



<https://earli.org/SIG6-7>

## Program overview

Monday, August 22

	Program	Time	Room
	Registration	09:00 – 11:00	
	Opening	11:00 - 11:15	Aula Magna
	Junior Keynote Prof. Dr. Dominik Petko	11:15 -12:15	Aula Magna
	<i>lunch break</i>	12.15 – 13.30	
SLOT A.1	Paper Presentation: Educational technologies	13:30 – 14:50	S0 06
SLOT A.2	Paper Presentation: Manipulation, VR and simulation		S0 10
SLOT A.3	Paper Presentation: Assessment of learning		Aula Magna
	<i>short break</i>		
SLOT B.1	Symposium	15:00 – 16:30	S0 06
SLOT B.2	Symposium		Aula Magna
	<i>coffee break</i>	16.30 – 17.00	
SLOT C.1	Demonstrations	17.00 – 18.00	Aula Magna
SLOT C.2	Poster presentation		Piazza
	<i>Social Evening</i>	18:00 – open end	

## Program overview

### Program overview

Tuesday, August 23

	Program	Time	Room
SLOT D.1	Symposium	09:00 – 10:30	Aula Magna
SLOT D.2	Symposium		S0 10
	<i>coffee break</i>	10:30 – 11:00	
SLOT E.1	No-or-not-perfect data presentations Technology in Science	11:00 – 12:00	S0 06
SLOT E.2	No-or-not-perfect data presentations Validation and assessment		S0 10
	<i>lunch break</i>	12:00 – 13:00	
	<b>Keynote</b> Prof. Dr. Jürg Schweri, SFUVET, Switzerland	13:00 – 14:00	Aula Magna
	<i>short break</i>		
SLOT F.1	Paper presentation Instructional design and learning strategies	14:10 – 15:30	S0 06
SLOT F.2	Paper presentation 21st century and transversal skills		S0 10
SLOT F.3	Paper presentation Educational instructor's relevance		Aula Magna
	<i>coffee break</i>	15:30 – 16:00	
SLOT G.1	Symposium	16:00 – 17:30	S0 06
SLOT G.2	Symposium		S0 10
	<i>short break</i>		
	SIG 6 & SIG 7 business meeting	17:40 – 18:30	Aula Magna
Conference Dinner	Altes Tramdepot Bern (Including vegetarian/vegan options)	from 20:00	

## Program overview

### Program overview

Wednesday, August 24

	Program	Time	Room
	Invited symposium	09:00 – 10:30	Aula Magna
	<i>coffee break</i>	10:30 – 11:00	
SLOT H.1	No-or-not-perfect data presentations Virtual Reality	11:00 – 12:00	SO 06
SLOT H.2	No-or-not-perfect data presentations Instructional choices and learning outcome		SO 10
	<i>Mentoring Lunch</i>	12:00 – 13:00	
SLOT I.1	Paper presentations Foreign-language learning & Reading	13:00 – 14:20	SO 06
SLOT I.2	Paper presentations The role of school leaders, teachers and students on technology integration		SO 10
SLOT I.3	Paper presentations Instructional design and Collaborative learning		Aula Magna
	<i>short break</i>		
	<b>Keynote</b> Prof. Dr. Lennart Schalk, PH Schwyz, Switzerland	14:30 – 15:30	Aula Magna
	Closing and Award Ceremony End of conference	15:30 – 16:00	Aula Magna

## Detailed program

Monday, August 22

Keynote  
Aula Magna

11:15 – 12:15

*Prof. Dr. Dominik Petko, University of Zurich*

**From SAMR to ICAP:**

**Changing the way we study technology integration in education**

The Substitution-Augmentation-Modification-Redefinition (SAMR) model is one of the most prominent frameworks of technology integration in education. However, it has been criticized because it mainly focuses on technological rather than pedagogical innovation. The Interactive-Constructive-Active-Passive (ICAP) model takes a different approach. It draws on educational theory and attempts to describe key learning activities with increasing levels of complexity and effectiveness. Although the ICAP model was not developed specifically to analyze and inform educational technology integration, it has the potential to be applied in this area as well. The keynote compares both models, provides initial empirical insights, and discusses how these conceptual models might be combined.

*Lunch break*

*12:15 – 13:30*

**Room:** S0 06

**Chair:** Sascha Schneider

## **Learning from Video Examples during an Online Training Intervention**

*Markus H. Hefter and Kirsten Berthold*

Many recent effective digital learning environments feature video examples. Open questions refer to learning mechanisms behind their active components. In an online experiment with university students (N=138), we compared four conditions: (A) training intervention with an introduction, video examples, and self-explanation prompts, (B) condition A without self-explanation prompts, (C) condition B without video examples, and (D) no training intervention. A-priori contrasts allowed us to test assumed effects of video examples and self-explanation prompts on self-explanation quality and knowledge gain. We found that video examples already fostered self-explanation quality, but additional self-explanation prompts provided an extra boost. Regarding learning outcome, the introduction alone did indeed already foster knowledge, but only the additional video examples provided a boost in knowledge gain. Finally, self-explanation quality mediated the video examples' effect on knowledge gain. Our findings provide further empirical support that video examples and prompts lead to high self-explanation quality and thereby knowledge gain.

## **Age as a moderator for the benefits of a pause button in videos**

*Martin Merkt and Daniel Bodemer*

Previous research implies that allowing learners to self-pace the learning materials particularly benefits those who are at risk for cognitive overload. Therefore, this contribution focusses on the exploratory research question whether the beneficial effect of a pause button in videos is moderated by participants' age. In the online experiment, participants watched three videos. Next to giving participants different task instructions, it was varied whether a pause button was available. We observed that the availability of a pause button only resulted in better learning outcomes for older participants, but not for younger participants. Measures of ICL and GCL imply that higher age was associated with higher perceived task difficulty and more deliberate effort during the learning phase.

## **Play games for learning and/or winning: Effect on achievement goals, performance, and achievement emotions**

*Yuanyuan Hu, Pieter Wouters, Marieke van der Schaaf and Liesbeth Kester*

Instructional design features that enhance game-based learning are needed. This study focuses on achievement goal instructions. It is hypothesized that mastery-approach goals and performance-approach goals (i.e., multiple goals) instructions benefits 1) cognition (i.e., test and game performance), 2) motivation (i.e., achievement goals), and 3) emotion (i.e., achievement emotions). 320 students participated in a 2 × 2 factorial design experiment with two factors: mastery-approach goal instructions (yes/no) and performance-approach goal instructions (yes/no). Data are to be collected and analyzed.

## **How a procedural character and a narrative embedding help learning with whiteboard animations**

*Sascha Schneider, Felix Kriegelstein, Maik Beege and Günter Daniel Rey*

Whiteboard animations play an increasingly important role in education and self-teaching. However, research on how these forms of animation help to foster learning are rare. In two experiments (N = 133 secondary school students) typical features of such animations were examined. In a 2 (presentation mode: static pictures vs. progressive drawing) × 2 (narrative context: with vs. without a narrative) between-subject design, motivational and cognitive processes as well as learning outcomes were examined. In both experiments, a progressive drawing as well as a narrative context helped to increase learning. These results are explained by varying motivational and cognitive processes.

Room: S0 10

Chair: Alexander Renkl

**The need for touch in learning. Cognitive and motivational effects of haptic learning materials**

*Michael Montag, Lena Büscher and Steffi Zander*

Not only does haptic interaction play a role in shopping or social interaction, but also in the learning context: a haptic representation could benefit learning success, motivation and cognitive load. In this context, the individual preference for haptic experience in learning could also influence the results. To investigate this, a study was conducted with 87 students using a mixed within-between design to convey knowledge about the structure and functioning of the heart and spine with haptic and pictorial representations of the organs. It could be shown that the different representations show no effect on the learning success but depending on the learning content they do affect the reported intrinsic motivation and cognitive load, more precisely the extraneous and the germane load, in favor of the haptic representation. Furthermore, it could be shown that haptic learning preference also has an influence on at least learner motivation.

**Object Manipulation in Immersive Virtual Reality: Expert Strategy Instruction influences Performance**

*Andrea Vogt, Tobias Drey, Michael Montag, Laura Steinherr, Nico Rixen, Enrico Rukzio, Steffi Zander and Tina Seufert*

Virtual reality (VR) environments offer new opportunities for mastering complex procedures (e.g. manipulating 3D objects). Novices might be confronted with challenges that they can overcome with the help of an expert. For example, expert strategy instruction might facilitate the performance of 3D object manipulations. Moreover, the available interaction techniques in VR play an important role in performing procedures. In our 2(expert strategy instruction) x3(interaction technique) mixed-design study, we investigated the effects on performance (accuracy, speed) and cognitive load (active, passive). Expert strategy instruction led to more accurate solutions and higher active cognitive load, while solution speed depended on the interaction techniques. Extended support approaches in the perspective of cognitive apprenticeship seem to be promising to improve speed as well as accuracy.

**Promoting a diagnostic strategy with modelling examples and self-explanation prompts in a simulation-based learning environment**

*Julius Meier, Peter Hesse, Stephan Abele, Alexander Renkl and Inga Glogger-Frey*

Self-explanation prompts in example-based learning are usually directed backwards: Learners are required to self-explain problem-solving steps just presented (retrospective prompts). However, it might also be helpful to self-explain upcoming steps (anticipatory prompts; Renkl, 1997). The effects of the prompt type may differ for learners with different expertise levels, with anticipatory prompts being better for learners with higher expertise (Renkl, 1997). In an experiment, 78 automotive apprentices learned about diagnosing car malfunctions. In two conditions, the apprentices learned with modelling examples and received either retrospective or anticipatory prompts. The third condition was a control condition without modelling examples. Here, participants worked with the same problems as the example groups. No positive effects of the modelling examples were found, but the anticipatory and retrospective prompts had differential effects on learning outcomes, self-efficacy, and cognitive load as a function of learners' prior knowledge. These findings suggest using different self-explanation prompts for learners with different levels of expertise.

### **Multimedia Learning Principles for Augmented Reality**

*Jule M. Krüger and Daniel Bodemer*

Augmented reality (AR) combines virtual and physical elements within a real-world environment. Within this context, it enables the combined presentation of verbal and pictorial, visual and auditory elements. The cognitive theory of multimedia learning (CTML) addresses design principles for combinations of text and pictures, which can basically also be applied to AR. In this presentation, we will describe exemplary studies implementing and examining two multimedia principles in the specific case of AR: the modality principle in the study solARsystem (N = 80) and the spatial contiguity principle in the study buildAR(N = 138). Results concerning cognitive load and learning outcomes in these studies show first indications for no support for the modality principle, but partial support for the spatial contiguity principle in these AR specific implementations. The implementation of the principles in AR will be discussed and recommendations for future research will be made.

**Slot A.3 Paper Presentation: Assessment of learning**

**13:30 – 14:50**

**Room:** Aula Magna

**Chair:** Julian Roelle

### **Quizzing Boosts Learning Gains and Efficiency in Six Sigma Continuing Education**

*Linda Froese, Vanessa Looock, Katharina Teich, Laura Czach, Sascha Draht, Markus Maier, Yves Gensterblum, Blanca Wannöffel and Julian Roelle*

Quizzing before and after studying new content is a widespread means to foster lasting learning. However, to date few studies have addressed the effects of quizzing in continuing education, which is why it is unclear whether quizzing would foster learning in this common learning setting as well. The present study faces this research gap by implementing pre- and postquizzes in an online Six Sigma continuing education program. N = 78 participants either passed the quiz-enhanced course (quizzing condition) or the regular course (control condition) before taking an immediate and an eight-week delayed posttest. We found that learners who received pre- and postquizzes showed higher learning gains and learning efficiency. These results contribute to filling the outlined research gap by showing that quizzing can effectively boost learning and improve its efficiency in continuing education settings as well.

### **Combining the Advantages of Open- & Closed-Book Quizzing: Starting with Open-Book Quizzing Supports Long-Term Learning**

*Sebastian Trentepohl, Roman Abel, Linda Froese, Svenja Heitmann, Rebecca Krebs, Niklas Obergassel and Julian Roelle*

Combining open- and closed-book quizzing formats can be theorized to foster long-term learning because of combining the respective advantages, establishing coherence of mental representation (open-book) and memory consolidation (closed-book). We addressed the research question of how to beneficially combine both formats in practice quizzing. We employed a 2x2 factorial between-subjects design with open-book format vs. closed-book format of the first and the second quizzing phases, respectively, followed by a one-week delayed test. Providing open-book quiz questions first supported the quality of answers in the first quizzing phase, improved the mental representation, as indicated by a higher retrieval success of open-then-closed-book group over closed-book twice group in the second quizzing phase, and in turn supported long-term memory and comprehension. However, we found no additional value of open-then-closed-book quizzing over open-book twice quizzing, probably because learners would mainly engage in practicing retrieval when repeatedly answering a quiz question.

### **Testing Compared to Learners' Standard Practice**

*Sophia Christin Weissgerber and Rummer Ralf*

Monday, August 22

For test-potentiated learning (TPL) to be justified as the recommended strategy in self-regulated learning, research has to show that TPL is superior to students' individual standard practices (home remedies). We present a (preregistered) online experiment (N = 153) comparing an unregulated control group (learners apply their individual activities), a TPL group without feedback, and a TPL group with feedback (manipulated between subjects) regarding delayed retention performance after two weeks. In the learning phase, participants had studied an expository text for 15 minutes (without incentives). Retention of the unregulated control group equaled TPL without feedback, while TPL with feedback was best. In the unregulated control group, learners mixed activities, primarily note-taking, rereading, and small dosages of TPL. Learners' JOLs for TPL with feedback were (accurately) higher than for TPL without feedback, but (inaccurately) highest for unregulated learning. Thus, TPL with feedback (which would be recommended for practice) outperformed learners' individual learning strategy.

*Short break*



**Room:** S0 06

### **On the When and Why Students (Under)Utilize Effective Learning Strategies**

Organizer: *Erdem Onan and Eva Janssen*

Discussant: *Dr. Mariëtte van Loon*

Chair: *Tamara van Gog*

In higher education, students spend considerable self-study time, where learning takes place without the explicit guidance of teachers. During this unsupervised learning, how students' study has strong implications for their educational outcomes, since study methods (learning strategies) differ in their effectiveness to promote long-term learning (Dunlosky et al., 2013). Recent research, however, indicates that how students' study is far from perfect: Typically, students underutilize the learning strategies characterized as effective (Blasiman et al., 2017). For example, in category learning, students heavily rely on blocked practice (i.e., grouping the study materials of to-be-learned categories together), even though interleaved practice (i.e., alternating between the study materials of to-be-learned categories) leads to more durable learning (Bruinmar & Richter, 2019). Because the nature of these poor study decisions remains unclear, the present symposium aims to extend our understanding of when and why students (under)utilize effective learning strategies. Contributions 1 and 2 focused on potential reasons for why most students prefer blocked practice over interleaved practice. Contribution 1 investigated how students' perceived effort during studying was related to their perceived learning, to their perceived effectiveness of the used strategy, and to their willingness to use that strategy again. Contribution 2 investigated the role of learners' motivation to avoid confusion and learners' awareness of that detecting subtle differences matters. Contribution 3 focused on whether students can be trained to use interleaved practice. This study tested the effects of minimal strategy instruction and metacognitive prompts on learning strategy decisions. Contribution 4 will discuss the symposium's theme at a more general level, also taking the balance between task characteristics and learners' resources into account. This contribution conducted a study to validate a theory on the interplay between Cognitive Load, learners' resources, and their effective use of self-regulation strategies. Finally, our discussant – expert in the field of self-regulated learning – will discuss the four contributions and will provide critical comments.

Students' Effort Regulation during Blocked and Interleaved Practice

*(Janssen E, Van de Groep L, De Lange A, Onan E, Wiradhany W, De Bruin A, Van Gog T & EFG-MRE)*

Unmotivated and Unaware? Reasons for Disuse of Interleaving in Learners' Study Sequence Choices

*(Roman Abel & Julian Roelle)*

Instruction Meets Experience: Using Minimal Strategy Instructions and Metacognitive Prompts to Improve Study Strategy Decisions

*(Erdem Onan, Wisnu Wiradhany, Felicitas Biber, & Anique de Bruin)*

The interplay between Cognitive Load, learners' resources and self-regulation

*(Tina Seufert, Verena Hamm, & Andrea Vogt)*

**Room:** Aula Magna

## **Indirect Benefits of Retrieval Practice in Comprehensive Learning?**

Organizer: *Veit Kubik and Tino Endres*

Discussant: *Prof. Shana Carpenter*

Chair: *Veit Kubik and Tino Endres*

It is a well-established finding that retrieving information from memory has a direct benefit on retention, including in real-world environments with authentic educational materials (Yang et al., 2021). Beyond this direct effect, retrieval practice also enhances subsequent, remedial learning relative to restudy– the so-called indirect effect of retrieval practice. As shown in a recent meta-analysis (Rowland, 2014), the effect size of retrieval practice on later test performance nearly doubles when adding one or more relearning opportunities, specifically when retrieval success is low. However, the indirect testing effect has received only scarce attention in more real-world educational scenarios (e.g., when using more complex and exam-relevant materials or during self-study). The main aim of this symposium is to investigate the indirect effects of retrieval practice on metacognition, the value of retrieving previously learned materials, and future learning of new materials. We present studies from different international labs that provide insights into these different aspects and educational implications of indirect retrieval-practice effects and their underlying metacognitive and motivational mechanisms (Endres et al., 2020). Contribution 1 investigates the efficacy of covert versus overt retrieval on metacomprehension. The results show that only overt retrieval exhibits metacognitive benefits. Contribution 2 investigates the indirect retrieval effect on both metacognitive control (i.e., remedial learning time) and text comprehension as well as its motivational and metacognitive mechanisms. Contribution 3 widens the scope and examines how to enhance students' self-regulated use of retrieval practice by providing strategy support. Finally, Contribution 4 analyses the future-oriented retrieval-practice benefits on subsequent learning of new text materials and unpacks the underlying mechanisms of this forward effect of retrieval practice. All four contributions rely on well-designed and innovative experimental studies that cover different aspects of and approaches to the indirect retrieval-practice effects. At the end, Shana Carpenter integrates and discusses these four contributions from different theoretical, methodological, and practical perspectives. As an expert in the field of learning and instruction, and specifically on retrieval practice, she will offer insights on how to maximize the potential of retrieval practice, and how to effectively combine both their direct and indirect effects with complex materials and in educational settings.

**The Effects of Covert Retrieval on Metacomprehension and Text Learning**

*(Hannah Hausman, Hannah Trillo & Veit Kubik)*

**The Indirect Benefits of Testing in Self-Regulated Learning with Text Materials**

*(Tino Endres, Veit Kubik, Kirsten Berthold & Alexander Renk)*

**Effects of Strategy Support on Self-regulated Use of Retrieval Practice in Higher Education**

*(Marloes Broeren, Peter Verkoijen, Guus Smeets & Lidia Arends)*

**The Indirect Retrieval Practice Effect on Learning New Text Materials: The Forward Testing Effect in Tertiary Education**

*(Veit Kubik, Hannah Hausman, Florian Hahne, & Robert Gaschler)*

**Slot C1: Demonstrations**

**17:00 – 18:00**

**Room:** Aula Magna

### **Designing an app that supports school children's self-regulated learning in digital environments.**

*Lea Nobbe, Jasmin Breitwieser, Daniel Biedermann and Garvin Brod*

Self-regulatory abilities are a prerequisite for successful learning. Especially when learning with apps and other digital media, children are often learning in a self-directed manner. They are then also responsible for planning, monitoring, and judging their own learning activities. However, children often do not yet possess the self-regulatory ability to successfully complete said tasks. Within the project "PROMPT", we develop an app supporting children in their self-directed learning within digital environments. One major component of this support are prompts, intended to stimulate self-regulated learning. The app is tested and optimized over the course of multiple studies, two of which have already been completed. Once finalized, the app will include effective interventions targeting children's self-regulated learning and fostering children's distributed practice. The final version of the app will be available as an open educational resource.

### **Inquiry Learning Spaces for Introductory Quantum Physics Education**

*Luiza Vilarta Rodriguez, Jan van der Veen and Ton de Jong*

This contribution demonstrates a series of online lessons designed to teach introductory quantum physics topics using principles of inquiry-based learning. The online environments, created in the Go-Lab ecosystem ([www.golabz.eu](http://www.golabz.eu)), are designed to structure and guide a collaborative, student-led investigation of different quantum physics phenomena via instructionally embedded virtual labs that help the students conduct their investigation. In this submission we briefly lay out the context of introductory quantum physics education, define inquiry-based learning and describe the structure of our lessons. We also outline how our lessons can be used by instructional designers, researchers and teachers to investigate the learning of other highly complex topics.

### **LearningView a tool for individualized and self-organized learning and teaching in primary education**

*Michael Hielscher, Beat Döbeli Honegger and Doreen Prasse*

More and more schools start using digital devices in primary grades and 1:1 equipment is becoming more common in Switzerland. In 2016 we started the development of the digital learning tool LearningView especially designed for a 1:1 setting and for the hand of the children as a personal learning companion. In a design-based research approach we try to find the right balance between usability for young children and the complexity of a learning management system for general learning purposes. The tool is developed and operated as software as a service (SaaS) by the Schwyz University of Teacher Education. It is being used by thousands of teachers in Switzerland, providing a fruitful basis for research projects that can be conducted under real school conditions. A brief example of a research project based on LearningView as research tool is given. Finally, a software plugin design for research purposes within LearningView is discussed.

### **SCINE Interactive: A quantum-based virtual learning environment for chemistry with haptic feedback**

*Charlotte H. Müller, Manu Kapur and Markus Reiher*

Haptic feedback has been considered to be a facilitator for learning in multiple ways. On the one hand, the haptic feedback can connect multiple representations and scaffold their integration. On the other hand, haptic feedback creates grounding opportunities according to the theoretical framework of grounded cognition. Haptic learning environments are therefore particularly promising when it comes to abstract concepts such as those often encountered in chemistry. To this end, we introduced a real-time haptic quantum chemistry learning environment to bachelor chemistry students.

Room: Piazza

### 1. Conceptualizing the Mobile-Learning Adoption Process in Teacher Education in the COVID-19 Era

*Rivi Frei, Yulia Muchnik-Rozanov and Orit Avidov-Ungar*

Using mobile learning (ML) has become exceedingly relevant in times of distant teaching. Although much is known about the factors affecting ML usage, less is known about the ML adoption process under constraints such as the COVID-19 pandemic. The aim of this exploratory case study was to gain insight into the ML adoption process using the lens of Rogers' Diffusion of Innovation Theory. Participants were in-service (32, IST) and preservice (29, PST) teachers who attended ML training. Data were collected using semi structured interviews (20), focus groups (6), and participants' reflections (183) at three time points. Data underwent multilevel analysis (content and linguistic analysis), revealing 12 themes that denote the ML adoption process. The study provides theoretical insight into the ML adoption process under crisis and highlights the features that must be addressed to promote optimal ML adoption in teacher education in both routine and emergency conditions.

### 2. Describing and understanding the role of artefacts in the construction and regulation process of the Personal Learning Environment

*Laura Molteni*

This poster presents an exploratory study on the interaction between learners and their Personal Learning Environment (PLE). The theoretical framework adopts an original approach to environmental self-regulation by relating it to the theory of distributed cognition (Pea, 1993). Considering the PLE as the pragmatic extension of what Perkins (1993) defines the person-plus, we focus on the idea of the distribution of executive functions between learners and the environment. This distribution is described based on qualitative data collected from learners at each educational level, from primary to university (Felder et al., 2020), and analyzed with an adaptation of a theoretically based system of categories describing a learning practice and representing it visually. In learning situations, which factors, and conditions are involved in the process of construction and regulation of learning instruments (Rabardel, 2005)? In this process, which are the indicators of the distribution of the executive function (Perkins, 1993) between learners and artefacts?

### 3. Design of Learning Activation and Interaction with myScripting

*Claude Müller and Jennifer Erlemann*

Learning activation and interaction is of central importance in the design of digital learning. The educational design tool myScripting supports this challenge by systematically developing the activities and thus the learning process. Information on the activities for activation, interaction and assessment of learning is provided adaptively. These activities are presented visually in different ways in the design board in comparison with the content delivery, and the corresponding workload is continuously analyzed and shown in relation to the content delivery. In addition, the design of learning assignments in the sense of the ICAP model, especially as an extension to content delivery activities such as instructional videos or instructional lectures, is promoted via suggestions and, in turn, the proportion of active, constructive and interactive learning assignments is reported. With its diverse support and analysis functions, the educational design tool myScripting promotes the systematic development and reflection of activating online and blended learning environments.

### 4. Does providing static visualizations as feedback help school-age students improving their spatial navigation in a virtual environment?

*Sandra Berney, Fatou-Maty Diouf, Sophie Bénard Linh-Quang, Sylvia Coutat, Mireille Bétrancourt and Roland Maurer*

Children's daily lives are surrounded by technologies and virtual environments (GPS, Google earth, video games, etc.), which significantly modify some of their spatial behaviors. Primary education rarely provides spatial training by teaching situations involving interactions between map readings and navigation in virtual environments. In this study school-aged students were presented with an innovative learning virtual environment for training spatial navigation, which was coupled with static visualization feedbacks displaying sequential/simultaneous static visualizations of their navigation activity. It was expected that school-aged students would understand their mistake: i.e. the location of the incorrect (quarter) turn, enabling them, then, to pass that intersection correctly. Unfortunately, findings did not support this hypothesis. Findings as well as theoretical and practical implications will be further discussed.

### 5. Does sequentially combining generative and retrieval practice tasks foster the acquisition of declarative concepts?

*Niklas Obergassel, Alexander Renkl, Tino Endres, Matthias Nückles, Shana Carpenter and Julian Roelle*

Declarative concepts play a key role for learning in numerous domains. When it comes to promoting their acquisition, generative learning tasks and retrieval practice tasks have been found to be beneficial. Building on the theoretical complementarity of their functions (generative learning tasks: knowledge construction; retrieval practice tasks: knowledge consolidation), researchers have recently started to investigate the benefits of combining the two task types. Nevertheless, research on how to effectively combine the two task types in learning declarative concepts is still in its infancy. The present study aims at contributing to this emerging field of research by investigating the benefits of combining the two task types sequentially. To do so, an experiment with  $N = 199$  university students and a 5x2-between-subjects design with the factors sequence of learning tasks and posttest timing will be conducted. Data acquisition is scheduled to start in April 2022.

### 6. Effectivity of a Virtual Reality car workshop for the learning of automotive mechatronics

*Rita Cosoli, Alessia Coppi and Martin Dobricki*

The reflection on the purpose of educational technologies for the training of apprentices is an ongoing process in Vocational Education and Training (VET). In this study we have investigated if there was a difference between an immersive Virtual Reality (VR) system and a desktop-based VR system, when using them to train apprentices in automotive mechatronics. We found that using the VR system resulted in fewer errors in the execution of simulated mechatronic work and in a greater sense of presence in terms of feeling part of the virtual environment. This was probably facilitated by taking a first-person perspective in the immersive environment. These results are promising for the use of VR in training programs of automotive mechatronics.

### 7. Gestures by teachers in German as a second language classes

*Moritz Sahlender and Inga ten Hagen*

Teachers' use of gestures in their instruction can support the language acquisition of learners in German as a second language (GSL). Depending on learners' language skills, different types of gestures are considered to facilitate successful language comprehension. This study investigates which gestures teachers use in GSL classrooms and whether teachers adapt their gestures to learners' language skills. Therefore, teacher gestures of 10 videorecorded integration and preparation classes in Germany were analyzed. Two coders were able to reliably identify 4143 gestures ( $\kappa=.82$ ). Results showed that GSL-teachers predominantly used deictic gestures, metaphorical gestures, and head movements. Moreover, between-learner variability of the use of deictic and metaphorical teacher gestures was significantly explained by teacher-perceived German language skills of the learners. These results indicate that teachers can systematically adapt some types of gestures in GSL classes, thus emphasizing the importance of studying nonverbal interactions for a better understanding of language acquisition processes.

### 8. How task-based factors influence retrieval practice choice?

*Tian Fan, Luotong Hui, Liang Luo and Anique B.H. de Bruin*

Although retrieval practice is a more effective learning strategy than restudying, students often prefer restudying during self-regulated learning. Kirk-Johnson et al. proposed the misinterpreted effort hypothesis to explain this process, but they investigated factors affecting learning strategy choices at the strategy level. The present study will focus on the learning task level and has two main aims. The first aim is to gain insight into how an important factor at the learning task level (i.e., item difficulty) affects participants' learning strategy choices (i.e., retrieval practice vs. restudies). The second aim is to investigate how task-based mental effort and perceived learning vary with item difficulty, and how these three task-based factors relate to students' retrieval practice choices. The findings of this study will help educational practitioners to further understand students' retrieval practice choices and will contribute to understanding how to improve the use of effective learning strategies during self-regulated learning.

### **9. Instructional knowledge: examining the level of sophistication of university students' overarching knowledge of instruction**

*Morane Stevens and Jan Elen*

A substantial body of research indicates that students' knowledge on the functionality of (Components of) learning environments is limited. Moreover, the nature of students' so-called "instructional knowledge" can hinder their use of these components that support their learning, which in turn negatively affects learning outcomes. However, findings regarding these effects are ambiguous, leaving the role of instructional knowledge within the learning process highly contested. This contribution argues that findings are most likely distorted due to some fundamental issues within current studies on instructional knowledge. Furthermore, this study aims to address these shortcomings by systematically examining instructional knowledge and its precursors, using a drawing task, a series of instructional design tasks and a subsequent interview in which students reflect on all of these tasks.

### **10. Interest Development in VR: Findings from VR Learning Environments With and Without Laser-Scanning**

*Maximilian C. Fink, Volker Eisenlauer, Diana L. Sosa and Bernhard Ertl*

The present study investigates to what extent Virtual Reality (VR) can induce situational interest and what variables explain situational interest. Further, a new method of content creation is considered. In addition to the established 3d modeling method, the emerging laser-scanning method enables the creation of authentic VR. Consequently, a randomized controlled trial with N = 45 educational science students as participants and a pre- and posttest was conducted. The control group faced a learning environment created through 3D modeling. The intervention group encountered a learning environment created by laser-scanning. Interest increased from the pre- to the posttest in the full sample. This result adds new empirical support that VR can induce situational interest. Moreover, posttest interest was explained by pretest interest and presence. This finding identifies presence as a new important variable to consider when explaining interest development.

### **11. Learning to diagnose cases collaboratively in medicine: Who benefits from structured reflection and collaboration scripts in simulations?**

*Constanze Richters, Matthias Stadler, Anika Radkowitzsch, Felix Behrmann, Marc Weidenbusch, Martin R. Fischer, Ralf Schmidmaier and Frank Fischer*

This study examined the effects of structured reflection and collaboration scripts on collaborative diagnostic skills of medical students with varying levels of prior knowledge in simulations. 151 advanced medical students were asked to diagnose patients in collaboration with an agent-based radiologist. Meanwhile, learners either received reflection prompts, collaboration scripts, both, or no support. The results showed that structured reflection with, and without collaboration scripts enhances specific diagnostic sub-skills only of learners with high prior knowledge indicating that students need sufficient knowledge levels to benefit from structured reflection as it builds on a rather high level of self-regulation. Future research should address reflection designs that could compensate for disadvantages for learners with low prior knowledge.

### **12. Supporting Preservice Teachers in Creating High-Quality Instructional Videos**

*Malte Ring and Taiga Brahm*

Instructional videos have become a very popular teaching and learning tool. More and more teachers either use existing videos from the internet or develop instructional videos, in which they explain domain concepts or principles. Whether these videos are effective, however, depends on their instructional quality. To support preservice teachers in creating a high-quality video, we conducted a training as part of a larger course that was dedicated to the use of digital media in economic education. We compared the instructional quality of videos developed by future economics teachers (N=24) before and after the training period. To assess the quality of the videos, twelve criteria from five areas (content, learner orientation, representation and design, language, process structure) were rated based on a previously developed framework. We identify small improvements regarding the overall instructional quality. Our findings, therefore, suggest that preservice teachers can be supported in creating high-quality instructional videos.

### **13. Testing and supporting Japanese elementary school students' phonological awareness with a bespoke web application**

*Kaori Nakao, W. L. Quint Oga-Baldwin, Alex Shum and Luke K. Fryer*

Background: Phonological-awareness is the awareness and understanding of the sounds of many languages; it is an established fundamental for all later language development. Students (especially young learners) in many foreign language learning contexts do not get sufficient quantity or quality of opportunity to develop this awareness. This project was designed to address this gap with a web application to support elementary school students' phonological-awareness.

Aims: The present intervention was undertaken as a trial of the new software and progressive testing of students' phonological awareness.

Methods: The web application was trialed with 16 classes (years 3-6) from two elementary schools in Japan over a four-month period. Intermittent testing in addition to activities designed to support phonological awareness were conducted weekly during class.

Results: Findings will both signal the current state (and development) of Japanese elementary school students' phonological awareness and provide feedback for the enhancement of the trialed software.

### **14. The Effect of Worked Examples and Retrieval Practice on Primary School Students' Mathematical Problem-Solving Performance**

*Sterre Ruitenburg, Gino Camp, Paul Kirschner and Halszka Jarodzka*

To help students acquire (mathematical) problem-solving skills, two practice strategies are generally effective: practicing through worked examples and practicing through retrieval practice. To better understand what strategy works under which conditions, we integrated two existing perspectives into one new model. In this model, we argue that the optimal practice strategy depends on the complexity of the learning task and the time between the last practice opportunity and the test (i.e., the retention interval). We propose a preregistered multi-classroom experiment to test this model. More specifically, we plan to use a 2 (Task Complexity: simple vs. complex) x 2 (Practice Strategy: worked examples vs. retrieval practice) x 2 (Retention Interval: 5 minutes vs. 1 week) between-subjects design (N = 176). We also plan to perform a Bayesian 2 x 2 x 2 ANCOVA on participants' problem-solving performance to test the hypothesized three-way interaction effect.

### **15. TPACK, contextual knowledge, and teaching experience: comparing novice, experienced preservice, and inservice teachers**

*Eliana Brianza, Mirjam Schmid, Jo Tondeur and Dominik Petko*

The technological pedagogical content knowledge framework describes the complex domains of knowledge teachers rely on for teaching with digital technologies. In this study, we attempted to disentangle the effects of formal training and teaching experience on the interplay of these knowledge components by comparing novice preservice teachers (without teaching experience) to experienced preservice teachers (with prior teaching experience) and in service teachers (with regular teaching experience). Findings indicate that, independent of formal training, experience is positively related to education-specific knowledge domains.

### **16. Using 360-degree video to support simulation-based analytical observation in healthcare: the role of immersion, sense of presence and cognitive load**

*Francesca Amenduni, Vito Candido, Rita Cosoli and Alberto Cattaneo*

The aim of the contribution is to explore how 360-degree video (360°V) could be exploited to enhance the quality of analytical observation of apprentices in a VET healthcare simulation-based learning activity. Specifically, we would like to understand how immersion and sense of presence affect the quality of analytical observations while watching a 360°V recorded simulation of a venipuncture. Two classes will be involved in the experimentation (N = 32). Simulations will be video recorded through 360° cameras. The videos will be used to ask participants to analytically observe the simulated professional situations and identify relevant details. Participants will be assigned to two conditions: watching the video through a desktop pc and its screen or through a head mounted display (HMD). Results will be presented during the conference.

### 17. Utilizing gamified formative assessment to support English language learning in schools

*Chunqi Li, Luke K Fryer and Samuel K.W. Chu*

Gamified formative assessment has been increasingly popular within English language education due to its potential to promote learning processes. However, no existing review was identified to synthesize the effectiveness of gamified formative assessment for English language learning, especially for school-aged learners. This scoping review contributes to the extant literature by providing a comprehensive overview concerning how gamified formative evaluation affects children's English learning outcomes and ascertaining relevant research gaps. This scoping review draws on 30 interventions from 25 articles between 2008 and 2021. The results indicated: (1) vocabulary and grammar were the dominant addressed skills; (2) immediate simple feedback was the most common feedback type; (3) gamified formative assessment was normally beneficial to young English learners. However, the actual usefulness of this teaching tool requires further examination because many reviewed studies had methodological and theoretical weaknesses.

### 18. Examining the effects of grade goals on beliefs and motivations in first-year higher education with a bespoke online testing platform

*Alex Shum, Luke Fryer and Chi Wing Wong*

*Background:* Students arrive at university with varying readiness to navigate high-stakes large-enrolment courses. Declines in students' ability beliefs, motivations and achievement are well documented. A bespoke mobile testing platform is used to moderate these declines through automated large-scale feedback comparing goals and formative testing performance. *Aims:* The experimental effects of grade-goals on course self-efficacy beliefs, domain interest, and achievement across a large first-year university mathematics course were tested using the platform, offering unintrusive, anonymous, and automated student experiences. *Methods:* The platform enabled participants (n=175) to complete a pretest, three surveys, and four formative tests. Participants were randomly assigned to make explicit performance goals or receive no goal-setting instructions. Fully-forward Maximum-Likelihood SEM was employed. *Results:* Grade-goals predicted middle-of-term course self-efficacy beliefs, a known predictor of achievement. Grade-goals did not predict end-of-term self-efficacy but negatively predicted interest. Platform improvements including at-scale out-of-class mastery testing and enhanced visualization of peer achievement are proposed.

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**Social Evening**

18:00 – open end

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**Slot D.1: Symposium**

**09:00-10:30**

**Room:** Aula Magna

**New ways to investigate teachers' and students' technology use - Applying the ICAP model to TEL research**

Organizers: *Michael Sailer Christina Wekerle and Dominik Petko*

Discussant: *Teemu Valtonen*

Chair: *Dominik Petko*

Digital technologies are believed to facilitate student learning in schools and in higher education (Sung et al., 2016). However, technology use per se does not necessarily lead to better learning processes and outcomes. Research shows that the types of learning opportunities provided by teachers and the resulting learning activities of students are critical to effective learning (e.g., Chien et al., 2016; Schmid et al., 2014). A systematic way to differentiate student learning activities and cognitive engagement is the ICAP model (Chi & Wylie, 2014). ICAP differentiates between passive (P), active (A), constructive (C), and interactive(I) learning activities. The model assumes that students' learning gains increase with the level cognitive engagement ( $P < A < C < I$ ). In this symposium, we want to illustrate how the ICAP model can help to measure and understand technology use in classrooms. The four studies elaborate on several aspects of using ICAP in the context of technology enhanced teaching and learning: the measurement of digital learning activities, the relationships of learning activities and learning outcomes, and recommendations on how to effectively use technology in classrooms. The first paper introduces the validation of an instrument to assess technology-enhanced learning activities along the ICAP framework from the teachers point of view (Antonietti et al.). The second paper investigates the association between technology-enhanced ICAP learning activities and students' cognitive and affective learning outcomes in higher education (Wekerle et al.). The third paper illustrates how the technology-enhanced ICAP learning activities moderate the connection of students' learning effort and cognitive activation. Finally, the fourth paper is a systematic review of a meta-analyses on technology use in higher education. It uses ICAP to compare the learning activities of the experimental and control groups to delineate recommendations for technology use (Sailer et al.) The symposium seeks to provide guidance on how to use ICAP as a conceptual model to unfold the full potential of digital technologies in classrooms and to provide instruments and approaches for measuring and fostering technology use based on student learning activities. Teemu Valtonen will provide a critical perspective on our use of ICAP in the different projects.

The ICAP Technology Scale to measure how teachers integrate technologies in Swiss upper-secondary schools  
(*Chiara Antonietti, Maria-Luisa Schmitz, Tessa Consoli, Alberto Cattaneo, Philipp Gonon & Dominik Petko*)

Technology-Enhanced Learning Activities, Cognitive and Affective Motivational Learning Outcomes in Higher Education – How are they related?  
(*Christina Wekerle, Martin Daumiller & Ingo Kollar*)

How Cognitively Activating was Digitized Instruction During School Closures and how can Teachers be Supported?  
(*Tim Fütterer, Emely Hoch, Andreas Lachner, Katharina Scheiter & Kathleen Stürmer*)

A Systematic Review of Meta-Analyses on the Effects of Digital Technology from a Learning Activity Perspective  
(*Michael Sailer, Rebecca Maier, Sonja Berger, Tamara Kastorff & Karsten Stegmann*)

Room: S0 10

**How to Beneficially Integrate Retrieval Practice Into Established Educational Activities?**

Organizers: *Julian Roelle and Roman Abel*

Discussant: *Lennart Schalk*

Chair: *Julian Roelle*

The benefits of engaging learners in practicing retrieval of knowledge from memory is beyond dispute. It is well established that retrieval practice enhances lasting learning (e.g., Karpicke, 2017; Rowland, 2014). However, there is still a paucity of research concerning whether and how retrieval practice can be integrated into established educational activities such as watching instructional videos, learning from multimedia learning material, or learning by teaching in beneficial ways. Against this background, the aim of this symposium is to extend our knowledge on how to integrate retrieval practice into different established educational activities in beneficial ways. Contribution 1 investigates whether learners should be engaged in retrieval practice prior or subsequent to restudy to enrich learning from instructional video with respect to learning outcomes and perceived competence. Contribution 2 analyzes whether the effectiveness of multimedia learning can be enhanced by retrieval practice and whether learners are aware of these potential benefits. Contribution 3 investigates the effectiveness of non-interactive learning by teaching in dependence of whether learners are required to practice retrieval while generating their explanations or not (open-book vs. closed-book explaining). Finally, Contribution 4 analyzes whether reading interleaved expository texts can be enriched by retrieval practice to good effects and whether, in this context, retrieval practice can be optimized by varying the sequence of the to-be-retrieved information in an interleaved manner. The four contributions, which all involve soundly designed experimental studies, take different theoretical perspectives and hence illuminate the symposium's main topic from different angles. The four contributions will be discussed by Lennart Schalk, who is highly knowledgeable in the field of teaching methods and instructional design in school learning. Thus, his view on the presented research will certainly help to draw fruitful conclusions on beneficial ways of how to integrate retrieval practice into existing educational activities

Effects of Enriching Instructional Video Learning with Retrieval Practice Before or After Restudy on Learning and Motivation

*(Vincent Hoogerheide & Kim van Lieshout)*

Adding retrieval practice to multimedia learning: A synergistic combination for text recall and comprehension?

*(Veit Kubik, Florian Hahne, Kirsten Berthold & Robert Gaschler)*

It's better when I see it: Students benefit more from open-book than closed-book explaining

*(Leonie Jacob, Logan Fiorella & Andreas Lachner)*

Effects of Incorporating Interleaving Into Retrieval Practice

*(Roman Abel & Julian Roelle)*

*Coffee break*

*10.30 – 11:00*

**Room:** S0 06

**Chair:** Mariane Frenay

**Visualizing Effect Sizes for Science Communication: Which Plot Types and Enrichment Options Support Sense-Making?**

*Jürgen Schneider, Kirstin Schmid, Andreas Lachner and Samuel Merk*

Effect sizes are a key piece of information in scientific evidence. Science communication aims to provide this information in a way that is easy to understand. In three studies, we are exploring ways to visualize effect sizes to support teachers' sense-making from effect sizes. In a completed pilot study, four data visualization experts collected and ranked 44 visualization types suitable for the target audience of teachers. The four most promising visualization types are examined in Study 1 for their ability to promote information processing (cognitive load), understanding (sensitivity, accuracy, efficiency), and derivation of practical implications (consequences for practice, relevance to practice, likelihood of implementation) in student teachers. Study 2 explores the additional enrichment options of 'benchmarking' and 'textual cues' for visualization and their effect on information processing, comprehension, and derivation of practical implications. The findings hold potential for evidence-informed practice and school development, as well as for professions beyond teaching.

**Comparing example-based learning, perceptual learning and adaptive stepped supporting tools to support students in organic chemistry**

*Gyde Asmussen, Marc Rodemer and Sascha Bernholt*

Organic chemistry poses a variety of challenges for students at university level. For example, students have difficulties deriving relevant information from representations commonly used in organic chemistry and applying their knowledge to solve tasks. The theoretical assumptions and foundations of the two instructional approaches perceptual learning and example-based learning each fit one of students' particular difficulties, but the approaches have not yet been tested in this discipline and rarely in combination. In this project, therefore, we aim to quantitatively investigate how these instructional approaches impact students' performance in organic chemistry. Since there is also evidence that students need support adapted to their individual prerequisites, we will integrate both instructional approaches into adaptive stepped supporting tools and include them in the quantitative comparison. In the following, we present the planned research design and possible results, these will be discussed at the conference.

**Conceptual learning process of Corporate Social Responsibility: specific role of scientific input and content-related debates in a MOOC**

*J Pauline de Montpellier d'Annevoie, Valérie Swaen and Mariane Frenay*

This paper investigates the development of knowledge about essentially contested concepts in Massive Open Online Course (MOOC). We aim to evaluate how the perceptions evolve with scientific input of academics and experts and content-related debates between individuals in a MOOC, in the light of two socio-constructivist theories: conceptual change and socio-cognitive conflict. We focus on two MOOCs on the concept of Corporate Social Responsibility (CSR), which is perceived differently among individuals and is subject of debates. We analyze the messages shared in the MOOC discussion forums and conduct semi-directed interviews with former learners to gather information about the potential evolution of their CSR perceptions and the role of the MOOC scientific content and of debates in forums in this process. The expected contributions concern the discussion of the strengths and limitations of today's MOOCs in the necessary co-construction of knowledge for learning essentially contested concepts.

**Slot E.2: No-or-not-perfect data presentations: Validation and assessment** 11:00 – 12:00

**Room:** S0 10

**Chair:** *Julian Roelle*

**A first validation of the Gamification User Types Hexad scale for the context of digital learning systems**

*Simon Schultze and Jan Hochweber*

Gamification is used in a variety of application contexts, including digital learning systems. However, different users prefer different gamification elements. The popular Gamification User Types Hexad model (Marczewski, 2015) distinguishes six player types. A corresponding instrument, the Hexad scale, was developed and empirically studied by Tondello et al. (2016, 2019), but not specifically for digital learning systems. In this study, students in German-speaking Switzerland/Liechtenstein from 18 classes in the most academically demanding school type work on the Hexad scale and report on their preferences for gamification within a newly developed digital learning system (“Lernnavi”). Based on confirmatory factor analyses, the data are analyzed with respect to fit to the Hexad model, complemented by latent profile analyses of the Hexad subscales to identify different player profiles. Moreover, the relationships of the Hexad subscales and player profiles to students’ preferences for gamification elements in digital learning systems will be explored.

**Leveraging the Testing Effect using Parametrized Tasks in Learning Management Systems**

*Carolin Baumann and Samuel Merk*

The learning-promoting effects of carrying out practice tests are still clearly underestimated (Dunlosky & Rawson, 2015), at least if one looks at the rather low frequency of use by both, teachers and learners. Furthermore, in research, there is only a slow move away from experimental laboratory studies towards ecologically valid work in application contexts (Schwerter, Dimpfl, Bleher & Murayama, 2022). Hence, we want to answer the question which role tests (quizzes) can play as a supplement to online blended learning concepts to boost learning effectiveness in a group of student teachers. We also investigate the relationship between learners’ motivation and the use of parametrized tasks (with wildcards) as opposed to fixed task sets. The present study aims to further support the practical importance of the testing effect and should enable well-founded decisions to be made for one's own teaching and learning planning in online settings.

*Lunch break*

*12:00 – 13:00*

Keynote  
Aula Magna

13:00 – 14:00

*Prof. Dr. Jürg Schweri, SFUVET, Switzerland*

### **An economist's view on the changing world of work, skills and education**

The keynote begins with an overview of the much-discussed change in labor markets worldwide, namely the change in the composition of work tasks due to technological, economic and social developments. In many countries, these changes are also leading to a problematic polarization between high-skilled and low-skilled work. These developments pose challenges for education systems to prepare students for lifelong careers in dynamic labor markets. One controversial argument in the literature is that vocational education does not provide enough transferable skills to ensure long-term flexibility and mobility in the labor market. This argument relies on certain assumptions about the skills needed to adapt to new situations, which seem to be under-researched in the vocational context. The talk discusses results on how graduates from general and vocational education fare on labor markets and ends with reflections on how research from different disciplines can inform the public debate on change, education systems and lifelong learning.

*Short break*

**Room:** S0 06

**Chair:** Andreas Lachner

**Effects of Prior Instruction and Elaborated Feedback on Students' Learning**

*Salome Wagner, Leonie Jacob, David Weiler, Jan-Philipp Burde, Vincent Hoogerheide, Katharina Scheiter and Andreas Lachner*

Instruction and feedback are powerful strategies to enhance learning. A combination of those strategies is often recommended, however, it is unclear, whether it contributes to learning. Investigating combination effects, we conducted experiments (N1 = 439, N2 = 310), crossing two factors: prior instruction (strategy versus control) and feedback (yes versus no). In Experiment 1, we found a main effect of instruction for far transfer that was qualified by a significant interaction, as the instruction effect was reduced when feedback was given. To rule out, whether the interaction effect resulted due to low-level feedback, in Experiment 2, we aimed at replicating the obtained effect with high-level feedback. We found a main effect of feedback on near transfer. For far transfer, we replicated a main effect of instruction; the interaction effect was no longer significant. Our findings suggest that the instruction-feedback-combination does not contribute to learning. Additional mediation analyses will be presented.

**Do Rubrics Enhance Self-Assessment Accuracy and Regulation?**

*Rebecca Krebs, Björn Rothstein and Julian Roelle*

Rubrics are a widespread means to enhance task performance. However, the mechanism via which rubrics exert their beneficial effects is still unclear. Frequently, the benefits of rubrics are attributed to beneficial effects on self-assessment accuracy, which, in turn enhances regulation. The present experiment was designed to test this potential mechanism. 116 students read a scientific article and were told to write an abstract for it. Afterwards, they self-assessed their performance, dependent on the condition, the learners were supported by a rubric during self-assessment. Then, all learners could choose to receive further instruction and were provided the opportunity to revise their abstracts. We found that rubrics fostered self-assessment but did not enhance subsequent regulation. These results question the above-mentioned potential mechanism via which rubrics affect task performance. However, in the present study the learners could not access the rubrics during revising their abstracts, which might have limited the benefits of rubrics.

**Combining active and passive tasks to improve visual learning in skin lesion classification**

*Nadja Beeler, Esther Ziegler, Alexander A. Navarini and Manu Kapur*

Developing visual skills is an important, but challenging task for students in various medical fields. In dermatology, for example, learning to discriminate between benign and malignant skin lesions is crucial. We investigated how findings from the learning sciences, namely from research on interleaving and on problem-solving prior to instruction, may improve visual learning in skin lesion classification. Concretely, we compared four experimental groups learning from either mere passive tasks, passive tasks followed by active tasks, active tasks followed by passive tasks, or mere active tasks. We found that for difficult-to-classify skin lesions, interleaving passive tasks and active tasks lead to greater long-term performance improvement than blocking one of these task types. Additionally, we observed that active tasks prior to passive tasks, as in problem-solving prior to instruction learning designs, outperformed passive tasks prior to active tasks. Our findings will inform the development of an online learning tool for medical education.

**Room:** S0 10

**Chair:** Sandra Berney

**Can an augmented reality escape game help to fight fake news?**

*Josef Buchner*

The deliberately dissemination of fake news is a challenge for societies worldwide. Consequently, promoting digital literacies becomes highly important in education. Recently, problem- and game-based learning approaches were proposed as effective methods to do so. However, empirical results proving this claim is scarce. Therefore, this research study investigates if an augmented reality (AR) escape game, Escape Fake, can help to fight fake news. A total of 28 students (mean age = 14.71) participated in this preposttest study. Knowledge acquisition, the application of knowledge and students' attitude toward the necessity to verify information found on social media was assessed. Results show that after playing Escape Fake students significantly know more about fake news, were better able to distinguish fake from real news, and were more critical toward the trustworthiness of online information. Based on these findings, the use of Escape Fake in digital literacy education is recommendable.

**Effects of a Fake News Literacy Training for Elementary School**

*Benedikt Artmann, Christian Scheibenzuber and Nicolae Nistor*

Fake news literacy training has been so far insufficiently conducted and evaluated, and even less so with youngest news consumers. We designed, carried out, and evaluated a fake news literacy training with 36 elementary school students from Germany. Quantitative data from N = 29 students attest high participant acceptance, and substantial effects of the problem-based training on participants' ability to correctly assess online news credibility, and on the corresponding cognitive processing route. We interpret these positive results by the knowledge construction and reorganization associated with problem-based learning and recommend the training for further educational research and practice.

**"MusiMath": Developing of Patterns' Creative Thinking via Music, Math and Technology**

*Libby Azaryahu, Shai Cohen, Orit Broza, Sara Hershkovitz and Esther Adi-Japha*

**Video recorded presentation:** <https://www.youtube.com/watch?v=ajr2oGxyp8I>

The present study examines the effectiveness of learning mathematical patterns in music using explicit instruction and its impact on the creative thinking of 3rd graders (N=84) in both music and math. For the purpose of the study, an original intervention program, "MusiMath", was developed with an emphasis on patterns' creative thinking. The mathematical knowledge, the musical knowledge and components of the students' creative thinking in both disciplines were tested using writing assignments and separate computerized tests. In order to collect the data, we developed software that allowed the students to perform musical and mathematical tasks which included questions with one correct answer and questions that enabled original and varied answers thus encouraging creative thinking. The results are being analyzed these days. Preliminary results show differences in all areas between the three experimental groups and the control group.

**Joint effects of school grade and gender on spatial knowledge**

*Sophie Bénard Linh Quang, Sandra Berney, Mireille Bétrancourt and Roland Maurer*

This study examined in 2nd and 3rd graders how school level and gender can affect spatial knowledge. Spatial knowledge was assessed by recognizing (a) landmarks, (b) their location, (c) the route taken and (d) distance estimation, in spatial tasks after learning a virtual route. The results indicate an interaction between gender and grade on landmark knowledge and relative distance estimation. Girls improved on landmark recognition and location tasks, while boys improved on relative distance estimation tasks. Theoretical and practical implications will be discussed.

**Room:** Aula Magna

**Chair:** Christina Sondermann

**Temporary Instructor Presence: The Best of Two Worlds?**

*Tim Kühl, Felicia Teske, Martin Merkt and Christina Sondermann*

It was investigated whether online-learning can be improved when the lecturer is only temporarily presented in online-lectures. It was assumed that temporary instructor presence would lead to better learning outcomes compared to conditions where the instructor would either always or never be presented. It was also examined whether potential differences between conditions for learning outcomes would be mirrored by differences in cognitive load and social response. One-hundred and twenty-five University students were randomly assigned to one of three conditions (“temporarily present” vs “always present” vs. “never present”). In line with assumptions, results showed that learners in the condition “temporarily present” tended to perform better in a transfer test than learners in the conditions “always present” and “never present”. No differences for retention, social response, and cognitive load were observed. A problematic methodological aspect of this study will be addressed in a second experiment that will be presented at the conference

**Does the clothing of a pedagogical agents and the setting of a virtual learning environment affect learning?**

*Daniela Decker and Martin Merkt*

In this experiment, we investigated the effects of the thematic appropriateness of a pedagogical agent's clothing and the setting of a learning video on the retention of the video content. Participants (N = 200) watched one of four videos about craft knowledge in which the pedagogical agent wore either brown dungarees (appropriate) or a suit (inappropriate) and which depicted either a workshop (appropriate) or a living room (inappropriate) as a setting, resulting in a 2x2 design. There were no main effects of clothing or setting on the learning outcomes, but a significant interaction with very small effect size. Post-hoc tests implied that the effect of setting may be moderated by clothing. However, given the non-existent effects of clothing and setting, there seem to be some degrees of freedom for designers of animated educational videos, even though these degrees of freedom may be limited to at least moderate levels of appropriateness.

**Fostering utility-value of research evidence in future teachers: Results of an intervention study**

*Annika Diery, Ricardo Böheim, Maximilian Knogler, Tina Seidel and Judith Harackiewicz*

Following the movement toward evidence-based practice in education, teachers are required to act and argue based on research evidence. A critical variable in promoting evidence-based practice among teacher students is the extent to which they consider research evidence useful for their practice (i.e. utility-value). The present study investigated the added value of an easy-to-implement utility-value intervention. Sixty-one teacher students enrolled in a course on effective teaching were randomly assigned to two conditions. In the first condition (regular course design), teacher educators used two strategies for promoting utility-value, i.e. direct communication of utility-value and application tasks. In the second condition (enhanced course design), students were additionally stimulated to reflect on the utility-value in two written assignments. Value perceptions were measured at the beginning and at the end of the semester. T-tests revealed a significant increase in students' value perceptions in the enhanced course design, but not in the typical course design.



**Fostering Pre-service Teachers' Assessment Skills in Simulations: Effects of Conceptual Prompts and a Utility Value Intervention**

*Michael Nickl, Daniel Sommerhoff, Ricardo Böheim, Stefan Ufer and Tina Seidel*

Assessing students' learning is a crucial, yet challenging task for teachers, especially for pre-service teachers. To facilitate their assessment skills, simulations and additional scaffolding might be effective. The present study examines, if conceptual prompts as cognitive scaffolding and a utility value intervention as motivational scaffolding can support pre-service teachers' assessments. It further examines, if success expectancy influences the effectiveness of either type of scaffolding. Results indicate that both scaffolds improve assessment accuracy of pre-service teachers individually. However, their combination is less effective. Regarding the role of success expectancy, results indicate that learners with high success expectancy especially profit from the utility value intervention while learners with low success expectancy especially profit from conceptual prompts. Concluding, both prompts can be effectively used to support assessment skills. Their differential effectiveness underlines that personalization of the simulation can further improve learning by adapting the presented scaffold to the individual learner's success expectancy.

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*Coffee break*

*15:30 - 16:00*

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**Room:** S0 06

**Symposium: Immersive technologies: New perspective on training**

Organizers: *Juliette C. Désiron*

Discussant: *Tina Seufert*

Chair: *Juliette C. Désiron*

With the development of technologies aiming at reproducing or enhancing reality, new perspectives for training emerge. Immersive technologies (like augmented reality – AR, virtual reality – VR) provide new forms of multimedia learning environments (Parong, 2021). In addition, learning might be fostered by higher levels of immersion that might stimulate increased motivation and engagement. Immersion mostly refers to the individual's sense of presence, which corresponds to feeling of "being there", and can be further divided into subjective personal presence, social presence and environmental presence (Heeter, 1992). While the sense of presence was higher in AR than VR in the beginning of the century (Tang et al., 2009), the rapid development of VR reduced this difference by integrating the view of self and more possibilities to interact with the environment with ones' hands. Although learning in immersive reality compared to desktop virtual reality was found to be overall efficient (Wu et al., 2020), studies still find higher motivation with VR compared to video, but lower learning outcome (Makransky et al., 2019; Parong & Mayer, 2021). This raises the question of variables other than presence significantly affecting learning in immersive environments, and that could counter risks of distraction.

In the first contribution to this symposium from Jean-Michel Boucheix and colleagues investigate the application of written verbal and/or visual signals to support learning in a virtual reality application, together with feedbacks. Both strategies are beneficial for learning. In the second contribution, Vito Candido and colleagues conducted 72 interviews to study how educators of vocational education and training in 10 different professions see the potential use of AR and hypervideo to support teaching and learning. Perceived advantages and disadvantages of the two technologies are particularly discussed. Results show that educators mainly perceive positive affordances of these technologies. In the third contribution, Juliette Désiron and colleagues highlight that learning performance with VR is influenced not only by learners' engagement in-VR but also by attitude toward this digital technology. An overall theoretical and practical discussion of this symposium will be provided in a discussion by Tina Seufert

Learning forest ecosystem in the context an immersive virtual reality living forest simulator: effect of signaling and feed-back on action decision and justification

*(Jean-Michel Boucheix, Laurie Porte, Louis Rapet, Benoît Haigre & Jean-Luc Martinez)*

Does VET benefit from AR and HV technologies? An interview study

*(Vito Candido, Patric Raemy, Francesca Amenduni & Alberto Cattaneo)*

Virtual reality to train hand hygiene: What predicts performance?

*(Juliette C. Désiron, Lauren Clack, Valerie Lapaire, Cinzia Ullrich & Dominik Petko)*

Room: S0 10

**The learning design of MOOC discussion forums: Towards evidence-based practices,**

Organizers : *Mariane Frenay, François Lambotte, Magali Paquot, Valérie Swaen and Dennis Rivera*

Discussant: *Bernadette Charlier*

Chair: *Mariane Frenay*

Discussion forums in massive open online courses (MOOCs) are educational environments aimed at engaging learners in the social construction of knowledge through collaborative interactions. To achieve this goal, MOOC discussion forums should be conceptualized as a tool to learn with, not one to learn from (Jonassen, 1996). More specifically, MOOC instructors need to design discussion forums to support learners as they interact and co-construct knowledge. Such a design should consider the learning context to integrate the technological affordances of the forum with pedagogical goals and strategies. Current learning design of MOOC discussion forums, however, is still largely informed by face-to-face classroom practices and theoretical or normative approaches based on learning design theory (e.g., Olivier & Tattersall, 2005). Evidence-based approaches to MOOC forum design are scarce. The main objective of this symposium is to challenge current theories and practices by empirically exploring the effects of discussion forum learning design on the types of interactions that occur in MOOC forums and the way learners engage in the social construction of knowledge. The first presentation reports preliminary results of an intervention study that addresses the issues of limited learner interactions and navigation difficulty in MOOC discussion forums. The second presentation investigates the characteristics of learning networks and patterns of interactions between MOOC learners in discussion forums. The third presentation adopts a discursive and material perspective on learning design and focuses on how MOOC instructors integrate discussion forums in the MOOC learning experience to invite for different forms of agency. Together, the three contributions will identify ways to improve current educational discussion forum learning design and sketch a research agenda for future empirical studies in that area. The symposium will therefore be of interest to MOOC researchers as well as MOOC instructors who want to design forum-based learning activities that involve interaction, collaboration and knowledge co-construction.

Redesigning discussion forums to increase learner participation and posting quality in a MOOC on Corporate Social Responsibility

*(Dennis Rivera, Mariane Frenay, Pauline de Montpellier & Valerie Swaen)*

Using Social Network Analysis to explore learning networks in MOOCs discussion forums

*(Ali Soleymani, Marcus Specht)*

Configuring agency in the discussion forums of three edX MOOCs? A discursive-material perspective on learning design?

*(Jan Zienkowski, François Lambotte)*

*Short break*

Tuesday, August 23

17:40 – 18:30
<b>SIG 6 &amp; SIG 7 business meeting</b>
<b>Aula Magna</b>

20:00 – ...
<b>Conference Dinner</b>
<b>Altes Tramdepot Bern</b>
(including vegetarian/vegan options)

Wednesday, August 24

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<b>Invited symposium</b>	Aula Magna
	09:00 – 10:30

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<i>Coffee break</i>	<i>15:30 - 16:00</i>
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<i>Slot H.1: No-or-not-perfect data presentations: Virtual Reality</i>	<i>11.00 -12.00</i>
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Room: S0 06

Chair: Francesca Amenduni

**Take a VReak! Effects of Temporary Immersion Reduction on Metacognitive Monitoring in a Medical Virtual Reality Simulation**

*Valentin Riemer, Julian Kreiser, Alexander Hann, Dorothea Henniger, Monika Engelke and Tina Seufert*

The projected study will investigate whether and how phases of reduced immersion affect metacognitive monitoring in an immersive virtual reality simulation (IVRS). A minimum of 68 medical students and personnel will complete technical and non-technical tasks in an IVRS for endoscopy training. In the experimental condition, immersion will be temporarily reduced on several instances by altering the amount of visual input. Among other variables, participants' extraneous cognitive load (ECL), monitoring activity, judgment of learning (JOL) accuracy, mental effort, and learning achievement will be assessed. In the temporarily reduced immersion condition, we expect learners to experience less ECL, while monitoring activity and JOL accuracy should be increased. Further, mental effort is expected to be a more valid cue for JOL (i.e. a better predictor of learning achievement) in the reduced immersion condition.

**Virtual Reality in vehicle painting: Applying the Meaningful-immersive Virtual Reality-Learning (M-iVR-L) model**

*Mulders Miriam*

The HandleVR research project develops a Virtual Reality (VR) training in the field of vehicle painting based on the 4C/ID model (van Merriënboer & Kirschner, 2018) and aims at the integrative competence acquisition. The paper presents results of an instructional design process by applying the recommendations developed in the Meaningful-immersive VR Learning model (M-iVR-L; Mulders, Buchner & Kerres, 2020) to the VR training application.

**Slot H.2: No-or-not-perfect data presentations: Instructional choices and learning outcomes**  
11.00 -12.00

Room: S0 10

Chair: Martin Merkt

**Which students benefit most from metacognitive prompts during learning in a digital learning environment?**

*Glenn Iten, Franziska Aeschlimann, Michael Hielscher and Doreen Prasse*

Digital metacognitive prompts have been found to promote metacognitive activities during self-regulated learning (SRL) and to improve learning outcomes. However, studies also suggest that prompts might not always be effectively made use of by students and can then lack positive learning effects. Therefore, our research question addresses specific learner characteristics which explain why only certain students benefit from metacognitive prompts. In our study in 22 primary-school classes, we tested a software-based support system (Learn2Learn-Assistant), which, by providing metacognitive prompts, helps students with monitoring their learning. Results show that the perceived usefulness of prompts, and the metacognitive activities they triggered, differed between students. We are now analyzing questionnaire and interview data to explore how patterns of students' attitudes and self-efficacy for SRL, as well as perceived difficulty of learning tasks during the intervention, impact the perception and effectiveness of metacognitive prompts during learning. Implications for designing metacognitive prompts will be deduced.

**Activation of Relevant Prior Knowledge as Preparation for Learning in Problem Solving Prior to Instruction**

*Charleen Brand, Katharina Loibl and Nikol Rummel*

Problem solving prior to instruction (PS-I) approaches are instructional designs that start with a problem-solving phase as a preparation for learning, followed by a direct instruction. It is assumed that students activate their prior knowledge during the problem solving, which helps them to process the subsequent instruction more easily. However, little is known yet about why and how prior knowledge activation is beneficial for learning in PS-I. We experimentally investigate students' prior knowledge activation. To enable this, we ask students to study solutions that trigger the activation of knowledge and vary the coverage of relevant knowledge components of the targeted concept in these solutions. The sets of student solutions vary in the number of addressed knowledge components across solutions (high vs. low coverage). With our findings, we aim to contribute to a better understanding of how students can be prepared for learning in PS-I through prior knowledge activation.

**Distracted by an instructor? Effects of instructor presence on learning outcomes, visual attention, and learners' assessment of the learning materials**

*Christina Sondermann, Markus Huff and Martin Merkt*

Should the instructor in instructional videos be visible in addition to the actual learning content? Theory and prior research indicate both potential advantages (e.g., deeper processing) and disadvantages (e.g., distraction) of instructor presence in learning videos. Therefore, we intend to conduct an experiment in which N = 96 participants watch eight videos on different topics while their eye movements are recorded. Using a within-subjects design, we will vary whether an instructor is present next to the learning content or not. We aim to investigate how instructor presence affects knowledge test performance (recall) and visual attention (e.g., time spent on learning content). In addition, we will examine the effects of instructor presence on the learners' assessments of the videos (e.g., perceived learning, satisfaction). Data will be collected in May 2022.

*Mentoring lunch*

*12:00 - 13:00*

**Room:** S0 06

**Chair:** Amos van Gelderen

**An analysis of factors significantly affecting EFL students' implementation of didactic applications**

*Lan Anh Thuy Nguyen and Anita Habók*

In the field of teaching and learning English as a foreign language (EFL), it has been indicated that didactic technologies can foster language education, especially they have a positive impact on learners' language skills (Golonka, Bowles, Frank, Richardson, & Freynik, 2014). Thus, multiple education systems have issued various policies to encourage teachers and students to implement digital applications in language education. The current quantitative study seeks to examine potential factors that may have effects on the usage of technology among EFL undergraduates including digital literacy and the demographic variables through an adapted questionnaire. It could be concluded from the research that students' knowledge, skills, and their attitudes toward the application of digital tools significantly correlate with their frequency of technology usage. Also, learners' accessibility, English learning experience, computer using experience, and English liking also significantly contribute to the usage of digital applications in language education.

**Foreign-language vocabulary learning using paper versus digital flashcards: The effect of study-test medium congruency**

*Vered Halamish and Dorit Elias*

Paper flashcards have been commonly used for foreign vocabulary learning, but today digital flashcards can be easily designed and used. Are digital flashcards as effective as paper ones, and should the medium of testing be considered when deciding on the medium for learning? To examine these questions, participants studied foreign vocabulary words using either paper cards or digital "cards" and were then tested on the words either on paper or digitally. Importantly, the study medium and the test medium were congruent for half of the words and incongruent for the other words. The results revealed a benefit for paper-based learning over digital learning, and, importantly, a study-test medium congruency effect, with better performance when the study medium matched the test medium. The results challenge common educational practices such as studying digitally for on-paper tests and therefore have important implications for instructional design.

**Promoting the regular use of a vocabulary app in children's everyday lives: The effects of implementation intention prompts**

*Jasmin Breitwieser, Lea Nobbe, Daniel Biedermann and Garvin Brod*

Using learning apps regularly in their daily lives can be challenging for children, especially when initial motivation to use a new learning app wanes. In this intensive longitudinal study, 130 children were asked to use a vocabulary app for 54 days to study their English vocabulary. At the start of the study, all children watched a video prompting them to practice their vocabulary daily. In addition, some children were prompted to create an implementation intention, specifying when and where they would study with the vocabulary app. Implementation intentions effectively buffered against decreasing motivation to use the vocabulary app. Furthermore, some children received regular reminders of their implementation intention over the course of the study. These reminders increased learning motivation on the same day that they were presented. These findings suggest that implementation intention prompts are an effective way to help children use learning apps more regularly in their daily lives.

**Task-Oriented Reading in Higher Education: Effects of a Technology-Enhanced Learning Environment**

*Mariska Okkinga and Amos van Gelderen*

Task-oriented reading is an important skill in higher vocational education. However, many students in higher vocational education have little experience in this type of reading and lack strategies for executing it efficiently and effectively. A technology enhanced learning environment (TELE) was designed and tested experimentally to aid teacher students in different directions (N = 105) in the process of task-oriented reading in two stages: homework and group discussion. Scripted collaboration was compared with a control group that was allowed to collaborate more freely. Both groups significantly improved performance between pre- and posttest. However, results showed no statistical differences between the experimental and control group in growth between pre- and posttest. Logs of task execution showed that students spent more time on reading relevant text parts at posttest and spent less time on question reading at posttest, suggesting that students executed task-oriented reading more efficiently as result of the learning environment.



**SLOT 1.2: Paper presentation: The role of school leaders, teachers and students  
on technology integration**

13:00 – 14:20

Room: S0 10

Chair: Dominik Petko

**Transformational leadership for technology integration in schools: Impact on enablers and technology use in class**

*Maria-Luisa Schmitz, Chiara Antonietti, Tessa Consoli, Alberto Cattaneo, Philipp Gonon and Dominik Petko*

This study investigates the relationships between transformational leadership of school leaders, technology-related enabling factors like technological infrastructure, teachers' beliefs and skills, as well as the frequency of technology use in class, as reported by teachers. Multilevel correlation analyses show that transformational leadership is significantly and positively related to all enabling factors. However, transformational leadership is not directly related to the frequency of technology use. Frequency of technology use is only correlated with teachers' beliefs and skills. Multilevel linear modeling (MLM) was used to further explore the interplay of these factors.

**Primary School Teachers' Role in the Promotion of Self-Regulated Learning in a Digital Learning Environment**

*Désirée Fahrni, Glenna Iten, Michael Hielscher, Hascher Tina and Doreen Prasse*

Recent studies show that digital learning environments can promote various aspects of students' self-regulated learning (SRL). However, few studies have attempted to understand teachers' role in promoting SRL in digital learning environments. The current study investigates which teachers' beliefs and practices about promoting SRL can be identified in using a digital learning platform (LearningView) and what instructional practices have been developed. Analysis of qualitative data collected from interviews with twenty primary school teachers identified direct and indirect approaches to promote students' SRL. Direct promotion includes coaching students on setting learning goals, time management, or the use of learning strategies in a learning setting. Indirect promotion was explored in the use of a supportive instructional design within the digital learning environment. The study underlines the importance of the teachers' role in applying direct and indirect methods to promote SRL in digital learning environments in primary schools.

**Students' Habitual Use of Effective Learning Strategies**

*Louise David, Felicitas Biber, Rik Crutzen and Anique de Bruin*

Habits drive a large portion of our behaviour and can either help or harm long-term achievement. More specifically, beneficial study habits relate to increased academic performance and lower motivational conflicts when studying. Nevertheless, many students struggle to form and maintain beneficial habits as they engage in less profitable ones. While the use of effective but effortful learning strategies is essential for academic achievement, students often rely on ineffective learning strategies. Study habits could help students to incorporate these effective but effortful learning strategies consistently. To support students breaking old, ineffective habits and forming new, effective study habits, we need to first understand what students' study habits look like. Therefore, in this study, we aim to explore university students' study habits in focus group discussions. We will collect data in early summer and analyze data using thematic analysis. We aim to present our results and interpretations hereof during a paper presentation.

**Cleaning up the mess: A systematic review on the diverse conceptualizations of TPACK**

*Armin Fabian, Kenneth Kirchner and Andreas Lachner*

The Technological Pedagogical and Content Knowledge (TPACK) model operationalizes teachers' professional knowledge needed for successful technology integration during teaching. To date, many researchers have adapted the TPACK-model to their specific research needs. By doing so, however, they introduced a variety of different TPACK conceptualizations making it difficult to compare research findings across studies. In this study, we therefore seek to offer first insights into a possible pathway of systemizing TPACK conceptualizations comprehensively. In our approach, we combined strategies of a systematic review and content analysis to analyze  $k = 140$  TPACK-based interventions with regard to which of the seven TPACK components (i.e., TK, PK, CK, TPK, TCK, PCK & TPCK) were explicitly addressed in these interventions. Preliminary results suggest that TPACK is viewed from a rather technocentric perspective which is in line with previous research. The results are discussed in light of possible TPACK conceptualizations that arise from these findings.

**SLOT 1.3: Paper presentation: Instructional design and Collaborative learning 13:00 – 14:20**

**Room:** Aula Magna

**Chair:** Samuel Tobler

**Source memory and collaborative learning: the role of group composition and conflicting information**

*Oktay Ülker and Daniel Bodemer*

Source memory (SM), i.e., remembering the origin of information, is often analyzed in fields where the reliability of information must be assessed, like eyewitness testimony or advertising psychology. Paradigms used in these fields are rarely transferred into the learning sciences. We examined effects of group composition (partners with differing knowledge-levels vs. same knowledge-levels) and conflicting information (with conflict vs. without conflict) on SM and learning in a pseudo-collaborative learning scenario (128 participants). SM was analyzed with multinomial models, which allow estimations of SM unconfounded by guessing biases. Group composition and conflicting information did not influence learning, but they influenced SM: Participants better remembered which partner presented a piece of information in groups with differing knowledge-levels, especially the highly knowledgeable partner. SM was worse in a context with conflicting information. Our study demonstrates that SM-paradigms used in cognitive psychology could enrich the learning sciences by adding new perspectives to source-content links.

**Students' Perceived Multidisciplinary Teamwork Skills: The Case of a Challenge-Based Learning Course**

*Canan Mesutoglu, Dürdane Dury Bayram-Jacobs, Annemieke Vennix and Birgit Pepin*

While science and engineering students experience collaboration in multicultural teams, they frequently report improved understanding of how people from other disciplines think and act. Therefore, it is important to understand how students' skills develop to function in multidisciplinary teams. This mixed-methods research explored the changes in students' perceived multidisciplinary teamwork skills. Data was collected through a questionnaire and interviews. Findings collectively suggest perceived improvement in identifying one's own disciplinary contributions to the design decisions. The qualitative analysis also showed growth in recognizing the contributions of other discipline.

**Mechanisms of Group Awareness Tool Design**

*Lenka Schnaubert*

Group awareness (GA) is a pre-requisite for goal-oriented collaboration and thus often supported by respective tools that collect, transform and visualize GA information during CSCL. However, it is yet unclear how these tools need to be designed to best support learners. In an experimental study (N = 130), we thus systematically varied aspects of tool design and studied the effects on dyadic learning. Results show that generativity of GA-information collection affects quantity and quality of the assessed information and mental load. Simplifying the information by aggregating it negatively affects invested mental effort during collaboration and learning outcomes. Supporting between-learner comparability did not have an effect. GA-tool design is an important factor to be considered and systematic research is needed to provide recommendations for research and practice.

**Teaching Biology with Narratives: Insights in Students' Understanding of Molecular Interactions**

*Samuel Tobler, Katja Köhler, Tanmay Sinha, Ernst Hafen and Manu Kapur*

Using analogies in science education is a broadly acknowledged method to better convey abstract concepts, even though analogies can also lead to misconceptions if not used properly. Narratives instead could be helpful to tackle such misconceptions by inducing students' dissatisfactions with their explanations. To investigate the potential of narratives compared to expository texts on refuting misconceptions, we examined students' understanding of molecular interactions, focusing on the frequently reported "lock and key"-principle. Results indicate that narratives might be superior to expository texts to tackle misconceptions related to that principle. Implications and future work are discussed.

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*Short break*

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**Keynote  
Aula Magna**

**14:30 – 15:30**

*Prof. Dr. Lennart Schalk, PH Schwyz, Switzerland*

**The real educational world is much more diverse and complex:  
Considering the interplay of levels of explanation, methodology,  
and the theory-practice schism**

Research on learning and instruction aims to inform, develop, or even transform the real educational world; well, at least the educational implication statements in scientific articles often imply such aims. These statements however frequently neglect the diversity and complexity of real classrooms and educational settings, and, thus lack meaning for practice, fail to convince practitioners or even reinforce their conception of an insurmountable theory-practice schism. In this keynote, I will argue that diversity and complexity per se are not a problem, but that the meaning of methodologies (and statistics) and different levels of explanation have to be carefully considered and taken into account when planning, interpreting, and communicating research. I will emphasize the value of methodological pluralism and interdisciplinary work as well as the need to find productive ways of aligning different methodologies and disciplinary approaches in research on (technology-enhanced) instructional design to evolve educational practice.

**15:30 – 16:00**

**Closing and Award Ceremony**

**Aula Magna**

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**End of conference**

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