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Education and Information Technologies (EAIT) is a research journal that covers the complex relationships between Information and Communication Technologies and Education. EAIT is the official journal of the International Federation for Information Processing (IFIP), Technical Committee on Education (TC3).

To begin this issue is an article from Flora Charles Lazarus and Rajneesh Suryasen (Banasthali Vidyapith, NiwaiTonk, Rajasthan, India): Academic library MOOC services and success scale. The benefits of MOOCs have attracted many Higher Education institutions globally to use them as a means of increasing efficiency of education delivery and process, but without institutional support the MOOCs have a high dropout rate of 90 – 95 percent, leading to low academic impact. This article describes the development of a list of ‘Academic Library MOOC Services’ (ALMS) and attempt to create an ‘ALMS – Success Scale’ based on DeLone and McLean Information Systems Success Model.

Adoption model for a hybrid SEM-neural network approach to education as a service is from Noawanit Songkram and Suparoek Chootongchai (Chulalongkorn University, Bangkok, Thailand). The success of a learning system depends on the level of acceptance by instructors and learners, and research has identified Education as a Service (EaaS) as a resource that enables instructors and learners to access a new kind of service for learning system, containing: (1) support tools and services, (2) curriculum, and (3) cloud service. This paper develops an adoption model to understand the causal relation and predict the effect of personal characteristic (Perceived usefulness and Perceived ease of use) and quality characteristics (Service quality, System quality, and Information quality) on the continuous intention to use EaaS from instructors and learners, which is critical to success.

Teachers’ virtual communities of practice: A strong response in times of crisis or just another Fad? This article is by Norma Ghamrawi (Qatar University, Doha, Qatar); The purpose of this study was to investigate the perceived effectiveness of a virtual community of practice (vCoP) designed to support knowledge and expertise sharing between K-12 teachers during Covid-19 pandemic. The vCoP was developed by the researcher herself as part of a consultancy to UNESCO. Findings
showed that participants viewed vCoPs as effective tools for e-professional development in general and particularly during crises.

**Designing and coding with BBC micro:bit to solve a real-world task – a challenging movement between contexts**, by A-M. Cederqvist (University of Gothenburg, Sweden). The author notes that programmed technological solutions (PTS) with programming materials have become a way to contextualise educational content related to PTS and programming, but that studies show that pupils have difficulties conceptualising central phenomena involved in the process, which affects their ability to design PTS. In order to understand these difficulties, this study investigates pupils’ ways of experiencing the process of solving a real-world task with a programming material.

The next study: **Examining the Relationships Between English Teachers’ Lifelong Learning Tendencies with Professional Competencies and Technology Integrating Self-Efficacy** was contributed by Nihal Şen and Hatice Yıldız Durak (Bartın University, Turkey). They argue that teachers’ self-efficacy in integrating technology and professional competencies are predictors of their lifelong learning tendencies. In addition, it was observed that there was a significant difference in English teachers’ self-efficacy in integrating technology, lifelong learning tendencies, and professional competencies according to gender.

Uğur Atıcı (Sivas Cumhuriyet University, Türkiye), Aylin Adem and Mehmet Burak Şenol (Gazi University, Ankara, Türkiye) and Metin Dağdeviren (Gazi University, Ankara, Türkiye and Council of Higher Education Türkiye) next offer: **A comprehensive decision framework with interval valued type-2 fuzzy AHP for evaluating all critical success factors of e-learning platforms**. They point out that the COVID 19 pandemic not only affected our health and social life in many aspects, but it also changed the classical way of training in classrooms and education preferences of society. As a solution various e-learning platforms were developed and preferred by many educational institutions. It was thought necessary to define all critical success factors determining the efficiency of e-learning systems.

**Impact of AR-based collaborative learning approach on knowledge gain of engineering students in embedded system course** by Amit Kumar, Archana Mantri, Gurjinder Singh and Deepit Prit Kaur (Chitkara University, Punjab, India) notes that collaborative learning is the favoured approach educators use to inculcate social skills and promote peer interactions in students. Embedded Systems is a compulsory Electronics and Communication Engineering and Electrical Engineering course, which solves real-time problems. The research aimed to analyse the impact of AR-based collaborative learning activity on the learners’ knowledge gain and collaborative skills while undergoing an embedded system course.

**Comparative analysis of students and faculty level of awareness and knowledge of digital citizenship practices in a distance learning environment: case study** is by Mahmoud Hawamdeh, Zehra Altnay and Fahiye Altnay (Near East University, Nicosia, Cyprus), Ahmet Arnavut (University of Kyrenia, Cyprus), Kezban Ozansoy and Idris Adamu (Near East University, Nicosia, Cyprus). The COVID-19 pandemic increased the use of distance learning, but studies have shown that there is insufficient digital knowledge among students as they do not adequately use technology as a digital citizenship indicator, while the awareness and knowledge of digital...
citizenship among teachers and students remains a key criterion for improving distance learning that mainly depends on information technology.

Preparing students to collaborate with AI remains a challenging goal, say Jinhee Kim, Hyunkyung Lee and Young Hoan Cho (Seoul National University, South Korea) in their article: Learning design to support student-AI collaboration: perspectives of leading teachers for AI in education. As AI technologies are new to K-12 schools, there is a lack of studies that inform how to design learning when AI is introduced as a collaborative learning agent to classrooms. Their study explores teachers’ perspectives on what (1) curriculum design, (2) student-AI interaction, and (3) learning environments are required to design student-AI collaboration in learning and (4) how SAC would evolve.

Joanna Leek and Marcin Rojek (University of Lodz, Poland) then present: Functions of digital learning within the international mobility programme – perspectives of university students and staff from Europe. This paper is based on research studies conducted in the academic community of students and staff members (teachers, researchers and administrative staff) from 16 European universities that focus on digital learning in international mobility. The context of the study is digital learning during an international mobility scheme when university staff and students do not go abroad for their mobility programme but take courses offered by a partner university from home. This study puts forward the assertion that distinctive features of learning in a digital environment within international mobility are systems thinking, self-directed learning and focus on course content. Digital learning environments support motivation to learn, and independence in gaining knowledge.

A systematic review of digital storytelling in language learning in adolescents and adults. Digital storytelling (DST) is a novel approach that uses computer technology to amplify language learning and teaching, and Nikki Zhi Li Lim, Azrifah Zakaria and Vahid Aryadoust (National Institute of Education, Nanyang Technological University, Singapore) present a study to review how the published DST research utilizes visuals and audio to influence the learning environment and engage adolescent and adult language learners. This was measured through their improvement in the four main language skills: reading, writing, listening, and speaking.

Faith O. Mesagan (University of Nigeria, Nsukka, Nigeria), Chiedu Eseadi (University of Johannesburg, South Africa) and Charles O. Omekwu (University of Nigeria, Nsukka, Nigeria) next present: Influence of gender and expected competencies on access to and utilization of cyberspace resources and services for research by postgraduate students. This descriptive survey studied a purposive sample of postgraduates from five universities. The results indicate that postgraduate students showed the expected competencies that should be possessed for the effective utilization of cyberspace resources and services for research. The study recommended that universities should provide free access to electronic resources; and the internet connection should be improved upon.

A personal annotation is a rich object with an important cognitive facet say Tarek Boutefara (Ecole nationale Supérieure d’Informatique, Algiers, and Algeria and University of Jijel, Jijel, Algeria), Latifa Mahdaoui (Ecole nationale Supérieure d’Informatique, Algiers, Algeria) and Abdessamed Réda Ghomari (Ecole nationale Supérieure d’Informatique, Algiers, Algeria) in their article: Exploring the
emotional aspect in Learner’s personal annotation colours. This study investigates the relationship between the learner’s emotional state during the learning session and the colours chosen for annotations. Black and Red are strongly related to Fear and Anger, while green and blue are strongly associated with Envy and Sympathy.

Designing an intelligent tutoring system for computer programming in the Pacific is by Priynka Sharma and Mayuri Harkishan (The University of the South Pacific Suva, Fiji). Intelligent Tutoring Systems are educational systems that reflect knowledge using artificial intelligence, and in their paper, they outline the Programming-Tutor architectural design with core implements on user interaction. This pilot proposal is for designing a model domain of a subset in the programming language. The completed project would be adequate to show the idea of a completely developed computing Intelligent Tutoring System in online programming courses to offer benefits to students in the Pacific.

Effects of programming tools with different degrees of embodiment on learning Boolean operations comes from Baichang Zhong and Liying Xia (South China Normal University, Guangzhou, China) and Siyu Su (Nanjing Normal University, China). They note that one of the aspects of programming that novices often struggle with is understanding abstract concepts such as variables, loops, expressions, and especially Boolean operations. This paper explores the effects of programming tools with different degrees of embodiment on learning Boolean operations in elementary school.

The next paper models the direct effects of the theorized relationships of academic self-efficacy, computer use self-efficacy, learning management system self-efficacy, internet and information-seeking self-efficacy, and online learning self-efficacy. A structural equation model predicting adults’ online learning self-efficacy is by Noriel P. Calaguas (Holy Angel University, Philippines) and Paolo Maria P. Consunji (International Data Corporation, Needham, USA). Their study provides empirical evidence on a previously theorized set of relationships and informs policy makers on significant relationships they can employ to inform program development aimed at improving online learning self-efficacy anchored on their particular use cases.

Intelligent conversational agents have been implemented as virtual assistants in mobile applications to facilitate, engage, and interact with users for optimal learning experiences, point out Kanyarat Srisayathiyakun (King Mongkut’s Institute of Technology Ladkrabang, Bangkok, Thailand) and Chawporn Dhamanitayakul (Rangsit University, Pathum Thani, Thailand) in their article: Enhancing digital literacy with an intelligent conversational agent for senior citizens in Thailand. With 24/7 availability, providing instant and consistent responses, chatbots, as a type of intelligent conversational agent helps benefit the learning communication and makes the entire learning experience more engaging for the learners. They have also been successfully used by the elderly to encourage behavioural change for their intended purpose.

Measuring language ability of students with compensatory multidimensional CAT: A post-hoc simulation study by Burhanettin Ozdemir (Prince Sultan University, Riyadh, Saudi Arabia) and Selahattin Gelbal (Hacettepe University, Ankara, Turkey) who note that computerized adaptive tests (CAT) apply an adaptive process in which the items are tailored to individuals’ ability scores. The multidimensional CAT (MCAT) designs differ in terms of different item selection, ability estimation,
and termination methods being used. This study investigated the performance of the MCAT designs used to measure the language ability of students and to compare the results of MCAT designs with the outcomes of corresponding paper–pencil tests.

Tze Chang Liu (National Chung Hsing University, Taichung City, Taiwan) then offers: A Case Study of the Adaptive Learning Platform in a Taiwanese Elementary School: Precision Education from Teachers’ Perspectives. The Taiwan adaptive learning platform (TALP) can be viewed as a form of precision education (PE) because it can identify students’ learning deficits, offer various learning materials, and provide feedback. The ways in which TALP enhances teaching and learning is meaningful for educational technologies, and to help improve TALP and applications of PE. This study suggests that TALP and PE may enhance students’ learning to identify learning challenges and offer feedback.

Learning through technology in middle school classrooms: Students’ perceptions of their self-directed and collaborative learning with and without technology by Chantal Labonté and Veronica R. Smith (The University of Alberta, Edmonton, Canada) examines this, with and without technology in ICT-supported middle school classrooms. Students’ self-directed learning with and without technology was significantly related to the instructional quality in their classroom with lower instructional quality classrooms having a significant small effect on self-directed learning. Gender was also found to have a small effect, with girls more readily engaging in self-directed learning, although this difference was not sustained when using technology. When learning with technology, while indicating that they engage in self-directed learning within their classrooms, students reported less engagement in collaborative activities with their peers, particularly in earlier middle school grades.

Li Ling, Nicola Yelland and Maria Hatzigianni (University of Melbourne, Australia) and Camille Dickson-Deane (University of Technology Sydney, Australia) then write on: The use of Internet of Things devices in early childhood education: A systematic review. Internet of Things (IoT) devices are becoming ubiquitous and gradually impacting on young children’s play, learning and growth worldwide so it is vital for educators and parents to understand how the IoT devices have been used and with what consequences. Attempts have been made by researchers to explore varied IoT device usage in early childhood education (ECE), but there lacks a consolidated review on this topic. The researchers conducted a systematic review on the IoT device deployment in ECE using four major databases over the past 20 years. Additionally, the IoT devices could provide the young children with opportunities to connect digital and physical worlds for their playful explorations, help them to build their knowledge base, arouse their interest and enthusiasm, and encourage them to be autonomous learners.

Due to the advent of coronavirus disease in most nations throughout the world, the manner of education altered from traditional face-to-face to remote or online teaching, writes Christian Sunday Ugwuanyi (University of the Free State, Bloemfontein, South Africa) in: Developing Sound Knowledge of Basic Science Concepts in Children Using Flipped Classroom: A case of simple repeated measures. This study tested this effectiveness on children’s development of sound knowledge of Basic Science concepts. Thirty-one primary three children took part in the treatment session, which was conducted using a simple repeated measures design. The

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findings demonstrated that using a flipped classroom instructional technique boosted children’s development of a good understanding of Basic Science.

Pre-service teachers’ perceptions of technological pedagogical content knowledge in mainland China: A survey of teachers of Chinese as a second language is by Chun-an Qiu, Hui-xian He, Guo-li Chen and Min-xuan Xiong (Guangdong University of Foreign Studies, China). They point out that there is an urgent need to address the critical demand for qualified Chinese language teachers against the background of China’s seeking greater Sino–foreign cultural and educational cooperation. The literature on integrating technological pedagogical content knowledge (TPACK) in language teaching has been increasing in the last few years, but most of these studies focus on English language teachers. The objective of their study was to examine pre-service teachers’ understanding of TPACK for teaching Chinese as a second language.

Students’ understanding and skills on voltage and current measurements using hands-on laboratory and simulation software comes from Ishlah Rahman (Politeknik Brunei, Brunei Darussalam) and Marlizayati Johari (Universiti Brunei Darussalam). They point out that skills competency is important especially in vocational and technical education and the aim of this research was to develop the student conceptual knowledge and skills in electrical measuring devices to equip the students with the necessary skills to become a competent and skilful Technologist/Technician.

A wiki-based framework for collaborative learning design in teacher education is by Eleni Zalavra and Kyparisia Papanikolaou (School of Pedagogical and Technological Education, Athens, Greece). Harnessing the potential of wikis in teacher education is a significantly challenging task and researchers suggest that incorporating wikis in the educational process requires a proper design rationale. This paper extends the previous research scope by proposing a wiki-based framework for organising collaborative Learning Design (LD) activities in teacher education. Aiming to exploit wiki’s functionalities to foster collaborative LD tasks, cultivate LD knowledge and promote collaborative learning behaviour, the innovation of the particular framework stands in two elements. First: setting a blended learning context organised around five stages by adapting Salmon’s model to gradually familiarise student teachers with wiki functionality, collaboration, and the LD process. The second involves balancing individual and collaborative tasks through the five stages to cultivate trust and promote work-sharing among groups of student teachers.

José Antonio González (Universitat Politècnica de Catalunya, Barcelona, Spain), Mónica Giuliano and Silvia N. Pérez (Universidad Nacional de La Matanza, Buenos Aires, Argentina) then present: Measuring the effectiveness of online problem solving for improving academic performance in a probability course. They say that research on the impact in student achievement of online homework systems compared to traditional methods is ambivalent and methodological issues in the study design, besides of technological diversity, can account for this uncertainty. This study estimates the effect of size of homework practice with exercises automatically provided by the ‘e-status’ platform in students from five Engineering programs.

The next study: Online teaching research in universities based on blockchain explores the use of blockchain in the course design and evaluation in Chinese universities.
and explores the value of teachers’ views and experiences on blockchain in course design. It is by Li Min (Henan University, Kaifeng, China) and Ge Bin (College of Technology and Communication Kaifeng Henan, China). Previous studies have shown that blockchain has a positive effect on the improvement of online teaching management and evaluation quality. Their research focuses on the management of online teaching by using blockchain, and this qualitative case study investigates the design and evaluation of online course based on blockchain by five teachers of different specialties.

Verica Milutinović (University of Kragujevac, Jagodina, Serbia) points out that many seem to believe that today’s pre-service teachers as born after 1980 are digital natives, or that they are “native speakers” of the digital language. This is the topic of the next article: Examining the influence of pre-service teachers’ digital native traits on their technology acceptance: A Serbian perspective. There is, however, no evidence that their digital native characteristics determine whether they would use technology in the classroom. Although not widely evaluated, the four-factor, 21-item Digital Nativity Assessment Scale (DNAS) was one of the first instruments to assess digital nativeness (DN) and this study explores the influence of pre-service teachers’ DN on their intention to use technology in the future classroom in Serbia, by evaluating the DNAS on Serbian sample and using it for measuring the DN.

Programming education in the frameworks of reverse engineering and theory of didactical situations is from: Mustafa Serkan Abdüsselam, Ebru Turan-Güntepe and Ümmü Gülşüm Durukan (Giresun University, Turkey). This study evaluates the teaching of the programming process carried out through scenarios related to daily life within the framework of Reverse Engineering and the Theory of Didactical Situations. After applications based these, it was determined that the prospective teachers’ perceptions of self-efficacy towards programming and their academic achievement increased, and that their analytical and holistic thinking skills when solving problems were also positively affected.

Mailizar Mailizar and Rahmah Johar (Universitas Syiah Kuala, Banda Aceh, Indonesia), Rahmad Sadli (Université Polytechnique Hauts de France, Valenciennes, France) and Tuti Zubaidah (Universitas Syiah Kuala, Banda Aceh, Indonesia) next present: Mathematics teachers’ interactions on online community of practices: A social network analysis. Mobile instant messengers such as WhatsApp have become an essential part of everyday life and can be a transformative tool for teacher professional development, and studies have addressed the use of WhatsApp in a community of practices. This study aimed to investigate teachers’ interactions with emphasis on frequency and pattern of interactions in eight groups of WhatsApp community of practices, which were voluntarily formed.

Psychological capital development effectiveness of face-to-face, online, and Micro-learning interventions describes research by Justin W. Carter (University of North Alabama, Florence, USA) and Carolyn Youssef-Morgan (Bellevue University, USA). They point out that there is growing empirical support for the benefits of developing psychological capital (PsyCap), and the effectiveness of PsyCap interventions (PCIs) in the workplace, but that PCI delivery modes have not been compared. The first study in this article compares a face-to-face to an online PCI. The second compares an online PCI to a micro-learning PCI utilizing a mobile application.
Project-based assessment has been used to evaluate coding projects created by students for a long time, but there is a lack of rigorously tested project-based coding rubrics that are developmentally appropriate for early childhood, say Apittha Una-kalekhaka and Marina Umaschi Bers (Eliot-Pearson Department of Child Study and Human Development at Tufts University, Medford, USA) in their paper: Evaluating young children’s creative coding: rubric development and testing for ScratchJr projects. Their study presents development and testing of a coding rubric to evaluate children’s creations with the popular ScratchJr app for early childhood, as well as results from field testing of the rubric.

Impact of online social capital on academic performance: exploring the mediating role of online knowledge sharing is by Ghasem Salimi, Elham Heidari, Mahboobeh Mehrvarz, and Ali Akbar Safavi (Shiraz University, Iran). This study examined the hypothesis that online social capital can improve the students’ academic performance, as one of the main academic goals, through the mediation of knowledge sharing in the online environment. The findings indicated that the bridging of online social capital had a positive and significant effect on the cognitive and social integrative benefits of online knowledge sharing.

An extended CCtalk technology acceptance model in EFL education was contributed by Yong Wang (Beijing Language and Culture University, China), Liheng Yu (Jiangsu Ocean University, Jiangsu Province, China) and Zhonggen Yu (Beijing Language and Culture University, China). Numerous scholars are devoted to investigating the technology acceptance model (TAM) and its extensions, but a comprehensive TAM is still under investigation. This study aims to formulate a relatively comprehensive model by including personal investment and identify factors that influence students’ adoption of CCtalk-aided English as a foreign language (EFL) course.

Dilek Doğan and Hakan Tüzün (Ankara University, Turkey) then offer: Modelling of an instructional design process based on the problem-based learning approach in three-dimensional multi-user virtual environments. In this study, the instructional design process was examined, and design experiences shared. Also, a design model was proposed to guide people who want to design these 3D MUVEs and to use these environments for educational purposes. A 3D MUVEs design model based on a problem-based learning approach was proposed.

The need to benefit from information technologies in the twenty-first century digital age is increasing in all economies to overcome problems and difficulties and to have desired solutions, so developing algorithmic thinking is important as a skill that requires application of knowledge from different disciplines, especially science, technology, engineering and mathematics. Uğur Sarı, Hüseyin Miraç Pektaş, Ömer Faruk Şen, and Harun Çelik (Kirikkale University, Turkey) enlarge on this theme in: Algorithmic thinking development through physical computing activities with Arduino in STEM education. There is a need for practical studies on how to develop algorithmic thinking and what kind of activities and learning content can be used in classrooms.

Changemakers as digital makers: Connecting and co-creating is from Emma Whewell and Helen Caldwell (University of Northampton, UK), Mark Frydenberg (Bentley University, Waltham, USA) and Diana Andone (Politehnica University
of Timisoara, Romania). This paper presents data from two international projects focused on the interaction between changemaking and digital making in university students. The data is drawn from the contributions of 63 university students located in the United States, Romania, Spain, Belgium, Norway, Denmark and England. Using a design thinking methodology and a thematic analysis of student responses, the aim was to understand how the creative use of immersive technologies, such as augmented and virtual reality, might create an environment for changemaking practices in an international context.

A comparison of recursive and non-recursive models of attitude towards problem-based learning, disposition to critical thinking, and creative thinking in a computer literacy course for preservice teachers is by Sacip Toker (Atılım University, Ankara, Turkey) and Tuncer Akbay (Burdur Mehmet Akif Ersoy University, Turkey). They included factors associated with the outcome variables in the development of the recursive and non-recursive measurement models. The recursive model suggests cooperative learning process is associated with all the outcomes. Personality traits have a great potential as complementary factors. Spare time activities played a prominent role in the disposition to critical thinking.

From Rustam Shadiev and Chuanwen Dang (Nanjing Normal University, China) then comes: A systematic review study on integrating technology-assisted intercultural learning in various learning contexts. They point out that in today’s globalized world possessing intercultural communicative competence is important. This is why technology-assisted intercultural learning programs are widely implemented in all academic levels and in business, healthcare and tourism because it is important for students who study in these to be interculturally competent and have abilities to smoothly interact and collaborate with colleagues, partners or customers from different cultural backgrounds.

Contemporary education is often based on using e-learning courses, which have become a popular means of delivering didactic material to students, say Smyrnova-Trybulska (University of Silesia, Katowice, Poland), Nataliia Morze and Lilia Varchenko-Trotsenko (Borys Grychenko Kyiv University, Ukraine) in their article: Adaptive learning in university students’ opinions: Cross-border research Eugenia. The purpose of their article was to provide a description of the various approaches to adaptive learning, to present the comparative research results of a Polish-Ukrainian study, as well as to highlight the options offered by LMS Moodle (Modular object-oriented dynamic learning environment Learning Management System) for the implementation of adaptive learning and the possibility of taking into account the expectation of students regardless of the country.

The next article: Investigating the effect of Imikode virtual reality game in enhancing object-oriented programming concepts among university students in Nigeria describes research by Kissinger Sunday (Usman Danfodiyo University Sokoto, Nigeria), Seng Yue Wong (University of Malaya, Kuala Lumpur, Malaysia), Balogun Oluwafemi Samson and Ismaila Temitayo Sanusi (University of Eastern Finland, Joensuu, Finland). Learning object-oriented programming (OOP) has been a daunting and challenging task for students across tertiary institutions in Nigeria but literature has suggested use of technology as a way to improve students’ understanding of the subject. In this study, the overall aim is to investigate the effect of
Imikode – a virtual reality (VR) game amongst students of higher educational institutions in Nigeria studying object-oriented programming courses and whether there is a positive correlation in their understanding of the subject on one hand and an improvement in their programming skills on the other.

Co-designing and piloting an Integrated Digital Literacy and Language Toolkit for vulnerable migrant students in higher education is from Angela Smith (University of Bradford, UK), Lourdes Rubio-Rico (Catalunya Universitat Rovira i Virgili, Tarragona, Spain), Gabrielle Tracy McClelland (University of Bradford, UK), Silvia Monserrat-Gómez (Universitat Rovira i Virgili, Tarragona, Spain), Isabel Font-Jiménez (Universidad Europea de Madrid, Madrid, Spain) and Inmaculada de Molina-Fernández (Universitat Rovira i Virgili, Tarragona, Spain). This paper presents the process of co-design, co-production, piloting, evaluation and revision of a Toolkit for Vulnerable Migrant Students (VMs) in Higher Education. The language element focuses on academic language skills of reading, writing, listening and speaking required for effective involvement in both the host society and HE learning, the acquisition and improvement of digital literacy skills enable VMs to successfully participate in, and contribute to, university and societal collaboration, creativity and content curation.

Digital learning has often been criticized due to its lack of student engagement, which results from the physical absence of teachers and the lack of direct communication with their students say Fayiz M. Aldhafeeri and Asmaa A. Alotaibi (Kuwait University, Kuwait) in their article: Effectiveness of digital education shifting model on high school students’ engagement. Digital learning is regarded as a temporary arrangement and not a potential replacement for face-to-face education because of shortcomings that can lead to disengagement among students. Their research involved training teachers in the digital education shifting (DES) model. Following this model, they placed emphasis on student–teacher communication, cooperation among students, and enhanced the principles of digital learning.

Next, Atefeh Taherian Kalati and Mi Song Kim (Western University, London, Canada) present: What is the effect of touchscreen technology on young children’s learning?: A systematic review. Using PRISMA principles, they identified 53 studies in their review. The literature generally advocated positive effects of touchscreen devices on young children’s learning with 34 studies reporting positive effects, 17 studies obtaining mixed findings, and 2 articles reporting negative effects. The factors/conditions of touchscreens affected young children’s learning were classified into five categories including app features/contents, applied pedagogical approach, adult mediation, instructional grouping, and child age and previous experience/familiarity with touchscreens.

Teachers’ perceptions on technology-assisted mathematics teaching and the interactive activities relates work by Sezer Kose Biber, Mahir Biber and Hatice Nur Erbay (Istanbul University-Cerrahpasa, Turkey). They point out that the methods and techniques used by teachers have an important place on the basis of many students’ negative perspectives and failures towards mathematics. This study examines the effectiveness of technology-assisted interactive activities that make the students learn mathematics with fun and love, and teachers’ perceptions on technology-assisted mathematics teaching.
Rysbek Maussumbayev and Rymshash Toleubekova (L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan), Karas Kaziyev (Kh. Dosmukhamedov Atyrau University, Atyrau, Kazakhstan), Axaule Baibaktina and Altynshash Bekbauova (Aktobe Regional University named after K. Zhubanov, Aktobe, Kazakhstan) then offer: Development of research capacity of a future social pedagogue in the face of digital technologies. The aim of their article is to theoretically and practically justify the development of a future social pedagogue’s research capacity in the context of digital technologies. Practical implementation of a model for building social pedagogues’ research capacity within the framework of an online educational course can provide effective training of pedagogues in a digitalized educational environment and ensure a high level of pedagogical excellence. They conclude that research capacity brings proficient results in creative, innovative, communication, leadership, pedagogical, and digital activities, and thus remains an important component of pedagogical excellence.

Learning through chemistry simulations: an analysis of cognitive skill levels follows. It was written by Renan Amorim da Silva and Flávia Cristina Gomes Catunda de Vasconcelos (Federal University of Pernambuco, Brazil). This paper presents an analysis of cognitive skill levels expressed in high school students’ performance using laboratory simulations. They address lower-order cognitive skills (LOCS) and higher-order cognitive skills (HOCS) situations in a virtual simulation activity, in order to identify and underly further discussions about students’ reasoning when dealing with different levels of questions in such an environment. The outcome of this study suggests that combining LOCS and HOCS in laboratory simulations may help teachers identify and progress on students’ reasoning between cognitive skill levels, and also contribute to the assessment and adaptation of simulations in order to facilitate learning.

Next, Rabia Meryem Yilmaz, Fatma Burcu Topuand Ayşegül Takkaç Tulgar (Ataturk University, Erzurum, Turkey) present: An examination of vocabulary learning and retention levels of pre-school children using augmented reality technology in English language learning. Their purpose was to explore this. Results showed that there was an increase in the children’s word/concept learning after the implementation. Qualitative results indicated that children liked AR materials in general and that it had a positive effect on their learning.

The next study, by Ufuk Tugtekin (Mersin University, Turkey) and Hatice Ferhan Odabasi (Anadolu University, Eskişehir, Turkey), considers the question: Do Interactive Learning Environments Have an Effect on Learning Outcomes, Cognitive Load and Metacognitive Judgments? Their study examines Augmented Reality Learning Environments (ARLE) and Virtual Reality Learning Environments (VRLE) as interactive learning environments. Findings revealed no significant differences in the learning outcomes and metacognitive judgments, although significant differences were reported in the objective cognitive load.

Developing K-12 students’ programming ability: A systematic literature review comes from Lihui Sun (Minzu University of China, Beijing, China), Zhen Guo (Tianjin University, China) and Danhua Zhou (Beijing Normal University, China). The argue that in the program-driven information age, programming education is concerned by the global education system, which makes the cultivation
of children’s programming ability become the focus of attention, but that there is no clear definition of programming ability and teaching models.

**Developing a Learning Analytics Intervention in E-learning to Enhance Students’ Learning Performance: A Case Study** is by: Si Na Kew and Zaidatun Tasir (Universiti Teknologi Malaysia, Johor Bahru, Malaysia). Much is still unknown about the development of Learning Analytics intervention in terms of providing personalised learning materials to students to meet their needs in order to enhance their learning performance, so this study aims to develop a Learning Analytics intervention in e-learning to enhance students’ learning performance. In order to develop the intervention, four stages of Learning Analytics Cycle proposed by Clow: learner, data, metrics and intervention were carried out, integrating with two well-known models: Felder-Silverman’s and Keller’s Attention, Relevance, Confidence and Satisfaction (ARCS) models in e-learning, to develop various Learning Objects in e-learning.

Funda Erdogdu (Kutahya Dumlupinar University, Turkey) the presents: **ICT, learning environment and student characteristics as potential cross-country predictors of academic achievement.** This study looks into potential predictors of educational achievement using OECD’s original Pisa 2018 dataset. It explores (i) access to ICT, (ii) physical characteristics of learning environment at school, (iii) quality of teaching staff and educational material, (iv) student characteristics and learning climate, and (v) political and economic structure of the country as potential true predictors of academic achievement.

With the increasing technology integration practices in education, the adoption of computer simulations to teach conceptual understanding of science concepts is widely accepted by educators across the globe says Firas Almasri (University of Warwick, Coventry, and UK Gulf University for Science and Technology, Hawally, Kuwait) in the paper: **Simulations to Teach Science Subjects: Connections Among Students’ Engagement, Self-Confidence, Satisfaction, and Learning Styles.** To understand the connections between learners’ engagement and satisfaction with simulations for science learning and their learning styles, this study analysed university students’ perceptions and experiences of using simulations for learning physics, chemistry, and biology subjects.

**The impact of lecture capture availability on academic performance in a large biomedical science course** is by Landon D. Baillie and Ryan Banow (University of Saskatchewan, Saskatoon, Canada) and Justin J. Botterill (University of Toronto Scarborough, Canada). They remind us that lecture capture is a technology where live lectures are recorded in a digital format and made available to students to view at their convenience, and that use of this technology in higher education has steadily increased despite mixed results as to whether it is beneficial to student achievement. The study utilized a two group quasi-experimental design to examine the impact of lecture capture availability on academic performance in a large enrolment, two-term, second year biomedical science course.

Luz E. Gutiérrez (Universidad del Norte, Barranquilla, Colombia), Carlos A. Guerrero (Universidad Santo Tomás, Tunja, Colombia) and Héctor A. López-Ospina (Universidad del Norte, Barranquilla, Colombia) then write on: **Ranking of problems and solutions in the teaching and learning of object-oriented programming.**
This study describes the most relevant problems and solutions found in the literature on teaching and learning of object-oriented programming (OOP), identified the IEEE Xplore, Scopus, ACM Digital Library and Science Direct repositories. The problems and solutions were ranked through the multi-criteria decision methods DEMATEL and TOPSIS in order to determine the best solutions to the problems found and to apply these results in the academic context.

Development of intellectual and scientific abilities through game-programming in Minecraft by Alessandro Bile (Sapienza Università di Roma, via A. Scarpa, Italy) begins by stating that in recent years, the technological revolution has changed the way we see reality and interact with it, and that education and didactic planning have also had to deal with new technologies. Many educational realities have exploited this digital transformation to speed up and specialize learning, customizing study plans and type of software according to age groups. The activity of the Digital Education Lab is part of this context. It is a digital education school which uses the game software Minecraft Education Edition to teach its students the fundamental principles of computer science, geometry and mathematics. This article discusses learning key science concepts through game learning.

With the development of mobile communication technology and the widespread popularization of mobile devices, mobile learning (m-learning) as a new learning model has achieved rapid development in many fields, and Dejian Yu, Zhaoping Yan and Xiaorong He (Nanjing Audit University, Jiangsu, China) write on this in: Capturing knowledge trajectories of mobile learning research: A main path analysis. This paper reviews 1396 articles associated with m-learning since 1992 to explore the knowledge trajectories. The majority of research focuses on personalized guidance and acceptance and adoption of m-learning.

Improving Students’ Higher Order Thinking Skills and Achievement Using WeChat based Flipped Classroom in Higher Education by Dongping Liu and Hai Zhang (Northeast Normal University, Jilin, People’s Republic of China) compares traditional teacher-centred instruction with a WeChat based flipped classroom to investigate student achievements and higher order thinking skills, such as critical thinking and problem-solving. The WeChat based flipped classroom adopted a Structured Query Language (SQL) lesson from an information technology course. It was found that the flipped classroom student achievements and higher order thinking skills were significantly better than their peers who had been taught in a traditional classroom environment.

MOOC performance prediction and personal performance improvement via Bayesian network describes work by Jia Hao, Jianhou Gan and Luyu Zhu (Yunnan Normal University, Kunming, China). In order to analyse the non-linear and uncertain relationships among the student related features, curriculum-related features as well as the environment-related features, and then quantify the corresponding impacts on students’ final MOOC performance in a valid way, they first construct a Students performance Prediction Bayesian Network (SPBN) via the hill-climbing and maximum likelihood estimation (MLE) method. With SPBN, they could predict the students’ MOOC performance and then quantify the uncertain dependencies of all the relevant features.
The last paper in this issue is by Ji-Yun Kim (Korea National University of Education, Cheongju, South Korea), Jae Seon Seo (Korea Research Institute for Vocational Education and Training, Sejong, South Korea) and Kwihoon Kim (Korea National University of Education, Cheongju, South Korea) and is titled: Development of novel-engineering-based maker education instructional model. Attaining equitable education for all is one of the sustainable development goals, as not only the gap of education between urban and rural students but also a gap of access to information and communications technology also exists. This study combines novel engineering, which is the fusion of engineering and literacy educational methods with maker education, to create a sustainable model of maker education. Through this process, an instructional model for a novel engineering-based maker education is proposed that would enable the utilization of the model in a rural elementary school environment.

Articles in this issue come from researchers in: Algeria, Argentina, Australia, Brazil, Brunei Darussalam, Canada, China, Colombia, Cyprus, Fiji, Finland, France, Greece, India, Indonesia, Iran, Italy, Kazakhstan, Kuwait, Malaysia, Nigeria, Philippines, Poland, Qatar, Romania, Saudi Arabia, Serbia, Singapore, South Africa, South Korea, Spain, Sweden, Taiwan, Thailand, Turkey (Türkiye), UK, Ukraine and USA.

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