

Learning Analytics and Artificial Intelligence

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Innovative impact

A/B/C/-TEACH uses a unique methodology, which incorporates hybrid and innovative processing techniques.

A/B/C TEACH's integration of a-/b-/c-learning and iLMS is realized in a personalized and inclusive way supporting educational principles; hence, it is able to adapt to the various different learning styles learners have and dynamically provide them with constructive feedback (e.g., QoI, QoC, AS); though originated within formal education, the A/B/C-TEACH is potentiated towards other forms of learning (e.g., in/non-formal).

A/B/C-TEACH analyzed data from 5200 students from 75 disciplines (80-teachers) coming from the Faculdade de Motricidade Humana (Portugal) and the Open University (Greece).

It is anticipated soon to be embraced by the educational system of Khalifa University of Science and Technology (UAE), which is designed around the everyday use of LMS Moodle.

Consequently, a significant increase in the A/B/C-TEACH students (~8000-10000) is expected in the next years.

A/B/C-TEACH Framework: The application of AI in Blended Learning

Introduction

Learning Management Systems (LMSs) under a blended (b-) learning modality can efficiently support online learning environments at Higher Education Institutions (HEIs). Thus, mining of LMS users' data, involving Artificial Intelligence (AI) and uncertainty modelling, e.g., via fuzzy logic, is a fundamental challenge (e.g., Dias et al., 2017). In addition, LMSs like Moodle, despite their proliferation, are commonly used as educational material repositories, solely providing some basic analytics that are not integrated as constructive feedback within the educational process. A/B/C-TEACH (<http://abcteach.fmh.ulisboa.pt/>) attempts to renovate this status by proposing a holistic educational approach, which integrates affective (a-), blended (b-), and collaborative (c-) learning within an intelligent LMS (iLMS) environment, by providing tangible, dynamic and personalized indices, i.e., quality of interaction (QoI), quality of collaboration (QoC) and affective state (AS) of the LMS users, as novel tools for rethinking the way knowledge is delivered.

AI in Education

The present research follows recent developments concerning the introduction of AI in Education. According to Holmes et al. (2020), "AI-powered learning systems are increasingly being deployed in schools, colleges and universities, as well as in corporate training around the world. While many people fear that AI in education means robot teachers, the reality is less dramatic but potentially still transformative. Student-facing applications of AI include intelligent tutoring systems, dialogue-based tutoring systems, exploratory learning environments, automatic writing evaluation, and conversational agents." (p.3). In addition, a systematic review conducted by Zawacki-Richter et al. (2019), shows that most of the areas involved in AI in Education current research come from Computer Science and Science, Technology, Engineering and Mathematics (STEM), and that quantitative methods were the most frequently used in empirical studies. A synthesis of results of the study indicates four areas of AI applications in academic support services, and institutional and administrative services, namely: 1) profiling and prediction, 2) assessment and evaluation, 3) adaptive systems and personalisation, and 4) intelligent tutoring systems. In this vein, the present work brings an added responsibility to decision makers, educators, learning scientists and other stakeholders to engage with the emergence of AI in Education, as in many other fields, to ensure the development of teaching and learning approaches

Transferability to EU contexts

The innovative character of A/B/C-TEACH has been integrated in the educational procedures within the area of active and healthy living, justifying its generalization power of advancing education at the level of a more integrated practice, seen via affective, blended and collaborative educational approaches.

This is achieved by the clustering with European projects, more specifically, the concepts of a-/b-/c-learning and the relevant methodologies have been adopted by the i-PROGNOSIS project (www.i-prognosis.eu) as educational means for older adults, in order to re-educate them towards healthy ageing and sustaining their quality of life.

References

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that make appropriate use of AI.

The A/B/C-TEACH Framework

Using LMS Moodle data logger, built on the pedagogical approaches of behaviourism, cognitivism, constructivism, connectivism, A/B/C-TEACH produces new metrics regarding the interaction and collaboration amongst users. A schematic representation of the A/B/C-TEACH architectural structure is depicted in Fig. 1. From the latter, the dynamic flow of information between the distinct structural modules and participants is evident; more specifically, the interconnected elements of Fig. 1 include the following:

- *Users*: M teachers and N learners are coexisting and interacting both through the F2F and online learning environments under the b/c-learning concepts.

- *Data Acquisition/Management Module*: in general, online learning environments easily allow the acquisition and management of user data; from this vein, a series of metrics regarding the interaction and collaboration amongst users are available. In particular, 110 LMS metrics were used (e.g., wiki, blog, forum, chat, quiz, edit), forming interaction qualities and contributed to the estimation of QoI. At the same time, collaborative interactions (e.g., proposals, contra-proposals, questions, turn-taking balance) were used for the estimation of the QoC.

- *Affective Module*: considering the data from the users' affective module, supporting a-learning, this module will avoid the typical path of evoking questionnaires to measure the learners' affective experience - such as how much pleasure, frustration, or interest they felt during the learning processes, and evaluating the motivational characteristics of an instructor's delivery. On the contrary, by using affective computing cutting-edge technology (e.g., EEG EMOTIV EPOC/INSIGHT, webcams/depth cameras, portable functional near-infrared (fNIR) spectroscopy) it would provide real-time data, related to the users' ASs.

- *Fuzziness/Hybrid Modeling*: considering the data from the previous modules, the hybrid modeling will use innovative techniques from the fields of fuzzy set theory, neuro-fuzzy modeling, fuzzy cognitive maps, dynamic nonlinear analysis, and affective computing. Moreover, by adopting Lang's emotion space combined with advanced signal processing techniques emotion recognition processes of the AS data will take place.

- *Features*: the main features that will be outputted from the constructed models include users' QoI, QoC and AS (learners only).

- *Feedback*: having the estimated features per user, the construction of personalized feedback will be fired. The latter will be focused upon initiating metacognitive processes, helping the users to become more aware of their interaction, collaboration and affect - building a kind of "interactive/collaborative/affective mirror" in which the learners are encouraged to reflect upon how their interaction/collaboration behavior and affective state are influencing their learning experience.

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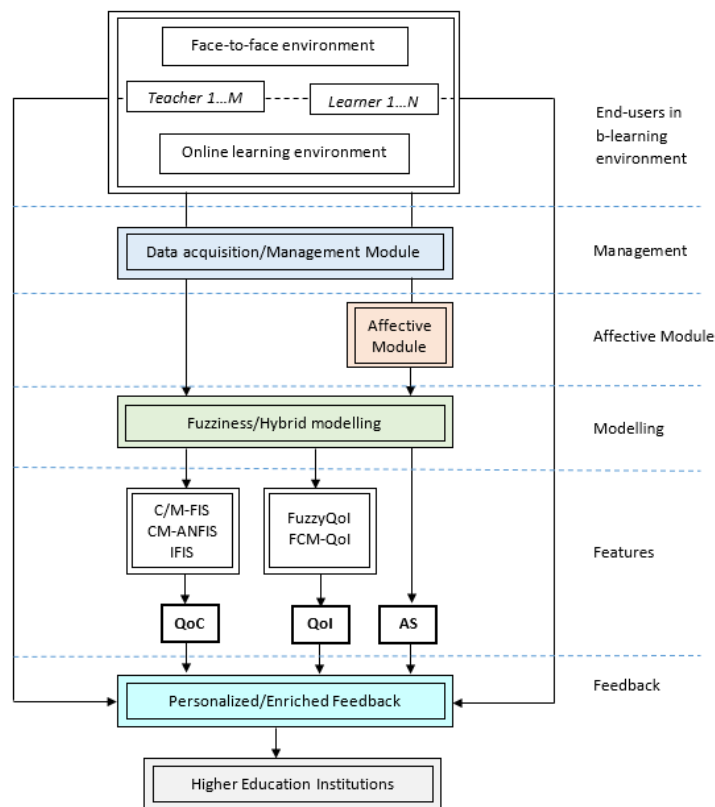


Fig. 1. Schematic flow-diagram of the A/B/C-TEACH framework towards effective teaching, by bridging affective-, blended- and collaborative-teaching and learning potentialities.

Moreover, innovative modelling/analysis techniques are used in the A/B/C-TEACH modelling module (see Fig. 1) by incorporating hybrid and innovative processing techniques from the fields of fuzzy set theory, neuro-fuzzy modelling, dynamic nonlinear analysis, and affective computing, namely: the Collaboration/Metacognition-Adaptive Fuzzy Model (C/M-AFM) (Hadjileontiadou, and Hadjileontiadis, 2005), the Collaboration/Metacognition-Adaptive Neuro-Fuzzy Inference System (C/M-ANFIS) model (Hadjileontiadou et al., 2015), the Fuzzy Logic-based modeling of the Quality of Interaction (FuzzyQoI) model (Dias and Diniz, 2013), the Fuzzy Cognitive Map-based modeling of the Quality of Interaction (FCM-QoI) model (Dias et al., 2015), and the emotion recognition process approach using EMOTIV EPOC Headset and EEG analysis (Petrantonakis, and Hadjileontiadis, 2015).

Next steps

Future always seems appealing and the briefly examined hybrid model could further be extended including, for instance, dynamic nonlinear analysis and affective computing, in order to contribute to the enrichment of the HEIs services and re-examination of educational policies/practices.