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Use of Networked Learning Strategies in the Online Classroom: A Systematic Literature Review

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ABSTRACT

This systematic literature review examines the use of networked learning strategies and tools in supporting active learning in fully online higher education classrooms since the COVID-19 pandemic. With the increasing adoption of online and blended learning, there is a growing need to understand how networked learning can facilitate engagement, interaction, and collaboration among students and instructors. This review synthesises findings from twenty studies to understand the theoretical perspectives, various networked learning strategies, and networked learning technological tools that were used. The results showed that the theoretical perspectives guiding networked learning implementations have remained consistent both before and after the pandemic. The review revealed that while asynchronous methods of communication and collaboration that were used pre-pandemic continued to be used post-pandemic, there was a heightened dependence on networked learning strategies and technological tools that enabled synchronous communication and collaboration, and interactions with multimedia content. The findings suggest that in comparison to pre-pandemic implementations of online and blended learning, post-pandemic fully online classrooms are providing more interactive and engaging experiences for learners.

Keywords: *Networked Learning; Networked Learning Strategies; Networked Learning Technological Tools; Active Learning; Collaborative Learning; Online Learning; Higher Education; Systematic Literature Review*

INTRODUCTION

Learner-centred environments incorporating active learning through collaborative and cooperative interactions between learners have been widely acknowledged as being essential to effective learning. Pre-pandemic, this was chiefly accomplished using face-to-face activities. Since the pandemic, when all teaching and learning moved online, these activities had to be conducted virtually using technology-mediated teaching and learning.

Networked Learning concentrates on the use of digital and social media to support learner connectivity, interaction and content generation in remote collaborations, and hence, would be an important instructional design in an online active learning classroom (Dohn, de Laat, & Ryberg, n.d.). The use of asynchronous technologies was more widespread pre-pandemic, as seen in its use in Massive Open Online Courses (MOOCs). Where synchronous communication was required, social media was widely used. Higher educational institutions used Learning Management Systems (LMS) to post content, while collaboration was facilitated using social media and in-person interactions. Research in the area of networked learning in higher education appeared relatively sparse pre-pandemic, possibly because most colleges and universities delivered face-to-face instruction only. With the onset of the COVID-19 pandemic, focus shifted to synchronous modes of communication and collaboration, which were made possible by an explosion of Internet-based technologies.

The area of networked learning in fully online learning environments impacts the author directly due to the strategic goals of the University where employed. During the pandemic, this University

invested considerable financial resources in online teaching and learning infrastructure, and is aiming to continue offering a flexible hybrid learning environment to accommodate both face-to-face and fully online students. In this way, the University hopes to target both local and international students. It is, therefore, an opportune time to examine the networked learning concepts and strategies that have been employed in fully online environments in the current post-pandemic era, for application to practice.

With the widespread availability of information and communications technologies (ICT) infrastructure and relatively new Internet-based communications software, this Systematic Literature Review (SLR) seeks to examine the networked learning theories, strategies, and tools that were employed post-pandemic in fully online environments. Similar SLRs have not been identified during review of the literature, so this study will contribute to the body of knowledge.

RESEARCH QUESTIONS

The main research question for this study is: "*To what extent did instructors at higher education institutions employ networked learning strategies and tools to facilitate active learning in their online classrooms post-pandemic?"*

The sub-research questions are:

RQ1: What were the theoretical perspectives that guided the studies?

RQ2: How did instructors use networked learning strategies and tools in their online classrooms?

LITERATURE REVIEW

An initial search of the literature was performed via Scopus using the key terms 'networked learning', 'active learning', and 'collaborative learning', to gain insight into how networked learning had been used to facilitate active learning in face-to-face, blended, and online environments. Further, literature related to the keywords was located in peer-reviewed journals and databases, while additional resources were found through snowball referencing.

The following sections discuss the theoretical underpinnings of active learning and networked learning, and consider studies that have investigated the use of collaborative and networked learning strategies and tools to facilitate active learning.

Active Learning

Active learning is an educational approach where students participate in the learning process through instructional activities and discussions rather than passively listening to the instructor (Freeman *et al*., 2014; Handelsman *et al*., 2007). Active learning is built on the constructivist (Elliott *et al*., 2000; Piaget, 1968) and social constructivist (Dewey, 1916; Vygotsky, 1978) learning theories, which emphasise the active role of individuals in building their knowledge. Moore (1993) proposed three types of interaction that distance educators needed to consider when designing and delivering courses for effective learning: learner-content, learner-instructor, and learner-learner interaction. Similarly, Garrison, Anderson, and Archer's Community of Inquiry model (2000) derives from social constructivism, with social, teacher, and cognitive presence manifesting through the interactions between learners, instructors, and content. In an SLR conducted by Ribeiro and Passos (2020), six main types of active learning strategies were identified: Flipped Classroom, Game-Based Learning, Problem-Based Learning, Project-Based Learning, Peer Instruction, and Team-Based Learning.

Networked Learning

Whereas active learning uses teaching strategies that can take place in both face-to-face and online environments, networked learning, as defined by Goodyear *et al.* (2004), considers digital technologies as being an essential element of the active learning environment. Goodyear's definition of networked learning builds upon Moore's contribution to propose that networked learning is

> "learning in which information and communication technology … is used to promote connections: between one learner and other learners, between learners and tutors; between a learning community and its learning resources" (2004, p. 1).

Goodyear *et al.* (1998) emphasised the importance of interaction, not simply between the learner and the online resources, but also the social interaction between learners.

A revised definition of networked learning that places strong emphasis on interpersonal connections has since been proposed in 2020:

> "Networked learning involves processes of collaborative, co-operative and collective inquiry, knowledge-creation and knowledgeable action, underpinned by trusting relationships, motivated by a sense of shared challenge and enabled by convivial technologies" (Networked Learning Editorial Collective, 2020, p. 319).

Thus, networked learning strategies leverage technology to facilitate communication, collaboration, and knowledge sharing among learners and between learners and instructors.

In a similarity shared with Constructivism, networked learning indicates that the learner creates their own learning experience, while the instructor serves as a facilitator to guide students to effectively create knowledge (Hodgson & McConnell, 2019). These characteristics are reflected in Anderson's (2011) Online Learning model and Picciano's (2017) Blending with the Pedagogical Purpose model. McGarrigle (2009) also found evidence for deeper knowledge construction when lecturers played a greater participatory role in discussion forums. The teacher's presence and interactions in the asynchronous discussion forums may vary, from being an active moderator to simply providing guidance and instructions (Salmon, 2000), but students felt encouraged when the teacher was more involved in the course (Vonderwell, 2003). Though the teacher's active presence is essential to student success, it is also necessary to guide students towards becoming independent, active learners who become leaders and supporters of their peers, while becoming less reliant on the instructor (Simons *et al*., 2000).

In addition to the internal construction of knowledge, students also use the connectedness of external informal networks, such as online social networks, to inform their learning. The importance of informal and online social networks in education has been highlighted by Ajibade *et al.* (2017), Bozkurt and Hilbelink (2019), Chen and Bryer (2012), Goodyear and Carvalho (2014) as a critical part of e-learning ecosystems as they facilitate social interactions and allow for collaboration, cooperation, creation and sharing of knowledge, all of which are important in personal development.

An important aspect of networked learning is the emphasis on technology-mediated group collaboration and discussion, allowing for the sharing of different viewpoints and perspectives, which can be used by the learner in informing their creation of new knowledge, and building on existing knowledge to aid in effective decision-making and problem-solving. Collaboration and discussions involve students articulating their understanding of content to their group members, arguing persuasively and conveying feedback, examining, and possibly modifying their viewpoints in light of others' views to build shared meaning (Koschmann, 1996). Collaboration also inculcates communication, such as learning how to manage conflicting opinions, and learning coordination

and self-management skills that are important in project-based and team-based activities in the workplace (Goodyear *et al.*, 2004; Dirckinck-Holmfeld, 2016).

Collaborative and cooperative learning strategies are well-suited to online education settings, as digital tools and resources can be used to create effective, interactive, and collaborative experiences between instructors and learners. Literature has revealed the use of various collaborative strategies used to promote learning: Discussion groups (Schellens & Valcke, 2005; Williams & Svensson, 2021), peer teaching (Velez *et al.*, 2011; Wagner & Gansemer-Topf, 2005), debates (Brown, 2015); simulations (Limniou *et al.*, 2009); games (Cooney & Eamon, 2020; Zhong, 2019), role plays (Acharya *et al.*, 2019; Zhang *et al.*, 2016), case studies (Hilvano *et al.*, 2014; Tan, 2019), virtual and augmented reality (Affendy & Wanis, 2019; Çoban *et al.*, 2022), social networking tools (Ansari & Khan, 2020; Boruzie *et al.*, 2022; Liu *et al.*, 2022), and gamification (Azmi *et al.*, 2015; Bilgin & Gul, 2019).

AIM OF THE STUDY

The practical implementations of networked learning in education are a relatively unexplored area since the pioneering work done by Goodyear *et al.* (2004). This SLR aims to comprehensively identify primary research studies in the higher education environment post-COVID-19 pandemic that describe active learning interventions administered by instructors that involve the use of formal networked learning strategies, and report instructor and/or student response outcomes to the intervention strategies used.

This review will be of benefit in 3 ways: provide educators with a current body of knowledge of various networked learning strategies used in higher education institutions in fully online environments; inform others of the experiences of educators in implementing the strategies; and guide future research in the area by identifying the theoretical perspectives used by researchers in the area.

METHODOLOGY

Definitions

The following terms have been defined to provide a clear understanding of key terms used in the context of this study, including those that describe information extracted from the papers reviewed.

Networked Learning (NL) refers to the revised definition proposed in Networked Learning Editorial Collective (NLEC) (2020). In accordance with NLEC, this definition has been used as the basis for determining whether an intervention described in the literature can be considered to be an example of networked learning, and has been used to select papers for inclusion in the SLR.

Networked Learning Strategies (NLS) refers to instructor activities used to aid implementation of the networked learning intervention. The interaction strategies within networked learning are as follows:

Learner-content interaction strategies refer to activities used to provide interaction between learners and the resources. **Learner-learner interaction strategies** refer to cooperative or collaborative activities designed to promote interaction between learners. **Learner-instructor instruction strategies** refer to activities that would allow communication and feedback between learners and instructors.

Networked Learning Technology Tools (NLTT) refers to the learning environment or platform and the technology tools used to support the three types of interactions.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

The SLR procedure used was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati *et al.*, 2009; Page *et al.*, 2021). It uses a methodology where the protocol and search strategy are specified in advance according to PRISMA, thus providing for a highly structured, transparent, unbiased, and reproducible process (Chandler & Hopewell, 2013) to identify, evaluate, and synthesise relevant studies.

Review Protocol

The protocol was specified in advance before the search and included the review objectives, review questions, and the PRISMA 2020 guidelines for extracting, analysing, synthesising and reporting systematic reviews.

Search and Selection Procedure

Eligibility Criteria

The exclusion criteria were specified to exclude a document if (1) it was a conceptual paper or a literature review, (2) the research was conducted before the pandemic, and (3) it involved the use of intervention strategies in a face-to-face environment.

Inclusion criteria were specified to include a document if (1) the study was conducted in the context of higher education, (2) it was an empirical study, (3) it was published in a peer-reviewed journal, and (4) it contained at least one formal networked learning strategy to facilitate active learning.

Based on the Networked Learning Editorial Collective (2020), the following elements were used to guide whether an article could be considered for this SLR on the use of networked learning. 1) use of collaborative, cooperative, and/or collective activities, 2) emphasis on strengthening social and interpersonal relationships between participants, 3) intervention used a shared challenge, 4) used digital technologies, and 5) generation of new knowledge being created as an end result.

Information Sources

Searches for papers to be used in this SLR were conducted using Scopus, Lancaster University's OneSearch, Google Scholar, and Educational Resources Information Centre (ERIC) to provide a comprehensive set of relevant results.

Search Strategy

The P (Population) E (Exposure) O (Outcomes) search guide for qualitative research was used to assist in formulating the search query. The search terms used were: Population (Higher Education, University), Exposure (Networked Learning, Collaborative Learning), Outcomes (Active Learning). The Boolean operators "AND" and "OR" were used to combine the terms.

The search query used in Scopus, ERIC, and Lancaster University's OneSearch was:

("Active Learning" AND ("Networked Learning" OR "Collaborative Learning") AND ("Higher Education" OR University) AND ("Online Learning" OR "E-Learning" OR "Online Course" OR "Virtual Classroom" OR "Online Teaching"))

The search phrase ("Networked Learning" OR "Collaborative Learning") was used because many studies did not use the term "Networked Learning" in their study, even though the research included all three types of interactions.

The search query was modified for Google Scholar since the results returned by the search engine tended to be centred around active learning and not networked learning. The search query was developed using the following terms:

(Active Collaborative Networked Learning Interaction "Higher Education")

The searches were carried out on May 15th, 2024. The filters used were peer-reviewed journal articles where the full-text was available and published over the period 2020 - May 2024. This year range was used because this SLR looks at the period covered by the post-Emergency Remote Teaching (ERT) in order to uncover research conducted purely in the stable online environment.

The search tools yielded the following results: Scopus (10), ERIC (11), OneSearch (31), and Google Scholar (37,209). Despite the fact that Google Scholar identified 37,209 results, it only provides access to approximately the first 1000 results. Thus, the total number of search results available for this study was 1,052.

Selection Process

Nineteen duplicates were identified from the 1,052 articles from the four sets of search results and removed. The remaining 1,033 articles were screened to ensure that they met the eligibility criteria specified. This involved a two-step process:

1. The titles and abstracts were scanned to check for relevancy in accordance with the pre-specified inclusion and exclusion criteria. 981 articles were excluded after they were reviewed against the criteria. This step yielded 52 articles. The title, authors' names, abstract, keywords, and year of publication of these identified articles were entered into an MS Excel spreadsheet.

2. All articles that met the criteria were then downloaded in their entirety, if available, and saved in a folder to be used for the data extraction and analysis process. 14 articles were excluded because the text was not available. Of the remaining 38 papers, 18 were rejected. Of these 18 rejected papers, 8 studies were published in 2020 or later; however, the interventions were conducted before the pandemic, in a few cases, several years before. 5 of the rejected studies simply investigated student participation in online learning during the pandemic without implementing any interventions. 5 studies that simply mentioned strategies in passing but did not explicitly describe the strategies in the implementation of networked learning were rejected, as Research Question 2 looks at *how* networked learning strategies are used, not simply the identification of the strategies. Only 20 of the 38 studies satisfied all the inclusion and exclusion criteria specified in the protocol. These 20 studies were used as the dataset for this SLR.

Table 1 presents a summary of the search tools and the number of articles included from each source in this SLR.

Table 1: *Sources & Number of Included Articles*

Source	**Number of Articles Included**
Scopus	1
ERIC	4
Lancaster University's OneSearch	7
Google Scholar	8

Figure 1 presents the PRISMA Flow Chart with the number of studies identified at each of the phases.

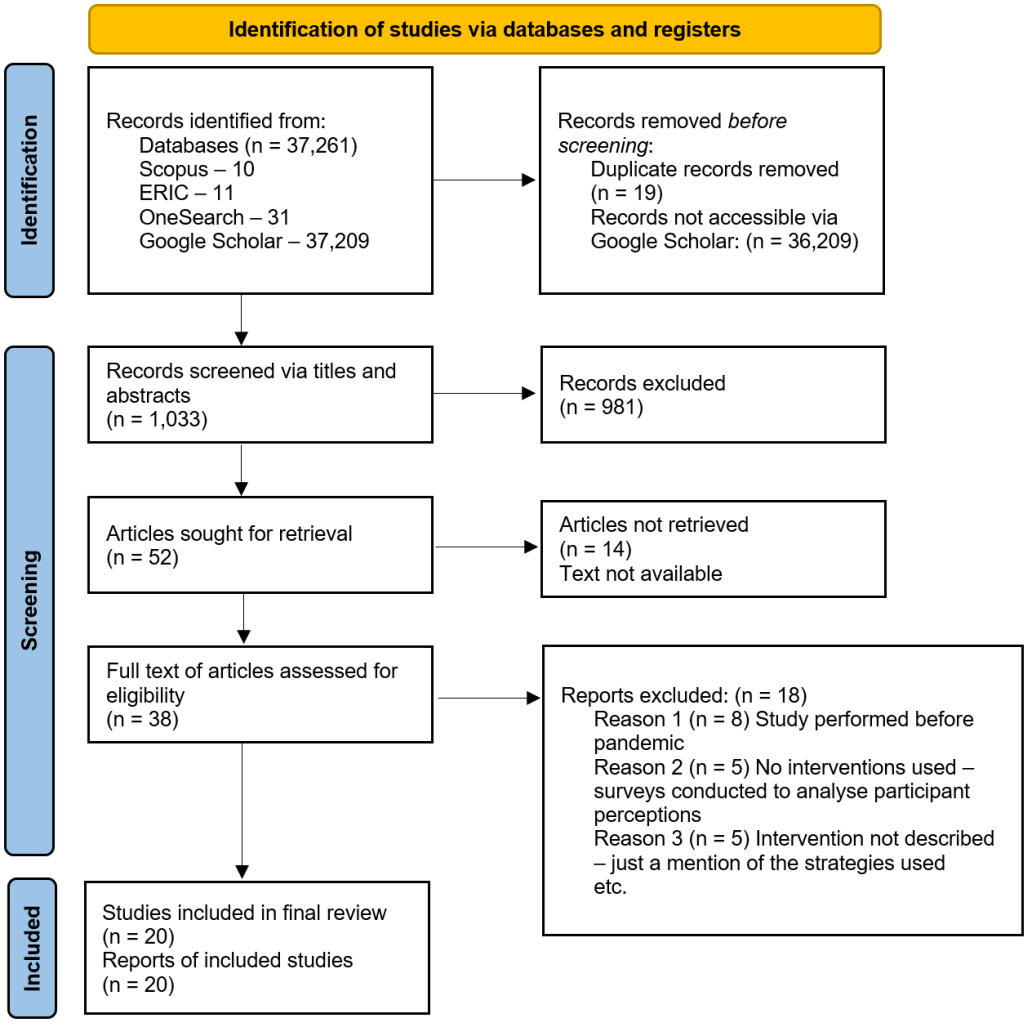

Figure 1: PRISMA Flow Chart of Study Identification Process

Data Coding and Analysis

The twenty (20) journal articles were read and reviewed in full. Each journal article was coded with an ID number prefixed by P. Relevant information was extracted and entered into tables.

Table 2 contains extracted data about the study characteristics. Table 3 was used to answer RQ1 and contains information about the theoretical frameworks used in the studies. Table 4 was used to answer RQ2 and contains information about networked learning strategies and tools used in the studies. Appendix A contains a summary of the networked learning interaction strategies employed in the studies. Appendix B contains a sample from the table containing the detailed extracted narrative.

Table 2: *Research Papers Reviewed in this SLR*

Characteristics of the Studies			
ID	**Reference: Author, Year, Title**	**Setting: Country, Duration, Sample size**	**Method**
P1	**Pichardo et al.,** (2021). Students and teachers using Mentimeter: technological innovation to face the challenges of the COVID-19 pandemic and post-pandemic in higher education	Spain; 1 academic year; 400 students, 12 academics	Mixed methods (Survey with quantitative and qualitative questions)
P2	**Liu & Shirley** (2021). Without crossing a border: exploring the impact of shifting study abroad online on students' learning and intercultural competence development during the COVID-19 pandemic	Germany, US, Brazil, India; 2 weeks; 16 students	Mixed methods (Survey, semi-structured interviews)
P3	**Petrova** (2021). The connectivist design studio	Mexico; 2 semesters; 30 students	Mixed methods (Survey with quantitative and qualitative questions)
P4	**Alfiriani et al.,** (2022). Developing networked online learning designs and its effectiveness on the works of students in higher education: case studies in Indonesia	Indonesia; 1 semester; 52 students	Quantitative (Performance results of students)
P5	**Castillo-Cuesta et al.,** (2022). Virtual workspaces for enhancing collaborative work in EFL learning: a case study in higher education.	Ecuador; 5 months; 122 (72 graduate and 50 postgraduate) students	Mixed methods (Survey, semi-structured interviews)
P6	**Moosa** (2022). Mediating epistemological access through asynchronous online discussion forums during the Covid-19 pandemic: implications for re-imagining online collaborative self-directed peer engagement and learning	South Africa; duration not specified; 2146 discussion threads from 1348 students from 5 faculties	Qualitative (Thematic analysis of discussion threads)
P7	**Shoepe et al.,** (2020). Instructor prompts and student engagement in synchronous online nutrition classes	USA; 1 semester; 27 students	Quantitative (Statistical analysis of interaction types from transcripts of video recordings of synchronous sessions)
P8	**Darici et al.,** (2021). Implementation of a fully digital histology course in the anatomical teaching curriculum during COVID-19 pandemic	Germany; 1 semester; 392 students	Mixed methods (Survey with quantitative and qualitative questions)

P9	**Sidi et al.,** (2022). Mapping active and collaborative learning in higher education through annotations in hyper-video by learning analytics	Israel; duration of a course; 25 undergraduate and graduate courses	Mixed methods (Quantitative analysis of students' and instructors' hyper-video interactions; Qualitative analysis of students' and instructors' annotations in the hyper-video environment)
P10	**Kurni & Saritha** (2021). Applying collaborative learning for enhancing the teaching-learning process in online learning through social media	India; 1 semester; 40 undergraduate students	Qualitative (Observation)
P11	**Lapitan et al.,** (2023). Design, implementation, and evaluation of an online flipped classroom with collaborative learning model in an undergraduate chemical engineering course.	Philippines; 6 weeks; 112 Chemical Engineering undergraduate students	Mixed Methods (Survey with quantitative and qualitative questions)
P12	**Creely & Lyons** (2022). Designing flipped learning in initial teacher education: the experiences of two teacher educators	Australia; 1 semester; 2 teacher educators	Qualitative (Interviews)
P13	**Estriegana et al.,** (2021). Analysis of cooperative skills development through relational coordination in a gamified online learning environment	Spain; duration of the course; 289 Computer engineering and Computer science students	Quantitative (Survey)
P14	**Fischer & Yang** (2022). Flipping the flipped class: using online collaboration to enhance EFL students' oral learning skills	Taiwan; 14 weeks; 54 undergraduate Business students	Quantitative (Pre- and post- oral test scores, quiz scores, course grades)
P15	**Zain et al.,** (2022). Promoting higher order thinking skills among pre-service teachers through group-based flipped learning	Malaysia; duration of the course; 17 pre-service teachers	Qualitative (Students' and instructors' reflective writings and students' works)
P16	**Lubicz-Nawrocka & Owen** (2022). Curriculum co-creation in a postdigital world: advancing networked learning and engagement	England; duration of the module; 25 Masters in Public Health students	Mixed Methods (Survey with quantitative and qualitative questions)
P17	**Antonis et al.,** (2022). Flipped classroom with teams-based learning in emergency higher education: methodology and results	Greece; duration of the course;	Quantitative (Individual and Team-based tests)

		133 Computer Engineering students	
P18	**Lim** (2023). Exploring the relationships between interaction measures and learning outcomes through social network analysis: the mediating role of social presence	South Korea; 7 weeks; 84 elementary education undergraduate students	Quantitative (Analysis of discussion threads, survey)
P19	**Cui & Wang** (2023). Empowering active learning: A social annotation tool for improving student engagement	Australia; 2 semesters; 313 post-graduate students	Mixed Methods (Survey with quantitative and qualitative questions)
P20	**Astarina & Herlinda** (2022). Promoting active and interactive learning in a higher education online class	Indonesia; 2 sessions of 2 hours each; 100 undergraduate students	Mixed Methods (classroom observation, questionnaire, interviews)

RESULTS

The results from the SLR process were used to answer the research questions.

Research Question 1: "What were the theoretical perspectives that guided the studies?"

Each paper was analysed to extract and document the theoretical framework(s) specified by the researcher(s) in the study. Some studies did not specify any frameworks. This information is summarised in Table 3.

Table 3: *Theoretical Frameworks used in the studies*

Theoretical Framework	**Paper**
Bloom's Taxonomy	P11
Chickering's Seven Principles for Good Practice in Undergraduate Education	P7
Cognitivism	P11
Collaborative Learning	P11, P12, P14, P15
Community of Inquiry	P9, P18, P19
Connectivism	P3, P4, P6
Constructivism	P1, P11
Flipped Classroom Model	P11, P12, P14, P15, P17
Framework for Student Engagement with Learning Technology	P20
Relational Coordination Model	P13
Slavin's Student Teams-Achievement Division Model	P10
Team-Based Learning	P17
6 Key Practices of Networked Learning	P16
None Specified	P2, P5, P8

The Flipped Classroom Model was the most popular framework (P11, P12, P14, P15, P17), followed by Collaborative Learning (P11, P12, P14, P15), Community of Inquiry (P9, P18, P19),

and Connectivism (P3, P4, P6). It is worth noting that all 5 studies that used the Flipped Classroom approach combined it with some form of collaborative learning. P11, P12, P14 and P15 used group-based flipped learning, while P17 combined flipped learning with Team Based Learning. The researchers justified their combined approach by citing previous research which found that using the flipped classroom model by itself for individual student learning had less impact on students' engagement, interaction, high-level thinking skills and on their scores. The studies found that the combined approach resulted in higher student achievement as well as improved self-perceived student learning outcomes as compared to individual flipped learning. Furthermore, P11 indicated that their study, in addition to using a collaborative flipped learning approach, also used an online course design based on the cognitivism and constructivism pedagogical models. The instructors in the study aligned their instructional activities and various learning strategies in the course with targeted cognitive skills according to the revised Bloom's taxonomy of educational objectives. The results of the study indicated that combining the different pedagogies promoted collaborative problem-solving, higher-order thinking, communication skills and higher final student grades.

While most theoretical perspectives aligned with networked learning, some studies chose uncommon or innovative theoretical lenses to guide their studies, such as the Relational Coordination Model (P13) and Chickering's Seven Principles for Good Practice in Undergraduate Education (P7). Three studies did not specify any framework used to guide their instructional strategy (P2, P5, P8).

Research Question 2: "How did instructors use networked learning strategies in their online classrooms?"

Each paper was analysed to extract and document the networked learning strategies and technology tools used in the study. This information is summarised in Table 4.

Table 4: *Networked Learning Strategies and Technology Tools used*

Networked Learning Strategy (NLS)	**Networked Learning Technology Tools (NLTT)**
Game-Based Learning	Kahoot (P13), Socrative (P13), NearPod (P20)
Collaborative Online International Learning	Virtual Reality (P2), Miro.com (P3)
Synchronous Discussions using Interactive Presentation Software	Mentimeter (P1)
Asynchronous Discussion Forums	Online Discussion Forums (P6, P12, P16, P18, P19, P20)
Synchronous Discussions using Digital Whiteboards	Miro.com platform (P3), Jamboard digital whiteboard (P5)
Synchronous Discussions using Videoconferencing	Zoom Video Conferencing (P2, P8, P11, P12, P20), Zoom Breakout Rooms (P2, P8, P12, P20), Skype (P7), Google Hangouts on Air (P14), Google Classroom (P15), Microsoft Teams (P17), Unspecified (P1, P3, P4, P13, P19)
Shared Social Annotations	Annoto (P9), Perusall (P19)
Asynchronous Discussions using Social Media	WhatsApp (P2, P10)
Flipped Classroom with Collaborative Learning	Zoom Video Conferencing (P11, P12), Blackboard LMS (P11), Moodle LMS (P12), Google Hangouts on Air (P14), Google Classroom (P15), Microsoft Teams (P17)

Polls	Mentimeter (P1), Zoom Polls (P8), NearPod (P20)
Learning Management System	Moodle (P1, P12), Blackboard (P3, P7, P11), Custom Environment (P13), Google Classroom (P15), Learning Activities Management System (P17), Unspecified (P4, P6, P8, P14, P16, P18)
Interactive Video Resources	Biteable (P15), Ed-Puzzle and Playposit web-based tools (P17)
Groupwork using Collaboration Tools	Google Workspace (P2), Jamboard (P5), Google Hangouts on Air (P14), Google Classroom (P15), Blogs (P16), Microsoft Teams (P17)

Networked Learning Strategies

The majority of the studies utilised Synchronous Discussions via Videoconferencing (n=14), and Learning Management Systems (n=14) to present course material. Learner-learner communications were facilitated by Asynchronous Discussions on various platforms (Forums (P6, P12, P16, P18, P19, P20), Social Media (P2, P10), and Social Annotations (P9, P19)), while collaborative activities were used to stimulate active learning through learner-learner interactions (Groupwork using Collaboration Tools (P2, P5, P14, P15, P16, P17), Synchronous Discussions using Interactive Presentation Software (P1), and Synchronous Discussions using Digital Whiteboards (P3, P5)). 5 studies (P11, P12, P14, P15, P17) employed the Flipped Classroom with Collaborative Learning approach, and 2 studies employed Game-Based Learning tools (P13, P20).

The elements of networked learning as identified by Goodyear *et al.* (2004) - connections between a learner and other learners, between learners and instructors, and between a learning community and its learning resources - were identified for each of the 20 studies used in this SLR. These results are summarised in Appendix A.

Learner-Content Interaction Strategies

The most commonly implemented learner-content strategy was the use of videos as educational tools (n=12: P3, P4, P7, P9, P11, P12, P13, P14, P15, P17, P18, P19). Two studies (P15, P17) embedded interaction in the videos, allowing students to actively engage with the material during the viewing process. Several studies used the more traditional textual format, either alone or in conjunction with videos, to provide course reading material to the students (n = 8: P3, P4, P5, P8, P10, P11, P12, P19). To move beyond passively reading or viewing material, two studies incorporated annotating lecture slides (P19) and videos (P9) to encourage students to formulate and share thoughts, questions, and reflections about the content. While videos appeared to be the technology of choice for self-directed learning, one study (P4) asserted that it was important to provide multimodal material to accommodate the preferred learning styles of the students.

Contemporary strategies enabled by the advances in ICT included formative online quizzes (P7, P11, P13, P14), polls (P1, P8, P20), and videos with embedded quizzes (P15, P17) to allow students to assess their understanding while they were engaging with the material. 2 innovative studies focused on the use of virtual reality (P2) and virtual simulations (P13) to create interesting and immersive learning environments. While gamification has been a point of interest in education, since there is an expectation that learning could naturally occur as a byproduct of playing a game, only 2 studies utilised educational games as one of their learner-content strategies (P13, P20).

Learner-Learner Interaction Strategies

Synchronous learner-learner discussions were used in 19 out of the 20 studies. In addition, 8 studies used the following technologies to facilitate in-class discussions - Zoom breakout rooms (n=4), Google Classroom (P15), MS Teams (P17), Miro.com (P3) and Jamboard (P5). Most studies

used a blend of synchronous and asynchronous online delivery methods using a variety of platforms for asynchronous communication, such as discussion forums (P6, P12, P16, P18, P19, P20), blogs (P16), WhatsApp (P2, P10) and Google Workspace formerly known as Google Apps (P2). This combination allowed interactions to extend beyond the in-class time period to enable both pre-class and post-class collaboration.

Most of the strategies were formal in nature and followed a structured format. The few informal activities were those navigated by the learners in informal (WhatsApp), or out-of-class (group preparatory activities, peers helping peers) settings. Given the informal and unstructured formats of these settings, students needed to demonstrate self-direction and self-regulation to utilise them effectively. One study (P14) attempted to formalise this informal setting by adding an instructor-monitoring element to the process. However, this may have altered learners' behaviours from how they would normally act when unmonitored.

Learner-Instructor Interaction Strategies

In all the studies, instructors played a significant role in facilitating the collaborative learning process, guiding the learners, providing feedback, and resolving encountered issues. In these studies, the instructors opted to play the "guide-on-the-side" role while promoting active participation and ownership of the learning process by the learners.

The importance of developing strong relationships between learners and between the learners and the instructor to create a cohesive learning unit was recognised by multiple studies. However, only one study (P12) sought to intentionally create opportunities to build relationships. While relationships may develop organically, instructors can aid this process to ensure that no student is excluded and to de-escalate conflicts equitably.

Networked Learning Technology Tools

The technology tools used in the studies aligned with the networked learning strategies and enabled the objectives of the respective activities. The reliance on videoconferencing to enable synchronous learner-instructor and learner-learner discussions saw the use of technologies that originated or were popularised within the past decade. Zoom (n=5) observed the highest adoption, with 4 studies utilising the Breakout Rooms feature to enable small group discussions. Skype (P7), Google Hangouts (P14), Google Classroom (P15), and MS Teams (P17) were also employed in separate studies. Participation in synchronous activities was encouraged through the use of digital whiteboards (P3, P5), Mentimeter (P1), Polls (P1, P8, P20), and games (Kahoot (P13), Socrative (P13), NearPod (P20)). The availability of these tools for use in the online classroom was likely determined by the respective institutions and would have impacted the tools that lecturers could access for their courses.

Asynchronous forums (n=6: P6, P12, P16, P18, P19, P20) were the favoured method for encouraging learner-learner discussions outside the classroom, possibly due to their availability on LMS platforms. WhatsApp groups were utilised in 2 of the studies (P2, P10), but these necessitated the lecturers to use their mobile phones to monitor the interactions. Specialised technology tools to annotate and discuss videos online (Annoto (P9), Perusall (P19)) were innovative ways to directly link learner-content and learner-learner interactions in close proximity to each other. Though all studies used collaborative activities to enhance learner-learner engagement, 6 studies (P2, P5, P14, P15, P16, P17) made use of collaborative tools such as Google Workspace, Jamboard and Blogs to enable online collaborative groupwork.

Uncommonly used technology tools were those that enabled learner-content interaction in the form of interactive videos (Biteable (P15), Ed-Puzzle and Playposit web-based tools (P17)). Also uncommon were Virtual Reality (P2), and Simulations and Virtual Laboratories (P13), which were both highly specialised for a particular context to encourage synchronous learner-learner

interactions in a virtual representation of the real world. The virtual reality technology (P2) was used by students in an online study abroad course to create and share cultural exchange virtual tours with their international colleagues in 4 countries. Simulations and virtual laboratories were used in the study (P13) to provide students with virtual practical work in computer engineering courses.

DISCUSSION

The purpose of this paper is to present a SLR of peer-reviewed, empirical studies that focused on how instructors at higher education institutions employed networked learning in practice, to facilitate active learning in their online classrooms post-pandemic. This SLR identified the networked learning strategies and tools that were widely adopted, as well as those that were innovative in their use, in fully online classrooms. It also revealed the theoretical perspectives that guided these studies.

Theoretical Perspectives

The theory of networked learning draws on active learning principles established in Constructivism (Elliott *et al.*, 2000; Piaget, 1968) and Social Constructivism (Dewey, 1916; Vygotsky, 1978). The theoretical perspectives of studies in this SLR were generally influenced by these theories, as reflected in the choice of theoretical framework or model. While some studies used more generalised lenses, such as Cognitivism and Constructivism, others were grounded in Social Constructivism, such as Connectivism, Collaborative Learning, and Community of Inquiry.

Theoretical frameworks and models, such as the three types of interaction for distance learners (Moore, 1993), the Community of Inquiry (Garrison, Anderson, & Archer, 2000), and the Flipped Classroom model (Flipped Learning Network, 2014) have provided a foundation for designing instructional strategies for networked learning by focusing on the types of synchronous and asynchronous interactions that support active learning. These frameworks have remained popular in their application for networked learning as evidenced by the studies in this SLR.

The theoretical lenses used in these studies of networked learning have remained much the same post-pandemic as they were pre-pandemic. As the theoretical basis for networked learning has remained unchanged, this observation is not unexpected.

Networked Learning Strategies and Tools

In the initial literature review, the majority of applicable pre-pandemic networked learning studies focused on using asynchronous communication and collaboration technologies. The findings of this SLR show that there has been a greater focus on synchronous learning and its associated technologies in the post-pandemic era.

Though guided by networked learning theory, the majority of the studies examined in this SLR appeared to focus on instructional practices that hinged on the use of technology tools to enable interaction, as opposed to practices that relied on pedagogical strategies (Ribeiro & Passos, 2020) to guide how the interactions should be structured. In this regard, only 7 studies utilised networked learning practices grounded in an instructional strategy, such as the Flipped Classroom with Collaborative Learning approach or Game-Based Learning.

The studies in this SLR encompassed a variety of synchronous and asynchronous networked learning strategies that aligned with active learning principles of interaction. 70% (n=14) of the studies facilitated synchronous conversations to virtually replicate face-to-face interactions. It was notable that the collaborative strategies of discussions (Schellens & Valcke, 2005; Williams & Svensson, 2021) and games (Cooney & Eamon, 2020; Zhong, 2019) that were originally designed for face-to-face interactions were successful when implemented in fully online settings with appropriate technologies (e.g. Breakout Rooms, Kahoot, Polls) and instructional strategies. In agreement with Ajibade *et al.* (2017), learners felt positively towards their synchronous interactions

via videoconferencing (e.g. Zoom) and collaborative technologies (e.g. Google Workspace, Whiteboards), as they felt more engaged with their peers and instructors. However, students exhibited greater discipline and focus if these interactions were formalised and monitored, as is the case in face-to-face classrooms. The characteristic of distance in fully online learning is, therefore, one that needs to be mitigated by strategies to encourage self-regulation.

The pre-pandemic literature recognised the vital role instructors played in blended classrooms (McGarrigle, 2009; Salmon, 2000; Vonderwell, 2003). In pre-pandemic blended classrooms, face-to-face interactions allowed the instructors to develop bonds with their students. This physical interaction was lacking in fully online classrooms post-pandemic, which meant that instructors needed to consciously nurture the learner-instructor relationships. This was reflected in this SLR, whereby all of the studies found that the visible virtual presence of the instructor played a crucial role in the success of the networked learning strategy. While most of the studies in this SLR opted to allow relationships to develop organically, one study (P12) found value in intentionally creating a safe and supportive environment for students to discuss and debate ideas with each other in group-related interactions. The instructors in the study attempted to intentionally build relationships among students by teaching them how to be collaborative digital citizens. The instructors felt that this resulted in a positive shift in the relationality and interactions of students which fostered the environment for higher order and more complex thinking. Students in the study reported feeling more valued in terms of sharing their thinking.

Pre-pandemic fully online courses, such as MOOCs, tended to be purely asynchronous with little instructor intervention in comparison to face-to-face settings. In the post-pandemic era, there was a heightened focus on using synchronous technologies to replicate face-to-face classes, which meant that instructors needed to find ways of engaging learners in online class sessions. To overcome the disadvantage of being geographically separated and to keep students engaged, instructors in all 20 of the studies adopted the “guide-on-the-side” role, while facilitating active learning through interactive, learner-centred activities.

Pre-pandemic blended classrooms utilised asynchronous communications for out-of-class work (Anderson, 2011; Picciano, 2017). Post-pandemic use of asynchronous technologies was similar, with an overwhelming 95% (n=19) of the studies in this SLR employing asynchronous activities that allowed learners to interact with course material or partake in interactive, media-rich activities beyond the classroom. P14 was significant in that it was the only study where the researchers replaced the asynchronous component with a synchronous/collaborative online out-of-class flipped-class component using Google Hangouts on Air. The students in the study participated in small, online interactive/collaborative discussion groups, where they viewed the pre-assigned videos for the week. The researchers used this novel approach in order to counteract low student accountability which often arises when dealing with the out-of-class asynchronous learning component of the flipped classroom, thus resulting in students coming to class unprepared. The study found the intervention to have a positive effect on students’ overall objective performances.

6 studies utilised discussion forums, while 2 used WhatsApp for communication and collaboration. However, 2 studies trialled innovative interactive video platforms Biteable and Edpuzzle, which allowed learners to interact with multimedia, and provided a social component to allow learners to create notes, discuss, and react to each other’s contributions. A further 2 studies made use of virtual reality or simulations to enable learners to interact with virtual environments. These contemporary methods of learner-content interaction are important to online learning as they have enabled learners to interact with content in new and engaging ways that were previously unavailable due to technological constraints.

CONCLUSION

The purpose of this SLR was to identify the theoretical perspectives that guided post-pandemic fully online implementations of networked learning, and to understand how networked learning strategies and tools were used to facilitate active learning in these environments. While networked learning theoretical perspectives have remained consistent pre-pandemic and post-pandemic, the results of this SLR have demonstrated how networked learning strategies and tools in online classrooms have evolved between these time periods. As implementations of pre-pandemic networked learning were potentially constrained by technological and infrastructural factors, pre-pandemic blended and fully online environments focused on asynchronous methods of communication and collaboration, which did not necessarily involve much multimedia. Post-pandemic implementations of networked learning have taken advantage of technological advancements to support synchronous communication and media-intensive content, giving rise to the creation of innovative active learning opportunities in fully online classrooms. Of importance is the use of synchronous communications technology in conjunction with instructional strategies to replicate face-to-face interactions, as this was an important classroom element that was lacking in pre-pandemic fully online and blended implementations.

Limitations

A limitation of this SLR is that, due to the scope of this paper, a limited number of search terms and databases/search engines were used to identify relevant articles. Future work should include a wider range of databases while expanding the search to include additional terms relevant to networked learning, such as cooperative learning and collective inquiry. Further, as this SLR reviewed articles written in English, it excluded articles written in any other language. Therefore, it is recommended that a comprehensive SLR including non-English articles be reviewed, in collaboration with academics from non-English-speaking countries.

Implications

Though there is considerable interest in the theory of networked learning, practical research in this area is quite scarce. Empirical research investigating the implementation of networked learning in online environments that also placed emphasis on learners' social and interpersonal relationships is quite limited. This study has uncovered a number of digital technologies that instructors have used to support collaborative and social learning in their fully online classrooms. These included annotated videos, breakout rooms, interactive presentations, interactive and annotated videos, polls, quiz games, virtual reality, and whiteboards. This systematic literature review should therefore be beneficial to educators involved in integrating the concept of networked learning into their online, blended or hybrid courses.

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Appendix A: Summary of Interaction Strategies Employed

Learner-Content Interaction Strategies	Learner-Learner Interaction Strategies	Learner-Instructor Interaction Strategies
Watch videos (P3, P4, P7, P9, P11, P12, P13, P14, P15, P17, P18, P19)	Participate in synchronous discussions (P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P17, P18, P19, P20)	Providing instruction/ guidance (P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20)
Read assigned text/readings (P3, P4, P5, P8, P10, P11, P12, P19)	Synchronous collaboration using videoconferencing (P2, P8, P12, P14, P15, P17, P20)	Providing feedback (P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20)
Complete formative quizzes and exercises (P7, P11, P13, P14)	Asynchronous collaboration using discussion forums (P6, P12, P16, P18, P19, P20)	Instructor as mediator/ facilitator (P1, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P17, P18, P19, P20)
Answer polls for multiple choice questions (P1, P8, P20)	Preparatory activities completed as a group (P14, P17, P20)	Provide emotional support/ pastoral care to students (P7, P8, P9)
Complete written assignments (P11, P18, P19)	Collaborative group assignments (P11, P12, P18)	Intentional relationship building (P7)
Complete self-reflection exercises (P5, P11, P15)	Brainstorming as a group (P1, P3)	Reviewing recorded student activity (P14)
Watch interactive videos (P15, P17)	Peer presentations (P11, P12, P15)	
Annotating learning material (P9, P19)	Competitive educational games (P13, P20)	
Play educational games (P13, P20)	Asynchronous collaboration using WhatsApp (P2, P10)	
Listen to audio learning resources (P4)	Social annotating (P9-Annoto, P19-Perusall)	
Create virtual reality videos (P2)	Peer assessments (P16, P17)	
Interact with virtual simulations (P13)	Asynchronous collaboration using blogs (P16)	
None specified (P16)	Asynchronous collaboration using Google Docs, Google Slides (P2)	
	Synchronous collaboration using digital whiteboards Jamboard (P5), Miro.com (P3)	
	Peers helping peers (P6)	

Appendix B: Sample of Table of Extracted Narrative

Interaction Strategies								
ID	**Reference: Author, Year, Title**	**Research Objective**	**Networked Learning Strategy/Tools**	**Learner-Content Interaction Strategies/Tools**	**Learner-Learner Interaction Strategies/Tools**	**Learner-Instructor Interaction Strategies/Tools**	**Types of Measures Used to Look At the Outcomes of the Strategies**	**Outcomes**
P1	**Pichardo et al.,** (2021). Students and teachers using Mentimeter: technological innovation to face the challenges of the COVID-19 pandemic and post-pandemic in higher education	To identify advantages and weaknesses of Mentimeter in teaching and learning.	Interactive presentation software – Mentimeter.	Use of questions to receive feedback on students' understanding of material covered and posted on the Moodle LMS.	Use of open-ended questions and word clouds to get responses and promote discussion with other students.	Use of reactions like Thumbs up during the lecture; Q&A to ask questions; obtaining feedback through questions; allow the use of anonymous participation.	Instructor and student's views on their perceived benefits of the intervention in terms of participation, engagement, maintaining students' attention and improving inclusion.	The chief benefit both teachers and students found was the increase in participation, engagement.
P2	**Liu & Shirley** (2021). Without crossing a border: exploring the impact of shifting study abroad online on students' learning and intercultural competence development during the COVID-19 pandemic	Investigate students' learning experiences and perceptions of the COIL course.	Collaborative Online International Learning.	Students used VR to create presentations of interesting places in their countries - increased intercultural awareness.	Online collaboration using Zoom breakout room activities and asynchronous group activities using Google docs, Google slides and WhatsApp.	Feedback from instructor.	Student perceptions of their experiences.	Positive outcomes especially with collaborative learning between students. Insufficient learner activities integrated with course content, insufficient opportunities of student-instructor interactions.