

Active learning in the time of the pandemic: Report from the eye of the storm

Iwona Czaplinski, Christine Devine, Martin Sillence, Andrew Fielding, Oliver Gaede, Christoph Schrank
Queensland University of Technology

This study investigated second- and third-year science students' perceptions of the effectiveness of their learning practices during the COVID-19 pandemic. The study focused on the concept of active learning, with special attention paid to self-regulation and self-direction. The data collected through mixed research methods provided evidence of students' flexible adjustment to the exceptional circumstances. However, the data also revealed a relatively limited range of learning strategies reported by respondents. Thus, this paper identifies an important need for further investigation of students' practices to enhance their awareness of learning strategies, as a way of becoming active learners. Finally, the study also made salient the need for teacher training in effective teaching strategies, as a complementary strategy to promote students' active learning. The conclusions from the study reach beyond the current circumstances, as they suggest implications for learning design in terms of educators' training and designing for active learning.

Keywords: Active learning, self-direction, self-regulation, pandemic, science, learning strategies

Introduction

Challenging times require firm responses and bold decisions. Despite the uncertainty and overall confusion caused by the COVID-19 pandemic (World Health Organization, n.d.), higher education institutions took unprecedented measures to keep fulfilling their core mission: educating future knowledge workers (Markauskaite & Goodyear, 2017). The challenge lay in supporting the system to function and deliver.

Educators, learning design teams, senior leaders and professional staff made considerable efforts to ensure the teaching, although disrupted, continued. Approaches to teaching and assessing were modified in an attempt to be adapted to the new educational reality. Reality that, on one hand, was confined to four walls of students' households, and, on the other hand, opened the doors widely to the virtual space.

As for students, the online approaches to teaching provided them with opportunities of living different experiences that required them to consciously take highly pro-active attitudes towards their own learning. In short, the pandemic crystallised the urgent need for active learning.

Thus, it is necessary (and urgent) to investigate to what extent the decisions taken by learning and teaching teams assisted students in becoming active learners in the time of a pandemic. More precisely, our team, composed of academics teaching the units of study and an educational researcher specialising in active learning, investigated students' self-reported perceptions of their learning practices during the semester taught in an emergency remote mode (Hodges et al., 2020). The aim of the study was to examine how the specific learning environment, and exceptional circumstances, impacted on the process of becoming active learners. As our understanding of the concept of active learning is anchored in educational psychology (Bjork, Dunlosky & Kornell, 2013; Dunlosky et al., 2013; Løkse et al., 2017; Neelen & Kirschner, 2017), the study focused on two key elements of active learning: self-direction and self-regulation.

Literature review

Following Bjork, Dunlosky and Kornell (2013), we understand the concept of an active learner as "a sophisticated and effective learner" (p. 314), one who has high levels of self-direction and self-regulation. The two conceptual pillars of this definition are discussed below.

First, the concept of self-directed learning originated from research on adult learning within a workplace and

thus emphasises the importance of taking a proactive attitude towards one's learning, especially through relationship with the environment (Rana, Ardichvili & Polesello, 2016). The concept can be described as a process during which one takes initiative and formulates their own specific learning goals and the ways of achieving them, by using elements available within surrounding environment. Self-directed learners should therefore have the ability to identify their learning needs, formulate learning goals, identify necessary resources within the environment as well as strategies to achieve the formulated goals, implement the strategies, and evaluate the levels of achievement with respect to the learning outcomes (Knowles, 1975). The literature describes self-regulatory practices as a process composed of four phases (Brand-Gruwel et al., 2014; Neelen & Kirschner, 2017): 1) determining learning and performance needs, 2) determining learning and performance objectives, 3) determining learning materials and / or (performance support) tools, and 4) completing a task that can be sub-divided into planning, monitoring, assessing (the outcome) evaluating (the outcome and the effort), and reflecting. To understand respondents' learning practices within special circumstances, the study applied the theoretical lens of self-directed learning, which can provide explanations of the ways in which learners interacted with their environment, perceived opportunities for learning, and took those opportunities up (or not).

Second, an active learner is also a self-regulated learner. While the concept of self-direction emphasises the importance of knowing oneself, diagnosing, and planning for achievement, self-regulation focuses on the importance of being aware of effective learning strategies that will help to achieve learning goals (Kirschner & Hendricks, 2020; Zimmerman, 2002, 2008). Social-cognitive accounts (Zimmerman, 2002; 2008) see self-regulation as a "triadic reciprocity" (Kirschner & Hendrick, 2020, p. 67), an interdependent relationship between three elements, constantly interacting: one's personal traits, behaviour, and environment. Self-regulation means setting learning goals, developing a learning strategy, implementing it through performance, and reflecting on the achieved results. In the literature, self-regulation is often presented as a process composed of three phases: 1) forethought, 2) performance, and 3) self-reflection (Zimmerman, 2002; 2008). Investigation of respondents' perceptions of their practices, analysed through the lens of self-regulation, can provide valuable information about learners' levels of awareness of learning strategies, and the ways of effectively applying them for learning within specific environments.

As explained above, our aim was to examine how a specific learning environment, and exceptional circumstances, impacted on the process of becoming an active learner. After having revised the literature, our team formulated the following research question: What were students' perceptions of their learning practices when the usual option of co-constructing knowledge through direct (i.e., face-to-face) interaction with either peers or academics was excluded?

With this research question, the study aimed to investigate whether, under the exceptional circumstances of a pandemic, respondents were becoming active learners in an accelerated manner by using their self-directed and self-regulated abilities for learning.

Methodology

Considering the uniqueness of the situation, our team was interested in collecting the data while we were *in the eye of the storm*, that is, after the decision to move all teaching and learning activities to the online environment, but prior to the examination period at the end of the semester. For all involved parties, this was the first experience of emergency remote teaching (Hodges et al., 2020) using specified platforms. 'Emergency' meant that the curricula had to be quickly adapted to the online only environment; new resources developed, approaches to teaching modified, and assessment strategies changed. Following the research question, we expected that investigation of students' perceptions of their learning practices would provide us with valuable insights into their choices when the usual option of co-constructing knowledge through direct (i.e., face-to-face) interaction with either peers or academics was removed.

With ethical clearance approved, research methodology was designed to ensure the study would generate meaningful and relevant data. Due to the challenging circumstances (e.g., limited time) and impossibility of collecting the data in a more empirical way through participant observation, a single data collection instrument was developed: an online survey (quantitative) with open-ended questions (qualitative sections) (Creswell et al., 2003).

The questions, developed in consultation with the academic teaching teams, were based on a review of the

literature and previous works of the first author, an educational researcher (Czaplinski, 2020). The survey was composed of three parts, all asking for respondents' perceptions of their learning practices. From the educational research perspective, each part targeted a different ability. That is, the first part aimed to investigate respondents' self-regulation, the second part looked at respondents' self-direction and the third part focused on respondents' ability to successfully learn (self-efficacy).

The online survey, open for one week only, was sent to six units of study taken by undergraduate science students. Out of six units, two were offered in third year and four in second year. The units encompassed the disciplines of biology, physics and geology (two units per discipline) and were selected due to their highly similar approaches to learning and teaching (i.e., blended learning), small group of experienced academics teaching the content, and non-overlapping student cohorts (to increase the chances of responses). In total, 262 students were invited to participate, with 97 filling in the survey (37% response rate).

The quantitative data were analysed using standard descriptive statistics, with the total number of responses and percentages calculated using Excel software. The parameters permitted establishments of a ranking of social agents and online resources that respondents had consulted (see Questions 1 and 2). Remaining quantitative questions used non-numerical Likert-scale responses, organising the responses into discrete categories (e.g., always, sometimes, rarely, or never). The qualitative data were analysed using an inductive content analysis method (Cole, 1988) to identify overarching concepts and recurring themes, leading to the identification of patterns, as recommended by Elo & Kyngäs (2008). To this end, the data were analysed using six-step qualitative data analysis methods (Creswell et al., 2003; Elo & Kyngäs): transfer from online survey to a word document, selection of unit of analysis (i.e., one contribution), coding, identifying the concepts, organising the concepts into overarching concepts, and finally formulating observations about identified patterns.

Findings

The data analysis revealed an interesting disjunction between respondents' low levels of self-reported ability to take control of their own learning (low levels of self-regulation and self-direction) and their strong beliefs in their self-efficacy.

Self-direction

Four questions enquired about respondents' learning practices that could be characterised as self-directed: recognising the need for support, identifying necessary resources within the surrounding environment and using them for learning.

Based on our experience as academics, teaching practitioners and educational researchers, we were aware of the existence of some elements (i.e., social agents and online resources) available within respondents' learning environments. With these questions we were interested in finding out which elements were used by the respondents and which were not. Table 1 summarises the findings from questions 1 and 2, presented in descending order of numerical parameters.

Table 1. Questions 1 and 2 on self-direction (n=97)

Question	Presupposed elements of the environment	Responses	Percentage
Question 1: When learning online, which of the following people assisted you with your learning?	Fellow students enrolled in this unit	75	77%
	University teaching staff	73	75%
	Student Support staff	18	19%
	Family member	15	15%
	Students from other Unis/ friends ¹	6	6%
	Professionals	4	4%
	Private tutors	1	1%
Question 2: When learning outside the contact hours (classroom activities), which online resource assisted you with your learning?	LMS Blackboard site	91	94%
	Internet websites	65	67%
	You Tube	64	66%
	Khan Academy	39	40%
	Facebook (if applicable)	12	12%
	Library site	5	5%

	Mobile phone apps	4	4%
	Social media (e.g., Twitter)	2	2%

It appears that respondents perceived and took up only the most salient opportunities for learning offered by the environment, that is, fellow students and university teaching staff. The extent to which opportunities for learning offered by other social agents who might provide assistance (e.g., student support team, family members, professionals, etc.) were perceived and taken up was limited.

As for the perception and uptake of opportunities for learning provided by online resources, it appears that, as in previous questions, the most salient opportunities for learning were most often used. The Learning Management System (LMS) is a required tool, standard communication platform, resource hub and the assessment platform. As for the second and the third positions (i.e., websites and YouTube), their high rank might indicate respondents' digital literacy practices of *surfing the web* for potentially useful information, as opposed to using educational, specialised resources, such as Khan Academy. It is interesting to note that respondents did not mention any educational website alternatives in either the "other" section of the survey or in open-ended comments. Facebook was reported sporadically, predominantly as a platform to communicate and collaborate with classmates, as was Twitter/other mobile apps. Taken together, the data suggests low levels of awareness and engagement with opportunities for learning offered by social media. Finally, a low number of responses for the University Library was identified, which is explored in more detail in the Discussion section.

The next two questions (Question 3 and Question 4) investigated overall satisfaction with the technological and methodological support provided to students during this time. Technological support included answering questions related to technical aspects of using some standard features of the LMS platform (e.g., Blackboard Collaborate), and new software made available during this time, such as communication tools (e.g., MS Teams, Zoom videoconferencing). Methodological support included developed instructions on how to complete learning tasks and explanations/ guidance by the teaching team on how to learn. For instance, four units introduced live online drop-in sessions, facilitated by teaching academics, as a form of additional support to online practicals, or simulations of practicals. Table 2 summarises the responses.

Table 2. Questions 3 and 4 on overall satisfaction with support (n=97)

Question	Presupposed elements of the environment	Responses	Percentage
Question 3: In your opinion, you were well supported by the teaching team to learn online: a) Technologically (i.e., appropriate technological support was provided by the university).	Agree	78	80.5%
	Neither agree nor disagree	16	16.5%
	Disagree	3	3%
Question 4: In your opinion, you were well supported by the teaching team to learn online: b) Methodologically (i.e., teaching staff guided you through the process of online learning).	Agree	71	73.5%
	Neither agree nor disagree	14	14.5%
	Disagree	12	12%

In response to both questions, respondents predominantly agreed that they were well supported technologically and methodologically. The number of respondents who either held neutral opinions or who disagreed was low for both, the technological and for the methodological types of support. Overall, respondents seemed relatively satisfied with the support provided by the teaching team (heavily supported by professional and technical teams). This supports the previous findings that indicated that the teaching teams and the LMS Blackboard site were the most used by respondents.

The analysis of open-ended comments confirms these findings. The inductive data analysis identified five overarching categories of resources students were using during the time of the pandemic: 1) LMS Blackboard site only, 2) textbooks, 3) peers (classmates, other students), 4) experts (lecturers, professionals, parents, friends), 5) online websites. Most often, several categories were used at the same time, as explained by one of the respondents2:

Sometimes it was easier to read the textbook to understand concepts a bit better and it was also good to

have a small group of other students connect via Facebook to discuss things we didn't understand, and help each other to understand concepts or just clarifying general questions about the unit. That really helped get through the learning material especially during this crazy time.

Only two respondents mentioned reaching beyond their usual sources of information and asked their parents (medical professionals) and their work colleagues for assistance. For instance, one respondent wrote:

Since I was still working for a small company which has copper-gold and coal assets that are structurally controlled, my work colleagues assisted me in understanding some difficult concepts and identifying these structures in the field.

In this instance, working and studying simultaneously created an opportunity to support and contextualise learning, as articulated by the respondent.

In summary, although the responses for this part of the survey appear positive for the teaching teams, when viewed from the perspective of self-directed learning, they raise some questions about respondents' awareness of alternative sources of support for learning embedded within their environments. This question is explored in more detail in the Discussion section.

Self-regulation

In the second part of the survey, four questions looked at respondents' self-regulatory learning practices. The questions investigated respondents' perceptions of the nature of their engagement with the online resources. That is, the first two questions in this part (Questions 5 and 6) asked whether, in the respondents' view, they actively engaged with the provided resources, while the next two questions focused on respondents' beliefs about the effectiveness of their practices and the potential need for more training in learning strategies. Table 2 summarises all four questions (n=97).

Table 3. Perceived effectiveness of respondents' engagement with learning resources (n=97)

Question	Response range	Response number	Percentage
Question 5: You watched the recordings provided	Mostly	65	67%
	Partly	26	27%
	Not at all	6	6%
Question 6: You actively engaged with the online content (e.g., through quizzes, open-ended questions, etc.)	Mostly	79	81%
	Partly	16	17%
	Not at all	2	2%
Question 7: You believe that your online learning practice was effective in learning the content	Agree	59	61%
	Neither agree nor disagree	26	27%
	Disagree	12	12%
Question 8: Would you like to have an explicit teaching on how to learn (including learning online)?	Yes	55	57%
	No	42	43%

Most respondents actively engaged with the online content by watching the online material and completing interactive activities (e.g., online quizzes, open-ended questions) (67%). Furthermore, most respondents believed that their learning practices were effective in learning the content (61%). Finally, when asked directly about the potentiality of learning explicitly about the effective learning strategies, the opinions were split, with a slight preference towards explicit teaching of learning strategies. The split in opinion was not based on the year of enrolment, which is an important note to make, as this suggests a more complex problem of respondents' overall awareness of effective learning strategies. This point is further explored in the Discussion section.

As for the previous section, the content analysis of the open-ended comments confirmed the findings from the

survey, which asked directly about respondents' learning routines during the pandemic. The data revealed a dominant pattern of learning practices which consisted of respondents learning alone by watching online recordings, doing practice activities and searching for alternative explanations (if needed). The collaborative learning was reported in the context of consulting and/or checking with classmates, if needed. The following statements are representative for this pattern:

Respondent 1: I think being able to learn at my own time and pace worked well. I learn well alone and prefer to be able to pause content, research the given concept, work through some actual examples (if it's a formula for example), and then continue the video once I'm comfortable with the concept.

Respondent 2: Daily routine – actually allowed more consistency than the irregular uni timetable. Alone with occasional discussion with people from class. Additional time allocated for timetabled classes (e.g., watch lecture content in advance in interactive sessions that were previously lectures).

Respondent 3: I used blackboard lecture slides, re-watched sections where I needed more in-depth clarification of content, and - if I was sufficiently confused – would seek out explanations elsewhere on the internet or via my uni friends.

These responses emphasise the importance of learning skills, especially the awareness of effective learning strategies that enable autonomous learning, described by respondents in terms of “learning/ studying alone”, and that support collaborative co-construction of knowledge through collaboration with classmates, or content experts (e.g., academics, student support team).

In this context, responses to the last two questions (Questions 7 and 8), which enquired about perceived effectiveness of respondents' learning practices and the need for more explicit teaching of learning strategies (including learning online), cast some doubt about respondents' active learning skills. In response to these questions, 61% of respondents agreed that their learning practices were effective and 57% did express their interest in having more training in learning how to learn. The open-ended comments provided more insight, with the following two quotations illustrating the issue:

Respondent 1: I find that staying motivated is the current challenge as a result of learning online. This is because going to university, either to sit in class, enabled me to engage better, as well as going to the library. However, I still enjoyed staying at home to watch recorded lectures as they allowed me to pause and play sections of the lecture (to write thorough notes). Staying motivated and focused is extremely difficult in a home setting where I constantly try and take breaks – therefore, not getting much study done. However, I do feel that I make my own study plan for the week prioritising the things that need to be done and when has helped me significantly – in terms of being motivated but also allocating “break times”.

Respondent 2: I have trouble staying on top of things. Previously I would have to finish certain lectures before I went into uni live pracs, but now that everything is online, it's easier to push study to the side and fall behind.

Both responses confirm findings to questions 5 and 6. On the one hand, it appears that respondents adjusted to the new circumstances and found their practices effective. On the other hand, many respondents also appeared to be aware of the need for learning strategies that would enable them to better take control of their own learning. What is needed then is to develop their ability to self-regulate and self-direct their learning.

Discussion

This study commenced and was completed during the COVID-19 pandemic, at the phase we called *the eye of the storm*, when respondents had already had time to take steps to familiarise themselves with the new circumstances and normalise their daily routines.

The findings revealed respondents' somewhat limited patterns of learning practices, which were primarily focused on the immediate learning environment. Furthermore, this work highlights a confounding issue in terms of respondents' awareness of effective learning strategies. Taken together, the findings suggest that respondents, second- and third-year students enrolled in science disciplines, require assistance in developing their self-

directed and self-regulatory abilities.

It appears that the respondents had been successful in establishing their online learning routines using resources adapted to fully online teaching. We call this *emergency remote learning*, as we called, after Hodges and colleagues (2020), the delivery of the content *emergency remote teaching*. The shift to the online environment occurred rapidly with the main objective being to provide students with necessary resources and access to support for learning. Most lectures were recorded and uploaded online, tutorials were delivered in real-time using videoconferencing tools, and communication with students was intensified. An important effort was made to deliver virtual practicals and laboratories, often with innovative practices, such as making specialised software available to simulate laboratory/ clinical conditions. The main objective was to ensure that units were taught and assessed with minimal disruption to students and minimal impact on the quality of learning experiences. Neither teaching teams nor the respondents were prepared for such circumstances.

The data suggests that, in most cases, the respondents were able to establish their learning routine and develop learning practices. The development and implementation of such learning practices requires identification of learning needs, planning, thinking ahead, performing, completing the task and reflecting on the effectiveness of the adopted approach (Brand-Gruwel et al., 2014; Neelen & Kirschner, 2017; Rana, Ardichvili & Polesello, 2016). Thus, it can be concluded that respondents were developing their active learning skills. However, two points need to be made at this stage.

First, the observed limited range of learning strategies suggests that respondents focused their attention predominantly on their immediate learning environment. The social agents consulted most often were classmates and academic teaching staff. The assistance provided by student support staff was certainly perceived, but less frequently used. This might come as no surprise, as the respondents were from more advanced years, and thus were already more advanced in becoming active learners. Nevertheless, considering the exceptionality of the situation, this finding still raises questions about respondents' ability to perceive other opportunities for learning, such as professional experts working outside academia (see section above on self-direction).

This observation is supported by findings related to the perception and uptake of opportunities for learning provided by online resources. For instance, the low uptake of assistance provided by the university Library site, a hub of reliable learning resources, confirms respondents' focus on their immediate learning environment. It would have been expected that, within exceptional circumstances and with limited access to teaching staff, such a reliable source of information would be consulted more frequently. As noted in the introduction, the concept of self-directed learning comes from research within the workplace and describes learners who are actively searching for opportunities to learn from their environment (Rana, Ardichvili & Polesello, 2016).

The findings suggest that respondents did not perceive, and thus were not aware, of many opportunities for learning embedded within their environment, which were not necessarily provided by the individual unit of study or institutionally created (e.g., student support team). It appears that the opportunities for extending their learning network and searching for assistance from social agents, because they were not being a part of an institutionally created network, were therefore not taken up. This could be interpreted as low awareness of self-directory strategies resulting in low levels of self-directed learning skills.

Second, the responses to the questions investigating respondents' self-regulation identified an interesting discrepancy between their perceived high levels of engagement with the learning environment and their need for more learning on how to learn. In fact, open-ended comments demonstrated that many respondents did apply some effective learning strategies (e.g., taking notes while watching pre-recorded lectures). This indicates, again, that respondents were in the process of becoming self-regulated learners. However, it appears that they needed a larger spectrum of learning strategies that would assist them with taking more structured and organised control of their learning. Research (Dunlosky et al., 2013; Kirschner & Hendrick, 2020; Pomerance, Greenberg & Walsh, 2016) provides evidence of high effectiveness, or high utility of such learning strategies (techniques) as, for example, elaborative interrogation, distributed practice, or interleaved practice. This study revealed respondents' low awareness of such learning strategies. Instead, they reported re-reading the notes or highlighting sections of the text, i.e., low utility strategies, in their learning practice. It appears that many respondents instinctively felt the need for learning how to learn, associated with the need for "better time-management" or "organisation" of learning. All the above leads to the conclusion that, as for previous skills, respondents were in the process of developing their self-regulated learning skills; however, they realised the

need for more structured teaching of learning strategies. This finding also indicates an important need for teaching staff to be aware of task design principles (Czaplinski, 2020; Rapanta et al., 2020) allowing powerful learning strategies to be used by their students.

At this point, a question needs to be raised whether the identified low levels of awareness of respondents' active learning strategies resulted from survival-mode learning that respondents might have adopted during the pandemic, or whether this is a symptom of a deeper problem, rooted in the respondents' overall low levels of awareness of effective learning strategies. One needs to consider exceptional circumstances within which respondents were obliged to learn: lockdown in residence, using only technology for communication and collaboration, being anxious about study and personal circumstances, many could have felt confused and uncertain. Interestingly, some respondents reported having missed institutionally created structures, i.e., a timetable that, as it turns, not only organised types of learning activities, but also significantly assisted students with their learning practices by providing a frame with high points (e.g., lectures, practicals) around which learning (including independent and collaborative study) was happening. The timetable turned out to be the pivot, the point of reference that allowed students to "stay on top of things", as they needed to re-act according to the created schedule. Was the pandemic the reason for low awareness, or was it a phenomenon that magnified the already underlying problem?

The pre-pandemic literature provides evidence that students are often unfamiliar with effective learning strategies, and may use "trial and error" strategies with temporary effectiveness that can result in short-term performance and give them a metacognitive illusion of effectiveness of their learning practices (Czaplinski, 2020; Kornell, Rhodes, Castel, & Tauber, 2011; Soderstrom & Bjork, 2015). In consequence, students may (unknowingly) adopt ineffective learning strategies (McCabe, 2011; Soderstrom & Bjork, 2015) and develop an illusion of competence (Dunlosky et al. 2013; Løkse et al., 2017; Soderstrom, Yue & Bjork, 2016). There is a suggestion of this phenomenon in this study; however, more research is needed to investigate the extent of the pandemic conditions on the levels of students' awareness of effective learning strategies. At this point we can only hypothesise that, most probably, under the highly stressful circumstances, respondents applied the strategies they were most familiar with, and that they considered effective for their learning. Thus, it is also hypothesised that the observed low levels of awareness of effective learning strategies was not due to the exceptional circumstances, although these certainly illuminated many underlying issues (e.g., self-management).

Finally, the study was conducted prior to the examination period, and therefore the final results could not impact on respondents' perceptions of the effectiveness of their learning. Our team aims to complement the study with an analysis of final grades, to investigate whether the perceived effectiveness of learning practices translated into levels of achievement measured by final grades.

Conclusion

This study has investigated second- and third-year science students learning practices during the pandemic. Take away messages from the investigation, conducted from the perspective of active learning, are: 1) respondents were in the process of becoming active learners, but more explicit assistance with developing their self-directed and self-regulated learning skills was needed; 2) more explicit teaching of effective learning strategies is needed; 3) more teacher training in designing learning tasks that enable effective learning strategies is needed.

The implication of the study extends beyond its current scope. The study points towards a more in-depth investigation of the students' levels of awareness of effective learning strategies. On the flip side, the study also, indirectly, points towards the question of academic teaching teams' levels of awareness of effective teaching strategies. These may turn out to be extremely important, especially in exceptional times, such as the current COVID-19 pandemic.

References

- Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology*, *64*, 417–444. <http://doi.org/10.1146/annurev-psych-113011-143823>
- Brand-Gruwel, S., Kester, L., Kicken, W., & Kirschner, P. A. (2014). Learning ability development in flexible learning environments. In J. M. Spector, M. D. Merrill & J. Elen (Eds.), *Handbook of research on educational communications and technology* (pp. 363–372) (4th ed.). Springer. <https://doi.org/10.1111/jcal.12076>
- Cole F. L. (1988). Content analysis: process and application. *Clinical Nurse Specialist* *2*(1), 53–57. <https://doi.org/10.1097/00002800-198800210-00025>
- Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209–240). Sage.
- Czaplinski, I.A. (2020). An analysis of learning networks of STEM undergraduate students to promote active learning. PhD thesis by monograph. doi: [10.5204/thesis.eprints.201510](https://doi.org/10.5204/thesis.eprints.201510)
- Dunlosky, J., Rawson, K., A., Marsh, E.J., Nathan, M.J. & Willingham, D., T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 45–8. <https://doi.org/10.1177/1529100612453266>
- Elo, S. & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. <https://doi.org/10.1111/j.1365-2648.2007.04569.x>
- Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*. <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning>
- Kirschner, P.A. & Hendrick, C. (2020). *How learning happens. Seminar works in educational psychology and what they mean in practice*. Routledge.
- Knowles, M.S. (1975). *Self-directed learning: A guide for learners and teachers*. Association Press.
- Kornell, N., Rhodes, M. G., Castel, A. D., & Tauber, S. K. (2011). The ease-of-processing heuristic and the stability bias: Dissociating memory, memory beliefs, and memory judgments. *Psychological Science*, *22*, 787–794. <http://dx.doi.org/10.1177/0956797611407929>
- Løkse, M., Låg, T., Solberg, M., Andreassen, H.N., & Stenersen, M. (2017). *Teaching information literacy in higher education: Effective teaching and active learning*. Chandos Publishing.
- Markauskaite, L. & Goodyear, P. (2017a). *Epistemic fluency and professional education: innovation, knowledgeable action and actionable knowledge*. Springer. <https://doi.org/10.1007/978-94-007-4369-4>
- McCabe, J. (2011). Metacognitive awareness of learning strategies in undergraduates. *Memory & Cognition*, *39*, 462–476. <https://doi.org/10.3758/s13421-010-0035-2>
- Neelen, M. & Kirschner, P. A. (2017). *How to support self-directed learning in a learning organisation? 3-star learning experiences. An evidence-informed blog for learning professionals*. [Web log post]
- Pomerance, L., Greenberg, J., & Walsh, K. (2016, January). *Learning about learning: What every teacher needs to know*. http://www.nctq.org/dmsView/Learning_About_Learning_Report
- Rana, S., Ardichvili, A., & Polesello, D. (2016). Promoting self-directed learning in a learning organization: tools and practices. *European Journal of Training and Development*, *40*(7), 470–489. <https://doi.org/10.1108/EJTD-10-2015-0076>
- Rapanta, Ch., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education* (2020). <http://doi.org/10.1007/s42438-020-00155-y>
- Soderstrom, N. C., & Bjork, R. A. (2015). Learning versus performance: An integrative review. *Perspectives on Psychological Science*, *10*, 176–199. <http://dx.doi.org/10.1177/1745691615569000>
- Soderstrom, N. C., Yue, C. L., & Bjork, E. L. (2016). Metamemory and education. In J. Dunlosky & S. K. Tauber (Eds.), *Oxford library of psychology. The Oxford handbook of metamemory* (pp. 197-215). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199336746.001.0001>
- Winne, P. H., & Jamieson-Noel, D. (2002). Exploring students' calibration of self-reports about study tactics and achievement. *Contemporary Educational Psychology*, *27*, 551–572. [https://doi.org/10.1016/S0361-476X\(02\)00006-1](https://doi.org/10.1016/S0361-476X(02)00006-1)
- World Health Organization (n.d.). Coronavirus (COVID-19) pandemic.

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019>

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41(2), College of Education, The Ohio State University. https://doi.org/10.1207/s15430421tip4102_2

Zimmerman, B. J. (2008). Goal setting: A key proactive source of academic self-regulation. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 267–295). Erlbaum.

Czaplinski, I., Devine, C., Sillence, M., Fielding, A., Gaede, O. & Schrank, C. (2020). Active learning in the time of the pandemic: Report from the eye of the storm. In S. Gregory, S. Warburton, & M. Parkes (Eds.), *ASCILITE's First Virtual Conference*. Proceedings ASCILITE 2020 in Armidale (pp. 263–272). <https://doi.org/10.14742/ascilite2020.0107>

Note: All published papers are refereed, having undergone a double-blind peer-review process. The author(s) assign a Creative Commons by attribution licence enabling others to distribute, remix, tweak, and build upon their work, even commercially, as long as credit is given to the author(s) for the original creation.

© Czaplinski, I., Devine, C., Sillence, M., Fielding, A., Gaede, O. & Schrank, C. 2020