Sustainable Education in a Digital Age of rapidly Emerging Technologies

IFIP TC3 Zanzibar Declaration – Outcomes of Webinar 4:

Power of AI-Methods and Algorithms for Decision-Making – Educational Challenges

5 October 2021, 08.00-9.30 a.m. GMT (UTC)

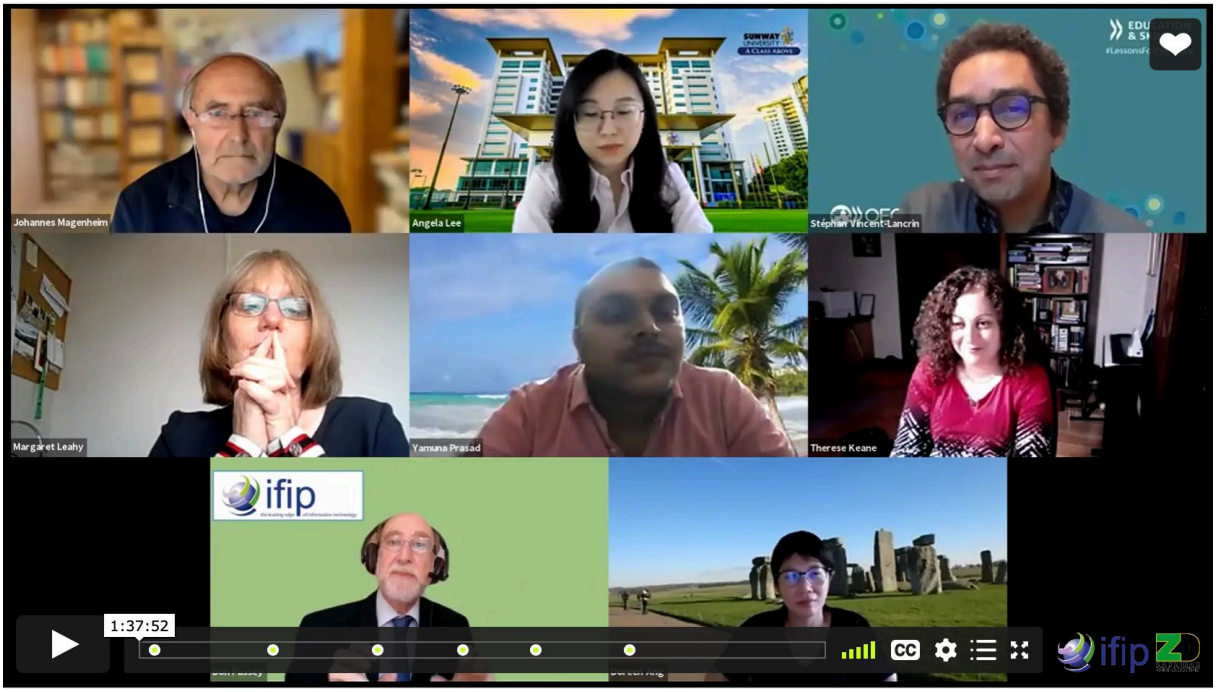
IFIP TC3 is taking forward the Zanzibar Declaration (ZD) through a series of four webinars, a summary webinar as part of the IFIP60 Events series, and a follow-up workshop. The fourth webinar offered perspectives on the topic of "Power of AI-methods and algorithms for decision-making – Educational challenges", to consider how recent important digital technology developments in this area are having societal impact, and resulting educational challenges.

Over 160 participants were registered for the webinar, and over 35 took part in the event live.

Accompanied by 2 co-moderators, 5 panellists from different countries (India, France, Australia, Singapore, and Malaysia) discussed the topic from different perspectives and from their respective cultural and working contexts.

Further information on the panellists and the content and discussion of the webinar can be found on the ZD website: https://zanzibardeclaration.cicei.org

The webinar was recorded and the video can be viewed asynchronously: https://vimeo.com/623304375/52234afd21



Examples of statements and questions discussed in the webinar were:

- Automated decision-making systems are never fully automatic, but are based on an interaction between software and human actors. When the AI methods are applied, the quality of the data used and the process of interactive model adaptation are essential criteria for the quality of the results achieved (such as classification, or prediction).
- To achieve good results as a human actor in the decision-making process (e.g. pattern recognition in microbiology based on images, prediction of developments, e.g. the course of a pandemic), sound knowledge of the mathematical and informatics concepts underlying machine decision-making systems is required.
- Automatic decision-making systems (ADMS) apply different AI concepts, partly in combination: machine learning and deep learning, supervised learning (e.g. regression, vector machine, decision trees, random forest, neuronal network) and unsupervised learning (e.g. K-means, cluster analysis (hierarchical), Density-Based Spatial Clustering of Applications with Noise (DBSCAN), auto-encoders).
- To improve the quality of the data underlying the applied AI methods, various parameters of data extraction, preparation, and data cleansing (noise removal) must be considered: user-centric or model-centric view of the data, source of data (human or sensor, structured, semi-structured, unstructured), incomplete (missing values) and uncertain data, small sample size, data augmentation without bias, etc.
- In the process of interactive decision-making between ADMS and humans, the expertise of the human factor plays an essential role in the quality of the predictions. The complexity of the predictive model used (number of parameters), the quality of the data used (estimation of bias effects), the quality of data visualisation must be designed and balanced in such a way that the interpretation of the results, provided by the ADMS, delivers reliable predictions based on reasonable model assumptions.
- In the OECD, projects are investigating the connection between smart data, digital technology and education. There are different focal points in this context: AI application in terms of personalisation of learning, in terms of classroom analytics, and in terms of support at an institutional level for educational management purposes.[1]
- The use of intelligent tutorial systems has been talked about for many years. Through the further development of AI methods and the expanded possibilities of recording learner data, there are also many possibilities for individualising and personalising learning (tracking a student's activities in a computer-based learning environment, face recognition (sentiment analysis, etc.)). This is used, for example, to support students with learning disabilities or to differentiate learning tasks for individual students within a class (to analyse where the students are on a specific learning curve and what their following exercises should be).
- The second group of applications of AI methods in learning analytics relates to classroom activities. Video recordings and their evaluation can, for example, be used to record teacher-student and student-student interactions in the classroom and evaluate them both on a formal communicative level and in terms of their content. The (partially) automated evaluation of such data can provide the teacher with important information about the lesson's quality and its future learning design. However, this type of data collection also raises critical privacy issues concerning data protection for the students and the misuse of the data, e.g. assessing teachers' behaviour.
- A third group of learning analytics applications at the level of educational management can attempt to map educational processes at the institutional level and, in this way, serve, for example, as an early warning system to reduce the dropout rates in a study programme. For this purpose, for example, students' test results and acquired certificates are examined. However, other data such as gender and the social background of the students are often collected as well. Here, too, privacy issues arise, and the principle of data minimisation should be observed.
- The functions of a robot in the industry are significantly different from those they may have in education. Whereas in industry robots are assigned roles such as increasing productivity, improving customer experience and delivering automation at a significant scale, in education they can fulfil

[1] https://digital-education-outlook.oecd.org/ https://oecd-events.org/digital-education

completely different requirements: tools that assist a teacher, learning companions for students, an autonomous teacher who provide some unit of instruction more or less entirely.
As classroom assistants, they can ask questions, providing information, comment on answers, responding to requests, recognise individual students and maintain a record of those interactions.

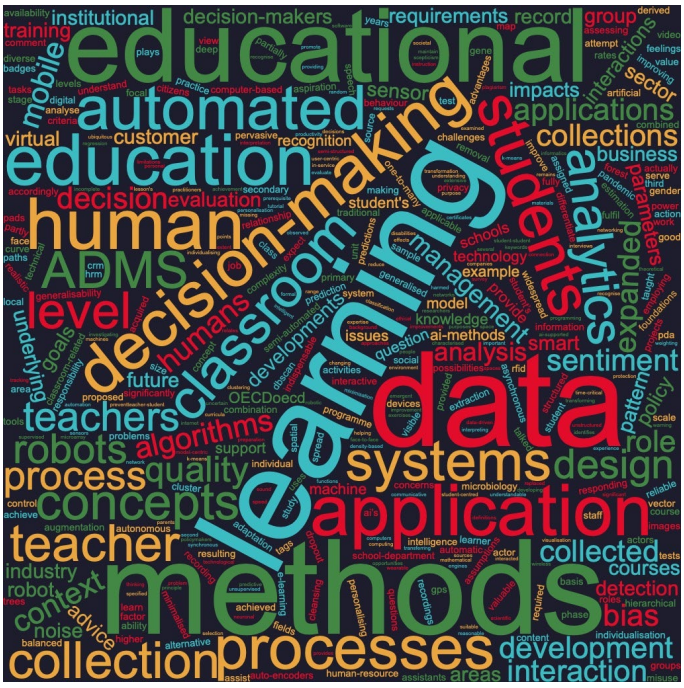
- Besides the advantages of using robots in schools (helping students to learn and to understand how they work by programming them), there are also several concerns: technological limitations in AI's ability to recognise speech; if robots replaced teachers and students just interacted with robots, will they be harmed if their social interaction is minimalised; there is so much a teacher, but not a robot can do (AI is not the same as human intelligence).
- Another application of ADMS is plagiarism detection and the smart classroom, which provides teachers with various student and classroom-related interaction data. However, the question remains whether it is realistic for smart classroom concepts to become widespread in educational practice or whether the scepticism of the people involved (parents, teachers, students, decision-makers) will prevent their spread.
- The application of AI for the needs of educational management is in an emergent stage. During the transformation phase of traditional data collection (interviews, tests) to AI-supported evaluation systems employing semi-automated collection systems in the educational sector (smart classroom), the question arises to what extent the data collected based on small data collections in a specific learning situation (e.g. classroom) can be generalised without further ado. In interpreting the data, the context of the survey and the question of generalisability is a critical problem.
- The increasing availability of mobile devices and the networking of learning spaces via internet technology is changing the traditional concept of the 'classroom' from a local to a virtual space. This development is characterised by the keywords pervasive and ubiquitous computing. This means that the type of data collection in learning processes and its evaluation can be expanded accordingly using AI methods: student-centred data can be derived from mobile devices, PDAs, wearable computers, GPS, RFID tags, sensors, pads, and badges, as well as wireless sensor networks.
- The diverse data sources of mobile learning can also provide the basis for sentiment analysis. AI methods combined with pervasive technology allows for a better knowledge of each student's requirements and problems and identifies paths to personal achievement (a student's level of knowledge, speed of learning and desired goals, student's feelings about learning).The one-to-many learning situation in a classroom can be significantly expanded through the virtual classroom without the individualisation of learning having to suffer (combination of face-to-face learning, synchronous and asynchronous e-learning). However, the development of suitable learning materials and an adequate learning design is an essential prerequisite.

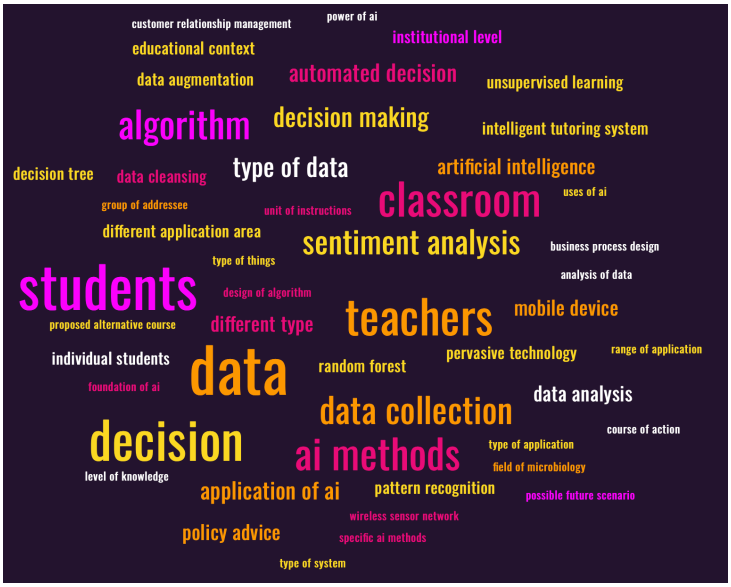
- How can AI methods and their use in algorithms for decision making be transforming of an extensive range of application fields?
- What are essential, indispensable scientific foundations of AI-methods and algorithms for decision-making engines, and issues of transferring responsibility and control from humans to machines?
- What are the essential educational, societal, theoretical, and technical impacts resulting from the power of AI-methods and algorithms for decision-making in different application areas, and what are the resulting opportunities and challenges for education?
- How can educational curricula make this visible, valuable and understandable for future practitioners, policymakers, researchers and citizens?
- How can data collections, AI concepts and algorithms be used to support decision-making processes?
- What specific AI methods exist in pattern recognition, especially in the field of microbiology?
- What is the role of humans in decisions when they are proposed by automated systems and may still be time-critical (gene selection in microarray data, friend-foe detection systems)?
- Which AI methods and algorithms for decision-making are used for policy advice in the OECD area?
- Which data collections are used for decision-making systems, and how are they specified for different groups of addressees?
- What is the weighting of human and automated proposed alternative courses of action in decision-making processes for policy advice in the OECD?
- When thinking of different application areas of learning analytics and AI, does the intelligence actually lie within the artificial system, or does it lie with the teacher, and how will we think about that in the future?

- What are your definitions and concerns for robotic developments and uses of AI-methods in schools?
- Where do you think this field is developing to in schools and what are possible impacts on and challenges for education?
- Which data are collected in your school-department with which methods and how is it used for which decision-making processes?
- What improvements in data collection and data analysis do you expect from the application of AI methods in an educational context?
- Can these AI methods also lead to an improvement in decision-making processes in your school-department, and do you foresee any ethical problems that might arise due to a bias in the data or the design of algorithms?
- How are AI methods applied in sentiment analysis and churn analytics, and how do they contribute to decision-making?
- What is the relationship between human decision-makers and automated decision making systems in business process design and CRM (Customer Relationship Management)?
- What will be the future role of understanding and using ADMS (automated decision-making systems) in HRM (human-resource management) in-service training?
- Are data-driven approaches from companies designed to promote their business goals and applied in on-the-job training courses of their staff as well applicable in the educational sector (primary, secondary, higher education)?
- Can concepts of AI already be taught to students prior to tertiary education (i.e. in primary, secondary education)?

The following word clouds were created based on the notes of the two moderators and on transcript excerpts of the Webinar and the discussion contributions in the chats.

The first shows an unfiltered version, the second a filtered version applying AI methods.





Event organisers of Webinar 4
Co-moderator: Dr Margaret Leahy
Co-moderator: Prof Johannes Magenheim
Technical organisation: Prof Javier Osorio
Organisational planning: Dr Christophe Reffay
Organisational support: Prof Don Passey

Panellist
Dr Yamuna Prasad (India)
Dr Stéphan Vincent-Lancrin (France, OECD)
Dr Therese Keane (Australia)
Dr Doreen Ang (Singapore)
Dr Angela Siew Hoong Lee (Malaysia)

The next event in this series
The next event of the Zanzibar Declaration activities will take place as part of the IFIP 60th anniversary 'Future Information Processing' event series, and will be held on 6 December 2021, 09.45-10.45 a.m. GMT (UTC).

For further details and registration please visit the IFIP60 Website: https://ifip.org/jubilee60/?r=event10

Please contribute to the Zanzibar Declaration
To contribute to the Zanzibar Declaration and to the discussion on the impact of ICT on education and society please enter short contributions in the ZD-grid: https://jsilab.ch/zdApp/