

CICERO Workshop on Learning, Brain, and Technology

Friday 2 October 2015

Minerva Plaza, K2 floor (basement), Minerva building, Siltavuorenpenger 5A, University of Helsinki

Abstracts

Keynote talks

Unesco Professor Heikki Lyytinen, Jyväskylä University

Effective digital learning environments to support reading acquisition in a global context

In our intensive follow-up study of children at familial risk for dyslexia (N=100+100 controls; Jyväskylä Longitudinal study of Dyslexia, JLD) developmental indices supposedly associated with later reading acquisition were collected from birth to puberty. Results revealed that children who will face problems in reading acquisition can be identified years before they enter school. This motivated us to develop digital learning environments which support the acquisition of the basic reading skill independent of which bottlenecks child has to become able to open to acquire the skill. Due to the need of extensive training to overcome also genetically compromised learning we implemented the training in an enjoyable, game-like format. It is called Ekapeli in Finland where it has now been in use for years (see www.lukimat.fi) by hundreds of thousands children. When we observed how efficiently it helps we started studies making comparable support available to children also outside Finland. The resulting version have been called Graphogame. The principles we follow require e.g. empirical documentation that the implementation to the language/writing system/culture has been made successfully before accepting its distribution. Related studies have been running now in more than 20 countries. In Africa Zambia's studies have been completed and efforts have been under way to make Graphogame available there because almost all Zambian children would benefit from its use. The presentation illustrates the research – emphasizing brain research – on which Graphogame is based and proceedings in our GraphoLearn Initiative which means preparation to make it available to as many as possible from the millions of children in need globally.

Dr. Elena Kushnerenko, University of East London, UK

Assessing the impact of socio-economic status on infant neurocognitive development

Recent work suggests that socio-economic status (SES) disparities are associated with specific profiles of neuro-cognitive differences in childhood (Noble et al, 2005, 2007). There is emerging evidence that SES associated factors may specifically affect attention and language functions in infants and the results of our studies demonstrated that differences in brain functioning are already identifiable in 6-9 months old infants from low SES backgrounds (Tomalski et al, 2013). It is of concern that these early differences may set some infants on a developmental pathway that leads to poorer education outcomes. Given this concern, it is important for researchers to begin to work towards developing effective ways of identifying neuro-cognitive differences as early as possible. Early individual differences may subsequently be used to inform early interventions. I will talk about two studies performed at the Children Centres of East London using eye-tracking equipment. Eye-tracking equipment uses the corneal reflection of an infrared light source to record the direction and duration of looking and these measurements are very precise. The results of the first study confirmed the association of the SES factors with language development at the age of 2 years in our cohort. The second study investigated the feasibility of intervention and training in the Children Centres, using gaze-contingent eye-tracking methodology (Ballieux et al, in press). These results warrant further investigation into the potential of this method for targeting 'at-risk' infants in community settings.

Prof. Markus Specht, Open University of the Netherlands

Does technology disrupt our learning experiences?

The keynote will discuss some of the approaches for integrating technology into formal and informal learning spaces and its adoption and effects. Today's tools and learning environments are often not designed for supporting situated, social, and mobile learning experiences. Based on the potential of new technologies to enhance the human learning experience opportunities are highlighted on a micro-, meso-, and macro-level of learning support and examples for enhancing learning on these levels are given.

CICERO Special Interest Group Presentations

Minna Huotilainen, Brain and Learning SIG

Brain and Learning Special Interest Group is part of CICERO Learning Network. In Brain and Learning SIG, we aim at bringing together those CICERO researchers and others interested in how to use brain research methods in learning research. We aim at building a new research area, quantified learning research, which uses brain research and other quantified measurements to understand and develop learning. The research involves all age groups from babies and even fetuses to children, youth, adults and the elderly. Brain and Learning SIG organizes meetings and get-togethers, public talks and training. The SIG is also involved in organizing the Cognitive Neuroscience Summer School, where teaching on brain research methods and their use in learning research is given to a group of international post-docs, PhD students and master's level students. Brain and Learning SIG has a blog (mainly in Finnish) where we popularize the scientific results created by our researchers and also evoke discussion on brain and learning.

Ari Korhonen, Educational Data Mining and Learning Analytics in Digital Learning SIG

The advent of online education in Finnish higher education can be traced back in early 1990s when information and communication technologies became mature enough to allow teaching through Internet. Especially Computer Science departments found it a great way of offering assignments and feedback in large courses. Nowadays, it is hard to find courses that do not use any kind of online materials. However, the potential in current online learning environments is greater than how we actually utilize them. In addition, despite the fact that digitalization has helped improve education, many challenges exist. CICERO learning network has established a Special Interest Group (SIG) on Educational Data Mining and Learning Analytics in Digital Learning (EDM SIG) to address issues involved in online education. The aim is to foster the use of data mining techniques to develop online learning opportunities further and to tackle the future challenges in education. In this presentation, we will introduce the approach this SIG has taken and invite all the interested parties to join us in developing the next generation online education in Finland.

Kristian Kiili, Games and Learning SIG

Researchers have increasingly argued that the sense-making practices that occur when people engage with digital games constitute a form of literacy that is potentially better suited to address the needs of learners of 21st century. Unfortunately, only a fraction of existing learning games is founded on theoretically sound principles, relies on good pedagogical practices, and utilizes the possibilities that game technologies could provide for learning. Thus, the overall aim of the Games and Learning SIG is to provide a forum to exchange and disseminate scientifically proven knowledge, research results, and experiences related to wide range of game based learning issues. In 2015 the SIG edited a special issue on mathematics learning games for International Journal of Serious Games that will be published on December. The SIG has planned to facilitate the development of high quality learning games by creating a forum for presenting scientifically informed learning game designs. Furthermore, in order to facilitate collaboration and dissemination the SIG has planned to organize a two-day Paper Jam event that gathers together researchers to plan and write joint papers about digital learning games.

Oral Presentations

Dr. Annika Hultén, Aalto University

Neural correlates of incidental and intentional foreign word learning

Adults learning a novel language generally wish to achieve well-integrated and stable lexical representations with minimal effort and preferably as quickly as possible. The question is, whether some approaches to learning are more efficient in achieving this goal than others? In the present fMRI study we focus specifically on incidental and intentional word learning and seek to evaluate the effectiveness and neural underpinnings of both strategies. Using a covert picture naming task 20 participants were explicitly thought the foreign Japanese names of 32 items, and implicitly exposed to 32 control items 4 consecutive fMRI sessions on first day. On the next day the fMRI picture naming task was repeated overtly to assess learning. The left inferior frontal and posterior inferior temporal regions were more active during active encoding than during incidental learning. These areas, in addition to the hippocampus and the tempo-parietal cortex were furthermore indicative of the success rate of the intentionally encoded items. Conversely incidental learning activated the tempo-parietal junction more than intentional encoding. Behaviorally the intentional encoding was more efficient, but marked individual variation was observed in both conditions. In conclusion, it seems that the intentionality during encoding modulates the neural mechanisms of foreign word learning.

Dr. Esko Lehtonen, University of Helsinki

Learning game for training children's hazard perception in bicycling

Getting more children to bicycle would create environmental and health benefits. However, bicycling accidents are a major source of injuries and fatalities among children. In this submission, we present a prototype of a learning game, which aims to develop children's hazard perception skills in the bicycling context. The game consisted of videos filmed from a bicyclist's perspective. Players' task was to point out other road users - present or potential - early enough to gain points using a touchscreen. If such a target was missed or pointed out too late, the video was paused and feedback given. In this regard, the game resembled popular first-person shooter games, which has been shown to improve players' visuospatial cognitive skills. The game was tested with 49 children from the 2nd grade of primary school (aged 8-9). The effect of the game was assessed with situation awareness tests and through the analysis of the game performance. The results suggest that the learning game could be used to teach hazard perception for children. However, further studies are needed in order to understand what is the role of the game in the learning. Especially, does the game support learning through motivation, feedback, or both?

Researcher Mona Moisala, University of Helsinki

The effects of media multitasking on attention

It has been shown that the current generation of young people indulge in more media multitasking behavior (e.g. instant messaging while talking on the phone) in their everyday lives than older generations. Concerns have been raised about how this might affect their ability to focus. In the current study, 149 adolescents and young adults (aged 13-24) performed tasks which required the ability to maintain attention in the presence of a distractor stimulus or to divide attention between two concurrent tasks, while brain activity was measured using functional magnetic resonance imaging (fMRI). The level of self-reported daily media multitasking (MMT) was compared to task performance and brain activity. The results showed that in the presence of a distractor stimulus, a higher MMT was associated with worse performance and greater brain activity in right dorsolateral prefrontal regions, with a similar trend observed when attention had to be divided. This suggests that daily media multitasking is associated with increased distractibility and heavier recruitment of brain areas known to be important for attentional control, and that media multitasking in everyday life does not translate to performance benefits in multitasking in the laboratory setting.

Dr. Rebekah Rousi, Jyväskylä University

Cognitive enhancement in work and educational environments

Information technologies (IT) are becoming ever more pervasive and integrated into our daily lives, so much so that the barriers between IT and the physical, psychological and social realities of people are growing ever

more blurred. In particular, technologies which are intended to either correct or enhance natural human function - hearing aids, eyewear, prosthetic limbs and cognitive enhancement technologies are on the increase. Because of this, work regarding cognitive performance enhancing technologies has gained much attention in the academic world over recent years. The perspectives covered include: the social dimensions and impact of cognitive enhancement; the biological and surgical perspectives; hardware/software development perspectives; psychological and cognitive; attitudes and ethical perspectives; and education; in addition to the general reviews regarding the state of the art in the field. Moreover, when discussing the educational and work environments especially, substantial research has been undertaken regarding cognition and technologically enhanced. Given this variety of approaches, we have chosen to discuss cognitive enhancement in terms of in-body, wearable and external technologies. The focal contexts of this proposed project are work and educational environments, for we have noticed that one factor which is noticeably absent from previous and current approaches, is an active multidisciplinary approach which takes into account the neurological, cognitive, learning and engagement, as well as business perspectives. That is, looking at cognitive enhancement holistically within these specific contexts from within the individual towards human-technology and human-human interactions, to further looking the effects of these technologies prior to, during and after use on the context and community as a whole.

Prof. Kirsi Tirri, University of Helsinki

How can we study students' mindsets for learning with brain research?

It has been shown that individuals with a growth mindset for learning see mistakes as opportunities to learn and improve. For fixed-minded individuals mistakes indicate lack of ability. Earlier empirical research on mindsets includes both quantitative surveys and qualitative approaches with observations and stimulated recall method. With performance monitoring it is possible to probe event-related brain potentials (ERPs), the neural mechanisms underlying students' different reactions to mistakes. ERP studies have shown that growth mindset is associated with an enhancement of the error positivity (Pe), an ERP reflecting awareness of and attention allocation to mistakes. More growth-minded individuals also show superior accuracy after mistakes compared to those endorsing more of a fixed mindset. Most importantly, Pe amplitude mediates the relationship between mindset and post-error accuracy. These results suggest that neural mechanisms indexing online awareness of and attention to mistakes.

Prof. Hannu Vanharanta, Tampere University of Technology

Commitment application as a tool for improving positive learning environment

Studying, learning and self-development require commitment from students to their schoolwork. Without commitment and passion for learning, there is a high risk of dropping out. We believe that commitment to studies will advance learning because of the strong will to study and motivation to complete one's studies. This sort of commitment, interest in self-development and hard work might well follow a person into working life, and consequently become valuable to a future employer. In our research, we have evaluated students' commitment to their studies and the university where they are studying. Using a fuzzy logic-based application that utilizes linguistic scale values, we have evaluated commitment and engagement from students who are at various stages in their studies at five different university units in three different countries, i.e., Finland, South Korea, and Poland. In addition, for a selected group of students, we have identified how various factors affecting commitment, such as academic goals, self-confidence, institutional commitment, as well as social involvement, have changed as their studies progress. The developed instrument contains 124 statements, which are assessed by the respondents regarding their current situation and outlook for the future. This collective information can be used to form effective strategies to support the students and to help them become more engaged and integrated into academic life, leading to better learning environment and to the prevention of drop-out problems.

Doc. Sari Ylinen, University of Helsinki

"Say it again, kid!" - combining learning, technology and gaming in children's learning

As a result of globalization, foreign- and second-language (L2) learning have become increasingly important. This socio-cultural change challenges traditional learning environments. Gaming combined with speech

technology has great potential in childrens L2 learning which requires extensive training. Here we present a plan of project, aiming to develop a computer-based game that facilitates childrens L2 learning. The project will develop advanced speech technology needed for the game, including automatic speech recognition for child users and L2 learners. We will also assess the feasibility of the game in childrens L2 learning and in the remediation of L2 learning difficulties and use the game in combination with brain recordings to unravel the mechanisms of L2 learning. The results are expected to produce methodological advances in speech technology as well as new solutions and theoretical perspectives in L2 learning and its brain mechanisms.

Poster presentations

Jenni Riikka Ahokas, Jyväskylä University, University of Helsinki and University of Oulu

Exploring Embodiment in Special Music Education

The students with Special Educational Needs (SEN) have difficulties in learning, perception and communication that often pose challenges for them to attend traditionally organized music lessons with instruments (Darrow 2010; Kaikkonen & Kivijärvi 2013; Kivijärvi 2012). Bodily music making (e.g. music and motion, musiikkiliikunta in Finnish) does not require ability to read music notation, which is based on co-operation and coordination of vision and motor skills. It is stated that versatile sensory perceptions connect with cognition, reasoning and emotions in embodied musical interaction. This presentation introduces an interdisciplinary approach to this phenomenon (Exploring Embodiment in Special Music Education). Ahokas has studied the impact of an body percussion-based intervention on executive functions with neuroscientific (EEG) and neuropsychological (Tower of London test) measures. Sutela and Nygård concentrate on the development of SEN-students agency and social participation in embodied musical interaction. Ahokas, Kivijärvi and Nuorsaari share their expertise on special music education in developing new implementations (a pilot study based on embodiment for developing literacy skills of students with cognitive disabilities, e.g.) to be utilized within this chosen context.

Rosemary Francisco, Helsinki University

Knowledge Creation and Sharing to Solve Problems in the Mobile Workers' Context

Knowledge is created and shared through social action and interaction. This knowledge, that can be accumulated and renovated by organizations over time, is an asset that supports the organization's skills, differentiating working groups and business units. To benefit from these assets, however, organizations need to identify, in time, the knowledge domain required for their own strategies and operations. The adoption of mobile and ubiquitous technologies to organizational practices, in turn, promotes autonomy and flexibility for workers. This allows workers to work and interact at anytime in anywhere, distant from other workers, as well as, formal physical workspaces. On the other hand, this creates some barriers to create and share knowledge once knowledge is distributed, technologies are in constant changing and the workers have faced in a paradox between individual autonomy and social interaction. The main purpose of this study is to understand how knowledge creation and sharing is accomplished to solve problems in the mobile workers' context. The results present a model and some initial propositions for future research in social development in mobile workers' context.

Jarkko Hautala, University of Jyväskylä

Multimedia in early science education

Multimedia presentations are effective in promoting understanding of complex phenomena typically examined in science education. However, multimedia technology is still rarely used in early science education, partly because scientific studies with small children are few. In two studies, we explored the effectiveness and feasibility of interactive multimedia technology in teaching life science to first grade children. The results indicated meaningful learning of science, and teachers and students indicated generally positive evaluations of the learning program. It is concluded that multimedia lessons can be integrated into classroom science instruction as early as kindergarten and first grade with the potential to motivate children and help them understand and reason about science. Detailed analysis of students' answers and iterative

development and testing in a further study, provided insights on how the proposed tutoring system can be improved via more advanced pedagogical modeling and through iterative design and testing.

Jenni Heikkilä, University of Helsinki

Neural processing of congruent and incongruent audiovisual speech in children

Speaker's articulatory gestures affect speech perception. Visual gestures can even change the perception of auditory speech signal, which is known as the McGurk-effect. In children, McGurk-effect is often weaker than in adults, and little previous knowledge exists about the neural level correlates of McGurk-effect in children. Using event related potentials, we investigated brain responses for congruent and incongruent audiovisual syllables in school-aged children. We used an oddball paradigm with congruent audiovisual /mi/ as the standard and congruent audiovisual /ni/ and incongruent A/mi/V/ni/ (McGurk-stimulus) as the deviant stimuli. The response to the congruent /ni/ deviant was significantly more positive at frontal and central areas than response to standard /mi/, and more negative at the occipital areas. The response to the McGurk deviant was significantly more negative at occipital areas than response to standard /mi/. The results indicate that in children, congruent audiovisual and McGurk syllables are processed differently at the neural level. The change detection response of the congruent deviant stimulus can be observed both at fronto-central and occipital areas whereas the incongruent deviant stimulus causes processing differences at the occipital areas. This may reflect weaker auditory discrimination for McGurk-stimuli in children.

Daniele Morselli, University of Helsinki

Expansive Learning theory to underpin entrepreneurship education

This presentation discusses the expansive learning theory as unique background for studying and promoting entrepreneurship education. It is part of a Marie Curie project on teacher training in entrepreneurship education conducted between Finland and Italy. When examining entrepreneurship education, scholars have considered the learning mechanisms underpinning entrepreneurial conduct. As learning is an important element of the entrepreneurial process, a theory of entrepreneurship calls for a theory of learning. Only few learning theories have been used in research to underpin entrepreneurship education: Mezirov theory of transformative learning, Lave and Wengers situated learning, Wengers communities of practice, and Kolb theory of experiential learning. The most used being Kolb's theory, and this is because entrepreneurial learning is considered experiential in nature. While experiential learning is centered on the individual, expansive learning enlarges the focus on the interacting

Johanna Penttilä, University of Helsinki

Digital storytelling for 21st century learners

In this poster presentation we will discuss about digital storytelling and how it can be integrated into learning in various domains (i.e., science and humanities). We will also discuss the possibilities of a specific digital storytelling tool (MoViE). The aim is to share our experiences from the field and discuss the pedagogical potential embedded in the creation of stories on one hand, and the utilization of multimedia in storytelling on the other.

Kaisa Tiippana, University of Helsinki

Semantic congruency improves memory for audiovisual and visual stimuli

Audiovisual semantic congruency during encoding has been shown to facilitate later unisensory recognition memory performance. However, it is still unclear whether this improvement is due to multisensory semantic congruency or just semantic congruency per se. We investigated whether dual visual memory encoding facilitates recognition memory performance in a same way as audiovisual encoding. The participants memorized auditory or visual stimuli (sounds, pictures, spoken words or written words) presented together with a semantically congruent, incongruent or non-semantic stimulus in the same or opposing modality during encoding. In the following recognition memory task the memorized stimuli were presented again with an equal number of new stimuli, and the participants made a new/old judgment. Memory performance was better when the stimulus was initially presented with a semantically congruent stimulus than with a non-semantic stimulus. This congruency effect was observed with audiovisual stimuli (spoken words presented

with pictures) and dual visual stimuli (written words presented with pictures, and pictures presented with pictures). Our results show that not only multisensory but also unisensory semantically congruent stimuli can improve memory performance.

Ge Wei, University of Helsinki

Teachers' Workplace Learning: A Case Study from China

Teacher learning and teacher professional development are important research topics in the field of education. In this context, teacher collaboration is presumed to be a powerful learning environment for teachers' workplace learning. This article is an empirical exploration of how Chinese teachers learn in a school-based collaborative research team. After a one-semester participatory observation and a series of in-depth interview, the achievements of teacher collaborative research are illustrated from five aspects, namely outcome, process, democratic, catalytic, and dialogic validities. The improvement of teachers' reflection levels are emerged upon a changed mindset from a culture-of-doing to a culture-of-thinking, which could be regarded as the achievement of teacher as researcher. Based on the analysis of an excerpt, the inner learning mechanism, dialogue which mediates the occurrence of learning activities, is found. Finally, some implications for future research and practice on teacher collaborative learning are discussed.

Sari Ylinen, University of Helsinki

Neural correlates of the ability to represent words in verbal working memory

Magnetoencephalography (MEG) was used to investigate how verbal (phonological) working memory is linked with the brain representations of auditorily presented novel words, and this way to language learning. During MEG recording, we used matching or mismatching auditory stimuli to probe brain representations of auditorily presented novel words that were maintained in working memory with covert rehearsal. In a control condition, MEG responses were recorded by using identical stimuli but no rehearsal. According to preliminary results, participants with good working memory were able to represent novel words more accurately in the brain, since in this group the brain responses to phonologically matching and mismatching stimuli differed in the left hemisphere, whereas in participants with poor working memory no such difference was found. The left-hemispheric brain response was interpreted as phonological mapping negativity. The current results increase our understanding of memory mechanisms of language learning.