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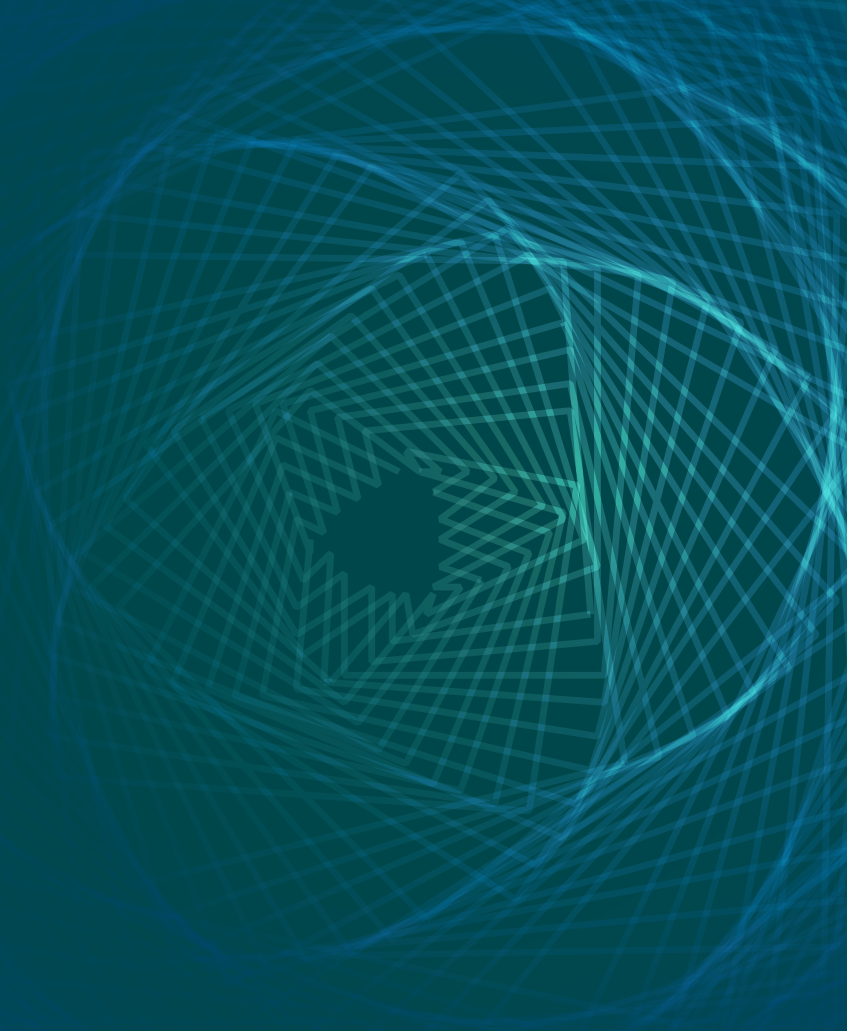

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Teaching for Knowledge Transfer: Best Practices From a Graduate-Level Educational Psychology Distance Learning Program

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Abstract

One measure of effective instruction is the ability to solve authentic real-world problems by effectively transferring and applying classroom and textbook knowledge. While many students can productively earn high grades and learn course content, they are not always able to apply the knowledge they gain. As such, this quasi-experimental study compared the comprehensive exit exam results of learners across instructional modalities who completed a prominent graduate-level educational psychology program. ANCOVA revealed superior knowledge transfer for blended-learning students compared to those who completed distance education and significantly greater transfer of declarative, procedural, and self-regulatory knowledge by the blended-learning students. This paper briefly summarizes the study results while highlighting evidence-based programmatic and course level modifications that were implemented to specifically address transfer of learning and practical application of educational psychology knowledge.

Keywords: assessment, distance learning, educational psychology, knowledge transfer

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Introduction

The prevalence of post-secondary distance education continues to rise. As of fall 2018, over 35% of undergraduate enrollments participated in distance education, with 3.6 million students, or 16% of total US enrollment, exclusively completing degrees online (USDOE, 2019). Blended learning, defined as face-to-face instruction supplemented by up to 79% distance education, has also experienced astronomical growth. The impact of blended learning is substantial, with 70% of universities stating that blended learning is instrumental to long-term university strategy and growth (Allen & Seaman, 2011). As of 2017, 30% of learners take all their post-secondary education online (Allen & Seaman, 2017), a figure that will likely increase based on the COVID-19 pandemic and the need for remote instruction.

Most studies show limited learning advantages based on instructional modality alone (Means, Toyama, Murphy, Bakia, & Jones, 2009). Meta-analytic findings from 176 studies revealed students in fully online conditions performed modestly better than those learning the same material through exclusive face-to-face instruction ($g+ = .24$), a larger advantage was attributed to blended learning in comparison to face-to-face ($g+ = .35$). Typically, advantages for blended learning are attributed to the "best of both worlds" axiom, with learning gains based on the more frequent

interaction between the teacher and learner in the classroom, combined with greater content ownership and community for blended learners (Hansen, 2008).

Surprisingly, scant studies investigated the types of knowledge gained across modalities (Hanson, 2008), authentic problem-solving skills (Callister & Love, 2016), or knowledge application in real-world settings. Considering the strong emphasis on transfer of knowledge, as the holy grail of learning (Kolb, 1984; Mayer, 2014, 2019; Perkins & Salomon, 2012), more evidence is needed on the implications of instructional modality using transfer and problem-solving measures. Current most modality comparisons focus on dependent variable differences such as grade point average (GPA) or test scores, but fail to measure knowledge transfer, defined as the application of existing knowledge to new or novel problem-solving (McKeough et al., 2013).

Knowledge transfer is a paramount to work effectiveness (Foley & Kaiser, 2013). Considering that most individuals pursue graduate education to enhance their credentials and employability, it is incumbent upon program and course designers to emphasize content that can be used in the workplace. Ironically, an effectively designed course or graduate program that imparts learners vast declarative knowledge may have little emphasis on how that knowledge is applied in disparate settings. Devoid of transfer individuals may lack the capability to solve real-world problems, despite having background knowledge within a particular domain. Thus, optimally designed instructional programs should have a dual emphasis on knowledge acquisition and application.

Transfer can ensue in via two methodologies. Near transfer occurs when the knowledge is applied in similar situations (e.g., application of classroom management techniques to corporate meeting situations), or through far transfer when theoretical principles are applied to real-life problem-solving situations, a design that resembled the focus in the current study (Perkins & Solomon, 2012). Regardless of categorization, all learners must be knowledgeable and motivated to apply critical thinking and metacognitive skills to accomplish transfer, suggesting that prospective transfer of knowledge can be prompted through a variety of instructional design strategies. As such, teacher professional development at the secondary and university level should focus on how to prompt knowledge transfer during instruction (Brion, 2020).

Transfer can be measured in several ways. One viable option is to present problem-solving situations, such as vignettes or case studies and require issue identification and resolution. This type of approach challenges the learner to take domain-specific knowledge and apply that knowledge in a domain-general situation (Funke et al., 2018). By example, if a learner knows how to calculate the area of a living room rug based on room dimensions, they should also be able to determine crop configuration and area requirements for the design of a prospective farm. Similarly, a learner might use knowledge of developmental theory to design a pre-school course curriculum that teaches students age-appropriate skills. Specific measurement of transfer can include the application of algorithms to novel situations, identification of additional evidence needed to solve a problem, and elaboration on the limitations of specific strategies identified in a problem-solving condition (Wood, 2006).

The current study controlled for cumulative GPA and real-world experience of graduates from an applied, skills-based master's program in educational psychology. Using comprehensive exam scores based on authentic case studies, learning transfer differences between distance and blended learners on response quality, domain knowledge, and problem-solving ability were compared to

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answer three research questions; 1) is greater transfer related to predominately distance or blended instruction, 2) if transfer is observed, does domain of application (learning, motivation, and life-span development) influence transfer, and 3) does knowledge type (declarative, procedural/conditional, and self-regulatory) influence transfer quality? Additionally, qualitative content analysis examined the nature and depth of knowledge transfer.

Methods

Sample

Participants were 32 graduates (64.7% F, 35.3% M) from a 33-credit-hour educational psychology master's degree program at a large, public, southeastern US research university. The program trains students in the application of psychological theories and research to improve learning and instruction, and includes coursework in lifespan development, motivation, learning science, and cognitive psychology. Program graduates (70.6%) were aged <33 years, with mean GPA of 3.73. Learners were categorized as blended (N=12) when completing >66% of the program with a face-to-face and online instructional component, while distance learners (N=22) completed >66% of program credits in a fully online instructional modality.

Data Collection

Program graduation requires passing a take-home, case-study essay exam that includes identification of learning, motivation, and development issues, evidence-based strategies, and practical limitations to resolve the identified problems. Case studies were counterbalanced and standardized to ensure similar word number and lexical complexity. A 0-3 scale per category rubric was used to evaluate knowledge transfer (see Figure 1) including domain-level knowledge (learning, motivation, development), and type of knowledge described and applied (declarative, procedural/conditional, self-regulatory). Exam total and six sub-scale scores were analyzed using ANCOVA and mixed-design ANOVAs to determine significant differences and effect sizes among modalities and type of knowledge transfer. Author inter-rater scoring reliability for exam results was 96.6% initially, and 100% upon discussion.

Qualitative transfer evaluation was measured by content analysis of exam narrative that applied theory to mediate authentic problems in teaching and learning. By example, a student demonstrated how to implement culturally relevant pedagogy by stating, "As a teacher, you must develop an ability to key in on the nuances of community structure to know how to best address the needs of your students." Similarly, a student reflecting on why a motivational strategy might backfire demonstrated transfer using procedural and regulatory knowledge when discussing how attentional lapses might be misinterpreted; "For instance, if a student is facing distractions or have issues in their personal lives, they may struggle to pay attention to the course content, and a teacher could be incorrectly identifying that as boredom with the course content, rather than preoccupation with other life matters." The statements above contrasted with non-transfer categorized statements that merely analyzed the specific case study presented to the learner and did not mention any type of application beyond the specific problem presented.

Figure 1: Knowledge Transfer Scoring Rubric

(Points for each category) Ratings:

(1) No evidence = Answers case study incorrectly or provides no knowledge transfer evidence.
(2) Developing =Answers case study accurately. May merely identify problems or propose solutions based on theoretical premises but shows limited or no knowledge transfer.
(3) Proficient =Answers case study accurately. Additionally, demonstrates knowledge transfer from core classes in expected ways. Includes appropriate-researched based evidence to substantiate claims and solutions.

Exemplary = Answers case study accurately. Additionally, demonstrates knowledge transfer from core classes in novel and innovative ways. Includes appropriate-researched based evidence to substantiate claims and solutions.

Category	Learning (0-3)	Motivation (0-3)	Development (0-3)	Marginal Means
A. Identifies authentic problems related to teaching, students, organizations, and social systems.				
B. Identifies, describes, and applies contextually based strategies to solve Part A problems				
C. Identifies, describes, and applies contextually based Part B strategy limitations				
Marginal Means				
Total Score				

Findings

After controlling for years of program experience and GPA, ANCOVA determined no significant effects on exam scores. A statistically significant main effect for instructional modality was discovered, $F(1, 32) = 4.725$, p= .037. Mixed design ANOVAs revealed students who received blended instruction consistently exhibited statistically significant higher mean scores in learning (*Mblended* = 5.00, SD = 2.29; *Mdistance*= 3.41, SD = 2.46, *d* = .67), motivation (*Mblended* = 5.42, SD = 2.39; *Mdistance* = 4.23, SD = 2.35, *d* = .51), and development (*Mblended*= 3.75, SD = 2.45; *Mdistance*= 1.95, SD = 2.44, *d* = .74). Additionally, blended-instruction students earned statistically significant higher mean scores in declarative knowledge (*Mblended*= 5.08, SD= 2.07; *Mdistance*= 3.55, SD = 2.04, d = .74), procedural/conditional knowledge (*Mblended*= 4.92, SD= 2.15; *Mdistance*= 3.68, SD = 2.17, *d* = .57), and self-regulatory knowledge (*Mblended*= 4.17, SD = 2.25; *Mdistance*= 2.36, SD = 2.11, *d* = .82). Pairwise comparisons revealed that the mean development sub-scale scores differed significantly from both the learning and motivation domains, and mean self-regulatory knowledge differed significantly from both declarative knowledge and procedural/conditional knowledge.

Interpretation and Educational Significance

Based on the results, three instructional design considerations are advanced. First, although no cumulative GPA differences existed, distance learners scored significantly lower on all transfer measures across both content and knowledge domains, suggesting the need for greater emphasis on transforming theory into practice during distance instruction. Second, a ceiling effect was observed for all learners as mean transfer scores across all domains and knowledge types were 3.73 (0-9 range), a grand mean, which if normally distributed would fall at the 33rd percentile. Cumulative scores this low suggest the glaring need to modify instructional materials and practices to emphasize transfer. Third, all learners were highly deficient in scrutinizing the suitability of

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their proposed case study solutions, indicating gaps in self-regulatory knowledge that is necessary to evaluate the consequences of implementing evidence-based solutions.

While these results may lack generalization across graduate education programs, the conclusions advanced question the ability of distance learners to apply theoretical knowledge in problem-solving situations. This study is one of the few to illuminate the need to consciously evaluate and perhaps change course design to promote a greater emphasis on using transfer strategies to improve teaching, learning, and student achievement. Considering the explosive growth of online learning (Seaman & Allen, 2017) combined with the notion that "transfer is routinely taken to be one of the most important instructional goals" (Driscoll, 1994, p. 160) these findings warrant additional consideration of which methods or strategies best promote knowledge transfer during distance learning.

Teaching for transfer can be accomplished in several ways. First, instructional design can have a deliberate transfer design emphasis. Ford and Weissbein (1997) suggested incorporating active learning techniques such as deliberate reflection on learned material, assessments that use concept mapping and basic repetition of course content. Transfer goals can be accomplished through a variety of specific pedagogical methods including relating theoretical concepts to typical lifestyle or vocational challenges, requesting multiple solutions to problem-solving dilemmas, or requiring learners to assume philosophical positions that contrast with their own world views (Foley & Kaiser, 2013). Collectively, these types of techniques were considering during the program redesign process.

Changes Implemented

Based upon the observed results numerous programmatic and course modifications were implemented to address the transfer skills deficit described above. Program faculty convened and evaluated research-based transfer strategies (Mayer, 2019; McKeough et al., 2013; Perkins & Salomon, 2012) to determine what types of standardized course changes could be implemented to address the transfer issues. Changes were made in three main areas, course instructional design, pedagogical methods, and knowledge assessment. The changes implemented focused on improving knowledge transfer but also were designed to leverage learner engagement for those students who elect to complete the degree exclusively through distance-learning instruction.

Instructional Design

The first step in the redesign process targeted course structure and course materials. This instructional approach corresponds with the transfer paradigm of "detect, elect, and select," which is advocated to enhance the efficiency of learning transfer (Perkins & Salomon, 2012). Detecting means to recognize a link between learning content and a transfer opportunity. To enhance the efficiency of detection all learning objectives were redesigned to make detection explicit. By example, each instructional unit included prompts such as "by the time you finish this module you will be able to…resolve disciplinary issues both inside and outside the classroom." This approach specifically focused the learner to apply the course information beyond the basic context of the learning module, in addition to alluding to the case study structure that would be employed in the comprehensive exam.

Next, at least one multimedia component was added to each instruction module to illustrate how the unit concepts were embedded in authentic discourse. This method often used YouTube clips from popular television shows that illustrated instructional objectives. One highly effective approach was a clip from the hit TV show "Big Bang Theory," whereby the lead character Sheldon attempts to quiet one of his chatty friends by using behavioral reinforcement strategies. These types of media examples were devoid of any theory but illustrated how a theoretical concept could be applied in an authentic problem-solving situation. The popular media approach embeds the practicality of the concept in the learner's mind, but also enhances engagement as learners can relate to the media content, which occurs outside of typical course room instruction.

Additionally, each learning module was scrutinized to decrease repetitive text-based discussions. Instead, a deliberate design focus shifted to an emphasis on cultivating higher-order skills through techniques such using refutational text. This approach was coordinated with discussion prompts that require the learner to defend a position contrary to one's own beliefs. Evidence supports the approach that assuming an epistemologically inconsistent position that induces deductive reasoning is often beneficial to overcome misconceptions related to beliefs inconsistent with evidence-based practices (Lee & Park, 2013). For example, one discussion required defending a position of why gun control is unnecessary. Assuming alternative conceptions of course concepts externally focus the learner because they must justify positions contradictory to accepted beliefs and normal thinking patterns.

Pedagogical Methods

From an instructional perspective, the revised focus included creating discussion prompts designed to enhance personal relevance of instructional material combined with an added emphasis on monitoring learning effectiveness through metacognitive prompting. Creating relevance means identifying instructional elements that potentially encourage application of theory to practice but also entailed creating bridges from existing knowledge to program content. Creating personal relevance is often shown to enhance both learning and student motivation (Albrecht & Karabenick, 2018). By example, to help learners master concepts related to social-cognitive theories of motivation and to understand the importance of motivational self-beliefs, a discussion topic was created that asked students to analyze the motivational beliefs of a popular media character or celebrity. The activity allowed students to choose their focus and provided the ability to see how motivational beliefs influence behavior in practice. Subsequently, an additional prompt in the same discussion required the student to compare their self-beliefs to the character selected. This aggregate approach induced personal relevance due to topic choice, but also served as a model as to how course knowledge could be applied to the self based on authentic real-world encounters. This relevance inducing paradigm was incorporated into multiple discussions and assignments as a method to enhance the utility of the concepts being studied while concurrently relating the material to the individual learner.

Metacognition refers to the process of monitoring, reflecting, and evaluating one's own thinking and behavior (Flavell, 1979). Research across domains generally concludes the superiority of learning outcomes when learners actively monitor their learning progress compared to when they do not (Zimmerman et al., 2017). Distance learning is a highly conducive modality to prompt users to reflect on their learning using technology, hyperlink, and tracing techniques to ensure sufficient reflection to justify a quality contribution. As such, mouseovers and random pop-ups were

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incorporated in all instructional activities, whereby learners are prompted to justify the reliability and validity of all submitted work. By example, learners may receive random prompts that ask questions such as "have you used practical evidence to support your inferences?" or "How can this concept be applied outside the course?" These techniques focus learners toward application of concepts and evaluating what they submit before submission.

In addition, all modules require interaction among learners with specific prompts designed to highlight practical application of material. By commenting on the work of others and providing feedback to fellow learners the content contributor can assess the practical and cultural suitability of their proposed solutions. Finally, regular instructor scaffolding to learners includes targeted feedback that focuses on application of theory to practice. This external monitoring serves as necessary scaffolding to reinforce a focus on how course knowledge can be applied beyond the context of the course assignment.

Assessment

Comparatively, the area of assessment underwent the greatest degree of program modification. The structure of the comprehensive exit exam was changed to reflect greater emphasis on the need to solve a case study using theoretical *and* practical emphasis, or as Mayer (2019) advocated, a shift to knowledge construction through cognitive guidance that results in *meaningful learning*. Although learners are still required to demonstrate theoretical mastery, unless contextual details are supplied related to the application of theory to practice the learner cannot earn scores in the highest categories of the scoring rubric shown in Figure 1. In addition, the exam instructions now require elaboration upon why any proposed strategy intervention may not work or what obstacles might be encountered during problem mediation, evoking metacognitive reflection about the answers provided.

The modification process included revising the exam instructions to reflect the greater emphasis on practical application without explicit direction to comment on 'transfer of knowledge." The scoring rubric was adjusted to provide credit for content that demonstrated "effectively transferring theoretical knowledge to application" and by "demonstrating relevance of identified strategy to solve practical problems." Students were afforded a pre-exam preparation session that repeatedly emphasized the need to show the application of theory in exam responses. Students were told that the entire purpose of the exam was to measure if their program curriculum was beneficial to solve day-to-day learning and motivational challenges encountered in the classroom and other instructional environments. The scoring rubric was provided in advance to alert learners how their work would be evaluated.

Over the course of the program learners are required to write a literature review. The literature review serves as the substance for what is called the "scholarly product," a milestone that must be completed to exit the program. The scholarly product demonstrates the students' depth of professional knowledge through a personal contribution to their respective field and is designed to initiate the student to scholarly activities of the professional community. The scholarly product milestone is completed when the student submits their literature review for presentation at a research conference. This activity is designed to allow the student the opportunity to promote transformation of highly technical cognitive science knowledge into a format that can convey meaningful learning to the layperson. While the scholarly product is not specifically designed to

promote knowledge transfer, students are coached to use practical and authentic examples as a means communicate their expertise, with the implicit goal of allowing knowledge transfer from the classroom to the professional community.

Conclusions

One primary goal of learning acquisition is the generalization of knowledge. This study used a mixed-methods and cumulative assessment approach to determine if transfer of educational psychology knowledge is an embedded outcome of the graduate school learning process. Comprehensive exam results via both quantitative and qualitative analysis showed confluent patterns in favor of blended learning students as superior in detecting the differences between mere graduate program success and the ability to transfer knowledge to authentic problem-solving situations. As such, a variety of strategies were advanced to infuse the application of theory to practice. Despite the intuitive appeal of strategies such as creating relevance in discussions, prompting metacognitive reflection, and revising assessments for practical emphasis, it is unknown if these strategies will ultimately cultivate knowledge transfer.

The next step is to empirically justify if these course and program changes promote practical application of program principles, regardless of instructional modality. It should be noted that these results and recommendations may lack generalization to other programs based on program structure, student population, and instructor expertise. While the situational use of computer technology often boosts short-term learning (Tamim et al., 2011), online instruction has also been found to reduce knowledge transfer resulting in less practical value for the content taught. However, one ubiquitous inference in educational literature is that good teachers are good teachers, regardless of modality (Jackson & Anagnostopoulou, 2018). One hallmark of good teaching is using data to make instructional decisions and all educators are encouraged to consider and empirically test the suggestions advanced here.

References

Albrecht, J. & Karabenick, S. (2018). Relevance for learning and motivation in education. *The Journal of Experimental Education*, *86*(1), 1-10. doi: 10.1080/00220973.2017.1380593

Allen, E., & Seaman, J. (2011). Going the distance: Online education in the United States, 2011. The Sloan Consortium. Needham, MA: Sloan-C. Retrieved March 18, 2020 from http://www.onlinelearningsurvey.com/reports/goingthedistance.pdf

Allen, I. E., & Seaman, J. (2017). Digital compass learning: Distance education enrollment report 2017. *Babson Survey Research Group*. Retrieved April 8, 2021 from https://files.eric.ed.gov/fulltext/ED580868.pdf

Brion, C. (2020). Learning transfer: The missing linkage to effective professional development. *Journal of Cases in Educational Leadership*, *23*(3), 32-47.

Callister, R. R., & Love, M. S. (2016). A comparison of learning outcomes in skills-based courses: Online versus face-to-face formats. *Decision Sciences Journal of Innovative Education*, *14*(2), 243–256. http://doi.org/10.1111/dsji.12093

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive– developmental inquiry. *American Psychologist*, *34*(10), 906-911. http://dx.doi.org/10.1037/0003-066X.34.10.906

Foley, J. M., & Kaiser, L. M. (2013). Learning transfer and its intentionality in adult and continuing education. *New Directions for Adult and Continuing Education*, *2013*(137), 5-15.

Ford, J. K., & Weissbein, D. A. (1997). Transfer of training: An updated review and analysis. *Performance Improvement Quarterly*, *10*(2), 22–41.

Funke, J., Fischer, A., & Holt, D. V. (2018). Competencies for complexity: Problem solving in the twenty-first century. In E. Care, P. Griffin, & M. Wilson (Eds.). *Assessment and teaching of 21st century skills* (pp. 41-53). Springer.

https://digitalcommons.usf.edu/m3publishing/vol3/iss2021/2
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Hansen, D. E. (2008). Knowledge transfer in online learning environments. *Journal of Marketing Education*, *30*, 93-105. http://doi.org/10.1177/0273475308317702

Jackson, B., & Anagnostopoulou, K. (2018). Making the right connections: Improving quality in online learning. In *Teaching & learning online* (pp. 53-64). Routledge.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Mayer, R. E. (2014). What problem solvers know: Cognitive readiness for adaptive problem solving. In H. F. O'Neil, R. S. Perez, & E. L. Baker (Eds.). *Teaching and measuring cognitive readiness* (pp. 149-160). Springer.

Mayer, R. E. (2019). Thirty years of research on online learning. *Applied Cognitive Psychology*, *33*(2), 152-159.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Washington, DC: US Department of Education.

McKeough, A., Lupart, J. L., & Marini, A. (2013). *Teaching for transfer: Fostering generalization in learning*. Routledge.

Perkins, D. N., & Salomon, G. (2012). Knowledge to go: A motivational and dispositional view of transfer. *Educational Psychologist*, *47*(3), 248-258.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4–28.

U.S. Department of Education, National Center for Education Statistics (2019). *Digest of Education Statistics*, Table 311.15. Retrieved from https://nces.ed.gov/fastfacts/display.asp?id=80

Wood, C. (2006). The development of creative problem solving in chemistry. *Chemistry Education Research and Practice*, *7*(2), 96–113. doi:10.1039/b6rp90003h.

Zimmerman, B. J., Schunk, D. H., & DiBenedetto, M. K. (2017). The role of self-efficacy and related beliefs in self-regulation of Learning and Performance. In A. J. Elliot (Ed.), *Handbook of competence and motivation* (2nd ed., pp. 313–333). Guilford Press.