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Cognitive presence and self-regulated learning: Learning transfer in an online allied health course

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Abstract

Online learning has become more common since the COVID-19 pandemic, but limited research has examined factors affecting students' ability to transfer learning from online to the real world. This mixed-methods study explored the relationships between higher-order thinking skills, namely cognitive presence and self-regulation, and their roles in learning transfer in an online postgraduate medical sonography course in an Australian University. Performance data was evaluated for 53/54 students who allowed their online learning platform data, grades, and written contributions to learning tasks to be collected. Students also completed questionnaire measures of cognitive presence and online self-regulation, and seven students were interviewed about learning transfer. Cognitive presence and online self-regulation strategies were positively correlated. Interviews revealed that internal factors, such as cognitive presence and self-regulation, and external factors, such as supervisor support and workload, affected online learning transfer. Student performance indicated a high percentage of the Resolution phase of cognitive presence, which means near transfer. Our results suggest that cognitive presence and self-regulation can enhance students' ability to transfer learning within and beyond the course. Despite the complexities in online pedagogy, educators should create online content to foster cognitive presence and self-regulation to enhance students' ability to transfer learning to the real world.

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Introduction

Higher education for professional qualifications supports students in obtaining the skills, knowledge, and attributes required in the initial stages of their careers. It further fosters their ability to adapt to the changing workforce needs (Bennett et al., 2016; Cheng et al., 2022). This is especially true for competency- and skill-based programs like health, education, and business. In addition to specific professional skills, students must develop higher-order thinking skills such as problem-solving, critical thinking and self-regulation. Self-regulated learning involves cognitive (e.g. memory) and metacognitive (e.g. goal setting and planning) strategies (Cassidy, 2011) and is considered a higher-order thinking skill rather than a general skill in our study. To support this skill acquisition, higher education institutions offer students a range of work-integrated learning opportunities. These include practical experiences, such as internships, projects, simulations, fieldwork and traineeships, which expose students to job-related activities relevant to their studies (Universities Australia, 2019). Work-integrated learning involves partnership with industry, engagement with meaningful work, pedagogical approaches to enhance student learning and authentic assessment (Dean & Campbell, 2020). The post-pandemic era has witnessed an innovative transformation in both work and learning, with an influx of higher education degrees that offer flexible online delivery modes, therefore transforming work-integrated learning. This poses unique, complex challenges to educators around fostering transfer and the application of learned skills from online contexts to real-life work situations (Bennett et al., 2016).

Online learning comprises a complex interaction between cognitive, affective, social and environmental factors (Barak et al., 2016; Shea & Bidjerano, 2012). It is evolving with constant multimedia improvements such as asynchronous discussions, videos, audio lectures, and synchronous virtual collaboration and chats. This provides ample opportunities for educators to design and deliver sustainable online environments to facilitate meaningful learning for students (Beckmann & Weber, 2015). However, it also poses pedagogical and technological challenges unique to online contexts. Educational research has yet to fully explore the complexities behind developing higher-order thinking skills and learning transfer in students (Greener, 2018; Lodge et al., 2018). The flexible and asynchronous nature of online learning results in increased autonomy for students in managing their academic progress (Johnson & Davies, 2014; Wang & Hannafin, 2005). Research has shown that the educator plays a key role in facilitating higher order thinking in online modes through design and instruction (Garrison et al., 2007). Research has also shown that students must take more responsibility for their learning in an online environment in comparison to face-to-face settings (Barnard et al., 2008). Studies have shown that the development of cognitive skills, including learning transfer, requires self-regulation (Barnard et al., 2009) and that it has a positive relationship with cognitive presence (Doo et al., 2023). Skill acquisition and the ability to transfer newly learned skills to novel situations (Perkins & Salomon, 1992) are key factors that foster higher-order thinking in students. Yet, limited research exists on this skill acquisition and transfer in online environments. Therefore, our current study aims to explore the roles of higher-order skills and self-regulation on learning transfer in online learning.

Literature

Learning transfer refers to the ability to apply knowledge and skills learned in one context to another (Perkins & Salomon, 1988; Sasson & Dori, 2012). Online learning transfer refers to the transfer of knowledge from online courses to the real world, in this case, medical traineeships. In this paper, we use the shorthand 'transfer' to refer to learning transfer. Educators need an improved understanding of transfer to facilitate it in online contexts. Transfer is a key factor in student success in higher education and the workplace (Reece, 2005; Salomon & Perkins, 1989), yet it is relatively under-researched (Sala et al., 2019). Transfer is categorised into near and far transfer (Perkins & Salomon, 1992). In near transfer, learners apply a relatively small skill set to a new learning situation (Perkins & Salomon, 1992). In far transfer, learners apply higher-order skills to perform optimally in a new situation through the intentional transfer of critical thinking from one learning context to another (Reece, 2005). Transfer can be assessed through transfer tests and transfer tasks (Bransford & Schwartz, 1999). Near transfer can be evidenced when students solve complex problems within the course. Far transfer typically occurs outside the course (Chew & Cerbin, 2020), for example, the application of learnt knowledge from the course to the workplace or traineeship. In summary, both near and far transfer require higher-order thinking skills.

Transfer is a difficult skill to foster and evaluate, especially in online contexts, as it involves unique challenges. For example, developing transfer skills requires opportunities for students to practice applying newly learnt skills to novel situations in safe environments (Reece, 2005), and hence, the online learning tasks must demonstrate a connection between theory and practice to students (Delany & Golding, 2014). Furthermore, students must be trained to anticipate and recognise real-world situations (Dori & Sasson, 2013). Although this is true in face-to-face learning, it can be argued that teaching such skills in online delivery can be challenging for educators. Hansen (2008) compared transfer between conventional and online courses in students studying the marketing process. Transfer was determined by the grades obtained for the project and other summative assessments. Online delivery was suggested to be better for applied learning and knowledge transfer (Hansen, 2008). Barak and colleagues (2016) compared on-campus versus online students and found that online students demonstrated higher SRL and transfer skills.

For online learning, the Community of Inquiry framework provides direction for the acquisition and transfer of student skills (Garrison et al., 2000). It proposes three essential interdependent presences for a successful educational experience, namely, cognitive presence, social presence and teaching presence. Teaching presence and social presence have been researched extensively in the existing literature and are proven to have a positive impact on cognitive presence (Garrison, 2007; Maranna et al., 2022). Hence, the current study focuses on the relatively less explored cognitive presence. Cognitive presence refers to higher-order thinking skills and is defined as the ability of students to construct and confirm meaning through sustained reflection and discourse in a virtual learning environment (Garrison et al., 2000). It has four phases: Triggering, Exploration, Integration, and Resolution. In the Triggering event, a problem is identified, initiating the inquiry process. In Exploration, learners explore relevant information, either individually or in collaboration with peers. In Integration, learners construct meaning from generated ideas and share these within the community. In Resolution, learners apply or defend potential solutions to the problems with new ideas (Garrison et al., 2000). Integration and Resolution represent the higher levels of cognitive presence where learners build on each other's

ideas and synthesise information to provide real-world solutions. When students solve complex problems set within the course, they reach Resolution (Garrison et al., 2001), indicative of knowledge transfer within the course, also considered as near transfer (Chew & Cerbin 2020). Shea and Bidjerano (2012) claimed that reaching Integration and Resolution correlates with learner self-regulation in online environments. Along the same line, in a scoping review of the cognitive presence literature (Maranna et al., 2022), the authors put forth several strategies to enhance cognitive presence, which include fostering student self-regulation.

Self-regulated learning (SRL) refers to the learner's ability to select and apply appropriate strategies to achieve desired academic outcomes (Zimmerman, 2002). Some represent it as a cyclical process of forethought, performance, and self-reflection (Barnard-Brak et al., 2010). SRL includes goal setting, time management, task strategies, environmental structuring, self-monitoring and help-seeking (Schunk & Greene, 2017; Zimmerman, 2002). Self-regulated learners know their strengths and limitations, set personal goals and self-reflect on their effectiveness. Hence, they generally succeed with desired academic outcomes and develop lifelong learning skills (Zimmerman 2002). From a student's perspective, self-regulation is critical to experiencing deep and meaningful learning (Barak et al., 2016; Barnard et al., 2009). Moreover, self-regulation is essential for developing higher-order thinking, problem-solving and clinical reasoning (Sasson & Dori, 2012). Although there is literature on various aspects of cognitive presence and SRL, there is limited research evaluating the roles of cognitive presence and SRL on transfer. Educators need a better understanding of how transfer can be facilitated in the online mode. Therefore, we aim to explore the roles of cognitive presence and self-regulation in fostering transfer in an online environment.

Context

Sonographers must demonstrate clinical reasoning to carry out duties that involve history taking, physical examination, acquiring diagnostic images and interpreting sonographic findings to inform the shared decision-making process with the health care team. For sonography graduates, these are complex clinical skills that must be explicitly taught through training in coursework and the workplace. The sample participants were students (*N*=54) enrolled in an online obstetrics and gynaecology sonography course, a second-year postgraduate diploma in allied health. The co-requisite for this course required students to be in an industry traineeship for a minimum of 200 hours over 20 weeks. A traineeship is ‘on-the-job’ training with an employer at the same time as students study and get paid (Apprenticeship Careers Australia, n.d.). This work-integrated learning (traineeship and online coursework) required students to apply theoretical knowledge into practice. The time of commencing traineeship varied for each student. The traineeship location was geographically diverse and spread across Australia and included a broad range of settings such as public, private, rural, and remote hospitals and imaging departments. The learning management system was Moodle, through which the course was delivered. The course objective was to allow students to acquire the advanced knowledge and skills required to practice sonography with autonomy, well-developed judgment, adaptability, and responsibility.

Research Questions

We aimed to explore the relationship between cognitive presence and SRL and their roles in the transfer of learning from online courses to the workplace using a questionnaire, interview, and data from the learning management system (Moodle data), which included text from summative discussion tasks. Notably, we included cognitive presence in general in RQ1 and RQ2a, whereas in RQ2b, we measured the specific resolution phase of cognitive presence (see Table 1). The research questions were:

RQ1. What is the relationship between cognitive presence and SRL in an online allied health course?

RQ2a. How does cognitive presence in general and SRL affect students' ability to transfer learned knowledge from online courses to the workplace?

RQ2b. How does the Resolution phase of cognitive presence affect students' ability to transfer learned knowledge from online courses to the workplace?

Table 1

Summary of research questions, key variables, data collection methods, and analysis

Research question	Key variables	Data collection	Data analysis
RQ1	Cognitive presence in general and SRL	Online survey	Descriptive statistics and Spearman's rank correlation co-efficient.
RQ2a	Learning transfer, cognitive presence in general and SRL	Online interview	Descriptive statistics and thematic qualitative analysis
RQ2b	Cognitive presence, specifically Resolution	Moodle data including discussion text and grades	Coding for Resolution and course grade evaluation

Note. SRL= self-regulated learning

Method

Ethics was sought and received from the University of South Australia Human Research Ethics Committee (Ethics Protocol 203151). This is an exploratory study at the level of a course unit (The postgraduate diploma in medical sonography has eight units).

Participants

Overall, 53 of the 54 students participated. The students ranged between 22 and 42 years of age (M = 28 years, SD = 4.64). Six students (11%) were male, and 47 (89%) were female, the ratio

being consistent with the gender distribution of the Australian sonographer population. Geographically, with the location of the traineeship, the majority (22, 42%) were in New South Wales, and the remainder were from five other Australian states. Table 2 shows the respondents for each of the data collection methods from a total course sample of 54.

Table 2

Participant numbers for the different data collection tools

Data collection method	Participants (n)
Cognitive presence and online self-regulation questionnaire	19
Interviews to assess online transfer	7
Student grades and discussion text from summative tasks	53

Measures

Data collection included (1) an online questionnaire to measure cognitive presence and SRL (RQ1), (2) an online interview to explore students' perceptions of transfer (RQ2a), and (3) Moodle data, including student grades and online discussion text to measure resolution phase of cognitive presence (RQ2b). It is to be noted that the interview items were structured to obtain information on how course content, students' SRL and external organisation factors influenced their ability to transfer learning.

Cognitive Presence and SRL

To evaluate cognitive presence, we used all 12 cognitive presence items from the validated community of inquiry questionnaire (Arbaugh et al., 2008). This questionnaire also has 9 items for social presence and 13 items for teaching presence, which we omitted. The 12 items used consisted of 3 questions each on Triggering, Exploration, Integration and Resolution. Students rated their level of agreement with each item on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). Example items are: 'Problems posed increased my interest in course issues' (Triggering), 'I utilised a variety of information sources to explore problems posed in this course' (Exploration), 'Reflection on course content and discussions helped me understand fundamental concepts in this course' (Integration), and 'I have developed solutions to course problems that can be applied in practice' (Resolution).

To measure SRL, all 24 questions from the validated online self-regulated learning questionnaire were used to measure students' perceptions of goal setting, environment structuring, time management, help-seeking, task strategies, and self-evaluation (Barnard et al., 2009). These were responded to on the same five-point scale to rate agreement level. Example items are: 'I set standards for my assignments in my online courses' (Goal Setting), 'I find a comfortable place to study' (Environment Structuring), 'I prepare my questions before joining in the chat room and discussion' (Task Strategy), 'I try to schedule the same time every day for my online courses' (Time Management), 'I am persistent in getting help from the instructor through e-mail' (Help

Seeking), and ‘I summarise my learning in online courses to examine my understanding’ (Self Evaluation).

Online Learning Transfer

As there was no existing validated tool to evaluate students' perceptions of online transfer, 15 items were adapted from the learning transfer system inventory (Bates et al., 2012) and modified to suit our context. Although the inventory was designed for face-to-face settings and professional training contexts, it was the most applicable tool in the literature to answer the research question. The learning transfer system inventory assesses the factors affecting learning transfer and assumes that outcomes are a function of ability, motivation (SRL), and environmental influences at three outcome levels: learning, individual performance, and organisational performance (Bates et al., 2012). The interview questions in our study therefore were centred around how the online course content helped students to transfer their learning, how students’ motivation and confidence (SRL) helped students to transfer learning and how organisational factors such as supervisor support and workload helped transfer learning. During the interview, students provided a brief background of their training experience. The interview format involved reading participants each of the 15 statements. After each, they were asked to indicate their level of agreement (1 = strongly disagree; 5 = strongly agree) and to explain their response. This structured acquaintance interview format enabled participants to expand on experiences and understandings, which provided rich data about transfer.

Resolution phase of cognitive presence

Resolution was assessed in two ways, first from students’ online text from summative discussion tasks (a reflective role-play activity and reflections on a case scenario), and second from students’ course grades.

The first summative discussion task (role-play assessment) required students to actively reflect on delivering difficult news to patients in a clinical setting. The simulated scenario involved encountering a situation where the student had to convey to the patient that the fetus does not have a heartbeat and is not viable. The scenario, discussion prompts and marking rubric were provided to students before attempting the task. Discussions were structured to occur asynchronously over 6 weeks, and it was these reflective discussion posts that were analysed.

The second summative discussion task (case scenario) required students to make informed decisions by solving authentic problems. Students were allocated unique real-world case scenarios early in the semester. Students were provided with steps and exemplars to benchmark their presentations. Students had to summarise the findings in a five-minute multimedia presentation and share their final presentation with their peers. To reflect on their learning process, students submitted a self-assessment report, and it was this report that was analysed for resolution.

Finally, final exam grades and the scores from the above assessments were obtained. The final exam questions were centred around conceptual understanding and interpretation of pathology and were collated from the Moodle data.

Procedure

Data collection commenced in July 2020, with participant information and opt-out forms emailed to all students enrolled in the obstetrics and gynaecology sonography course between July and November 2020. An opt-out form was emailed in July 2020 (course start date) for students to choose to exclude their Moodle data from the study. The demographic data collected from the student dashboard included age, gender and location of training. Students were invited to participate in an online survey from October to November 2020 (course end date). In Feb 2021, this cohort of students were invited to a single 20-minute structured interview with the primary author. Interviews were conducted as one-on-one Zoom sessions in March 2021, four months after completing their course. The interviewer was the primary researcher and the coordinator of the course; thus, the time delay was important to reduce bias due to power dynamics between the interviewer and interviewees. Microsoft Office transcription tool was used to transcribe the interviews. Transcripts were cleaned by the primary author. Data collection concluded in June 2021.

Data Analysis

Cognitive Presence and SRL (RQ1)

To answer RQ1, descriptive statistics as a percentage of agreement were generated using IBM SPSS (version 24) to analyse the ordinal Likert scale data from the online questionnaire. Spearman's rank correlation coefficient was then used to evaluate the correlation between cognitive presence and SRL.

Online learning transfer? (RQ2a)

Interview responses were evaluated using Lumivero NVivo (version 12) to explore the factors that affect students' online transfer ability. For this, thematic qualitative analysis was conducted using the deductive coding method (Adu, 2019). A five-stage approach (Bingham & Witkowsky, 2022) was followed for analysis by organising the response data into predetermined categories (cognitive presence and SRL) to answer RQ2a. For example, for the item "What is taught in this online course closely matches my sonographer trainee/ sonographer job requirements", one student elaborated with the following comments: "Lectures and resources are up-to-date and relevant to my training needs and so being able to apply what we learnt, well, it improved my scanning." This response was coded under course content, which helped to enhance student cognitive presence and transfer ability. For the item "I am confident in my ability to use newly learned theoretical skills (from the online course) in my trainee job", one student commented: "I think I'm a much better scanner because before, I was just doing things because it was the protocol and now, I understand why. This understanding has made me more confident". This response was coded under student characteristics, which helped to enhance student SRL and transfer ability. Statements on goal setting and self-evaluation were also coded under SRL.

The primary author derived the codes and discussed them with the five research team members. Based on consensus, three themes were generated (Table 3): (1) Internal factors where cognitive presence from course content impacted transfer, (2) Student characteristics where SRL skills impacted transfer; and (3) External factors where external training impacted transfer.

The numerical responses (strongly agree, agree, neutral, disagree and strongly disagree) that participants gave for the 15 items were also analysed, although not reported in detail due to the small number of participants. The 15 items, de-identified and coded interview responses with NVivo analysis, are available as an open-access data set (Maranna et al., 2024).

Table 3

Themes from interview responses with examples of student comments

Themes		Example comments from interview responses
Internal factors	Summative assessments	*Reflection on breaking bad news was helpful as we encounter many scenarios in real life practice where we must cope with this situation*
	Peer sharing	*I appreciated the case scenarios being shared. I watched some. The information presented is detailed, so it's good to watch others and to gain knowledge*
Learning tasks	Basic practical skills	*Learning anatomy, recognizing what I'm looking at and then being able to apply that in the clinical setting helped*
	Pathology	*Pathology images helped to understand what they look like. I can recollect easier in practice when I have seen them prior*
	Lectures with real-life examples	*The video clips during the online lectures were helpful because we are familiar with what to expect rather than just hearing*
	Synchronous sessions with educator	*I have developed critical thinking skills after doing the course. When I had a case of acrania, I remembered to obtain that typical view*
Student characteristics	Goal setting	*I set my own goals for each semester*
	Confidence	*I am more confident with tackling pathology after completing the course*
External factors	Enablers	*My supervisor is supportive and checks in on what I am learning*
	Barriers	*I feel like my training wasn't the best. I was kind of let loose and I felt like I could do with more guidance from my supervisor*
	Concurrent training	*If we can engage in theory and practical simultaneously, that's when I connect the concepts into practice*
	Workload	*It can get crazy insane at the hospital where I just don't have the time to try new things*

Resolution phase of cognitive presence (RQ2b)

Students' online discussion text was selected for coding and content analysis (Rourke & Anderson, 2004) to determine the extent of Resolution (resolving the problems set within the course). Solving problems within the course also correlates with near transfer. The online summative discussion text included (i) Student discussion forum posts from the role-play activity and (ii) Student self-assessment reflections from the complex problem-solving case-scenario assessment. Method-driven content analysis (Krippendorff, 2018) was used to interpret the above two sets of text with a deductive approach, where pre-defined descriptors of cognitive presence were used for coding the categories based on the community of inquiry framework (see Table 4) (Garrison et al., 2001).

Table 4

Descriptors and indicators of cognitive presence with examples from student posts from the reflective role-play activity

Cognitive presence categories	Descriptor	Indicators	Example of student posts from reflective role-play activity
Triggering	Become aware of a problem by asking questions	Recognising the problem, Puzzlement, Divergence	*I am unsure how I would reach but the resources have helped*
Exploration	Explore a problem by searching or offering information	Information exchange, Suggestions, Brainstorming	*At work with a similar scenario, I had to get my supervisor to help clarify so I could learn from her*
Integration	Integrate interpretations and construction of a possible solution	Convergence, Synthesis, Solutions	*This activity led to discussions with work mates on ways to help the patient. It has shown me that there might not be one correct way to react, but many helpful ways to be empathetic*
Resolution	Resolve the problem by critical evaluation of the solution	Apply, Test, Defend	*I find that the best way to prepare for such cases is to explain to the patient before scanning them. This small introduction at the start of the scan gives the patient a 'heads-up' for what to expect and that not all pregnancies go to plan*

The text was exported to Microsoft Excel and analysed at the category level, where a single code was allocated to each post (see Table 3). Two coders (primary author and co-author) with prior experience coding the community of inquiry descriptors independently coded the data. Before coding, the coders discussed the coding scheme and the cognitive presence categories. Each

student post was given a code for the category that it represented. With student self-assessments from the complex problem-solving case scenario, 53 self-assessment reports (one per student, with an average word count of 70 to 100 words) were coded with 208 score decisions made across the two coders. With the role-play activity, 53 discussion posts (one post per student, with an average word count of 250 to 400 words) were coded with 208 coding decisions across the two coders. Disagreements due to discipline-specific terminology were resolved, and more than 88% agreement was reached. Intercoder reliability was evaluated to maintain internal reliability. As the coding categories are ordinal, K_w was performed to determine intercoder reliability on whether students' posts demonstrated the same cognitive presence category. For the reflective role-play activity, K_w was derived to be 0.87, and the agreement between coders was 95%. For the self-assessment of the complex problem-solving activity, K_w was 0.86, and the agreement between coders was 88%.

Results

Cognitive Presence and SRL (RQ1)

Of the 22 students (42%) who attempted the online questionnaire, three incomplete responses were excluded, with a final of 19 responses (35.2%) included for analysis. The mean scores for each of the indicators of cognitive presence and SRL are provided in Tables 5 and 6. The percentage of agreement analysis to individual items is available as an open-access data set (Maranna et al., 2024).

Spearman's rank-order correlation (r_s) tests were performed using SPSS to examine the relation between cognitive presence and SRL. There was a significant positive correlation between cognitive presence and SRL (r_s=.769, p=<.001, N=19), which means that higher levels of cognitive presence were related to higher levels of SRL.

Table 5

Descriptive statistics for the cognitive presence indicators (N=19)

Cognitive Presence Indicator	Mean (Standard deviation)
Triggering	3.80 (0.76)
Exploration	4.10 (0.82)
Integration	3.87 (0.80)
Resolution	3.87 (0.90)

Online learning transfer (RQ2a)

From the seven students who participated in the structured interview to assess the factors that affect their ability to transfer learning, the overall mean for the items was 4.29 (SD=0.57, Range=1.3 to 3.0, where 1 was the lowest level of agreement and 5 was the highest). We derived

three themes from the interview responses to understand the factors that influence students' transfer: (1) internal factors, (2) student SRL, and (3) external factors (see Table 3).

Table 6

Descriptive statistics for the self-regulated learning indicators (N=19)

Self-Regulated Learning Indicator	Mean (Standard deviation)
Goal setting	3.76 (1.03)
Environmental Structuring	4.09 (0.84)
Task Strategy	2.98 (1.09)
Time Management	2.94 (1.07)
Help Seeking	2.97 (0.93)
Self-Evaluation	3.10 (1.05)

Internal factors

Notably, students' perceptions of course content that influenced online transfer were also the activities that enhanced their cognitive presence. For example, course design, interaction with the teacher, nature of assessments and formative tasks. One student commented:

> *Agree; the course provided us with information, links, and resources. The online Zoom interactions with everyone were all useful. I made sure I attended as I had heard from people who had done the subject how helpful they were. I found them useful, more than reading the theory. The discussions made more sense*" (participant 5).

The formative and summative activities helped students to apply what they learned. For the statement, 'What is taught in this online course closely matches my sonographer trainee/ sonographer job requirements', there were three justifications. One interviewee explained:

> *Strongly agree that supervisors are specific with guidelines in the workplace. It is very structured, with lots of similarities to what we were taught through the course, including image criteria. They mirrored each other, which was beneficial for me, and I was able to see what we were learning and then eventually put them into practice* (participant 4).

Brainstorming sessions with the educator, expert lectures, real-life examples and authentic assessments, such as roleplay and complex problem-solving case scenarios, helped students transfer their learnt knowledge to their job, as elaborated by seven students. For the prompt, 'Activities and assessments which the online course instructors used helped me know how to apply my learning on my sonographer trainee/sonographer job', there were seven responses, of which all students agreed. One student elaborated:

Strongly agree the activities, in general, and the discussions that we were able to have in the course were helpful. The case scenario was good for focusing on one specific topic. Role-play was good for taking extra time to think about what you've learned and then applying it in a realistic setting but not under the pressure of patients (participant 4).

Student characteristics

Student factors that influenced transfer skills included SRL such as increased confidence from knowledge gained in the course, motivation to learn and apply learnt knowledge in training, goal setting and self-evaluation. For the statement, 'I am confident in my ability to use newly learned skills from the online course in my training', one student commented: "*The self-directed learning in the course forces us to think and self-evaluate"* (participant 3). Interestingly, student self-regulation enables them to manage their performance both within the course and in external training.

External factors

The external factors that influenced transfer (Table 3) were related to external organisation training. For example, these were factors such as supervisor support, workload and opportunities to apply learnt knowledge to the job. Students seemed to exhibit transfer when supervisors were supportive and interested in what they were learning with regular and timely feedback. For the statement, 'My clinical supervisor sets goals for me that encourage me to apply my course training on the job as a trainee sonographer', there were four justifications (two neutral and two disagreed). Notably, with feedback from clinical supervisors and workload, responses showed a lower agreement rate. One of the students commented: "*Disagree, probably something we should do*" (participant 2).

For the statement, 'After completing the online course, I get feedback from my clinical supervisors on how well I am applying what I learn and whether it has improved my trainee sonographer/ sonographer job performance', there were six justifications, of which two were neutral and four agreed. The perception of one student was, "*Yes, I get regular feedback from my supervisors. I can't learn unless I get that feedback*" (participant 7).

Opportunity to apply learnt knowledge emerged as one of the categories in the external factors that influence transfer. Concurrent training that mirrored the course context was conducive to enhancing transfer. If students were given extra time and space to test new things at work, this further enhanced transfer. For the item, 'My job performance as a trainee sonographer/ sonographer improves when I apply new things that I have learnt in the online course', there were six responses, all in agreement. One participant commented: "*If you can do the theory and apply it to practical components together, that's when you learn and retain info*" (participant 6).

Resolution phase of cognitive presence (RQ2b)

The student self-assessment and reflection codes indicated a high proportion of Integration and Resolution (see Table 7), indicating students' ability to synthesise information, find solutions to problems, and apply and defend their decisions. The de-identified sample posts and analysis are available as an open-access data set (Maranna et al., 2024). This coded data showed a high percentage of resolution indicating knowledge application and therefore the ability to transfer.

All 53 students were graded as meeting expectations or higher for the case scenario assessment (grading scale (number of students): < 50/100= fail (n=0); 50 to 64/100= pass (n=0); 65 to 74/100=

credit (n=3); 75 to 84/100= distinction (n=8); ≥85/100= high distinction (n=42)). With the final course grades, one student failed for not sitting the final exam. 79% (42/53) obtained an overall score of 85 or above out of 100. Achieving learning objectives by successfully applying learnt knowledge indicates near transfer, i.e., internal transfer. Our data suggests that most students performed well in the course and were able to demonstrate transfer.

Table 7

Percentage of cognitive presence categories as coded in student text

Code	Student self-assessment from case scenario	Student reflective posts from role-play activity
Triggering	2%	nil
Exploration	23%	15%
Integration	37%	33%
Resolution	38%	52%
Total	100%	100%

Discussion

Our study is one of the first to explore and evaluate the roles of cognitive presence and SRL on transfer in online contexts. The work-integrated learning context, wherein participants were enrolled in online courses in conjunction with traineeships, was especially conducive to gathering student perspectives on transfer. We first explored the relationship between cognitive presence and SRL in postgraduate medical sonography students (RQ1). Analysis showed that cognitive presence and online self-regulation strategies were significantly positively correlated, meaning that students who were able to self-regulate their online learning demonstrated enhanced cognitive presence. Although we have not evaluated the causality of the relationship, it can be speculated that increased SRL leads to increased cognitive presence. These findings are in line with previous research suggesting that self-regulated learning has a positive effect on cognitive presence (Doo et al., 2023; Shea & Bidjerano, 2012). For example, Shea and Bidjerano (2012) found that Integration and Resolution are specific aspects of cognitive presence related to learner self-regulation in online environments. Similarly, Johnson and Davies (2014) suggested that a key cognitive process for students in online environments is planning, which involves time management, regulation of effort and selecting relevant strategies to achieve their personal goals. From a student's perspective, the ability to self-regulate plays a critical role in experiencing deep and meaningful learning (Barak et al., 2016; Barnard et al., 2009). In our study, the postgraduate course consists of adult students (22 yrs) who have an inherent motivation to develop skills and knowledge required to achieve their goals. The flexible learning format required students to self-

regulate their learning, for example to meet deadlines, to seek help and to self-evaluate their performance. This was reflected in our findings.

Next, we explored the roles of cognitive presence and SRL on learning transfer (RQ2a). Interview data yielded three themes for factors that affected online learning transfer: internal, student characteristics and external. Internal factors, such as assessments and learning resources, indicated that increased cognitive presence within the course enhanced students' ability to demonstrate transfer within the course. Student characteristics were around SRL, such as motivation and goal setting, which helped students to perform better in both their online course and in training. On the other hand, external factors such as external industry supervisor support, workload in traineeship and opportunity to apply learning, highlighted the complex multifactorial nature of far transfer and is beyond the scope of the role of online educators and our study. Although most of the existing literature is on training transfer in professional environments, supervisor support is the highest-rated and most consistent relationship with favourable outcomes within the work environment, followed by opportunity to apply learning (Blume et al., 2010). Similarly, in our study, students perceived that a supportive supervisor who provided opportunities to apply learning enabled them to develop far transfer.

To answer RQ2b, we analysed student summative assessment text to evaluate Resolution. As the assessments tested students' application of learnt knowledge in real-life scenarios, reaching Resolution in online contexts can be considered as near transfer or transfer within the course. Coding of asynchronous discussion posts in the Community of Inquiry literature has informed various studies on cognitive presence (Rourke and Anderson, 2004; Schrire, 2006; Stenbom, 2018). Studies have suggested that using both qualitative and quantitative data provides a better understanding of the study than a single approach (Shea and Bidjerano, 2009). For example, to assess cognitive presence, student self-reports are best analysed in conjunction with Moodle data, performance indicators such as grades and interviews (Boekaerts, 2017; Schrire, 2006). In our study, coding for resolution has provided objective data of student performance. This adds to the evidence on reaching resolution as perceived by students.

Further, student grades were examined to evaluate Resolution. Higher grades indicated near transfer by measuring students' academic achievement through solving complex real-life case scenarios set within the course and demonstrating conceptual understanding (Chew and Cerbin, 2020). A study by Cakiroglu (2019) analysed student perceptions and online course grades. The study reported that students who achieved high academic scores also had high cognitive presence (Cakiroglu, 2019). Like earlier research, we have used grades to obtain an objective measure of student performance (Cakiroglu, 2019; Hansen, 2008). However, in our study, we have extended the inquiry to explore the link between the resolution phase and learning transfer.

With far transfer or transfer beyond the course, our interview responses shed light on students' perspectives. Their confidence to navigate new situations at work increased to a certain extent by solving real-life scenarios through assessments or familiarising themselves with such information through online content. Other enablers of transfer, as reported in the literature and our study, are the opportunity to apply learnt tasks (Lim & Johnson, 2002) and the use of multiple real-life examples as learning tasks by educators (Maranna et al., 2022). Also to note is that external factors such as goal setting, support and feedback from clinical supervisors or workload are beyond the scope of the online educator or the student. As the work environment directly

influences organisational learning, there is significant research on learning transfer in professional organisational contexts (Blume et al., 2010; Holton et al., 2000) as compared to higher education contexts. Blume et al. (2010), in a meta-analysis, analysed learning transfer and its predictors and reported that factors like supervisor support and peer support enhanced transfer. Chang and Chiang (2013) reported that learner readiness and motivation to transfer are significantly correlated with the transfer of training. Individuals' perceptions of various features of a workplace conducive to training transfer have been identified (Holton et al., 2000). These findings could complement existing research around challenges in mainstream academic settings from a student's perspective. For innovating ways to embed work-integrated learning in online courses, researching the complexities of far transfer is essential. Understanding far transfer remains a major challenge for conventional training, let alone in online contexts.

The key contribution of our study is identifying the link between the Resolution phase of cognitive presence and internal or near transfer in online contexts. In the community of inquiry literature, Resolution is achieved when learners create solutions or new insights through practical applications, such as decision-making, case presentation or experiments (Garrison et al., 2001). In the learning transfer literature, the near transfer can be evidenced when students solve complex problems within the course (Bransford and Schwartz, 1999; Chew and Cerbin, 2020). As Resolution is the learners' ability to test knowledge application in real-world situations, it is essentially near transfer in online contexts. Increased cognitive presence increases students' ability to apply learnt knowledge.

In earlier literature on cognitive presence, Resolution was found to be less evident because learners' knowledge application was considered limited in online environments (Garrison, 2007). Reasons for this were the lack of opportunities in online environments for students to demonstrate knowledge application and the lack of adequate teaching presence and peer interaction (Maranna et al., 2022). Resolution was found to be low when explicit teacher guidance was lacking, and students remained in the triggering and exploration phases (Garrison, 2007; Kanuka & Garrison, 2004). In a study by Chen and colleagues (2019), where students peer facilitated the online discussion, coding of student text revealed that Resolution was found to be the least prevalent (Chen et al., 2019). The authors concluded that the type of task, nature of facilitation and the type of questions are critical for students to reach a Resolution in their discussion text (Chen et al., 2019). Resolution does not result from random online discussions but rather occurs as the result of creating an intentional online instructional experience that facilitates learners' cognitive presence (Darabi et al., 2010). The strategies (for example, scaffolding) are designed to achieve the learning objective with interactive aspects and a task-oriented approach around authentic scenarios (Darabi et al., 2010). Garrison et al. (2001) concluded that when learners are given opportunities to critically analyse the learning content through a reflective discourse, new knowledge can be constructed. In line with this, a review of the literature on cognitive presence shows that Resolution was indeed implicated when students were provided with opportunities to reflect, justify, and construct new knowledge and to apply their newly constructed knowledge to arrive at possible solutions (Maranna et al., 2022). This supports the claim that by providing students with relevant instruction and opportunities, their transfer skills can be enhanced (Sasson & Dori, 2012).

In summary, though students must take responsibility of their learning in online environments, research shows that the role of the educator is crucial to facilitate the learning objectives (Garrison et al., 2007). As educators are responsible for designing effective online environments, the key implication from our study is for educators to create the course content (assessments, scaffolding, peer sharing, using real-life anecdotes) to enhance student cognitive presence and SRL, which in turn enhances their ability to transfer learning. Strategies that cultivate learners' cognitive presence, SRL and transfer should be innovated, examined and recommended. In line with earlier literature on learning transfer (Salomon & Perkins, 1989), we found "near" transfer to be more evident than "far" transfer. Another implication is that cognitive presence and self-regulation have a positive relation and can enhance students' ability to transfer learning. Far transfer or transfer beyond the course is impacted by a range of independent external factors such as workplace environment, workload and supervisor support. These external factors, although critical for embedding work-integrated learning in online contexts, are beyond the scope of our study.

Design Strengths and Future Directions

Although our study was impacted by nonresponse bias, where results and interpretation may be skewed and cannot be generalised (Elston, 2021), the study design addressed this concern. Data was gathered through an ethics-approved opt-out design (use of Moodle data including course assignment grades and text) and provided data from >95% of students, and thus, it was representative of the cohort. Moreover, this form of data, not generated specifically for the study and not based only on student self-perceptions, has a different epistemological status that is in some ways more true-to-life than perception data alone. We used qualitative and quantitative data to interpret and understand the findings (Creswell & Creswell, 2018). For example, for RQ2, we analysed summative discussion text and course grades in conjunction with interviews. In our study, the interviewer was the primary author and was familiar to the interviewees as the course coordinator. To reduce the perceived power hierarchy, interviews were held four months after completion of the course and after the results were released. Therefore, the interview data can be seen as providing a higher level of information disclosure than if the interviews were conducted by an unknown interviewer (Weinreb et al., 2018). As there was no existing validated tool to evaluate students' perceptions of transfer, 15 items were adapted from the learning transfer system inventory and modified as interview items to suit our context, highlighting the need to develop and validate a questionnaire to measure learning transfer in online contexts for future research and teaching practice.

Limitations

First, the structured acquaintance interview format had limitations and biases. Careful consideration was made around teachers interviewing students and the need to be aware of both explicit and implicit power relationships (McGrath et al., 2019). An unequal power relationship between the interviewer (course coordinator) and interviewee student could prompt higher levels of confirmation bias. Second, the response rate for the questionnaire and interview was poor. It is to be noted that the data was collected during the peak of COVID-19 in Australia and globally (Australian Institute of Health and Welfare, 2022). Nonresponse bias could be attributed to the associated challenges at the time. Recognising poor initial recruitment, we applied for an ethics amendment for generic vouchers as an appreciation of the time contribution by the participants,

although the final numbers were still sparse. Industry supervisor perceptions would add to the data. We suggest that supervisors be recruited independently of the student cohort for future projects. Finally, our findings are only exploratory and should be considered with caution. Clear causal links cannot be inferred from our analyses. Despite these limitations, initial insights to inform future research and teaching practice were distilled from the study. We suggest that multiple courses with careful consideration of ways to reduce nonresponse bias are required to obtain statistically meaningful data.

Conclusion

The findings of this study of an online postgraduate sonography course revealed that there was a positive correlation between students' cognitive presence and SRL. Factors that affect the transfer of online learning to real-world work contexts can be distinguished as internal factors relating to the course, student characteristics and external factors. Near transfer or transfer within the course was more evident than far transfer or transfer beyond the course. Enhancing work-integrated learning and developing safe, competent graduates through online delivery requires careful and intentional planning by educators. Some proven ways are through providing students with ideal opportunities to test and defend their solutions to real-life situations not only within the course but also beyond the course, such as in traineeships. In its current state, the results from our study only inform the initial contextual evidence for understanding how to research a complex model in online learning, using methods that could build a holistic picture of student experience and outcomes. Therefore, educators should consider course design in a way that fosters higher-order thinking, including cognitive presence and SRL, to foster near transfer. Graduates who have been exposed to such learning experiences may have increased work preparedness. Further research is required to explore how to enhance the transfer of learning between online and real-world work contexts.

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