models, and improving students' skills. This research is important to bridge the gap between research and practice and improve student learning outcomes.

5. Conclusion

Collaborative learning, used as a teaching and learning method in the present online learning environment, enables students to participate actively and interact with one another. This study seeks to identify future research gaps as well as the elements and constraints of collaborative learning in higher education institutions throughout the fourth industrial revolution. A systematic literature review, which is an appropriate method for strengthening research issues and gaps, was conducted with 61 papers. It should be noted that this manuscript only presents work from the Scopus database with journal criteria. This study has identified six factors related to collaborative learning in tertiary institutions in the fourth industrial revolution era including Task & Context, Environment, Social, Technology, Teacher, and Learner.

This research has made a substantial addition to learning education by bringing together the numerous and different strands of collaborative learning literature. It presents a comprehensive analysis of the literature on collaborative learning in higher education institutions during the fourth industrial revolution to generate a clear grasp of its relevance and use. Furthermore, the findings of this study have revealed that the online-based collaborative learning model has been widely adopted in several models in higher education. In addition, Comparing the current collaborative learning features reveals major gaps in the technological integration needed to achieve collaborative learning in higher education disciplines throughout the fourth industrial revolution.

However, there are still some limitations to this research, including that it only presents works from the Scopus database with journal criteria, future SLR studies may present from other databases such as the Web of Science, etc. Second, it can also present manuscripts from books, processes, etc. To accelerate the

implementation of Industry 4.0 in collaborative learning, further study on the validation of recommended ideas and concepts utilising empirical research methods such as simulations, prototypes, experiments, and case studies is necessary. Lack of research on sustainability, artificial intelligence, and machine learning indicates an undiscovered area of study that should be pursued in the future.

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6. References

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