Sirius Education Solutions Annotated Bibliography

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Introduction

This annotated bibliography represents an emerging compilation of relevant research on theories of learning, knowledge transfer, and student motivation. The research identified for this review includes studies focused on how 3-12 students learn, apply their learning, and feel motivated to learn. The literature search was conducted using APA PsychNet, Sage Journals, and Taylor & Francis. More details on the search and inclusion process are included in the Appendix.

Navigation of this Annotated Bibliography

The research presented in this annotated bibliography is separated by three sections: theories of learning, knowledge transfer, and student motivation. Each section includes the citation and the abstract provided by the authors. The citations are alphabetized by the primary author's last name.

Research References

How do students learn? (Theories of Learning)

Feedback

Byeon, S., & Kim, N. (2020). Impact of Korean students' individual learning time on math performance: Differential effect of teachers' assessment competency. *Asia Pacific Education Review*, *21*(4), 601–613. https://doi.org/10.1007/s12564-020-09643-z

From the abstract: "As the 2015 revised national curriculum is being implementing in Korea, a teacher's assessment competency has become a point of focus for the potential enhancement of students' self-directed learning. Relevantly, a teacher's competency in student assessment is correlated to his/her individual feedback practices. Although students' self-directed learning affects academic performance and may vary based on their teachers' assessment competency, few studies have investigated the effect of a teacher's assessment competency, especially feedback practices, on student outcomes. Therefore, this study aims to empirically investigate the differential effect of a teacher's assessment competency, particularly focusing on feedback practices (i.e., formative assessment feedback, homework feedback), on Korean students' individual learning times and math achievements. For the analysis, a 3-level hierarchical linear modeling (HLM) is employed using data of middle school students (N = 2942) and math teachers (N = 426) in 207 middle schools of the Gyeonggi Education Panel Study (GEPS). The study revealed that a teacher's formative assessment feedback has a positive differential effect on math performance when controlling for student-, teacher-, and school-level covariates. In addition, the effect of individual learning time on math achievement was significantly dependent on teachers' homework feedback. The study provides newfound empirical evidence that teacher feedback plays a pivotal role in promoting a student's self-directed learning and academic achievement. Based on these findings, the implications of improving a teacher's assessment competency are discussed", (p. 601).

De Sixte, R., Mañá, A., Ávila, V., & Sánchez, E. (2020). Warm elaborated feedback. Exploring its benefits on post-feedback behaviour. *Educational Psychology*, *40*(9), 1094–1112. https://doi.org/10.1080/01443410.2019.1687853

From the abstract: "This study provides evidence on the impact of including warm messages in elaborated feedback. These messages are aimed at the motivational process that can be mobilised by feedback and that which can condition its reception and the way students face the task (post-feedback behaviour). In a task where secondary school students had to learn a new strategy for improving their reading skills in a computer-based environment, we compared the use of elaborated feedback with the use of elaborated feedback enhanced with motivational messages (warm elaborated feedback) and a control condition (without feedback). The results showed that students receiving warm elaborated feedback revisited the text more often than those receiving only the elaborated feedback, and that both groups revisited the text more than the control group. This finding suggests that controlling the motivational aspects in feedback messages may increase the effectiveness of elaborated feedback", (p. 1094).

Guskey, T. R. (2019). Grades versus comments: Research on student feedback. *Phi Delta Kappan, 101*(3), 42–47. https://doi.org/10.1177/0031721719885920

From the abstract: "Opinions about whether comments, grades, or both are the most effective forms of feedback vary widely among teachers, school leaders, and even grading and assessment consultants. Thomas Guskey maintains that the truth is not as clear-cut as some suggest. He reviews the research, going back to the 1950s, to better understand when certain types of feedback are most useful. He concludes that grades and comments are not, in and of themselves, beneficial to student learning. Effective feedback, whether in the form of grades or comments, must give students a sense of where they are and what they need to do to improve", (p. 42).

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of educational research, 77*(1), 81-112. https://doi.org/10.3102/003465430298487

From the abstract: "Feedback is one of the most powerful influences on learning and achievement, but this impact can be either positive or negative. Its power is frequently mentioned in articles about learning and teaching, but surprisingly few recent studies have systematically investigated its meaning. This article provides a conceptual analysis of feedback and reviews the evidence related to its impact on learning and achievement. This evidence shows that although feedback is among the major influences, the type of feedback and the way it is given can be differentially effective. A model of feedback is then proposed that identifies the particular properties and circumstances that make it effective, and some typically thorny issues are discussed, including the timing of feedback and the effects of positive and negative feedback. Finally, this analysis is used to suggest ways in which feedback can be used to enhance its effectiveness in classrooms.", (p. 81).

Hauenstein, C. E., & Embretson, S. E. (2020). Modeling item difficulty in a dynamic test. *Journal of Cognitive Education and Psychology, 19*(2), 93–106. https://doi.org/10.1891/JCEP-D-19-00023

From the abstract: "The Concept Formation subtest of the Woodcock Johnson Tests of Cognitive Abilities represents a dynamic test due to continual provision of feedback from examiner to examinee. Yet, the original scoring protocol for the test largely ignores this dynamic structure. The current analysis applies a dynamic adaptation of an explanatory item response theory model to evaluate the impact of feedback on item difficulty. Additionally, several item features (rule type, number of target shapes) are considered in the item difficulty model. Results demonstrated that all forms of feedback significantly reduced item difficulty, with the exception of corrective feedback that could not be directly applied to the next item in the series. More complex and compound rule types also significantly predicted item difficulty, as did increasing the number of shapes, thereby supporting the response process aspect of validity. Implications for continued use of the Concept Formation subtest for educational programming decisions are discussed", (p. 93).

Ling, G., Attali, Y., Finn, B., & Stone, E. A. (2017). Is a computerized adaptive test more motivating than a fixed-item test? *Applied Psychological Measurement, 41*(7), 495–511. https://doi.org/10.1177/0146621617707556

From the abstract: "Computer adaptive tests provide important measurement advantages over

traditional fixed-item tests, but research on the psychological reactions of test takers to adaptive tests is lacking. In particular, it has been suggested that test-taker engagement, and possibly test performance as a consequence, could benefit from the control that adaptive tests have on the number of test items examinees answer correctly. However, previous research on this issue found little support for this possibility. This study expands on previous research by examining this issue in the context of a mathematical ability assessment and by considering the possible effect of immediate feedback of response correctness on test engagement, test anxiety, time on task, and test performance. Middle school students completed a mathematics assessment under one of three test type conditions (fixed, adaptive, or easier adaptive) and either with or without immediate feedback about the correctness of responses. Results showed little evidence for test type effects. The easier adaptive test resulted in higher engagement and lower anxiety than either the adaptive or fixed-item tests; however, no significant differences in performance were found across test types, although performance was significantly higher across all test types when students received immediate feedback. In addition, these effects were not related to ability level, as measured by the state assessment achievement levels. The possibility that test experiences in adaptive tests may not in practice be significantly different than in fixed-item tests is raised and discussed to explain the results of this and previous studies", (p. 495).

Phelps, R. P. (2019). Test frequency, stakes, and feedback in student achievement: A meta-analysis. *Evaluation Review, 43*(3–4), 111–151. https://doi.org/10.1177/0193841X19865628

From the abstract: "Background: Test frequency, stakes associated with educational tests, and feedback from test results have been identified in the research literature as relevant factors in student achievement. Objectives: Summarize the separate and joint contribution to student achievement of these three treatments and their interactions via multivariable meta-analytic techniques using a database of English-language studies spanning a century (1910-2010), comprising 149 studies and 509 effect size estimates. Research design: Analysis employed robust variance estimation. Considered as potential moderators were hundreds of study features comprising various test designs and test administration, demographic, and source document characteristics. Subjects: Subjects were students at all levels, from early childhood to adult, mostly from the United States but also eight other countries. Results: We find a summary effect size of 0.84 for the three treatments collectively. Further analysis suggests benefits accrue to the incremental addition of combinations of testing and feedback or stakes and feedback.

Moderator analysis shows higher effect sizes associated with the following study characteristics: more recent year of publication, summative (rather than formative) testing, constructed (rather than selected) item response formats, alignment of subject matter between pre- and posttests, and recognition/recall (rather than core subjects, art, or physical education). Conversely, lower effect sizes are associated with postsecondary students (rather than early childhood/upper secondary), special education population, larger study population, random assignment (rather than another sampling method), use of shadow test as outcome measure, designation of individuals (rather than groups) as units of analysis, and academic (rather than corporate or government) research", (p. 111).

Shin, J., Lee, Y., & Seo, E. (2017). The effects of feedback on students' achievement goals: Interaction between reference of comparison and regulatory focus. *Learning and*

Instruction, *49*, 21–31. https://doi.org/10.1016/j.learninstruc.2016.11.008

From the abstract: "The purpose of the present study was to examine the effect of reference of comparison (i.e., self-referential vs. normative) and regulatory focus (i.e., promotion vs. prevention) on students' subsequent achievement goals. We hypothesized that the negative effect of normative feedback on students' achievement goals would decrease or disappear when the feedback is promotion focused. The results from an experimental study (n = 155 sixth and seventh graders) supported the hypothesis. In general, normative feedback led students to more endorsement of performance-approach and performance-avoidance goals as compared to self- referential feedback. When students received promotion-focused feedback, however, normative feedback did not significantly lead to performance goal endorsement. Regarding mastery goal adoption, none of the feedback types had any significant effect on it. The results provide implications about how to buffer the detrimental effects of normative feedback on performance goal endorsement using promotion-focused feedback", (p. 21).

Tang, F., & Zhan, P. (2021). Does diagnostic feedback promote learning? Evidence from a longitudinal cognitive diagnostic assessment. *AERA Open*, *7*, 23328584211060804. https://doi.org/10.1177/23328584211060804

From the abstract: "Assessment for learning emphasizes the importance of feedback to promote learning. To explore whether cognitive diagnostic feedback (CDF) promotes learning and whether it is more effective than traditional feedback in promoting learning, this study conducted a quasi-experiment by utilizing a longitudinal cognitive diagnostic assessment to compare the effect of three feedback modes on promoting learning, including CDF, correct/incorrect response feedback (CIRF), and no feedback. The results provided some evidence for the conclusion that CDF can promote students' learning and is more effective than CIRF in promoting learning, especially in more challenging areas of knowledge", (p. 1).

Woods, D. (2022). Students viewing of feedback: An exploration of technology-mediated learning. *Journal of Educational Technology Systems, 51*(1), 586–602. https://doi.org/10.1177/00472395221107835

From the abstract: "Providing feedback on student work is a key part of the teaching process. Ideally, students use the provided feedback to learn and improve future work. In the age of technology-mediated learning, it is essential to study how technology affects the feedback process. This work uses data captured by a Learning Management System (LMS) to measure whether students view the feedback provided by an instructor. Unfortunately, the data show that only a limited number of students actually viewed the provided feedback. A technology-focused review of the feedback process is used to identify how technology may contribute to students? limited use of feedback. Suggestions are offered for how instructors, pedagogy researchers, and developers of technology used in learning can collaborate to ensure that technology supports the best pedagogical practices identified by research and also provides the tools and data needed to support ongoing pedagogical research", (p. 586).

Habits of Mind

Ghahremani, M., Karami, S., & Balcaen, P. (2017). Pentagram of habits: Considering science teachers' conceptions of "habits of mind" associated with critical thinking in several of Iran's special gifted schools. *Gifted and Talented International, 32*(1), 3–26.

https://doi.org/10.1080/15332276.2017.1397901

*From the abstract: "*In the last two decades, one can see the widespread acceptance of the importance of teaching critical thinking (CT) as a 21st-century competency for all students from primary to graduate school. Lack of effective instructional strategies cause problems in developing effective CT curriculum. This research study aimed at the exploring the problem of domain-general versus domain-specific tension associated with the definition and fostering critical thinking. We examined Iranian science teachers' conception(s) of this tension. We applied stratified random sampling for the observational phase (initial pool of participants).

Using our classroom observation scale, through the lens of the Critical Thinking Consortium's pedagogical framework (TC2) as a theoretical framework, we observed N = 27 gifted science classrooms to evaluate teachers' instructional strategies in terms of developing CT abilities.

Applying purposeful sampling, we interviewed expert teachers based on the observational phase, to investigate their understandings of CT's general-domain habits of mind. Applying 4 + 1 classical elements as a conceptual framework, we examined various dimensions of these science teachers' conceptualization of thinking critically. Traditional gradual reduction of interviews resulted in the development of a culturally informed five-elemental pentagram of habits of mind shared by these educators. Further, these teachers addressed some instructional strategies to embed CT in the science classes", (p. 3).

Metacognition

Atasoy, B., & Somyürek, S. (2009, October). A web-based learning system: Supporting students' metacognition by reflective prompts. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* **(pp. 3435- 3441). Association for the Advancement of Computing in Education (AACE).**

*From the abstract: "*In hypermedia environments, it is important for students to have metacognitive skills while planning, monitoring and evaluating the learning process, since they have more responsibility compared to the traditional learning process. One of the metacognitive activities which could be integrated into web-based learning environments in order to lead students to think about issues such as what, why and how to learn and in what issues they have learning deficiencies is reflective prompts. Reflective prompts support students in effective learning by enabling them to think about their own learning process and to become aware of how they accomplish a task. This article presents a web-based learning environment, which was designed to support students' metacognitive process by reflective prompts. In the study, the development stages of a goal-based learning environment which contains "web designing by using HTML language" is explained. Then, the general characteristics of the system along with its flow cycle are presented. In addition, the technologies used are summarized through discussing the usages of reflective prompts and other metacognitive tools in the environment.", (p. 3435).

Bae, H., & Kwon, K. (2021). Developing metacognitive skills through class activities: What makes students use metacognitive skills? *Educational Studies*, *47*(4), 456–471. https://doi.org/10.1080/03055698.2019.1707068

*From the abstract: "*Metacognitive skills can improve with appropriate instruction, however, educators may not be familiar with these methods of teaching. This study explores what factors

influenced students to implement metacognitive skills and how students perceived the purposefully designed metacognitive activity in a high school classroom in South Korea. 252 students were involved in the study and a survey and focus group interviews were employed for the data collection. A linear regression analysis revealed that perceived task values predicted the use of metacognitive skills. A thematic analysis of the interviews showed the possibility of transferring the metacognitive skills to new contexts, and the benefits of student-teacher interactions in developing their metacognitive skills. Implications of the results for research and the instructional design of the metacognitive activities are discussed", (p. 456).

Choi, Y., & Kim, J. (2021). Learning analytics for diagnosing cognitive load in e-learning using Bayesian network analysis. *Sustainability***, 13(18), 10149.**
https://doi.org/10.3390/su131810149

*From the abstract: "*A learner's cognitive load is highly associated with their academic achievement within learning systems. Diagnostic information about a learner's cognitive load is useful for achieving optimal learning, by enabling the learner to manage and control their cognitive load in the e-learning environment. However, little empirical research has been conducted to obtain diagnostic information about the cognitive load in e-learning systems. The purpose of this study was to analyze a personalized diagnostic evaluation for a learner's cognitive load in an e-learning system, using the Bayesian Network (BN) as a learning analytic method. Data from 700 learners were collected from Cyber University. A learner's cognitive load level was measured in terms of three components: extraneous cognitive load, intrinsic cognitive load, and germane cognitive load. The BN was built by representing the relationship among the extraneous cognitive load, intrinsic cognitive load, germane cognitive load, and academic achievement. The conditional and marginal probabilities in the BN were estimated.

This study found that the BN provided diagnostic information about a learner's level of cognitive load in the e-learning system. In addition, the BN predicted the learner's academic achievement in terms of their different cognitive load patterns. This study's results imply that diagnostic information related to cognitive load helps learners to improve academic achievement by managing and controlling their cognitive loads in the e-learning environment. In addition, instructional designers are able to offer more appropriately customized instructional methods by considering learners' cognitive loads in online learning.", (p. 1).

Choi, H. H., Van Merriënboer, J. J., & Paas, F. (2014). Effects of the physical environment on cognitive load and learning: Towards a new model of cognitive load. *Educational Psychology Review***, 26(2), 225-244.** https://doi.org/10.1007/s10648-014-9262-6

*From the abstract: "*Although the theoretical framework of cognitive load theory has acknowledged a role for the learning environment, the specific characteristics of the physical learning environment that could affect cognitive load have never been considered, neither theoretically nor empirically. In this article, we argue that the physical learning environment, and more specifically its effects on cognitive load, can be regarded as a determinant of the effectiveness of instruction. We present an updated version of the cognitive load model of Paas and Van Merriënboer (Educational Psychology Review, 6:351–371, 1994a), in which the physical learning environment is considered a distinct causal factor that can interact with learner characteristics, learning-task characteristics, or a combination of both. Previous research into effects of the physical learning environment on cognitive performance that could

inspire new cognitive load research is discussed, and a future research agenda is sketched.", (p. 225).

Dori, Y. J., Avargil, S., Kohen, Z., & Saar, L. (2018). Context-based learning and metacognitive prompts for enhancing scientific text comprehension. *International Journal of Science Education, 40*(10), 1198–1220. https://doi.org/10.1080/09500693.2018.1470351

From the abstract: "Context-based learning (CBL), promoting students' scientific text comprehension, and fostering metacognitive skills, plays an important role in science education. Our study involves CBL through comprehension and analysis of adapted scientific articles. We developed a module which integrates metacognitive prompts for guiding students to monitor their understanding and improve their scientific text comprehension. We investigated the effect of these metacognitive prompts on scientific text comprehension as part of CBL in chemistry. About 670 high school chemistry students were randomly divided into three groups exposed to high- and low-intensity CBL. One of the high-intensity groups was also exposed to metacognitive prompts. Research tools included pre- and post-questionnaires aimed at measuring students' conceptual chemistry understanding and metacognitive knowledge in the context of reading strategies, before and after exposure to the CBL. Chemistry understanding was reflected by students' ability to identify the main subject of the adapted article and by explaining concepts both textually and visually. We found that high-intensity CBL combined with metacognitive prompts improved students' chemistry understanding of the adapted scientific articles and the ability to regulate their learning. Our study establishes that reading context-based adapted scientific articles advances students' conceptual chemistry understanding. These gains are strongly amplified by domain-specific metacognitive prompts", (p. 1198).

Hsu, Y.-S., & Lin, S.-S. (2017). Prompting students to make socioscientific decisions: Embedding metacognitive guidance in an e-learning environment. *International Journal of Science Education, 39*(7), 964–979. https://doi.org/10.1080/09500693.2017.1312036

From the abstract: "This study aimed at improving the decision-making (DM) skills of 11th graders by incorporating a DM framework, visualisation tools, collaboration, and metacognitive guidance into a socioscientific issue context. Two classes, the experimental group (embedded metacognitive guidance, N = 42) and the comparison group (no metacognitive guidance, N = 32), were involved in the implementation of the experimental methodology. An open-ended test and worksheets were developed to assess the students' DM skills. The results indicated that the two versions of the DM learning modules had similar effects on the improvement in the students' DM skills, but there were significant differences in their overall skills in DM (Z =−6.410, p Z = −6.956, p Z = −2.533, p < .011) based on the student responses on the worksheets. These findings indicate that further studies need to explore the mechanism of metacognitive guidance for students with different socioscientific issue DM skills in e-learning environments", (p. 964).

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist,* 38(1), 1-4. https://doi.org/10.1207/S15326985EP3801_1

From the abstract: "Cognitive load theory (CLT) originated in the 1980s and underwent substantial development and expansion in the 1990s by researchers from around the globe. As the articles in this special issue demonstrate, it is a major theory providing a framework for investigations into cognitive processes and instructional design. By simultaneously considering the structure of information and the cognitive architecture that allows learners to process that information, cognitive load theorists have been able to generate a unique variety of new and sometimes counterintuitive instructional designs and procedures.", (p. 1).

Nieto-Márquez, N. L., Baldominos, A., & Pérez-Nieto, M. Á. (2020). Digital teaching materials and their relationship with the metacognitive skills of students in primary education. *Education Sciences*, *10*(4), 1–18. https://doi.org/10.3390/educsci10040113

From the abstract: "Metacognition is a construct that is noteworthy for its relationship with the prediction and enhancement of student performance. It is of interest in education, as well as in the field of cognitive psychology, because it contributes to competencies, such as learning to learn and the understanding of information. This study conducted research at a state school in the Community of Madrid (Spain) with a sample of 130 students in Grade 3 of their primary education (8 years old). The research involved the use of a digital teaching platform called Smile and Learn, as the feedback included in the digital activities may have an effect on students' metacognition. We analyzed the implementation of the intelligent platform at school and the activities most commonly engaged in. The Junior Metacognitive Awareness Inventory (Jr. MAI) was the measuring instrument chosen for the external evaluation of metacognition. The study's results show a higher use of logic and spatial activities. A relationship is observed between the use of digital exercises that have specific feedback and work on logic and visuospatial skills with metacognitive knowledge. We discuss our findings surrounding educational implications, metacognition assessment, and recommendations for improvements of the digital materials", (p. 1).

Tachie, S. A. (2019). Meta-cognitive skills and strategies application: How this helps learners in mathematics problem-solving. *Eurasia Journal of Mathematics, Science & Technology Education*, *15*(5), 1–12. https://doi.org/10.29333/ejmste/105364

From the abstract: "Learners' problem-solving in mathematics is often problematic for both the learners and teachers and this needs to be addressed by applying relevant skills and strategies in the teaching and learning of mathematics. Meta-cognitive skills and strategies acquisition is vital for a learner's academic success and particularly in mathematics problem-solving. The paper investigates the relevance of learners' use of metacognitive skills and strategies in mathematics problem-solving. A qualitative approach was used, including a case-study design; observation and semi-structured interviews were used to collect data. Four rural schools, four mathematics teachers and four learners from different schools (one from each school) were selected for the study. Content analysis was used to analyze the data together with verbal quotes that supported themes that emerged. The aim was to obtain condensed and broad descriptions of the phenomena. The findings revealed that learners' use of metacognitive skills and strategies, such as task analysis, planning, monitoring, checking and reflection, self and group-monitoring skills, reading and writing skills, self-regulation skills (SR) and self-assessment (SA) helped them in mathematics problem-solving. The learners could also solve problems more easily through group discussions and thinking about their own thinking. Recommendations were made to

benefit learners and further improve their use of meta-cognition for successful problem-solving", (p. 1).

Tian, Y., Fang, Y., & Li, J. (2018). The effect of metacognitive knowledge on mathematics performance in self-regulated learning framework—Multiple mediation of self-efficacy and motivation. *Frontiers in Psychology, 9.* **https://doi.org/10.3389/fpsyg.2018.02518**

*From the abstract: "*Metacognition, self-efficacy, and motivation are important components of interaction in self-regulated learning (SRL). However, the psychological mechanism underlying the association among them in mathematical learning remained ambiguous. The present study investigated whether the relationship between metacognitive knowledge (MK) and mathematics performance can be mediated by self-efficacy and motivation. The sample comprised 569 students (245 male, Mage = 16.39, SD = 0.63) of Grade 10 in China. The MK in mathematics questionnaire, the self-efficacy questionnaire, the academic motivation scale, Raven advanced progressive matrix, and mathematics tests were used for data collection. Our results suggested that the mathematics performance could be predicted by MK, self-efficacy and intrinsic motivation. Moreover, the association between MK and mathematics performance was mediated by self-efficacy and intrinsic motivation, as revealed by a multiple mediation analysis. Additionally, there were sex differences in MK, self-efficacy and intrinsic motivation. The findings highlight the psychological mechanism in the mathematics of Chinese students and will help teachers to improve students' mathematical learning in SRL framework more effectively. Implications for education and further studies are discussed", (p. 1).

van Gog, T., Kester, L., & Paas, F. (2011). Effects of worked examples, example-problem, and problem-example pairs on novices' learning. *Contemporary Educational Psychology, 36*(3), 212-218.** https://psycnet.apa.org/doi/10.1016/j.cedpsych.2010.10.004

*From the abstract: "*Research has demonstrated that instruction that relies more heavily on example study is more effective for novices' learning than instruction consisting of problem solving. However, 'a heavier reliance on example study' has been implemented in different ways. For example, worked examples only (WE), example-problem pairs (WE-PS), or problem-example pairs (PS-WE) have been used. This study investigated the effectiveness of all three strategies compared to problem solving only (PS), using electrical circuits troubleshooting tasks; participants were secondary education students who were novices concerning those tasks.

Based on prior research, it was hypothesized and confirmed that WE and WE-PS would lead to lower cognitive load during learning and higher learning outcomes than PS. In addition, the open questions of whether there would be any differences between WE and WE-PS, and whether there would be any differences between PS-WE and PS were explored. Results showed no differences between WE and WE-PS or between PS-WE and PS. This study can inform instructional designers on which example-based learning strategies to implement: it does not seem necessary to alternate example study and problem solving, but when doing so, example-problem pairs should be used rather than problem-example pairs", (p. 212).

Vettori, G., Vezzani, C., Bigozzi, L., & Pinto, G. (2018). The mediating role of conceptions of learning in the relationship between metacognitive skills/strategies and academic outcomes among middle-school students. *Frontiers in Psychology, 9.* **https://doi.org/10.3389/fpsyg.2018.01985**

*From the abstract: "*This study investigated the mediating role of conceptions of learning in the relationship between metacognitive skills/strategies and academic outcomes among middle-school students. The self-report "Learning Conceptions Questionnaire" (LCQ) and "Metacognitive questionnaire on the method of study" (QMS—in Italian) were administered to 136 middle-school students and their academic outcomes were collected. Correlation analyses revealed that within metacognitive skills/strategies only self-assessment was positively correlated with academic outcomes. Mediation analysis indicated that a conception of learning as internal attribution of success and failure was significantly involved as mediator in the relationship between metacognitive skills/strategies and academic outcomes. This study permitted to advance our knowledge about the relationship between metacognitive skills/strategies and academic outcomes and it has opened the way to practical implications", (p. 1).

Zee, M., & de Bree, E. (2017). Students' self-regulation and achievement in basic reading and math skills: The role of student–teacher relationships in middle childhood. *European Journal of Developmental Psychology*, *14*(3), 265–280. https://doi.org/10.1080/17405629.2016.1196587

*From the abstract: "*In this study, we explored both direct and indirect contributions of students' perceptions of the student–teacher relationship quality (i.e., closeness and conflict) to domains of self-regulation (i.e., task-orientation and metacognition) and basic reading and math skills (i.e., timed word reading and math performance) in middle childhood. Participants were 370 third-to-fifth graders from different regular elementary classrooms across the Netherlands.

Using structural equation modelling, evidence was found for positive direct associations between student-perceived closeness and both domains of self-regulation, and a negative direct association between student-perceived conflict and task-orientation. However, indirect associations of closeness and conflict with students' achievement in basic math and reading skills, through task-orientation and metacognition, could not be established. These results suggest that students' perceptions of the relationship quality, and closeness in particular, may be especially important for their ability to regulate motivational and cognitive aspects of their own learning", (p. 265).

Self-regulated Learning

Al-Abdullatif, A. M. (2020). Investigating self-regulated learning and academic achievement in an eLearning environment: The case of K-12 flipped classroom. *Cogent Education*, *7*(1), 1835145. https://doi.org/10.1080/2331186X.2020.1835145

*From the abstract: "*This study aimed to investigate the impact of a flipped classroom on the self-regulated learning (SRL) and academic achievement of seventh-grade junior high school students. A quantitative approach was used to compare the traditional and flipped classroom approaches. The data were obtained using the Motivated Strategies for Learning Questionnaire (MSLQ) along with students achievement scores. Cognitive learning strategies and metacognitive self-regulation strategies were investigated as indicators of students SRL strategies. The results indicated that 64 seventh-grade participants demonstrated a good-to-high level of practicing SRL within the flipped classroom environment. Moreover, the student participants appeared to self-regulate their metacognitive learning strategies in the flipped

classroom environment more than those in the traditional learning environment. In terms of their academic achievement, no statistically significant difference was detected between the traditional and flipped classrooms. Associations between the students SRL and academic achievement were identified, and several implications and recommendations were derived", (p. 1).

Alvi, E., & Gillies, R. M. (2020). **A case study of a grade 7 teacher's perspectives and practices related to self-regulated learning (SRL).** *Asia-Pacific Journal of Teacher Education*, *48*(2), 147–167. https://doi.org/10.1080/1359866X.2018.1542663

*From the abstract: "*This paper presents an in-depth case study of how a Grade 7 teacher, supported students' self-regulated learning (SRL) by highlighting her perspectives and classroom practices. Under the influence of social cognitive theory, we drew on the self-regulated strategy development (SRSD) model by Harris and Graham to frame the teacher's approach. Data reveal that the teacher emphasized the process of learning, giving a clear vision of goals, in order to support students' SRL. We document the components involved in the teacher's approach which include: developing the context for learning and tuning in, brainstorming, focused and explicit teaching, extending learning, evaluating, and developing advanced cognitive networks for linking understanding and new ideas. We describe these components in detail to be of use to educators and practitioners. We conclude that a teacher may employ different practices to support students' SRL within a real-life classroom", (p. 147).

Alvi, E., & Gillies, R. M. (2021). **Investigating the individual nature of teacher beliefs and practices about self-regulated learning and how this shapes their practices for supporting student learning.** *Educational Studies*, 1–23. https://doi.org/10.1080/03055698.2021.1966757

*From the abstract: "*This paper examines the teacher's role in developing students' self-regulated learning (SRL) by examining the beliefs and practices of one primary school teacher. The paper then describes how the teacher applied these in her classroom and how students benefitted.

Data were collected via interviews, classroom observations, and informal conversations. Findings suggest that although the teacher held positive beliefs that emphasise behavioural, cognitive, and motivated components of SRL, there was less focus on meta-cognition and strategic actions. Nonetheless, classroom observation data revealed that the teacher actively engaged students in meta-cognition and strategic actions. This implies that the teacher had an implicit understanding of her emphasis on these important components of SRL. It also shows that the teacher's SRL-supportive beliefs and practices were not well-aligned. We believe that a more candid cognisance of meta-cognition and strategic actions may help teachers to directly promote SRL. The study has implications for teacher education and professional development programmes", (p. 1).

Andrade, H. L., & Brookhart, S. M. (2020). **Classroom assessment as the co-regulation of learning.** *Assessment in Education: Principles, Policy & Practice*, *27*(4), 350–372. https://doi.org/10.1080/0969594X.2019.1571992

*From the abstract: "*Until recently, the classroom assessment literature has emphasized the role of teachers and tests, for example investigating teachers' assessment practices or the quality of classroom tests and other assessments. In contrast, current understandings of teaching and

learning emphasize the role of students, as well as the complex interactions between teachers, students, and contexts. We use the literature review method to give substance to a theory of classroom assessment as the co-regulation of learning by teachers, students, instructional materials, and contexts. We organize the literature using a version of Pintrich and Zusho's theory of the phases and areas of the self-regulation of learning, expanded to include the co-regulation of learning, in order to demonstrate how classroom assessment is related to all aspects of the regulation of learning. We conclude that this is a useful expansion for the field", (p. 350).

Baars, M., Leopold, C., & Paas, F. (2018). Self-explaining steps in problem-solving tasks to improve self-regulation in secondary education. *Journal of Educational Psychology*, *110*(4), 578–595. **https://doi.org/10.1037/edu0000223**

From the abstract: "The ability to learn in a self-regulated way is important for adolescents' academic achievements. Monitoring one's own learning is a prerequisite skill for successful self- regulated learning. However, accurate monitoring has been found to be difficult for adolescents, especially for learning problem-solving tasks such as can be found in math and biology. This study investigated whether a self-explaining strategy, which has been found effective for improving monitoring accuracy in learning from text, can improve monitoring and regulation-choice effectiveness, and problem-solving performance in secondary biology education. In 2 experiments, one half of the participants learned to solve biology problems by studying video-modeling examples, and the other one half learned by giving step-by-step self-explanations following the video-modeling examples (Experiment 1) or by following the posttest problem-solving tasks (Experiment 2). Results showed that in contrast to earlier studies, self-explaining did not improve monitoring and regulation-choice effectiveness.

However, the quality of self-explanations was found to be related to monitoring accuracy and performance. Interestingly, the complexity of the problem-solving tasks affected monitoring and regulation-choice effectiveness, and problem-solving performance. These results are discussed in relation to the cognitive demands that monitoring and regulating learning to solve problems combined with self-explaining pose on learners", (p. 578).

Callan, G. L., Rubenstein, L. D., Ridgley, L. M., Speirs Neumeister, K., & Hernández Finch, M. E. (2021). Self-regulated learning as a cyclical process and predictor of creative problem-solving. *Educational Psychology*, *41*(9), 1139–1159. **https://doi.org/10.1080/01443410.2021.1913575**

From the abstract: "This study used structured interviews to examine cyclical relations among self-regulated learning (SRL) processes before (forethought), during (performance), and after (self-reflection) engagement with a creative problem-solving (CPS) task. Theoretically, forethought influences performance, which subsequently influence self-reflection. We examined three forethought processes (self-efficacy, interest, & strategic planning), one performance process (strategy use), and one self-reflection process (self-evaluation). Strategic planning predicted strategy use during the task; however, strategy use did not predict self-evaluation. Contrary to assumptions that strategy use during the CPS task would be the best predictor of self-evaluation, self-efficacy before engagement best predicted self-evaluation. We also investigated the predictive relationships between SRL and four CPS outcomes including the number of ideas (fluency), number of ideas types (flexibility), idea uniqueness (originality),

and idea usefulness (usefulness). Self-efficacy and strategy use predicted fluency and flexibility whereas interest predicted the originality of ideas. No variables predicted idea usefulness", (p. 1139).

Chen, J., & Brown, G. T. L. (2018). Chinese secondary school students' conceptions of assessment and achievement emotions: Endorsed purposes lead to positive and negative feelings. *Asia Pacific Journal of Education*, *38*(1), 91–109. https://doi.org/10.1080/02188791.2018.1423951

*From the abstract: "*Student perceptions of the purposes of assessment have been shown to be significant predictors of self-regulated learning. Their relationship to achievement emotions is less well understood. This paper reports a survey study of Chinese middle and high school students (N = 1,393) self-reported conceptions of the purpose of assessment and their achievement emotions using inventories with previously developed Chinese versions. While pre-existing models were not replicated, exploratory techniques developed well-fitting measurement models for each inventory and a structural equation model showed that significant variance in achievement emotions was elicited by certain beliefs about assessment. Positive emotions of pride and enjoyment depended primarily on conceptions that assessment

(1) contributed to student moral and skill development, (2) was accurate, and (3) was not for evaluating schools or teachers. Negative emotions of anger and shame depended primarily on conceptions that assessment was (1) for evaluating schools and teachers and (2) not for improving teaching and learning. Thus, student emotional responses to assessment in China logically depend on beliefs that assessment reliably relates to developing their own learning, skills, and moral character", (p. 91).

Cleary, T. J., Velardi, B., & Schnaidman, B. (2017). Effects of the self-regulation empowerment program (SREP) on middle school students' strategic skills, self- efficacy, and mathematics achievement. *Journal of School Psychology*, *64*, 28–42. https://doi.org/10.1016/j.jsp.2017.04.004

*From the abstract: "*The current study examined the effectiveness of an applied self-regulated learning intervention (Self-Regulation Empowerment Program (SREP)) relative to an existing, school-based remedial mathematics intervention for improving the motivation, strategic skills, and mathematics achievement of academically at-risk middle school students. Although significant group differences in student self-regulated learning (SRL) were not observed when using self-report questionnaires, medium to large and statistically significant group differences were observed across several contextualized, situation-specific measures of strategic and regulatory thinking. The SREP group also exhibited a statistically significant and more positive trend in achievement scores over two years in middle school relative to the comparison condition. Finally, SREP students and coaches reported SREP to be a socially-valid intervention, in terms of acceptability and importance. The importance of this study and critical areas for future research are highlighted and discussed", (p. 28).

De Smul, M., Heirweg, S., Devos, G., & Van Keer, H. (2019). School and teacher determinants underlying teachers' implementation of self-regulated learning in primary education. *Research Papers in Education*, *34*(6), 701–724. https://doi.org/10.1080/02671522.2018.1536888

From the abstract: "Teaching students how to regulate their own learning has become a popular innovative practice in primary education. However, not much is known about how teacher as well as school characteristics enhance students' self-regulated learning (SRL). This study explores whether schools differ in the way they implement SRL and what factors at the school and teacher level are related to successful classroom implementation of SRL. Survey data was gathered from 331 teachers in 44 primary schools. A comprehensive theoretical model, identifying determinants on teacher and school level related to teachers' SRL implementation, was tested using structural equation modelling. Results indicate that teachers' beliefs and teacher self-efficacy are strongly related to SRL implementation. At the school level, the importance of a shared SRL vision and the engagement of teachers in reflective dialogue are highlighted with implications for the role of the school leader. Recommendations for future research and considerations for teachers' educational practice are discussed", (701).

Gidalevich, S., & Kramarski, B. (2019). The value of fixed versus faded self-regulatory scaffolds on fourth graders' mathematical problem solving. *Instructional Science, 47*(1), 39–68. https://doi.org/10.1007/s11251-018-9475-z

From the abstract: "Research has indicated that students can be taught self-regulated learning (SRL) in scaffolding programs focusing on a fixed continuous practice (e.g., metacognitive question prompts). However, the fading role of scaffolding to prepare autonomous learning is often an overlooked component. A unique approach for fading is suggested that offers a graduated reduction model of scaffolding prompts according to the SRL phases involved in the solution, which allows assimilation of processes to prepare learners for autonomous activity.

This quasi-experimental study of fourth-graders (n = 134) examines the effectiveness of metacognitive self-question prompts in a Fixed (continuous) versus Faded (graduated reduction) scaffolds model during planning, monitoring and reflection phases, on the facilitation of students' SRL (metacognition, calibration of confidence judgment, motivation), and sense making of mathematical problem solving at the end of the program (short-term effect) and 3 months later (long-term/lasting effect). Findings indicated that the Faded Group performed best in the metacognition knowledge aspect, motivation in the performance goal approach increased and, in the avoidance, goal decreased. No differences were found between the groups on the regulation aspect and calibration of confidence judgment in the solution success. Additionally, the Faded Group outperformed the Fixed Group on sense making of problem solving. These findings were manifested particularly in the long-term effect. The study supports theoretical claims relating the role of fading scaffolds to increase students' autonomous SRL (metacognition, motivation) and improvements in sense making, particularly on the long-term retention effect", (p. 39).

Grothérus, A., Jeppsson, F., & Samuelsson, J. (2019). Formative scaffolding: How to alter the level and strength of self-efficacy and foster self-regulation in a mathematics test situation. *Educational Action Research, 27*(5), 667–690. https://doi.org/10.1080/09650792.2018.1538893

From the abstract: "The aim of the present study is to advocate the use of a participatory action research programme, the Formative Scaffolding Programme (FSP), in mathematics. The FSP's main structure is presented as well as an implementation of a class intervention, with the aim of exploring the FSP test cycle's virtues in a social science class in a Swedish upper-secondary

school. The motivations for the FSP's development were to enhance students' awareness of their mathematical proficiency, alter the level and strength of their self-efficacy, foster self-regulated learning (SRL), reduce and prevent mathematics-related anxiety, and visualise the learning process in mathematics. The primary findings of the study were there was a resemblance between the FSP setting and SRL phases, and that participation in the test cycle altered the level and strength of students' self-efficacy and fostered self-regulation in a mathematics test situation. The benefits of working in a formative scaffolding manner indicate that it is worth implementing the FSP on a larger scale. The study is an example of how students can engage in transforming classroom practice and be radical agents of change", (p. 667).

Gu, P., & Lee, Y. (2019). Promoting students' motivation and use of SRL strategies in the web-based mathematics learning environment. *Journal of Educational Technology Systems*, *47*(3), 391–410. https://doi.org/10.1177/0047239518808522

From the abstract: "Compared with classroom learning, online learning requires students to self-regulate their learning processes and to maintain their motivation to achieve their learning goals. This study investigated whether the interventions based on the Attention, Relevance, Confidence, and Satisfaction model and the modified Introducing the new concepts, Metacognitive questioning, Practicing, Reviewing and reducing difficulties, Obtaining mastery, Verification, and Enrichment method can promote students' motivation and use of self-regulated learning (SRL) strategies in a web-based mathematics learning environment. Two-hundred thirty-six Chinese high school students were randomly divided into four groups: motivational design group, SRL intervention group, motivational design and SRL intervention group, and the control group. Questionnaires and tests were administered to measure the changes in motivation, use of SRL strategies, and academic gains before and after the respective interventions. Findings of this study suggest that the knowledge gain of students learning mathematics online can be maximized when they receive instructional assistance in both motivation and use of SRL strategies", (p. 391).

Harding, S.-M., English, N., Nibali, N., Griffin, P., Graham, L., Alom, B., & Zhang, Z. (2019). Self-regulated learning as a predictor of mathematics and reading performance: A picture of students in grades 5 to 8. *Australian Journal of Education*, *63*(1), 74–97. https://doi.org/10.1177/0004944119830153

From the abstract: "Students who can regulate their own learning are proposed to gain the most out of education, yet research into the impact of self-regulated learning skills on performance shows mixed results. This study supports the link between self-regulated learning and performance, while providing evidence of grade- or age-related differences. Australian students from Grades 5 to 8 completed mathematics or reading comprehension assessments and self-regulated learning questionnaires, with each response ranked on a hierarchy of quality. All assessments were psychometrically analysed and validated. In each cohort and overall, higher performing students reported higher levels of self-regulated learning. Still, age-related differences outweighed performance differences, resulting in significantly lower reported usage of self-regulated learning skills in Grade 7 students compared to those in Grades 5, 6 and 8.

These findings suggest that either age or school organisational differences mediate students'

self-regulated learning, counteracting ability-related associations", (p. 74).

Huh, Y., & Reigeluth, C. M. (2018). Online K-12 teachers' perceptions and practices of supporting self-regulated learning. *Journal of Educational Computing Research*, *55*(8), 1129–1153. https://doi.org/10.1177/0735633117699231

*From the abstract: "*With growing interest in and popularity of online learning and lifelong learners, students? ability to be engaged in self-regulated learning (SRL) has become more important. Moreover, online learning is becoming an important feature of K-12 education. Although SRL is known to be important and teachable, little research has been conducted on teachers' practices and perceptions of SRL. Survey responses of 112 teachers who were teaching at K-12 online schools in the United States revealed that they perceived the importance of both their students' SRL and their own responsibility for teaching SRL to their students. However, the survey also showed that their practices for supporting SRL had a narrow focus concentrating on conventional teaching, which may have prevented their students from developing the full range of SRL abilities. Possible solutions, limitations, and implication of the study were also discussed", (p. 1129).

Katsantonis, I. G. (2020). Self-regulated learning and reading comprehension: The effects of gender, motivation and metacognition. *Hellenic Journal of Psychology*, *17*(3), 286–307. https://doi.org/10.26262/hjp.v17i3.7835

*From the abstract: "*The study aimed at determining the effects of aspects of self-regulated learning (SRL) such as metacognition and motivation on reading comprehension. A nationwide, representative sample (N = 6,403) of 15-year-old Greek adolescents was drawn from the PISA 2018 database. The participants' data on metacognitive knowledge of reading strategies, reading task-specific metacognitive experiences, intrinsic motivation, and reading comprehension were selected for subsequent analyses. Multiple-group confirmatory factor analyses were conducted to test gender differences in metacognitive functioning via measurement invariance. Structural equation modeling was also utilized to assess predictive and mediating effects between motivation, metacognition and reading comprehension achievement. Results indicated gender-related individual differences in metacognitive functioning.

Further, structural equation modeling showed that metacognitive experiences, metacognitive knowledge and intrinsic task motivation predicted reading comprehension achievement; however, metacognition mediated the association of intrinsic motivation with reading comprehension achievement. Potential cognitive and educational implications are briefly discussed", (p. 286).

Lai, C.-L., & Hwang, G.-J. (2021). Strategies for enhancing self-regulation in e-learning: A review of selected journal publications from 2010 to 2020. *Interactive Learning Environments*, 1–23. https://doi.org/10.1080/10494820.2021.1943455

*From the abstract: "*Researchers have pointed out the important role of self-regulation in learning. The self-regulated learning (SRL) process consists of three stages (i.e. forethought, performance, and self-reflection), each of which could involve different strategies for achieving the aim of SRL. To enable researchers and teachers to have a whole picture of how each strategy could be applied, this study analyzed the 2010–2020 publications in seven SSCI journals of e-learning. In addition, the correlation between each SRL strategy and students'

learning performances was analyzed. It was found that, in 58% of the studies, the potential strategies for individual SRL stages were generally ignored. In addition, 40% of the studies did not clearly state how SRL could be applied to practical applications. By referring to those SRL studies reporting the use of the strategies in each stage in specific application domains, it was found that goal setting and planning, which highly related to students' learning achievement, has been frequently discussed. Nevertheless, some strategies that highly correlated to students' cognitive performances and affect perceptions, such as environmental structuring, seeking information and rehearsing and memorizing, are often ignored. According to the findings, some suggestions are provided as a reference for researchers to conduct related research", (p. 1).

Lai, C.-L., Hwang, G.-J., & Tu, Y.-H. (2018). The effects of computer-supported self-regulation in science inquiry on learning outcomes, learning processes, and self-efficacy. *Educational Technology Research and Development, 66*(4), 863–892. https://doi.org/10.1007/s11423-018-9585-y

From the abstract: "Recently, researchers have demonstrated the benefits of technology-enhanced science inquiry activities. To improve students' self-regulation and assist them in controlling their own learning pace through inquiry activities, in this study, a self-regulated science inquiry approach was developed to assist them in organizing information from their real-world exploration. A quasi-experimental design was conducted in an elementary school natural science course to evaluate the students' performance using the proposed learning approach.

One class assigned as the treatment group learned with the self-regulated science inquiry approach, while the other class assigned as the control group learned with the conventional science inquiry approach. The students' learning achievement, tendency of information help seeking, tendency of self-regulation, and self-efficacy were evaluated. The results of the study revealed that the self-regulated science inquiry approach improved the students' learning achievement, especially for those students with higher self-regulation. In addition, the students who conducted inquiry with the self-regulated learning strategy increased their tendency of information help seeking, self-efficacy, and several aspects of self-regulation, including time management, help seeking, and self-evaluation. Accordingly, this study demonstrated the effectiveness of the self-regulated learning strategy, an approach with high learner control, in terms of improving students' learning achievement and their self-regulation", (p. 863).

Lau, K. (2020). The effectiveness of self-regulated learning instruction on students' classical Chinese reading comprehension and motivation. *Reading and Writing: An Interdisciplinary Journal, 33*(8), 2001–2027. https://doi.org/10.1007/s11145-020-10028-2

From the abstract: "In this study, an intervention program was designed based on the instructional principles of self-regulated learning (SRL), and its effectiveness in enhancing Hong Kong secondary three students' classical Chinese (CC) reading comprehension and motivation was evaluated. A pretest–posttest treatment–control group quasi-experimental design was used. During the study, 191 students between the ages of 13 and 16 years were assigned to three groups and received different treatments: in the experimental group (EG), teachers implemented all the instructional practices designed based on SRL instructional principles in the intervention package; in the control group (CG1), teachers used the traditional

teacher-centered approach to teach the same instructional materials from the intervention program; and in the baseline control group (CG2), teachers adopted traditional teacher-centered, text-based instruction to teach the CC texts in students' original textbook. Reading comprehension tests, questionnaires, and interviews were used to evaluate the effectiveness of the intervention. The findings indicated that the EG and CG1 students had significantly better CC reading comprehension performance and prior knowledge than the CG2 students. The EG students also showed positive attitudes towards the intervention program. Implications of the findings are discussed to provide insights into the potential applicability of SRL instruction in the Chinese context", (p. 2001).

Long, Y., & Aleven, V. (2017). Enhancing learning outcomes through self-regulated learning support with an open learner model. *User Modeling and User-Adapted Interaction*, *27*(1), 55–88. https://doi.org/10.1007/s11257-016-9186-6

From the abstract: "Open Learner Models (OLMs) have great potential to support students' Self-Regulated Learning (SRL) in Intelligent Tutoring Systems (ITSs). Yet few classroom experiments have been conducted to empirically evaluate whether and how an OLM can enhance students' domain level learning outcomes through the scaffolding of SRL processes in an ITS. In two classroom experiments with a total of 302 7th- and 8th-grade students, we investigated the effect of (a) an OLM that supports students' self-assessment of their equation-solving skills and (b) shared control over problem selection, on students' equation-solving abilities, enjoyment of learning with the tutor, self-assessment accuracy, and problem selection decisions. In the first, smaller experiment, the hypothesized main effect of the OLM on students' learning outcomes was confirmed; we found no main effect of shared control of problem selection, nor an interaction. In the second, larger experiment, the hypothesized main effects were not confirmed, but we found an interaction such that the students who had access to the OLM learned significantly better equation-solving skills than their counterparts when shared control over problem selection was offered in the system. Thus, the two experiments support the notion that an OLM can enhance students' domain-level learning outcomes through scaffolding of SRL processes, and are among the first in-vivo classroom experiments to do so. They suggest that an OLM is especially effective if it is designed to support multiple SRL processes", (p. 55).

National Academies of Sciences, Engineering, and Medicine. (2018). How people learn II: Learners, contexts, and cultures. *The National Academies Press.* https://doi.org/10.17226/24783

From the introduction: "There are many reasons to be curious about the way people learn, and the past several decades have seen an explosion of research that has important implications for individual learning, schooling, workforce training, and policy. How People Learn II: Learners, Contexts, and Cultures provides a much-needed update incorporating insights gained from this research over the past decade. The book expands on the foundation laid out in the 2000 report and takes an in-depth look at the constellation of influences that affect individual learning.

How People Learn II will become an indispensable resource to understand learning throughout the lifespan for educators of students and adults.", (p. ix).

Pellerin, M. (2018). Affordances of new mobile technologies: Promoting learner agency,

autonomy, and self-regulated learning. *Journal of Interactive Learning Research*, *29*(3), 343–358. https://www.learntechlib.org/primary/p/184758/

*From the abstract: "*This article examines the complexity of the affordances that mobile technologies offer in the K-12 educational context. It builds on an ecological perspective (Mercer, 2012; van Lier, 2008) informed by theories of dynamic systems and complexity (Larsen-Freeman & Cameron, 2008) to explore the concept of affordance as a complex and dynamic system. The article is based on data that are part of larger inquiry project regarding the use of iPods and iPads by young language learners in K-12 French Immersion classrooms. The findings indicated the concept of affordance involves interplay between the technological affordances of the mobile devices; the learning environment, which includes the physical and social space as well as the pedagogical practices endorsed; and the learners' physical, social, cognitive, and metacognitive behaviors. The article is intended to provoke a paradigm shift in perceptions of the affordances of mobile technologies and their impacts on the learning process in the K-12 educational context. More specifically, it argues physical affordances of the mobile devices, by themselves, do not transform the nature of learning or the learning process", (p. 343).

Rutherford, T., Buschkuehl, M., Jaeggi, S. M., & Farkas, G. (2018). Links between achievement, executive functions, and self-regulated learning. *Applied Cognitive Psychology*, *32*(6), 763–774. https://doi.org/10.1002/acp.3462

*From the abstract: "*Student self-regulated learning (SRL) is theorized to draw upon cognitive resources such as executive functions (EF) in support of planning, monitoring, and control processes in the service of academic goals. Prior work has demonstrated connections between direct measures of EF and reports of regulation behaviors, but this has not been frequently extended using an SRL framework to classroom behaviors and resulting school achievement. We find relations between inhibition and shifting elements of EF and teacher reports of SRL and links between both and student achievement on standardized tests and classroom grades in mathematics and language arts. We also find that links between EF and math achievement are partially mediated through SRL. Our results suggest that aspects of EF can support or may be a bottleneck for SRL and thus academic achievement, and as such, they have implications for cognitive and educational interventions", (p. 763).

So, W. W. M., Chen, Y., & Wan, Z. H. (2019). Multimedia e-learning and self-regulated science learning: A study of primary school learners' experiences and perceptions. *Journal of Science Education and Technology*, *28*(5), 508–522. https://doi.org/10.1007/s10956-019-09782-y

*From the abstract: "*Multimedia-supported e-learning is considered useful as it can offer an enjoyable independent learning experience to learners. However, the effectiveness of e-learning for self-regulated science learning is still inconclusive. This study aimed to explore primary school students' perceptions and experiences of self-regulated science learning in a multimedia-supported e-learning environment. A total of 11 classes from grades 3 to 6 from four Hong Kong schools participated in this study. All e-learning lessons were observed, and 33 (3 from each class) were interviewed using cognitive walkthroughs of how they made use of the multimedia resources and system tools, scaffolds, or prompts to direct their own learning in each of the three self-regulated learning phases (forethought, performance, and reflection).

Results revealed that the combined use of the discussion forum and statistics table seemed to facilitate the students' diagnosis of their prior knowledge of natural phenomena in the forethought phase. In the performance phase, the students mostly enjoyed learning with the graphic data, animations, and/or simulation experiments. Some perceived the prompts or tools from the e-learning system as useful for operation and science learning. In the reflection phase, the students self-assessed their learning using quizzes with emoticons as positive feedback which seemed to increase their enthusiasm for learning science. However, not all students were able to effectively use the system tools or prompts, to keep focused self-discipline, or to achieve deeper science learning without the teacher's guidance. Hence, this study suggests providing more opportunities for students' exposure to e-learning resources, while at the same time assisting them in the use of digital tools or resources, in adjusting their learning strategies, and in internalizing scientific ideas and inquiry processes so as to ensure more effective self-regulated science learning", (p. 508).

Thomas, V., Peeters, J., De Backer, F., & Lombaerts, K. (2022). Determinants of self-regulated learning practices in elementary education: A multilevel approach. *Educational Studies*, *48***(1), 126–148.** https://doi.org/10.1080/03055698.2020.1745624

From the abstract: "Research indicated overwhelmingly the desirability of self-regulated learning (SRL) in elementary education and the role of teachers therein. Specifically, revealing correlates of teachers' engagement in SRL classroom activities is desirable. The study's main aim is to identify teacher and school mechanisms that facilitate or impede elementary teachers in introducing SRL practices. Teacher-reported data from 591 teachers were used in a multilevel random-effects model in order to consider the clustered structure of teachers within schools. The model was built in four steps mapping the role of different teacher and school mechanisms. Results indicate teacher-level components to be most important. Teachers' developmental beliefs about education, their orientation towards SRL in elementary education, and the nature of previous experiences with autonomous learning, significantly correlate with teachers' self-reported SRL promotion. However, a small proportion is still related to school differences. Only school policy concerning SRL was identified as a significant correlate of SRL promotion", (p. 126).

Tian, Y., Fang, Y., & Li, J. (2018). The effect of metacognitive knowledge on mathematics performance in self-regulated learning framework—Multiple mediation of self-efficacy and motivation. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.02518

From the abstract: "Metacognition, self-efficacy, and motivation are important components of interaction in self-regulated learning (SRL). However, the psychological mechanism underlying the association among them in mathematical learning remained ambiguous. The present study investigated whether the relationship between metacognitive knowledge (MK) and mathematics performance can be mediated by self-efficacy and motivation. The sample comprised 569 students (245 male, Mage = 16.39, SD = 0.63) of Grade 10 in China. The MK in mathematics questionnaire, the self-efficacy questionnaire, the academic motivation scale, Raven advanced progressive matrix, and mathematics tests were used for data collection. Our results suggested that the mathematics performance could be predicted by MK, self-efficacy and intrinsic motivation. Moreover, the association between MK and mathematics performance was mediated by self-efficacy and intrinsic motivation, as revealed by a multiple mediation analysis.

Additionally, there were sex differences in MK, self-efficacy and intrinsic motivation. The findings highlight the psychological mechanism in the mathematics of Chinese students and will help teachers to improve students' mathematical learning in SRL framework more effectively. Implications for education and further studies are discussed", (p. 1).

Voskamp, A., Kuiper, E., & Volman, M. (2020). Teaching practices for self-directed and self-regulated learning: Case studies in Dutch innovative secondary schools. *Educational Studies*, **1–18.** https://doi.org/10.1080/03055698.2020.1814699

*From the abstract: "*Although self-directed learning is considered important in both educational practice and theory as a 21st century skill and as a means to motivate students, most teachers find it difficult to integrate self-directed learning into their practice. An instrumental case study was conducted to investigate how teachers at four innovative Dutch secondary schools define self-directed learning and how they try to enhance it in their students. Special attention was paid to how the teachers dealt with differences in students' ability in self-directed learning. It was found that the teachers' definitions of self-directed learning varied from students working independently (which seemed closer to the concept of self-regulation) to students making decisions about learning goals and content. Methods used to enhance self-directed learning varied from clear instruction and well-organised learning materials to having students carry out self-designed projects. Teachers' ways of dealing with differences depended on their schools' interpretation of self-directed learning", (p. 1).

Wilburne, J. M., & Dause, E. (2017). Teaching self-regulated learning strategies to low-achieving fourth-grade students to enhance their perseverance in mathematical problem solving. *Investigations in Mathematics Learning*, *9*(1), 38–52. https://doi.org/10.1080/19477503.2016.1245036

*From the abstract: "*This study's purpose was to determine the effect of instruction in self-regulated learning (SRL) strategies on low-achieving fourth-grade students' perseverance in solving mathematics problems. This study was conducted with fourth-grade students who had been ability-grouped based on prior low achievement and testing data in math. Students were instructed in self-monitoring and goal setting. Students' progress in perseverance was evaluated based on their self-reporting of goals, concentration, and confidence on an Experience Sampling Form (ESF). Student work samples were examined for attempts to understand the problem, strategy choice, and solution accuracy. In this article, we argue that perseverance can be supported and learned by teaching students goal-setting and self-monitoring skills. The trends and changes identify areas for further research as well as suggest a focus for continued instruction", (p. 38).

van Alten, D. C. D., Phielix, C., Janssen, J., & Kester, L. (2020). Effects of self-regulated learning prompts in a flipped history classroom. *Computers in Human Behavior*, *108*. https://doi.org/10.1016/j.chb.2020.106318

*From the abstract: "*Flipping the classroom (FTC) is a didactical approach aimed at letting students come to class prepared and apply the learning material actively during class. As FTC places a higher demand on students' self-regulated learning (SRL) skills, our goal in the current study was to research the effects of SRL support in a flipped classroom on students' SRL (self-reports and online activities) and learning outcomes. Previous research showed that video

embedded SRL prompts enhances students' SRL and learning outcomes. We measured the effects of SRL prompts with a quasi-experimental design in six flipped History classrooms in secondary education where 154 students were randomly assigned to the SRL prompts or no SRL prompt condition. We found positive effects of the SRL prompts for the completion rate of the instructional videos (i.e., students in the SRL prompts condition watched more videos), but not for other indicators of SRL or learning outcomes. Thus, in contrast to previous research from higher education, our results show that implementing SRL prompts in a flipped classroom is not directly effective in secondary education. We address potential explanations for the absence of effects of the SRL prompts for theory and practice into SRL support in flipped classrooms", (p. 1).

Yang, T.-C., Chen, M. C., & Chen, S. Y. (2018). **The influences of self-regulated learning support and prior knowledge on improving learning performance.** *Computers & Education*, *126*, 37–52. https://doi.org/10.1016/j.compedu.2018.06.025

*From the abstract: "*Self-regulated learning (SRL) is helpful to students. On the other hand, prior knowledge has great effects on students' self-regulation and learning performance. To this end, this study aimed to examine how high prior knowledge students (HPKs) and low prior knowledge students (LPKs) behaved differently when interacting with a SRL environment. To achieve this aim, we proposed a self-regulated learning support system (SRLSS) for a mathematical course. The results showed that the gap of learning performance between the HPKs and LPKs was removed after a long-term learning process. Moreover, the LPKs and HPKs behaved similarly in the forethought and self-reflection phases but some behavior differences were found in the performance phase, where the LPKs relied on the notes and sought support the dashboard and quiz records while the HPKs did not demonstrate such a tendency. Our results' theoretical and methodological implications and possible applications for further research are also discussed", (p. 37).

Universal Design for Learning

Basham, J. D., Gardner, J. E., & Smith, S. J. (2020). **Measuring the implementation of UDL in classrooms and schools: Initial field test results.** *Remedial and Special Education*, *41*(4), 231–243. https://doi.org/10.1177/0741932520908015

*From the abstract: "*The design, flexibility, and iterative nature that is inherent to Universal Design for Learning (UDL) makes it difficult to consistently measure. With federal policy encouraging the implementation of UDL, there is an increased need for practitioners to reliably measure the occurrence of UDL. The UDL Observation Measurement Tool (UDL-OMT) was developed to measure UDL implementation in classrooms. This article presents the conceptual underpinnings of UDL measurement and the results of an initial field test. Results indicate that the UDL-OMT has good to excellent internal consistency and can characterize differences in UDL implementation across a continuum of settings. Discussion focuses on the reliability of the UDL-OMT and its potential as a formative evaluation tool for practitioners and school-based personnel. Additional considerations include promising research applications and how the nature and context of classroom instructional factors as well as observers' UDL knowledge influence interpretations of observations", (p. 231).

Basham, J. D., Smith, S. J., & Satter, A. L. (2016). **Universal design for learning: Scanning for**

alignment in K–12 blended and fully online learning materials. *Journal of Special Education Technology*, *31*(3), 147–155. https://doi.org/10.1177/0162643416660836

*From the abstract: "*In the process of evaluating online learning products for accessibility, researchers in the Center on Online Learning and Students with Disabilities concluded that most often consultation guides and assessment tools were useful in determining sensory accessibility but did not extend to critical aspects of learning within the Universal Design for Learning (UDL) framework. To help fill this void in assessment, researchers created the UDL Scan tool to examine online learning products alignment to the UDL framework. This article provides an overview of how accessibility has been historically measured and introduces the need to move beyond the traditional understanding of accessibility to a broader UDL-based lens. With this understanding, a UDL Scan tool was developed and validated to investigate the alignment of online learning content to UDL. This article will present the process of development, the validation, and discuss how the measurements provide critical benchmarks for educators and industry as they adopt new online learning systems."*, (p. 147).

Chambers, D., & Coffey, A. (2019). Guidelines for designing middle-school transition using universal design for learning principles. *Improving Schools*, *22*(1), 29–42. https://doi.org/10.1177/1365480218817984

*From the abstract: "*Transition from primary (elementary) to secondary school can be both an exciting and a daunting prospect for young adolescents. Ensuring that students quickly settle into their new secondary school environment is the goal of transition programmes employed by schools. These programmes typically comprise a number of discrete and interrelated initiatives that often commence in the year prior to the move and continue during the initial months in the new school. These activities generally include specific initiatives for both the students and their parents. The needs of both groups are many and varied. It is critical that whatever transition events and strategies are planned, the needs of all students and parents are catered for. In this article the authors propose that the principles of Universal Design for Learning (UDL) may provide a useful basis for the development of transition programmes that address the needs of all participants. UDL is based on three principles which are: multiple means of engagement, multiple means of representation, and multiple means of action and expression. Examples outlining how these principles can be applied before, during and after transition are provided. The authors conclude with the proposition that research be conducted in a variety of cultural contexts and across countries to investigate whether transition programmes based on UDL principles better enable schools to meet the needs of all transitioning students and their parents"*, (p. 29).

Dymond, S. K., Renzaglia, A., Rosenstein, A., Chun, E. J., Banks, R. A., Niswander, V., & Gilson, C. L. (2006). Using a participatory action research approach to create a universally designed inclusive high school science course: A case study. *Research and Practice for Persons with Severe Disabilities*, *31*(4), 293–308. https://doi.org/10.1177/154079690603100403

*From the abstract: "*Case study methodology was used in combination with a participatory action research (PAR) approach to examine the process of redesigning one high school science course to incorporate the principles of Universal Design for Learning (UDL) and to promote access to the general curriculum. The participants included one general education teacher and two

special education teachers. Two sections of the course were targeted for redesign. Each section included students with disabilities (mild, severe) and without disabilities. The redesign process involved changes to the course in the areas of curriculum, instructional delivery/organization of learning environments, student participation, materials, and assessment. Data were collected across one school year through documents, interviews, and focus groups and were analyzed qualitatively using a constant comparative method.", (p. 293).

Edyburn, D. L. (2021). Universal usability and universal design for learning. *Intervention in School and Clinic*, *56*(5), 310–315. https://doi.org/10.1177/1053451220963082

*From the abstract: "*Universal design for learning (UDL) is a construct that first appeared in the literature approximately 20 years ago. Yet, there is little agreement about what UDL looks like in the classroom. The purpose of this article is to assist students, educators, and parents in identifying universal usability designs, behaviors, and tools that reflect the practice of UDL in the classroom. Three types of exemplars are highlighted: platform tools, web-based curricula, and embedded supports. It is argued that knowing what UDL looks like is an essential step in measuring the outcomes of UDL", (p. 310).

Kieran, L., & Anderson, C. (2019). Connecting universal design for learning with culturally responsive teaching. *Education and Urban Society*, *51*(9), 1202– 1216. https://doi.org/10.1177/0013124518785012

*From the abstract: "*Urban students are increasingly diverse in race, culture, language, and background knowledge. Educators must consider how students' differences affect learning and align pedagogies that address this diversity. Universal design for learning (UDL) has provided educators with a framework for differentiation to address learner differences. Using UDL principles without explicitly considering how cultural differences and perspectives affect learning may increase the disparity in student achievement for students of color. Likewise, the same applies to the effect of socioeconomic status or language development on students' preparation for learning in a "typical" school environment. Culturally responsive pedagogies prompt educators to design instruction from the perspective of students' diversity as strengths rather than deficits. Frequently overlooked aspects of culturally responsive pedagogy are compared with the facets of the UDL framework to provide teachers with additional considerations when planning for effective instruction", (p. 1202).

King-Sears, M. E. (2020). Introduction to special series on universal design for learning. *Remedial and Special Education, 41*(4), 191–193. https://doi.org/10.1177/0741932520908342

*From the abstract: "*This special series of *Remedial and Special Education* features four articles about universal design for learning (UDL). One intervention study describes learning outcomes for middle school students with extensive support needs. These students receive schema-based instruction that is further developed, based on students' characteristics, using the UDL guidelines. Another intervention study examines learning outcomes for high school students with and without learning disabilities. Students receive either UDL-based chemistry instruction or "business as usual" instruction, each group in co-taught settings (Study 1). The researchers then identify results for students with learning disabilities who receive the same UDL instruction in a self-contained setting (Study 2). In the third analysis, results from applying

UDL Reporting Criteria to 20 UDL studies are reported. Focusing on practitioners and school-based personnel, the fourth study describes the application of the UDL Observation Measurement Tool in its beginning stages of development. The purpose of this UDL special issue is to consolidate information that can be used to promote and enhance how UDL is operationalized and measured by researchers, practitioners, and other stakeholders.", (p. 191).

King-Sears, M. E., Johnson, T. M., Berkeley, S., Weiss, M. P., Peters-Burton, E. E., Evmenova, A. S., Menditto, A., & Hursh, J. C. (2015). An exploratory study of universal design for teaching chemistry to students with and without disabilities. *Learning Disability Quarterly*, *38*(2), 84–96. https://doi.org/10.1177/0731948714564575

From the abstract: "In this exploratory study, students in four co-taught high school chemistry classes were randomly assigned to a Universal Design for Learning (UDL) treatment or a comparison condition. Each co-teaching team taught one comparison and treatment class. UDL principles were operationalized for treatment: (a) a self-management strategy (using a mnemonic, IDEAS) for the multi-step mole conversion process; (b) multi-media lessons with narration, visuals, and animations; (c) procedural facilitators with IDEAS for conversion support; and (d) student workbooks mirroring video content and containing scaffolded practice problems. All students completed a pre-test, post-test, and a 4-week delayed post-test. There were no significant differences between conditions; however, there was an interaction effect between students with and without disabilities for post-tests. Social validity indicated students found IDEAS helpful. Implications for future research include continued focus on disaggregated learning outcomes for students with and without disabilities for UDL interventions, and refinements for UDL interventions that benefit students with and without disabilities.", (p. 84).

Marino, M. T., Gotch, C. M., Israel, M., Vasquez, E., Basham, J. D., & Becht, K. (2014). UDL in the middle school science classroom: Can video games and alternative text heighten engagement and learning for students with learning disabilities? *Learning Disability Quarterly*, *37*(2), 87–99. https://doi.org/10.1177/0731948713503963

From the abstract: "This article examined the performance of 57 students with learning disabilities (LD) from four middle schools. Students were followed over the course of a school year in their inclusive science classrooms as they alternated between the use of traditional curricular materials for some units of study and materials that were supplemented with video games and alternative print-based texts to more closely align with Universal Design for Learning (UDL) guidelines during other units. Findings indicate that video games and supplemental text were effective at providing students with multiple means of representation and expression. The UDL-aligned units led to heightened levels of student engagement. There were no significant differences on posttest scores when students with LD were compared with peers without LD. Students' performance did not indicate significant differences between UDL-aligned units and those taught using traditional curricular materials. Findings suggest a need for alternative assessments to measure learning outcomes during UDL-aligned units. Implications for practice and areas of future research are discussed.", (p. 87).

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A review of research on universal design educational models. *Remedial and Special Education*, *35*(3), 153–166. https://doi.org/10.1177/0741932513518980

*From the abstract: "*Universal design for learning (UDL) has gained considerable attention in the field of special education, acclaimed for its promise to promote inclusion by supporting access to the general curriculum. In addition to UDL, there are two other universal design (UD) educational models referenced in the literature, universal design of instruction (UDI) and universal instructional design (UID). This descriptive review of 13 research studies conducted in pre-K–12 and post-secondary settings examined how researchers are applying and evaluating UD in educational settings. Results of the review illustrated that studies use a range of research designs to examine student outcomes and participant perceptions of UD-based curriculum and instruction. Researchers report on their application of UD principles in varied ways, with no standard formats for describing how UD is used. Based on results of the review, we provide recommendations to help establish a meaningful research base on the validity of UD in education.", (p. 153).

Rao, K., Torres, C., & Smith, S. J. (2021). Digital tools and UDL-based instructional strategies to support students with disabilities online. *Journal of Special Education Technology*, *36***(2), 105–112.** <u>https://doi.org/10.1177/0162643421998327</u>

*From the abstract: "*In online and blended learning environments, students may experience learning barriers that are more pronounced than in the traditional classroom. When designing online instruction, teachers can use digital tools along with instructional strategies to reduce those barriers. Digital tools have various instructional and assistive features, which can provide supports for students with disabilities as well as other learners. This article addresses how teachers can make meaningful use of various digital tools in alignment with the three principles of Universal Design for Learning (UDL) to reduce barriers and support students to meet learning and affective goals. The article describes how various commonly available digital tools coupled with instructional strategies provide supports for representation, action and expression, and engagement for students in online learning environments.", (p.105).

Root, J. R., Jimenez, B., & Saunders, A. (2022). Leveraging the UDL framework to plan grade-aligned mathematics in inclusive settings. *Inclusive Practices*, *1***(1), 13–22.** <u>https://doi.org/10.1177/2732474521990028</u>

*From the abstract: "*Universal Design for Learning (UDL) is a framework that can be applied when planning inclusive mathematics to benefit all students in a classroom, including students with extensive support needs. This article provides a step-by-step process for using the UDL framework to plan instruction, meeting the needs of all learners. Strategies such as collaboration, prioritizing learning goals, contextualizing mathematics to make it meaningful to learners, and planning for variability across the three principles of UDL—multiple means of expression, representation, and action and expression—are discussed.", (p. 13).

Tomlinson, C. A. (2014). *The differentiated classroom: Responding to the needs of all learners, Second edition.* **ASCD.**

*From the introduction: "*Although much has changed in schools in recent years, the power of differentiated instruction remains the same—and the need for it has only increased. Today's classroom is more diverse, more inclusive, and more plugged into technology than ever before. And it's led by teachers under enormous pressure to help decidedly unstandardized students meet an expanding set of rigorous, standardized learning targets. In this updated second edition

of her best-selling classic work, Carol Ann Tomlinson offers these teachers a powerful and practical way to meet a challenge that is both very modern and completely timeless: how to divide their time, resources, and efforts to effectively instruct so many students of various backgrounds, readiness and skill levels, and interests. With a perspective informed by advances in research and deepened by more than 15 years of implementation feedback in all types of schools, Tomlinson explains the theoretical basis of differentiated instruction, explores the variables of curriculum and learning environment, shares dozens of instructional strategies, and then goes inside elementary and secondary classrooms in nearly all subject areas to illustrate how real teachers are applying differentiation principles and strategies to respond to the needs of all learners. This book's insightful guidance on what to differentiate, how to differentiate, and why lays the groundwork for bringing differentiated instruction into your own classroom or refining the work you already do to help each of your wonderfully unique learners move toward greater knowledge, more advanced skills, and expanded understanding. Today more than ever, The Differentiated Classroom is a must-have staple for every teacher's shelf and every school's professional development collection.", (preface).

Walker, Z., McMahon, D. D., Rosenblatt, K., & Arner, T. (2017). Beyond Pokémon: Augmented reality is a universal design for learning tool. *SAGE Open, 7*(4). https://doi.org/10.1177/2158244017737815

From the abstract: "The success of Pokémon Go is demonstrating that augmented reality (AR) is reaching the masses quickly and can be a robust tool to enhance student engagement and learning. Leveraging AR for instructional purposes has the potential to become a powerful medium for Universal Design for Learning (UDL) by providing new tools for multiple means of representation, action and expression, and engagement. One of the advantages of using AR applications and AR platforms is the ability to display context relevant digital information to support students' needs in real time and in specific contexts. Although many educational AR applications are in their developmental stages, the rapid growth of AR is likely to continue. The examples presented in this article focus on how educators can use mobile devices and AR to apply the principles of UDL. Combining AR with the principles of UDL can help educators create lessons that are accessible, engaging, and powerful for a diverse range of learners.", (p. 1).

How do students apply their knowledge? (Knowledge Transfer)

Curriculum Alignment

English, F. W., & Steffy, B. E. (2001). Deep curriculum alignment: Creating a level playing field for all children on high-stakes tests of educational accountability. *Scarecrow Press*.

From the introduction: "This report discusses deep curriculum alignment and is designed to serve as a practical guide to an educational strategy that embraces the philosophy of "what is tested is what is taught." Chapter 1 describes misconceptions and misuses of rhetoric about public education, popular myths about tests, and the nature of curriculum alignment. Chapter 2 describes the dynamics of the educational playing field embodied in the tensions between curriculum alignment and high-stakes testing. Chapter 3 considers practical ways of starting and developing the alignment process. Chapter 4 reviews three case studies of curriculum alignment; describes pedagogical parallelism which creates an alternative but parallel

environment where students not only learn what is on a test but learn more; and lays out a practical step-by-step guide to implementing this environment. Chapter 5 discusses the problems involved with the current form of high-stakes accountability tests, positive trends in state assessment programs, the need for reasserting the primacy of curriculum in the testing debate, and problems involved with teaching social justice. It also considers the question whether colleges of education are contributors of solutions or problems to educational and institutional inflexibility. Chapters conclude with a list of key concepts, practical application guides, and lists of references. (RT)", (preface).

Leitzel, T. C., & Vogler, D. E. (1994). Curriculum alignment: Theory to practice.
https://files.eric.ed.gov/fulltext/ED371812.pdf

From the abstract: "Curriculum alignment is the conscious congruence of three educational elements: curriculum, instruction, and assessment. Alignment is rooted in the belief that instructional plans are established through outcomes-based content goals and the goal of assuring that delivery and assessment are congruent. Platform unity, based on the Principles of Performance Instruction, is a way to uphold curriculum alignment. The integration of planning and evaluating is often neglected in traditional approaches to instruction. Performance Instruction holds that course content should be planned, delivered, and evaluated consistently to assure unity. Test creation, for example, needs to be related to content planning decisions.

The domain-level at which content is planned becomes the basis for creating test items, with content planning and testing at the same domain level to assure unity. In the theoretical literature, considerable attention is given to faculty's inability to plan and test content consistently. These are arguably important and necessary faculty tasks, and should be the focus of staff development. Unfortunately, even the literature on planning and testing treats them as separate, independent activities. Many faculty have had no formal coursework or in-service training in assessment. As a result, classroom tests are usually short, objective, and of poor technical quality and usually call for the memorization of facts. There is little research in the assessment field regarding practical tools to help faculty evaluate criterion-referenced tests. By looking at the theoretical literature on planning and evaluation, one sees the need to move to practical implications for the benefit of aligning the planned and tested curricula, thus achieving efficiency, effectiveness, and overall unity of instruction.", (p. 1).

Traynor, A., Li, T., & Zhou, S. (2020). Gauging uncertainty in test-to-curriculum alignment indices. *Applied Measurement in Education, 33*(2), 141–158.
https://doi.org/10.1080/08957347.2020.1732387

From the abstract: "During the development of large-scale school achievement tests, panels of independent subject-matter experts use systematic judgmental methods to rate the correspondence between a given test's items and performance objective statements. The individual experts' ratings may then be used to compute summary indices to quantify the match between a given test and its target item domain. The magnitude of alignment index variability across experts within a panel, and randomly-sampled panels, is largely unknown, however.

Using rater-by-item data from alignment reviews of 14 US states' achievement tests, we examine observed distributions and estimate standard errors for three alignment indices developed by Webb. Our results suggest that alignment decisions based on the recommended

criterion for the balance-of-representation index may often be uncertain, and that the criterion for the depth-of-knowledge consistency index should perhaps be reconsidered. We also examine current recommendations about the number of expert panelists required to compute these alignment indices", (p. 141).

Knowledge Transfer

Jacobson, M. J., Goldwater, M., Markauskaite, L., Lai, P. K., Kapur, M., Roberts, G., & Hilton, C. (2020). Schema abstraction with productive failure and analogical comparison: Learning designs for far across domain transfer. *Learning and Instruction,* *65.* **https://doi.org/10.1016/j.learninstruc.2019.101222**

From the abstract: "Although there has been considerable research into knowledge transfer for over a century, there remains a need for specific, validated techniques for teaching for transfer. This article reports on classroom-based research in which students learned about complex systems and climate change with agent-based computer models using two different instructional approaches based on productive failure (PF). In both PF approaches, students initially explored a problem space on their own and then received teacher-led instruction. One treatment group used climate computer models whereas the other group engaged in analogical comparisons between the same climate computer models and complexity computer models in different domains. The study found both groups demonstrated significant learning gains by posttest on assessments of declarative and explanatory knowledge and on within domain near transfer. However, students in the two models treatment group performed at a significantly higher level on an across domain far transfer problem solving task. Theoretical and practical implications are considered", (p. 1).

Kubsch, M., Touitou, I., Nordine, J., Fortus, D., Neumann, K., & Krajcik, J. (2020). Transferring knowledge in a knowledge-in-use task—investigating the role of knowledge organization. *Education Sciences,* *10*(1), 1–16. **https://doi.org/10.3390/educsci10010020**

From the abstract: "Knowledge-in-Use, i.e., the ability to apply what one has learned, is a major goal of education and involves the ability to transfer one's knowledge. While some general principles of knowledge transfer have been revealed, the literature is full of inconclusive results and it remains hard to predict successful transfer. However, research into expertise suggests that how one organizes one's knowledge is critical for successful transfer. Drawing on data from a larger study on the learning of energy, we employed network analysis to investigate how the organization of students' knowledge about energy influenced their ability to transfer and what role achievement goal orientation may have played in this. We found that students that had more coherently organized knowledge networks were more successful in transfer.

Furthermore, we also found a connection between mastery goal orientation and the organization of students' knowledge networks. Our results extend the literature by providing evidence for a direct connection between the organization of students' knowledge networks, their success in transfer, and their goal orientation and hint at the complexities in the relationship between mastery approach goal orientation and successful transfer beyond what is reported in the literature", (p. 1).

O'Reilly, R. C., Ranganath, C., & Russin, J. L. (2022). The structure of systematicity in the

brain. *Current Directions in Psychological Science*, *31*(2), 124–130. https://doi.org/10.1177/09637214211049233

From the abstract: "A hallmark of human intelligence is the ability to adapt to new situations by applying learned rules to new content (systematicity) and thereby enabling an open-ended number of inferences and actions (generativity). Here, we propose that the human brain accomplishes these feats through pathways in the parietal cortex that encode the abstract structure of space, events, and tasks and pathways in the temporal cortex that encode information about specific people, places, and things (content). Recent neural network models show how the separation of structure and content might emerge through a combination of architectural biases and learning, and these networks show dramatic improvements over previous models in the ability to capture systematic, generative behavior. We close by considering how the hippocampal formation may form integrative memories that enable rapid learning of new structure and content representations", (p. 124).

How do students become motivated to learn? (Student Motivation)

Growth Mindset

Andersen, S. C., & Nielsen, H. S. (2016). Reading intervention with a growth mindset approach improves children's skills. *Proceedings of the National Academy of Sciences*, *113*(43), 12111-12113. https://doi.org/10.1073/pnas.1607946113

From the abstract: "Laboratory experiments have shown that parents who believe their child's abilities are fixed engage with their child in unconstructive, performance-oriented ways. We show that children of parents with such "fixed mindsets" have lower reading skills, even after controlling for the child's previous abilities and the parents' socioeconomic status. In a large-scale randomized field trial (N classrooms = 72; N children = 1,587) conducted by public authorities, parents receiving a reading intervention were told about the malleability of their child's reading abilities and how to support their child by praising his/her effort rather than his/her performance. This low-cost intervention increased the reading and writing achievements of all participating children—not least immigrant children with non-Western backgrounds and children with low-educated mothers. As expected, effects were even bigger for parents who before the intervention had a fixed mindset.",

Bai, B., & Wang, J. (2020). The role of growth mindset, self-efficacy and intrinsic value in self-regulated learning and English language learning achievements. *Language Teaching Research*, 1362168820933190. https://doi.org/10.1177/1362168820933190

From the abstract: "This study examined the role of growth mindset, self-efficacy, and intrinsic value in self-regulated learning (SRL) and English language learning achievements in Hong Kong primary school students. A sample of 690 4th graders participated in the study. The findings suggest that the level of SRL strategy use (i.e., monitoring, effort regulation, and goal setting and planning) was driven by the students? motivational beliefs (i.e. growth mindset, self- efficacy, and intrinsic value) in different ways. Monitoring and effort regulation, in turn, were significant contributors to the participants? English language learning achievements, but goal setting and planning did not predict their English language learning achievements. The finding suggests that growth mindset was a stronger predictor of SRL than self-efficacy and intrinsic value. Implications for fostering adaptive motivational beliefs and SRL are discussed.

Future research should consider the influence of the socio-cultural context on the relationships between motivational factors, SRL strategy use, and English language learning achievements", (p. 1).

Bostwick, K. C. P., Martin, A. J., Collie, R. J., & Durksen, T. L. (2019). Growth orientation predicts gains in middle and high school students' mathematics outcomes over time. *Contemporary Educational Psychology*, *58*, 213–227. https://doi.org/10.1016/j.cedpsych.2019.03.010

*From the abstract: "*Academic growth constructs, such as growth mindset and various forms of growth goals, have been of substantial focus in psycho-educational research. Recent research has sought to identify how such growth constructs are inter-related, finding that an underlying growth orientation (comprised of growth mindset, self-based growth goals, and task-based growth goals) was cross-sectionally associated with more positive outcomes for students.

However, for such a construct to have meaningful relevance to education and educational research, it must be associated with actual growth in academic outcomes. Accordingly, using two-wave longitudinal structural equation modeling in a large sample of Australian middle and high school students ($N = 2949$), we examined the extent to which students' growth orientation predicted growth in academic outcomes. We hypothesized that students' growth orientation would be positively associated with gains in students' mathematics engagement and achievement, while controlling for student demographic covariates (e.g., gender, age) and prior variance in each substantive factor measured one year prior. Results demonstrated that students' growth orientation in mathematics was a significant positive predictor of students' gains in mathematics engagement and achievement, above other sources of influence. Findings are discussed in terms of improving researchers' understanding of how growth constructs are inter-related and how to promote students' academic success in mathematics", (p. 213).

Dweck, C. S. (2006). Mindset: The new psychology of success. *Random House.*

*From the introduction: "*In this book, you'll learn how a simple belief about yourself-a belief we discovered in our research-guides a large part of your life. In fact, it permeates every part of your life. Much of what you think of as your personality actually grows out of this "mindset." Much of what may be preventing you from fulfilling your potential grows out of it. No book has ever explained this mindset and shown people how to make use of it in their lives. You'll suddenly understand the greats--in the sciences and arts, in sports, and in business--and the would-have-beens. You'll understand your mate, your boss, your friends, your kids. You'll see how to unleash your potential-and your children's. It is my privilege to share my findings with you. Besides accounts of people from my research, I've filled each chapter with stories both ripped from the headlines and based on my own life and experience, so you can see the mindsets in action.", (p. 1).

Fernandez, O. E. (2021). Second chance grading: An equitable, meaningful, and easy-to-implement grading system that synergizes the research on testing for learning, mastery grading, and growth mindsets. *PRIMUS*, *31*(8), 855–868. https://doi.org/10.1080/10511970.2020.1772915

*From the abstract: "*This article describes the synthesis of the research on mastery grading, growth mindsets, and testing for learning to produce a new grading system – Second Chance

Grading. The system and the research it is based on are described in detail. Reflections of the system's effectiveness, impact, and reception are also discussed. Finally, the appendix to the article contains an F.A.Q. section addressing some of the common questions and concerns related to the system", (p. 855).

Harsy, A., Carlson, C., & Klamerus, L. (2021). An analysis of the impact of mastery-based testing in mathematics courses. *PRIMUS, 31*(10), 1071–1088.

From the abstract: "Mastery-grading techniques such as mastery-based grading, specifications grading, and standards-based grading are assessment techniques professors are implementing in order to support a growth mindset of learning, decrease test anxiety, and help students develop a deeper understanding of course objectives. In this paper, we provide an analysis of research conducted in a variety of courses which used mastery-based testing (MBT). Some of the questions we explore include whether the students' attitudes about mathematics and learning changed throughout the course in addition to whether MBT impacted test anxiety and growth mindset", (p. 1071).

Lenarz, J., & Pelatt, K. E. (2020). A transition to mastery-based testing with the hope of increasing student persistence. *PRIMUS, 1–10.*

From the abstract: "Evidence shows that to improve student persistence in mathematics, we must change our course design to encourage students to have a growth mindset. By using standards-based grading, students earn grades based on their actual learning, so they are motivated to persist with difficult topics until they achieve understanding. Mastery-based testing has the potential to reduce test anxiety, improve students' confidence in their mathematical ability, reduce grading workload for faculty, and improve content retention", (p. 1).

Martin, A. J., Collie, R. J., Durksen, T. L., Burns, E. C., Bostwick, K. C. P., & Tarbetsky, A. L. (2019). Growth goals and growth mindset from a methodological-synergistic perspective: Lessons learned from a quantitative correlational research program. *International Journal of Research & Method in Education, 42*(2), 204–219.

From the abstract: "This review explores predictors and consequences of students' growth goals and growth mindset in school with particular emphasis on how correlational statistical methods can be applied to illuminate key issues and implications. Study 1 used cross-sectional data and employed structural equation modelling (SEM) to investigate the role of growth goals in mediating the link between interpersonal relationships and academic engagement. Study 2 conducted multi-group path analysis to investigate the role of growth goals in the academic outcomes of two groups of students (ADHD and non-ADHD). Study 3 used longitudinal data and SEM to test a cross-lagged panel design to investigate reciprocal links between growth goals and growth mindset. Study 4 conducted multi-level SEM where the effects of a growth orientation on engagement and achievement were investigated at the student-level (level 1) and the classroom-level (level 2). Taking these four studies together, we aim to show how correlational data and multivariate correlational analyses have been effective in answering research questions in a way that have practical and theoretical implications for students'

academic growth. We also position this review as a substantive-methodological synergy – an approach recently recommended in response to concerns about the increasing polarization of substantive and methodological research and researchers", (p. 204).

Mesler, R. M., Corbin, C. M., & Martin, B. H. (2021). Teacher mindset is associated with development of students' growth mindset. *Journal of Applied Developmental Psychology, 76.* https://doi.org/10.1016/j.appdev.2021.101299

From the abstract: "Are teachers' growth mindsets associated with the development of growth mindsets in their students? We know that teacher growth mindset (TGM) shapes the attributions teachers make about their students' abilities and can lead to assumptions about the role that perceived stable traits play in students' performance; however, to date, research has not focused on the relationship between TGM and the development of student growth mindset. This study fills a gap in our knowledge by testing this association over time. Findings from an analytic sample of 57 teachers and 1957 intervention students reveal that teachers with growth mindsets have a mild positive and statistically significant association with the development of their students' growth mindsets, particularly for boys. Implications for teacher education, practice, and future research are discussed", (p. 1).

Porter, T., Catalán Molina, D., Cimpian, A., Roberts, S., Fredericks, A., Blackwell, L. S., & Trzesniewski, K. (2022). Growth-mindset intervention delivered by teachers boosts achievement in early adolescence. *Psychological Science, 33*(7), 1086–1096. https://doi.org/10.1177/09567976211061109

From the abstract: "School underachievement is a persistent problem in the United States. Direct-to-student, computer-delivered growth-mindset interventions have shown promise as a way to improve achievement for students at risk of failing in school; however, these interventions benefit only students who happen to be in classrooms that support growth-mindset beliefs. Here, we tested a teacher-delivered growth-mindset intervention for U.S. adolescents in Grades 6 and 7 that was designed to both impart growth-mindset beliefs and create a supportive classroom environment where those beliefs could flourish (N = 1,996 students, N = 50 teachers). The intervention improved the grades of struggling students in the target class by 0.27 standard deviations, or 2.81 grade percentage points. The effects were largest for students whose teachers endorsed fixed mindsets before the intervention. This large-scale, randomized controlled trial demonstrates that growth-mindset interventions can produce gains when delivered by teachers", (p. 1086).

Rattan, A., Savani, K., Chugh, D., & Dweck, C. S. (2015). Leveraging mindsets to promote academic achievement. *Perspectives on Psychological Science, 10*(6), 721-726. https://doi.org/10.1177/1745691615599383

From the abstract: "The United States must improve its students' educational achievement. Race, gender, and social class gaps persist, and, overall, U.S. students rank poorly among peers globally. Scientific research shows that students' psychology—their "academic mindsets"— have a critical role in educational achievement. Yet policymakers have not taken full advantage of cost-effective and well-validated mindset interventions. In this article, we present two key academic mindsets. The first, a growth mindset, refers to the belief that intelligence can be developed over time. The second, a belonging mindset, refers to the belief that people like you

belong in your school or in a given academic field. Extensive research shows that fostering these mindsets can improve students' motivation; raise grades; and reduce racial, gender, and social class gaps. Of course, mindsets are not a panacea, but with proper implementation they can be an excellent point of entry. We show how policy at all levels (federal, state, and local) can leverage mindsets to lift the nation's educational outcomes.", (p. 721).

Rhew, E., Piro, J. S., Goolkasian, P., & Cosentino, P. (2018). The effects of a growth mindset on self-efficacy and motivation. *Cogent Education, 5*(1), 1492337. **https://doi.org/10.1080/2331186X.2018.1492337**

*From the abstract: "*The purpose of this study was to investigate whether a growth mindset intervention would improve adolescent special education students' self-efficacy and motivation. The sample included sixth, seventh, and eighth grade students receiving learning disability services in the area of reading. The study was quasi-experimental in design which included both a comparison group and a treatment group. The treatment group received a growth mindset intervention called Brainology. The Reader Self-Perception Scale 2nd Edition and the Motivation for Reading Questionnaire were used to measure whether there were differences in the mean scores for self-efficacy and motivation in reading. Results suggested that a growth mindset intervention had a significant difference in the motivation, but not self-efficacy, of adolescent special education participants", (p. 1).

Sriram, R. (2014). Rethinking intelligence: The role of mindset in promoting success for academically high-risk students. *Journal of College Student Retention, 15*(4), 515-536. **https://doi.org/10.2190/CS.15.4.c**

*From the abstract: "*This study utilized an experimental pretest-posttest control group design to determine if changing the way academically high-risk college students view intelligence affected their academic effort and achievement when compared to students in a control intervention.

Results indicated that students taught to view intelligence as malleable reported significantly higher levels of the multivariate variable academic effort and the univariate variable study skills than did the students who were directly taught study skills. No significant difference in GPA was found between the two groups. Implications for future research and current practice are discussed.", (p. 515).

Xu, K. M., Koorn, P., de Koning, B., Skuballa, I. T., Lin, L., Henderikx, M., Marsh, H. W., Sweller, J., & Paas, F. (2021). A growth mindset lowers perceived cognitive load and improves learning: Integrating motivation to cognitive load. *Journal of Educational Psychology, 113*(6), 1177–1191.* **https://doi.org/10.1037/edu0000631**

*From the abstract: "*Many large-scale, school-based interventions have attempted to improve academic performance through promoting students' growth mindset, defined as the belief that one's intellectual ability can increase with practice and time. However, most have shown weak to no effects. Thus, it is important to examine how growth mindset might affect retention and transfer of learning, as well as process-related variables such as cognitive load. In a double-blind, randomized controlled experiment based on 138 secondary school students, the effects of an experimentally induced growth mindset belief were examined during a learning phase in a classroom setting. Participants in the growth mindset condition perceived a lower intrinsic load and extraneous load and performed better on retention and transfer tests. Students with some

prior knowledge also reported a higher mastery goal orientation. Supplementary mediation analysis suggested that the effect on transfer could be fully accounted for by changes in cognitive load perceptions. Future interventions may benefit from designs that promote motivational beliefs that reduce intrinsic and extraneous cognitive load perceptions", (p. 1177).

Yan, V. X., & Sana, F. (2021). Does the interleaving effect extend to unrelated concepts? Learners' beliefs versus empirical evidence. *Journal of Educational Psychology*, *113*(1), **125–137.** https://doi.org/10.1037/edu0000470

*From the abstract: "*When learning new information, should students focus on studying 1 concept at a time or should they alternate studying between different concepts? Recent research shows that students should mix up or interleave the study of different concepts, particularly when the concepts are related or hard to discriminate (Carvalho & Goldstone, 2015). But students rarely study only 1 course, so how should the study of unrelated courses be sequenced? Should the study sessions be blocked by course to avoid unproductive juxtapositions or be interleaved across different courses because it inherently involves spaced practice, which is also effective for learning? In Experiments 1 and 2, we explored how students construct their study sessions by using hypothetical scenarios. Finally, in Experiment 3, we experimentally manipulated the study sequence of related concepts within 2 unrelated domains (i.e., physics and statistics).

Given only 1 level to schedule (related modules or unrelated courses; Experiment 1), students chose to block related modules but to interleave unrelated topics—even though the literature suggests the related concepts are more likely to benefit from interleaving. Given 2 levels to schedule (concepts and domains; Experiment 2), students chose to interleave everything—even though empirical data from Experiment 3 suggests that the optimal schedule involves interleaving at either the concept or the domain level, but not both or neither", (p. 125).

Mastery Learning

Bloom, B. S. (1973). Recent developments in mastery learning. *Educational Psychologist*, *10*(2), **53-57.** https://doi.org/10.1080/00461527309529091

*From the abstract: "*Mastery learning strategies have been widely used with considerable success in increasing the proportion of students attaining the mastery criterion. Students attaining mastery do, under appropriate conditions, change in their affect about the subject and themselves.

Research on time and achievement in relation to mastery learning procedures show reduction in student variability and increases in learning efficiency and learning achievement.", (p. 53).

Buch, R., Nerstad, C. G. L., & Säfvenbom, R. (2017). The interactive roles of mastery climate and performance climate in predicting intrinsic motivation. *Scandinavian Journal of Medicine & Science in Sports*, *27*(2), **245–253.** https://doi.org/10.1111/sms.12634

*From the abstract: "*This study examined the interplay between perceived mastery and performance climates in predicting increased intrinsic motivation. The results of a two-wave longitudinal study comprising of 141 individuals from three military academies revealed a positive relationship between a perceived mastery climate and increased intrinsic motivation only for individuals who perceived a low performance climate. This finding suggests a positive relationship between a perceived mastery climate and increased intrinsic motivation only when

combined with low perceptions of a performance climate. Hence, introducing a performance climate in addition to a mastery climate can be an undermining motivational strategy, as it attenuates the positive relationship between a mastery climate and increased intrinsic motivation. Implications for future research and practice are discussed", (p. 245).

Linhart, J. M. (2020). **Mastery-based testing to promote learning: Experiences with discrete mathematics.** *PRIMUS, 30*(8–10), 1087–1109. https://doi.org/10.1080/10511970.2019.1695236

From the abstract: "Math courses graded on homework, tests, and a final examination can result in students putting together enough partial credit to pass the class without gaining a reasonable mastery of the course content. Mastery-based testing can help to address this by allowing the instructor to align course grades with mastery of the learning objectives for the course. This article is a reflection on my experiences implementing mastery-based testing in Discrete Mathematics. I give a brief introduction to the ideas behind mastery-based testing and discuss the construction of two of my mastery tests. The change affected my teaching, helping me to see where students need help understanding the material. Instructor observation and feedback from student evaluations of instruction indicate that student learning was improved with the change", (p. 1087).

Maier, U. (2021). **Self-referenced vs. reward-based feedback messages in online courses with formative mastery assessments: A randomized controlled trial in secondary classrooms.** *Computers & Education, 174.* https://doi.org/10.1016/j.compedu.2021.104306

From the abstract: "Mastery assessments are used in many digital learning environments to control learning progression and support low-achieving students relearning important content. But research on personalized feedback following a mastery assessment is scarce and yielded ambiguous effects. Therefore, this study seeks to contribute to this area of research by investigating the effect of two different feedback messages in short online courses for German and English language grammar and spelling in secondary classrooms (grades 6–10). The study compares a reward-based feedback message to a self-referenced feedback message. The reward- based message indicates if the learner reaches the mastery criterion and how many points the learning app awarded for completing the test. The self-referenced feedback message applies motivation theory to strengthen students' internal attribution of causes for the test performance. The web-app MasteryX (www.masteryx.de) randomly assigned students to either the reward-based or the self-referenced feedback message. The study sampled 620 students (309 female, 311 male) in 53 classrooms from 27 secondary schools. It analyzed the effect of the two types of feedback messages on the level of test-retest-sequences (n = 2450). Results indicate small though significant positive effects of the self-referenced feedback message on subsequent learning behavior (reading elaborated item feedback, training behavior). However, a multilevel regression model showed small to medium effects of the reward-based feedback message on the higher course levels' follow-up mastery assessment score. The findings emphasize the complexity of designing personalized feedback strategies in online learning environments with mastery assessments", (p. 1).

Ramos, A., De Fraine, B., & Verschueren, K. (2021). **Learning goal orientation in high- ability and average-ability students: Developmental trajectories, contextual predictors, and long-term educational outcomes.** *Journal of Educational Psychology, 113*(2), 370– 389.

https://doi.org/10.1037/edu0000476

From the abstract: "Learning goal orientation is a prominent motivational construct that has been linked to positive student outcomes. For high-ability students, a lack of mastery learning goals has been theoretically and empirically associated with underachievement. However, longitudinal research examining the development and outcomes of their learning goal orientation, and comparing this development to that of average-ability peers, is lacking. In this study, we utilized a sample of 5,172 students to study the development of learning goal orientation in high-ability versus average-ability students across late elementary and early secondary school. Additionally, we investigated the association of perceived learning support from teachers and peers with this development. Finally, we examined the predictive value of learning goal orientation for the secondary school outcomes grade retention and nonacademic track pursuit. We found that high-ability students had lower initial learning goal orientation than their peers, and this remained lower across the transition to secondary school. Learning goal orientation declined on average for both groups of students. Perceived learning support from teachers and peers was found to be a general supportive factor to the development of learning goal orientation. Levels of learning goal orientation in late elementary school were found to predict the likelihood of completing an academic study track by the end of secondary education for both groups of students. Our findings affirm that learning motivation in middle school has long-term educational implications for high- as well as average-ability students, justifying the current trend of addressing student achievement outcomes through targeting their school motivation and engagement", (p. 370).

Shappell, E., Podolej, G., Ahn, J., Tekian, A., & Park, Y. S. (2021). Notes from the field: Automatic item generation, standard setting, and learner performance in mastery multiple-choice tests. *Evaluation & the Health Professions*, *44*(3), 315–318. https://doi.org/10.1177/0163278720908914

From the abstract: "Mastery learning assessments have been described in simulation-based educational interventions; however, studies applying mastery learning to multiple-choice tests (MCTs) are lacking. This study investigates an approach to item generation and standard setting for mastery learning MCTs and evaluates the consistency of learner performance across sequential tests. Item models, variables for question stems, and mastery standards were established using a consensus process. Two test forms were created using item models. Tests were administered at two training programs. The primary outcome, the test–retest consistency of pass–fail decisions across versions of the test, was 94% (κ = .54). Decision-consistency classification was .85. Item-level consistency was 90% (κ = .77, SE = .03). These findings support the use of automatic item generation to create mastery MCTs which produce consistent pass–fail decisions. This technique broadens the range of assessment methods available to educators that require serial MCT testing, including mastery learning curricula", (p. 315).

Slavin, R. E. (1990). Mastery learning re-reconsidered. *Review of Educational Research, 60*(2), 300-302. https://doi.org/10.3102/00346543060002300

From the article: "Kulik, Kulik, and Bangert-Drowns (1990) have written a technically proficient and comprehensive meta-analysis of research on mastery learning. In addition to the usual statistical distillation of effect sizes, they have discussed many of the key substantive and

methodological issues that have been central to the debate about the effectiveness of mastery learning methods, and have even discussed specific critical studies. In these respects the paper is a significant advance over earlier meta-analyses, including their own earlier articles on the topic (Kulik, Kulik, & Bangert-Drowns, 1986; Kulik, Kulik, & Cohen, 1979).", (p. 300).

Student-Teacher Relationships

García-Moya, I., Brooks, F., & Moreno, C. (2020). Humanizing and conducive to learning: An adolescent students' perspective on the central attributes of positive relationships with teachers. *European Journal of Psychology of Education, 35*(1), 1–20. https://doi.org/10.1007/s10212-019-00413-z

*From the abstract: "*The aim of this qualitative study was to identify central attributes of positive relationships with teachers from the adolescent students' perspectives that could help delineate the meaning of student–teacher connectedness while exploring to what extent its main attributes were similar or different in England and Spain. As part of the EU-funded project Well-being among European youth: The contribution of student-teacher relationships in the secondary-school population, we conducted focus groups in England and Spain with 42 students aged 11 to 18 years. Using a bottom-up approach for thematic analysis, we identified two main attributes that were linked to positive relationships with teachers as seen by our participating students from England and Spain: humanizing relationships, in which the students are acknowledged and respected as individuals and feel understood and supported by their teachers; and relationships conducive to learning, encompassing aspects such as a perception of a genuine commitment with their learning on the part of the teachers, a positive classroom management, and teachers motivating students. This study contributes to the conceptualization of student–teacher connectedness and provides useful insights for teachers and educational professionals. In addition, the study findings pointed to the importance of power and authority dynamics in student–teacher relationships that foster or undermine connectedness, and they revealed some cross-cultural differences in the role of emotions in the class, two important aspects which deserve further attention in future research", (p. 1).

Prewett, S. L., Bergin, D. A., & Huang, F. L. (2019). Student and teacher perceptions on student-teacher relationship quality: A middle school perspective. *School Psychology International, 40*(1), 66–87. https://doi.org/10.1177/0143034318807743

*From the abstract: "*This study investigated 336 fifth- and sixth-grade middle school students' relationships with their ten mathematics teachers. Authors used a five-step hierarchical multiple linear regression to examine teacher and student factors related to students' quality of relationships with their teachers. Analyses revealed that teachers' student relationship perceptions positively predicted their students' perceptions and the students' reports of their mathematics interest and self-efficacy positively predicted teacher relationships. Teachers' prosocial classroom behavior and social-emotional support behaviors were the strongest predictors of students' views of high-quality relationships with their teachers; both prosocial classroom behaviors and social-emotional support are malleable, and authors discuss implications for how teachers' behaviors shape students' positive views of their student-teacher relationships", (p. 66).

Newcomer, S. N. (2018). Investigating the power of authentically caring student-teacher

relationships for Latinx students. *Journal of Latinos and Education*, *17*(2), 179–193. https://doi.org/10.1080/15348431.2017.1310104

*From the abstract: "*Culturally responsive and authentically caring pedagogy is vitally important to academic success for Latinx students. This type of teaching is based on reciprocal relationships between students and teachers, and incorporates students' funds of knowledge. This qualitative case study brings the voices of Latinx students to the forefront by examining how their teachers help create "funds of caring" for the students by cultivating authentically caring relationships, and by highlighting what these relationships mean for the students. Findings show that teachers can make school a meaningful and positive experience for Latinx youth by interacting with students in authentically caring ways", (p. 179).

Whitehead, J., Schonert-Reichl, K. A., Oberle, E., & Boyd, L. (2022). What do teachers do to show they care? Learning from the voices of early adolescents. *Journal of Adolescent Research*, **0(0).** https://doi.org/10.1177/07435584221076055

*From the abstract: "*This mixed methods study examined how middle school students (ages 11-13) in middle-class neighborhoods in Western Canada characterized a caring teacher. Specifically, qualitative content analysis was conducted on 199 sixth and seventh grade students? written responses to the question ? What are three things that teachers do to show they care?? Guided by recent work in the area of mindfulness in teaching, we identified 19 themes: one was categorized as General Teaching (e.g., They teach?), and 18 that were grouped into one of three thematic categories associated with mindful teaching: Calm (e.g., calm/not reactive), Clear (e.g., democratic communication), and Kind (e.g., empathy). In their descriptions of caring teachers, almost all students (97.5%) used Kind themes, while many used Clear themes (41%); with fewer students using Calm (13.6%) or General Teaching (10.6%) themes. Chi square analyses revealed that girls were more likely to mention Clear themes compared to boys, while boys were more likely to use the specific themes of nurturance and helpfulness. Additional demographic differences were also explored. This research adds to the growing body of studies aimed at elucidating the role of mindful teaching in caring student-teacher relationships, particularly from the perspectives of early adolescents.", (p. 1).

Appendix

Table 1. Search Engines and Key Terms

Search Engines	Key Terms
APA PsychNet	Cumulative review
Sage Journals	Feedback
Taylor & Francis	Habits of mind
	Metacognition
	Self-regulated learning
	Context alignment
	Curriculum alignment
	Knowledge transfer
	Schema-based learning
	Mastery learning
	Growth mindset
	Student-teacher relationships
	Universal Design for Learning