



Editorial for EAIT issue 6, 2020

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Education and Information Technologies (EAIT) is the official journal of the Technical Committee on Education (TC3) of the International Federation for Information Processing (IFIP). It covers the complex relationships between information and communication technologies and education, from the micro of specific applications or instances of use in classrooms to macro concerns of national policies and major projects; from classes of 5 year olds to adults in tertiary institutions; from teachers and administrators, to researchers and designers; from institutions to open, distance and lifelong learning. The journal's breadth of coverage allows EAIT to examine fundamental issues at all levels, discuss specific instances and cases, draw inference and probe theory. This journal is embedded in the research and practice of professionals.

The COVID-19 pandemic and lock-down has had a profound effect on education around the world with many schools and universities offering only online teaching for many months. The EAIT Editorial Board, however, was concerned not to publish the sort of descriptive or conceptual articles found in newspapers. They believed that sufficient time was needed for identification and research of all the factors that the COVID-19 crisis might have introduced into education. Ideas need to be reinforced by experimental practice to analyse and validate. Formal and well-founded research studies are needed and to this end EAIT is offering a Special Issue on **Education, IT and the COVID-19 Pandemic** (deadline for submissions is 31st January 2021). You can find details of this by selecting Journal Updates, View all Updates from <https://www.springer.com/journal/10639>.

To begin this issue is an article from Bashir Khan Yousafzai, Maqsood Hayat and Sher Afzal (Abdul Wali Khan University, Mardan, Pakistan): *Application of machine learning and data mining in predicting the performance of intermediate and secondary education level student*. Their paper presents a student marks and grade prediction system using supervised machine learning techniques. The system is based on the historic performance of students. The aim of this work was to analyse education quality which is closely aligned with sustainable development goals. Implementation of the system produces an excess of data which needs to be suitably processed to gain

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more valuable information that can then be used for future development and planning. The classification system predicts the grade while the regression model predicts the marks. The results show the effectiveness and importance of machine learning technology in predicating student performance.

A quasi-experiment on using guided mobile learning interventions in ESL classrooms: Time use and academic performance comes from Siew Foen Ng, Mohammad Affiq Kamarul Azlan, Alia Nadhirah Ahmad Kamal and Alison Manion (University of Malaysia Kelantan, Malaysia). This quasi-experimental study examined a guided learning approach towards the use of mobile devices and investigated the performance of language learners who were guided in its usage. Students from two faculties were invited to participate in this 8-week intervention, with a control group and an experimental group. In the experimental group, the researchers incorporated guided activities Module Intervention Model using mobile devices into the ESL lessons, whereas the control group lessons were without guided activities. Participants from both groups were asked to record their daily mobile device use for activities related to English language learning. At the end of the study, students who received guided language activities utilising the mobile devices had significantly higher levels of language performance than control group students.

A comparative analysis of policies, strategies and programmes for information and communication technology integration in education in the Kingdom of Saudi Arabia and the republic of Ireland by Jawaher Alghamdi (Imam Abdulrahman Bin Faisal University, Jubail, Saudi Arabia) and Charlotte Holland (Dublin City University, Ireland) provides a comparative analysis of policies, strategies and programs for ICT integration in primary and post-primary education in the Kingdom of Saudi Arabia (KSA) and in the Republic of Ireland. The analysis showed that while KSA was a relative newcomer to the integration of ICT into education, it was responsive in seeking to enhance the quality of education and support transitions to the knowledge economy through a range of initiatives, including: reform of the curriculum, provision of teacher professional development in ICT integration, and supply of computer technologies and infrastructure. However, as in the Irish context, the framing of ICT in education' policies, strategies and programs needed to be strengthened through participatory partnerships with key stakeholders that endured throughout the life-cycle of ICT policy.

The widespread adoption of social networking sites among college students has motivated an increasing number of researchers to discern the relationship between social networking site use and academic performance, and Wondwesen Tafesse (United Arab Emirates University) next writes on: ***The effect of social networking site use on college students' academic performance: the mediating role of student engagement***. These studies mostly address the direct effect of social networking site use on academic performance, and do not identify and incorporate relevant explanatory mechanisms. The study in this article, however, addressed this gap by examining the mediating role of student engagement. An empirical test of the mediation model using the PROCESS macro demonstrates that student engagement mediates the negative association between social networking site use and college students' academic performance.

Kyrgyz learners' and teachers' experiences and perceptions related to ICT use in high school courses describes research by: Gülgün Afacan Adanır (Ankara University, Turkey), Bakit Borkoev, Kalipa Saliyeva and Gulshat Muhametjanova (Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic). They note that increasing use of

ICT in education results in advantages for teaching and learning processes and especially in developing countries. It is thus essential to examine stakeholders' experiences and perceptions about ICT use in courses. This study firstly aimed to investigate ICT use of Kyrgyz learners and teachers and secondly to examine learners' and teachers' perceptions with regard to ICT use in Science, Technology, Engineering, and Mathematics (STEM) courses in high schools in the Kyrgyz Republic. In the investigation, one questionnaire was applied to high school learners, and a second to high school teachers. The results explored the difficulties that teachers experience in courses, the materials they use, and their expectations related to ICT use. The crucial problems of Kyrgyz teachers are lack of ICT based materials, lack of equipment, and lack of training.

Darlan Sidik and Faisal Syafar (Universitas Negeri Makassar, Indonesia) next present: *Exploring the factors influencing student's intention to use mobile learning in Indonesia higher education*. Using the Unified Theory of Acceptance and Use Technology (UTAUT) they examined four direct factors: performance expectancy, effort expectancy, external influence, quality of services and another additional factor – individual innovativeness. They found that all these factors significantly influence the intention of students to use mobile learning. The result is also gave UTAUT two extra factors: personal innovativeness and prior mobile social media experiences as a catalyst.

Self-Directed Learning (SDL) is a process in which adult learners initiate their inner motivation to learn by themselves to increase their knowledge, skills and experiences from resources and evaluating learning outcomes. The next article, *Self-directed learning with knowledge management model to enhance digital literacy abilities* by Aime-acha Silamut and Sirirat Petsangsri (King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand) addresses this topic. Knowledge Management (KM) is the process of creating, sharing, using and managing the knowledge and resources of an organisation, and learners use KM to gain their knowledge using their Digital Literacy Abilities (DLA). The researchers developed a model for SDL with KM to enhance DLA. This was synthesised from related works and verified by experts in various fields. The data instrument was derived from focus group discussion including a Likert scale of appropriateness of the model, and experts' opinions and recommendations.

The quest in delivering quality IT services: The case of a higher education institution is from Chelma Slipe and Carl Marnewick (University of Johannesburg, South Africa). They point out that IT leaders in higher education institutions (HEI) face a challenge to incorporate the continuous transformation of technology and the way it is applied to improve the quality of IT service delivery. A multidimensional framework was designed to address the entire IT value stream and to improve the quality of service delivery and thus satisfy stakeholders' expectations. The framework incorporates various best practices, methodologies and standards. It was validated using in-depth interviews to determine which elements of the framework contribute to quality IT services. Respondents completed a service quality matrix as part of the interview. The results were analysed to determine the respondents' understanding and interpretation of the delivery of quality services. Results highlighted a discrepancy between the IT department's perception of quality service and the recipients' perception of these

services. The results also highlighted that the framework can be used to align the various service quality perceptions.

The use of computers in educational assessment is a widely explored territory say Sujan Kumar Saha and Rushali Gupta (Birla Institute of Technology Mesra, India). Their article is: *Adopting computer-assisted assessment in evaluation of handwritten answer books: An experimental study*. Several studies have been performed to show the effectiveness of computer-assisted assessment (CAA) and this has been accepted in various education sectors but due to lack of sufficient infrastructure, paper-based examinations are still being used in many countries including India. Existing CAA frameworks require the examination to be conducted on a digital platform and so do not apply to paper answer books. The authors propose a two-phase framework for automatic evaluation of handwritten answer books. The first phase converts the answers written on papers to a digital form using a neural network-based handwritten answer recogniser, and the second evaluates the answer to generate a numerical score. Experimental result shows that the proposed approach is quite promising.

Preservice teaching is one of the most difficult times in the course of becoming a teacher and Günizi Kartal (Boğaziçi University, Kuzey Kampus, Istanbul, Turkey) and Derya Kıcı (Ryerson University, Toronto, Canada) address this in: *Reflection through drama and concept maps for preservice teacher education in information communication technologies*. This study presents the results of technology-integrated implementation of a model of preservice teacher education based on drama and reflection. Its purpose was to help the participants build on their emerging concepts of teaching and being a teacher as detected through repetitive use of concept maps, and reflection on their maps. Changes over time in type and frequency of concepts used by the participants showed that they became increasingly aligned with a more egalitarian, student centred, and constructive view of teaching. The role of the teacher evolved from more of an implementer to a designer and learner, with a growing amount of teacher knowledge and knowhow.

A critical deconstruction of computer-based test application in Turkish State University by Ömer Gökhan Ulum (Mersin University, Turkey) notes that Artificial Intelligence (AI) can be observed not only from the rising recognition of assistance tools such as Siri (Apple) but also from the newly introduced Google Voiced Translator. Some crucial benchmarks, however, still have to be supplied before it can act as a proxy for a real instructor: imagination, creativity, and spontaneity. Automated assessment with use of AI is one of the recent education practices and claims to accelerate the time for exam grading, eliminate human prejudice and to be as precise as human assessors. This, however, has encountered criticisms in some education communities, including the English as foreign language (EFL) learning community. The reported phenomenological inquiry examined Turkish EFL students' and instructors' conceptions on the Versant English Test (VET), an automated test of spoken and written language functioning by means of AI software. The findings showed that EFL university students developed negative attitudes towards VET and that VET is not a reliable and valid test because the same questions were observed to have appeared in the computer-based test.

"I felt like I was missing out on something": an evaluation of using remote technology in the classroom say Charles L. T. Corsby and Anna Bryant (Cardiff Metropolitan University, UK) in the next article. As technology develops in Higher

Education, distance learning has adopted many different guises and supports many different needs, and the purpose of the reported study was to evaluate the use of Double Robotics on a Doctoral (level 8) postgraduate course at a Higher Education institution. The project aimed to generate an understanding of student and tutor experiences more generally, while examining the feasibility and impact of Double Robotics within a doctoral programme. Data was collected through a series of focus group interviews with student and tutors over the course of a single semester. Four key themes were identified: quality of technology, classroom familiarity, tutor facilitation and user isolation. The significance of this study lies not only in assessing the feasibility of Double Robotics but, specifically, shedding light on the nuanced understanding tutors require to enrol and engage distance learners remotely.

Jie He (Baoji Vocational & Technical College, People's Republic of China) then write on: ***Construction of “three-stage asynchronous” instructional mode of blended flipped classroom based on Mobile learning platform***. This paper addresses the principles that should be observed in the design of blended flipped classrooms, and constructs a ‘three-stage asynchronous’ teaching mode of online autonomous and collaborative learning before class, offline presentation and performance in class, and online consolidation and improvement after class. A mixed research method of qualitative, quantitative and tracking observation is used to verify the effectiveness of this teaching mode.

The next study examined internet addiction profiles of university students with latent class analysis based on their responses to Internet Addiction Test (IAT). ***Studying internet addiction profile of university students with latent class analysis*** comes from Irshad Hussain (The Islamia University of Bahawalpur, Pakistan), Ozlem Cakir (Ankara University, Turkey) and Burhanettin Ozdemir (Prince Sultan University, Riyadh, Saudi Arabia). The study participants were classified into four groups according to their total score: normal (0–30), mild (31–49), moderate (50–79) and severe (80 and above) level of internet addiction. The performance of latent classes across six factors of IAT found substantial difference among three latent classes for salience, excessive use, neglect of work and anticipation factors. These results suggest that the same clustering criterion cannot be applied to each factor of IAT and using the same criterion for each factor might lead to inaccurate and biased classification of individuals.

Employing the technology acceptance model in social media: A systematic review analyses up-to-date social media studies that involved the Technology Acceptance Model (TAM) as the primary theoretical model. It was contributed by: Noor Al-Qaysi (Universiti Pendidikan Sultan Idris, Tanjung Malim, Malaysia) and Norhisham Mohamad-Nordin (Universiti Pendidikan Sultan Idris, Tanjung Malim, Malaysia and University of Nizwa, Birkat Al Mawz, Oman) and Mostafa Al-Emran (Ton Duc Thang University, Ho Chi Minh City, Vietnam). Their research findings indicated that studying social media adoption and usage among students was the most frequent research problem tackled. They found that perceived enjoyment, subjective norm, self-efficacy, perceived critical mass, perceived connectedness, perceived security, and perceived trust were the most frequent factors that significantly extended the TAM.

The use of ICT in teaching geometry in primary school by Maria Arvanitaki and Nicholas Zaranis (University of Crete, Panepistimioupoli Gallou Rethymno, Greece) investigated whether ICT helps improve students' achievement in geometry regarding solids' nets. Their research compared the achievement of the students in the

experimental group taught using their ICT intervention, to students in the control group taught by traditional teaching methodology. In particular, they designed a teaching intervention with educational activities in which they incorporated Augmented Reality technology to test whether geometry teaching is enhanced. The results of the study indicated that teaching and learning through ICT is an interactive process for students at primary school and has a positive effect on learning geometry as compared to the traditional teaching method.

M. Mithun Mohan, Pallavi Upadhyaya and Rajasekharan Pillai (Manipal Academy of Higher Education, India) next write on: *Intention and barriers to use MOOCs: An investigation among the post graduate students in India*. They note that Massive Open Online Courses (MOOCs) have been widely acknowledged as a unified platform to reduce the digital divide and make education accessible to all. Despite several benefits, MOOC adoption and completion rate remain unimpressive, especially among developing countries. Using the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2), they examine the key factors that influence the behavioural intention to use MOOCs among students in an Indian private university.

The mandatory phasing in of the Moodle learning environment within South African universities has met with a variety of uptake challenges and Cedric Bheki Mpungose (University of KwaZulu-Natal, Durban, South Africa) discusses this in: *Beyond limits: Lecturers' reflections on Moodle uptake in South African universities*. The author points out that Moodle was officially introduced without clear exposition of the underpinning theory, training, and implementation framework for its adoption. This study reports on a qualitative case study drawing from a purposive sampling of two South African universities that have adopted Moodle to support the teaching and learning endeavour. It revealed that the top-down imposition of mandatory Moodle implementation was resisted by lecturers, hindering uptake, and maximum potential was difficult to measure.

The next article: *Investigating the impact of space design, visual attractiveness and perceived instructor presence on student adoption of learning management systems* reports research by: Amir Hossein Ghapanchi (Victoria University, Melbourne, Australia), Afroz Purarjomandlangrudi (Holmes Institute, Melbourne, Australia), Alasdair McAndrew (Victoria University, Melbourne, Australia) and Yuan Miao (Victoria University, Melbourne, Australia). They point out that a Learning Management System (LMS) is one of the most important educational technologies used in the tertiary sector, providing an online platform for teaching, as well as supporting student learning. However, despite all the effort put into deployment of LMSs in many universities, below expectation student engagement and acceptance is normally reported. To address this issue, they developed a conceptual model to investigate the impact of space design, visual attractiveness and perceived instructor presence on student acceptance of LMS.

Evaluation of information and communication technology in education programs for middle and high schools: GENIE program as a case study is by Jalal Ismaili (Moulay Ismail University, Meknes, Morocco). The Generalisation of Information and Communication Technologies in Education program (GENIE) has made the way for computers, video projectors, interactive whiteboards and multimedia rooms into many public schools in Morocco, and has worked to add a communicative dimension to the process of technology assisted teaching. This paper aimed to study the impact of GENIE on teachers and students in middle and high school using an evaluation model

conceived by Daniel Kirkpatrick and Thomas Guskey. The study concluded that the flagship ICT integration program in Morocco is a promising one, but falls short of delivering its promise of engaging the Moroccan school into the information society.

In the following article, José Mario Ríos Félix, Ramón Zatarain Cabada and María Lucía Barrón Estrada (Juan de Dios Tecnológico Nacional de México/IT de Culiacán, Mexico) point out that in Mexico, digital incursion programs are barely implemented, which represents an educational delay compared to other countries that have faced the need to integrate the teaching of digital skills, in a wide range of educational levels. ***Teaching computational thinking in Mexico: A case study in a public elementary school*** presents a learning environment of Computational Thinking called EasyLogic3D, which proposes a novel integration of emotional recognition, gamification, and a 3D environment. The results showed that the perceived enjoyment when using the learning environment was positive, but that learning gained through using the learning environment was comparable to a class session in which the same topics and exercises were presented.

Do “interdisciplinary” disciplines have an interdisciplinary impact? Examining citations between educational technology and library and information science journals by Brady D. Lund (Emporia State University, USA) examines the exchange of citations between two disciplines – Educational Technology (ET) and Library and Information Science (LIS) – as an indication of their interdisciplinary impact. Findings of this study reveal that about 1/10th of LIS articles and 1/30th of ET articles in the study sample were cited at least once in an article from the other discipline, suggesting that LIS has slightly stronger impact on ET research than vice versa. Overall, the findings indicate a fair amount of exchange of ideas between the disciplines of LIS and ET.

Norman Rudhumbu (Bindura University of Science Education, Zimbabwe) then offers: ***Antecedents of university lecturers’ intentions to adopt information and communication technology in Zimbabwe***. This study used a structured questionnaire on a sample of 600 university lecturers from 6 selected public universities. Results showed that policy support infrastructure (ICT policy, ICT policy implementation strategy and clear ICT vision), technical support infrastructure (competent support team, ICT tools and systems, internet and reliable power supply) and technical skills infrastructure (training and skills level) acted as antecedents to ICT adoption in Zimbabwean universities. A lack of ICT policy implementation plans and obsolete ICT infrastructure acted as major barriers to ICT adoption.

Explanatory model of barriers to integration of digital technologies in higher education institutions is by Cristina Mercader (Universitat Autònoma de Barcelona, Spain). This study aimed to elaborate an explanatory model of the barriers to digital technology integration into university teaching, including links between them and social and demographic factors that may be influencing them. The results showed there are seven main barriers to technology integration: technophobia, lack of time, absence of planning, lack of incentives, lack of evaluation, work saturation, and university accreditation model.

Student Teachers’ Knowledge in the Era of the Fourth Industrial Revolution comes from Cedric Bheki Mpungose (University of KwaZulu-Natal, Durban, South Africa). Inadequate knowledge of ICT negatively impacts the existing South African curriculum and assessment policy statement (CAPS) subjects, despite an attempt at

introducing the new fourth industrial revolution (4IR) curriculum into schools. This qualitative interpretive case study explored student teachers' knowledge of the teaching of CAPS subjects. A technological, pedagogical and content knowledge (TPACK) framework was used. This study revealed that student teachers are good at standard content, pedagogical, and technological knowledge, while having no notion of advanced knowledge that caters for 4IR.

Tomáš Měkota and Miroslav Marada (Charles University, Praha, Czechia) then write on: *The influence of the Nearpod application on learning social geography in a grammar school in Czecha*. They point out that in Czechia, where research on the effect of using computers, tablets or cell phones at schools has been carried out, the number of such studies is very low. Working with two classes of a high school in Prague they examined how tablets help high school pupils with learning social geography in the Czech educational system. Two lessons were taught in each class, one with the Nearpod application on the tablet, the other without it. They found that pupils enjoyed the lessons with tablet, they felt more motivated and they thought that they had learnt more with the tablet than without it. There were differences in pupils' relationship to digital technologies and in level of collaboration between the classes.

There are thousands of participants in different programming MOOCs which means thousands of solutions have to be assessed and this is very time-consuming if performed manually. Using automated assessment is essential say Erik Muuli, Eno Tõnisson, Marina Lepp, Piret Luik, Tauno Palts, Reelika Suviste, Kaspar Papli and Merilin Säde (University of Tartu, Estonia) in their article: *Using image recognition to automatically assess programming tasks with graphical output*. Since task requirements must be strict for the solutions to be automatically gradable, this often limits the types of different assignments and creativity. In order to promote more creativity they wanted to enable programming tasks with graphical output. They analysed a system capable of assessing the graphical output of a solution program using image recognition. The graphical output with a keyword attached is sent to an image recognition service provider that responds with a probability score. The evaluation of the usefulness of the system and overview of participants' feedback are presented as results.

Gamification of student peer review in education: A systematic literature review describes research by: Theresia Devi Indriasari (The University of Auckland, New Zealand and Universitas Atma Jaya Yogyakarta, Indonesia), Andrew Luxton-Reilly and Paul Denny (The University of Auckland, New Zealand). The goal of this work was to understand how gamification has been used to engage students in peer review activities and to summarise the empirical evidence for its effectiveness. They present a general model of the peer review process that captures the students' activities and an examination of the specific actions within this model that have been gamified in the current literature. They found that artifact assessment and artifact creation are the two most commonly gamified actions with respect to our peer review model and that the quantity and quality of both the artifacts and the generated feedback are the most popular reward criteria. Science, Technology, Engineering and Mathematics (STEM) are the discipline areas in which gamified peer review activities are most often reported.

Zheyu Tan, Razvan Beuran, Shinobu Hasegawa, Min Zhao and Yasuo Tan (Japan Advanced Institute of Science and Technology, Nomi, Japan) and Weiwei Jiang (The University of Melbourne, Australia) present: *Adaptive security awareness training using linked open data datasets*. They explain that cybersecurity is no longer an issue

discussed only between professionals or technologists, but is also closely related to ordinary people whose daily life is exposed to all kinds of cyberattacks. Womabat Security Technologies conducted a survey that revealed that ransomware is an unknown concept to nearly two-thirds of employees. As almost 95% of cybersecurity attacks are due to human error, expensive and sophisticated systems cannot work effectively without considering the human factor as this is the major vulnerability in cybersecurity, meaning that cybersecurity awareness training should be given. In their paper they present a system named ASURA that provides adaptive training aimed at improving cybersecurity awareness.

Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic was contributed by Mohammed Amin Almaiah (King Faisal University, Saudi Arabia), Ahmad Al-Khasawneh (Hashemite University of Jordan) and Ahmad Althunibat (Al-Zaytoonah University of Jordan). They note that provision and usage of online and e-learning system has become the main challenge for many universities during COVID-19 pandemic. E-learning systems such as Blackboard have several features that are valuable for use, but successful usage of e-learning systems relies on understanding the adoption factors as well as the main challenges that face the current systems.

Perspectives on the tensions in teaching with technology in Norwegian teacher education analysed using Argyris and Schön's theory of action comes from Steinar Thorvaldsen and Siri Sollied Madsen (The Arctic University of Norway, Tromsø, Norway). They point out that teachers' professional digital competence is of increasing importance in classrooms in the majority of EU countries. Norway is one of the countries exposed to a strong top-down implementation of ICT in education, but despite national efforts, practitioners in the education system do not seem to work in line with the given policy. There is a gap between the micro and macro levels, necessitating the need for a closer. They conducted a quantitative study of teacher educators and their students in Northern Norway.

Ontologies are used with great success in education because they allow us to formulate the representation of a learning domain by specifying all concepts involved, relations between concepts and all properties and conditions that exist. Kristian Stancin, Patrizia Poscic and Danijela Jaksic (University of Rijeka, Croatia) explore this in their article: ***Ontologies in education – state of the art***. Their goal in this paper was to present the field of ontologies and give an overview of recent research in the field in the context of education. As this paper presents a literature review, papers from the last 5 years were collected from the IEEE Xplore database, analysed and categorised based on the use of ontologies for: curriculum modelling and management, describing learning domains, learning data, and e-learning services.

The next article describes research undertaken by Therese Keane (Swinburne University of Technology, Melbourne, Australia), Marie Boden (University of Queensland), Christina Chalmers (Queensland University of Technology) and Monica Williams (Association of Independent Schools of South Australia). ***Effective principal leadership influencing technology innovation in the classroom*** reports on the implementation of a humanoid robot in five school settings and evaluates the success of the implementation based on the leadership of the school principal. As part of wider three-year multiple case study research that investigated the use of humanoid robots in different school settings, a robot was placed in the five selected schools for a fixed

period of time to see how the technology was used and how the principal's leadership impacted on its implementation in the classroom. The findings of this study highlight that principals who were invested in the implementation of the humanoid robot fostered a positive learning community and were directly supporting and encouraging of their teachers; led their team to a successful implementation of the new technology in their school.

The effect of educational computer games on students' academic achievements and attitudes towards English lesson is by Serkan Yeşilbağ, Özgen Korkmaz and Recep Çakir (Amasya University, Turkey). Their study aimed to determine the effects of educational computer games on tenth grades Turkish students' academic achievement and attitudes towards the course. The subjects were taught through traditional teaching activities based on the English education program in the control group while educational computer games were used as teaching activities in the experiment group. The results suggest that computer games can be used in education as an ICT tool to increase students' academic success in English learning.

Younah Kang and Keeheon Lee (Yonsei University, Seoul, Republic of Korea) then present: ***Designing technology entrepreneurship education using computational thinking***. They note that while Computational Thinking has been adopted in various educational settings, it has not been fully utilised in entrepreneurship education. Technology entrepreneurship education involves project-based learning for creating business value. To help students improve learning outcomes they propose a new framework of entrepreneurship education that combines business model development and Computational Thinking. They applied this framework to a capstone course for social innovation, in which undergraduate students were asked to define a social problem, develop a solution, and finally implement the appropriate products and services using Arduino, Raspberry Pi, sensors, and actuators.

"Kian Santang" game as historical educational media using digital storytelling concept comes from Mahardika Abdi Prawira Tanjung (Sekolah Tinggi Manajemen Informatika dan Komputer Royal, Kisaran, Indonesia) and Opim Salim Sitompul (Universitas Sumatera Utara, Medan, Indonesia). They point out that history of the Indonesian state is being forgotten by its younger, "millennial" generation who rarely study history of previous state fighters. One of these histories of the Indonesian state is the story of the wise character: Prince Kian Santang. This is used as an example for Indonesian people who are facing the current era of globalisation. Using the ADDIE methodology, researchers designed the game "Prince Kian Santang". Through Digital Storytelling and educational games, researchers hope that Indonesian teens will not forget the Prince Kian Santang story.

There are 80,000+ educational apps in the Apple App Store and maths apps are the most common. In the article that follows, ***Identifying quality educational apps: Lessons from 'top' mathematics apps in the Apple App store***, Adam Kenneth Dubé (McGill University, Montreal, Canada and Department of Educational & Counselling Psychology, Montreal, Canada), Gulsah Kacmaz, Run Wen, Sabrina Shajeen Alam and Chu Xu (McGill University, Montreal, Canada) searched for 'maths' in the education category and selected the top ten apps for each of the three filters provided by Apple (Relevance, Popularity, Rating) and three age categories (0–5, 6–8, 9–11). There was a surprising lack of transparency and meaningful information, meaning that the Apple

App store needs to explain how it selects ‘top’ apps and developers need to provide benchmarks of educational quality in their app descriptions.

İsmail Çakır (Ankara Yıldırım Beyazıt University, Turkey) and Mustafa Özer (Abdullah Gül University, Turkey) next discuss: ***Fostering intuitive competence in L2 for a better performance in EAP writing through fraze.it in a Turkish context.*** They argue that online corpus referencing through web applications such as fraze.it can help non-native language teachers train tertiary level learners of academic writing by providing them with native or near-native perspectives which come within concordance lines derived from authentic sources. Their study features a semi-experimental design in order to reach an understanding of the impact of simulated academic reading, which denotes a sentence-based approach to getting students familiar with the authentic use of English in academic texts.

The following article: ***Factors enabling the acceptance and use of a podcast aggregator in accounting education*** comes from Alex Sandro Rodrigues Martins, Alexandre Costa Quintana and Débora Gomes de Gomes (Federal University of Rio Grande, Brazil). They aimed to identify behavioural factors enabling students’ acceptance and use of a podcast aggregator that provides tips about contents taught in the classroom. Also to investigate its impact on knowledge formation among Accounting Sciences undergraduate students from a Federal University in Southern Brazil, based on the Unified Theory of Acceptance and Use of Technology (UTAUT) and on Vygotsky’s Historical-Cultural Theory. This research is justified by the need of conducting studies based on education theories and on theoretical frameworks associated with technology acceptance in order to help better understanding to what extent technology contributes to cognitive development.

Applying flow-based principles in teaching computer programming to high school students: A semiotic perspective was written by: Cesar Goudouris, Antônio Carlos de Abreu Mol and Ana Paula Legey (Centro Universitário Carioca, Brazil), Paulo Victor Rodrigues de Carvalho (Centro Universitário Carioca, Brazil and Instituto de Engenharia Nuclear, Brazil), Joana Loureiro Freire (Escola EDEM, Brazil), Bianca Maria Rego Martins (Universidade do estado do Rio de Janeiro, Brazil) and Alessandro Jatobá (Centro Universitário Carioca, Brazil and Centro de Estudos Estratégicos, Brazil). They note that teaching computer programming to children and adolescents has become popular in recent years, and that this has resulted in increased research into techniques for teaching introductory programming using visual languages, especially block-based languages. This study aimed to explore new possibilities for teaching programming by adopting a hybrid environment between the descriptive and flow-oriented paradigm. The use of the Semiotic Engineering’s Communicability Evaluation Method (CEM), a theoretical line of Human-Computer Interaction based on communication, was applied to assess its usefulness to a high school audience. Their results established that the use of CEM in education was appropriate, that the proposed environment was suitable for the study, and the topics were relevant to the target audience.

For the next article, Huseyin Artun, Alper Durukan and Atilla Temur (Van Yuzuncu Yil University, Turkey) offer: ***Effects of virtual reality enriched science laboratory activities on pre-service science teachers’ science process skills.*** They note that innovative instructional technologies, especially virtual reality devices, are becoming more prominent and feasible in science education. Activities enriched with virtual

reality technology have the potential to make unobservable phenomena accessible in any school, and this has the potential to lead in a new milestone in terms of acquisition of the science process skills, not only in secondary school students but also in the training of pre-service science teachers. The authors relate a mixed-method study aimed to investigate the effect of virtual reality enriched laboratory activities effects on the science process skills of pre-service science teachers in Turkey.

Multimodal data indicators for capturing cognitive, motivational, and emotional learning processes: A systematic literature review is from Omid Noroozi (University of Oulu, Finland and Wageningen University and Research, Netherlands), Héctor J. Pijera-Díaz, Marta Sobocinski, Muhterem Dindar, Sanna Järvelä (University of Oulu, Finland) and Paul A. Kirschner (University of Oulu, Finland and Open University of the Netherlands). This systematic review on data modalities synthesises the research findings in terms of how to optimally use and combine such modalities when investigating cognitive, motivational, and emotional learning processes. ERIC, WoS, and ScienceDirect databases were searched with specific keywords and inclusion criteria for research on data modalities, resulting in 207 relevant publications. From these publications, 98 focused exclusively on the cognitive aspects of learning, followed by 27 publications that only focused on motivation, while only five publications exclusively focused on emotional aspects. Only 10 publications focused on a combination of cognitive, motivational, and emotional aspects of learning. Rather than researching cognitive, motivational, and emotional aspects of learning separately, they encourage scholars to tap into multiple learning processes with multimodal data to derive a more comprehensive view on the phenomenon of learning.

Melody Maseko, Tinashe Gwendolyn Zhou and Theo Tsokota (Midlands State University, Zimbabwe) next write on: ***A framework to manage reluctance to bad news reporting on software projects in state universities in Zimbabwe***. They say that failure of IT projects is often attributed to the ‘mum effect’- an individual’s reluctance to report the exact position of troubled software projects, and with the increasing digitalisation of operations by most State Universities in Zimbabwe, the mum effect has the potential to rise to exponential proportions. Guided by the Design Science approach data was gathered from an intensity sample of participants comprising software project team members, ICT project managers, and users of the system drawn from three Zimbabwean state universities. The data collection was done using key informant interviews and focus group discussions. Their study suggests the establishment of clear channels of communication to manage bad news reporting and creating formal structures that function outside the traditional organisational hierarchy to convey information regarding anomalies.

Following this, Jika Saidu Muhammad, Azman Mat Isa and Ahmad Zam Hariro Samsudin (Universiti Teknologi MARA, Selangor, Malaysia) and Shah J. Miah (Victoria University, Melbourne, Australia) offer: ***Critical factors for implementing effective information governance in Nigerian universities: A case study investigation***. They say that universities in Nigeria are plagued with inefficient administration and management due to poor management of records and information, in most cases failing to comply with the National Universities Commission. This resulted in higher possibilities of revoking their licenses so the need for effective records and information management is imperative. The essence of this study was to explore the critical factors for implementing Information Governance framework in Nigerian universities. The

research found that critical factors such as funding, stakeholder involvement, policy, enabling environment, personnel and ICT are vital in implementing Information Governance for universities.

Learner modelling in cloud computing by Sameh Ghallabi and Fathi Essalmi (The Research Laboratory of Technologies of Information and Communication & Electrical engineering (LaTICE), Tunis, Tunisia), Mohamed Jemni (The Research Laboratory of Technologies of Information and Communication & Electrical engineering (LaTICE), Tunis, Tunisia) and The Arab League Educational, Cultural and Scientific Organisation, Tunis, Tunisia) and Kinshuk (University of North Texas, USA) begins by pointing out that with the emergence of technology the personalisation of e-learning systems is enhanced. Cloud computing is a new model of computing where standard and virtualised resources are provided as a service through the Internet, but these parameters are not based on classification and optimisation algorithms to implement them in the cloud. Their paper proposes an approach that allows learner modelling in the cloud where these parameters are integrated.

Sign language is considered an important communication means among normal people and the deaf. Safaa M. Elatawy, Doaa M. Hawa, A. A. Ewees and Abeer M. Saad (Damietta University, Egypt) elaborate on this in: **Recognition system for alphabet Arabic sign language using neutrosophic and fuzzy c-means**. The development of communication systems to help these people is an important issue, and in their article, they describe how the neutrosophic technique and fuzzy means are applied to detect and recognise the alphabet Arabic sign language. Their proposed system starts by using a Gaussian filter to delete the noise and prepare the input image to be used in the next step. After this, the image is converted to the neutrosophic domain and its features are extracted to start the classification phase where the corresponding letter is displayed.

The academic turn: Social media in higher education is presented by Thirusellvan Vandeyar (University of Pretoria, South Africa). Utilising a qualitative case study approach, this study set out to explore experiences of academics' as they made a pedagogic turn towards using social media technology for teaching in a resource-constrained context. The Technology Acceptance Model served as the theoretical mooring of this study. Three findings are presented; what the author calls 'academic turns'. The first is a turn away from the institutions' learning management system due to contextual exigencies. Second comes a pedagogical turn towards Web 2.0 technologies using social media tools to enhance their pedagogy. This is followed by a third turn in which beliefs and attitudes turn about the affordances of social media, augmenting academics' resilience to persevere with this technology of choice.

Sana Shams (University of Engineering and Technology, Lahore, Pakistan), Muhammad Ahsan ul Haq (National College of Arts, Lahore, Pakistan and University of the Punjab, Pakistan) and Yasira Waqar (Lahore University of Management Sciences, Pakistan) next report on: **Open educational resources (OER) usage trends among university students of Pakistan**. This is an initial study on baseline trends of use of Open Educational Resources by university students in Pakistan and presents perceived benefits of their use to attain academic challenge, collaborative learning, and to enrich their educational experience. The perceived benefits of OER use are significantly different for students studying at different education levels and across disciplines, with social science and female students having a better perception of the benefits of OER than other academic disciplines and their male counterparts.

Personalization of study material based on predicted final grades using multi-criteria user-collaborative filtering recommender system relates research by Dina Fitriya Murad, Yaya Heryadi, Sani Muhamad Isa and Widodo Budiharto (Bina Nusantara University, West Jakarta, Indonesia). In their article they note that the recommender system has gained attention from education research communities mainly due to increasing needs for personalised learning, and big data availability in the education sector. They present a hybrid user-collaborative, rule-based filtering recommendation system for the education context. User profiles are represented by learning outcome scores and contextual information. The user-collaborative filtering method is used for predicting the targeted student's learning outcome of a particular course. The predicted learning outcome combined with a set of decision rules are used for recommending some relevant link of learning materials to the targeted student.

Experienced educators' suggestions for solutions to the challenges to technology integration is by Oğuzhan Atabek (Akdeniz University, Antalya, Turkey) and relates the second phase of a two-phase study to reveal experienced educators' suggestions for solutions. Initially these were elicited and developed into a questionnaire which then was used to survey workshop attendees. Analyses revealed that, solution suggestions fall into three categories: Train, Allow Time, and Supply. In order to overcome barriers to technology integration, experienced educators suggested (a) improving the quality of in-service and pre-service training, (b) allowing teachers more time by simplifying and reducing the number of courses in the instructional programs, and (c) supplying teachers with technology incentives, quality educational content, technical assistance, and information technology solutions.

The next study investigates students' performance, perception and acceptance when experiential learning approaches are integrated into Computer Science courses, and comes from Katerina Tzafilkou, Nicolaos Protogeros and Adamandia Chouliara (University of Macedonia, Thessaloniki, Greece). ***Experiential learning in web development courses: Examining students' performance, perception and acceptance***. An experiential learning approach was designed to assist students in web development courses and was based on real-world examples and the abstraction of terminology using sequential wizard-based logic. Results demonstrated a high degree of perception and acceptance, as well as high performance scores. Perceived ease of use and usefulness were strongly correlated to each other as well as to self-efficacy, willingness to learn and satisfaction. Satisfaction and self-efficacy were not correlated to each other, while performance was not affected by any of the measured variables.

Clara Isabel López, Luis Eduardo Bautista and Carlos Mantilla (Universidad Industrial de Santander, Bucaramanga, Colombia) then write on: ***A novel approach to learning virtual engineering in the medical devices process***. The use of computer-based technologies has increased to support the design process of biomedical products, but the limited capacity of undergraduates to work with the technologies used in the development process negatively influences the research execution for biomedical product design leading the authors to design a framework for knowledge transfer required by undergraduate students. The study aim was to evaluate the framework proposed as a strategy for knowledge transfer and ICT skills strengthening. The framework presented was to manage the teaching and learning process for software tools used during the ideation and development of biomedical products.

The next article explores the possibilities and challenges of using the social media tool WhatsApp to support language teacher development in the Zataari refugee camp in Jordan. ***WhatsApp supported language teacher development: A case study in the Zataari refugee camp*** takes a socio-cultural perspective on teacher development where WhatsApp is a mediating tool in the broader sociocultural landscape. It was contributed by Gary Motteram and Susan Dawson (University of Manchester, UK) and Nazmi Al-Masri (Islamic University of Gaza, Palestine). A thematic analysis of the postings and exchanges from the WhatsApp group revealed three main uses of WhatsApp chat: for interpersonal interactions, professional development, and organisational purposes. The analysis suggests the WhatsApp group contributed to the teachers' English language knowledge, provided a platform for them to share and discuss issues related to the challenges of their particular context, enabled them to contribute to the development of some teaching materials and to begin to address some of the issues they had in a meaningful way.

Information technology teachers' perceptions of the benefits and efficacy of using online communities of practice when teaching computer skills classes by Nafeth Al Hashlamoun and Lina Daouk (Higher Colleges of Technology, Abu Dhabi, United Arab Emirates) explores the ways in which IT teachers experience the use of online communities of practice in teaching a computer course called Computer Skills 2. This is the second of two computer skills courses in the Work Readiness Program running at a Higher Education Institution in the Middle East. A phenomenological approach was chosen to help understand and explore the qualitatively different ways in which particular teachers experience the use of online communities of practice as a social and collaborative learning system.

In the article: ***Investigating the drivers and barriers to MOOCs adoption: The perspective of TAM***, Ahmad Samed Al-Adwan (Al-Ahliyya Amman University, Jordan) notes that MOOCs are emerging as the new trend for modern higher education institutions, and student acceptance is viewed as the key determinant of their success. The reported study examines factors influencing higher education students' behavioural intention to adopt MOOCs, making use of a modified Technology Acceptance Model (TAM). The results reveal that students' behavioural intention to adopt MOOCs is positively affected by the perceived ease of use and by the perceived usefulness. Self-regulated learning has a negative influence on behavioural intention. Computer self-efficacy and perceived convenience have positive indirect effects through perceived usefulness and perceived ease of use, and learning tradition has a negative indirect effect on behavioural intention through self-regulated learning.

The use of E-portfolio for self-reflection to promote learning: a case of TVET students relates research by Syazana Hj. Ebil (Office of the Permanent Secretary of Higher Education, Ministry of Education, Bandar Seri Begawan, Brunei Darussalam), Sallimah M. Salleh and Masitah Shahrill (Universiti Brunei Darussalam). The authors point out that the power of reflection is highly acknowledged to promote learning and to develop expertise, yet reflective skills are rarely explicitly taught in schools, meaning that it is often difficult to accomplish, especially in a Technical and Vocational Education and Training (TVET) setting. By employing the Technological Pedagogical Content Knowledge (TPACK) construct, this research investigated the use of structured reflection through digital learning portfolios (e-portfolio) and explored its relation to students' learning. Using mixed methods design, the study examined a group of

students from one of the TVET institutions in Brunei over an eight-week period as they practiced reflection through an e-portfolio designed to guide the students to reflect upon their own learning.

Over the past decade, the societal impact of digital transformation, with the prospects of a Fourth Industrial Revolution, has led to an innovation imperative in European policymaking regarding higher education institutions say Paulo Nuno Vicente (Universidade Nova de Lisboa, Portugal), Margarida Lucas, Vânia Carlos and Pedro Bem-Haja (Universidade de Aveiro, Portugal) in their article on *Higher education in a material world: Constraints to digital innovation in Portuguese universities and polytechnic institutes*. This article examines Portuguese universities and polytechnic institutes, the two components of the national higher education system, to characterise the quality of the available digital infrastructure and resources (hardware and software) and to identify the main constraints to digital innovation.

Robotics in the international educational space: Integration and the experience by Nurassyl Kerimbayev (Al-Farabi Kazakh National University, Kazakhstan), Nurbol Beisov (Al-Farabi Kazakh National University, Kazakhstan), Anatoly Kovtun (Kemerovo State University, Russia), Nurdaulet Nuryim (Al-Farabi Kazakh National University, Kazakhstan) and Aliya Akramova (Almaty University, Kazakhstan) begins by asserting that today, robotics is one of promising avenues in the sphere of emerging technologies. The teaching/learning environment deals with educational robotics which is a mixture of theory and practice, knowledge of computer technology, Mathematics and Physics. Robotics is interdisciplinary in nature and as an academic discipline and an area of practical application this means a very broad spectrum of modern knowledge of diverse academic engineering specialties. The work provides an overview of the research aimed at studying Robot – Man interaction.

From Finland, Altti Lagstedt (Turku University, Finland and Haaga-Helia University of Applied Sciences, Helsinki, Finland), Juha P. Lindstedt and Raine Kauppinen (Haaga-Helia University of Applied Sciences, Helsinki, Finland) present: *An outcome of expert-oriented digitalization of university processes*. They begin by noting that digitalisation challenges the way in which business processes are seen and the potential for enhancement is recognised even in business areas that traditionally have little to do with IT. The authors developed an expert-oriented digitalisation model (EXOD) for the digitalisation of university processes and tested it using a case study, interviewing the experts involved. They recommend further studies to refine and test the model more comprehensively.

The final article in this issue: *Clarifying the impact of surprise in e-learning system design based on university students with multiple learning goals orientation* is by Hsiu-Ju Chen (I-Shou University, Taiwan). The impact of surprise in the design of e-learning systems still needs clarification. E-learning systems, assessed through computers and/or mobile devices, are widely adopted to assist university students' learning, but the link of learners' multiple goals orientation to their e-learning system use behaviour also lacks clarification. This study aimed to clarify these issues based on the updated IS success model. The results reflected different roles of e-learning for learners with different learning goals orientations.

EAIT is a major international journal with articles in this issue from researchers in the following countries: Australia, Brazil, Brunei Darussalam, Canada, Colombia, Croatia, Czechia, Egypt, Estonia, Finland, Greece, India, Indonesia, Ireland, Japan,

Jordan, Kyrgyz Republic, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Oman, Pakistan, Palestine, People's Republic of China, Portugal, Republic of Korea, Russia, Saudi Arabia, South Africa, Spain, Taiwan, Thailand, Tunisia, Turkey, UK, United Arab Emirates, USA, Vietnam, Zimbabwe.

It was with sadness that we heard of the death of Professor Yaacov Katz. Over many years Yaccov did a great deal to support the work of the journal, both as an Editorial Board Member and as a reviewer. He also took an active role in other IFIP TC3 activities and was always ready to help. He will be sadly missed.

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