

Contextual Dimensions of an Ambient Intelligent Classroom

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Abstract: The classroom is the classical environment where the formal education process traditionally takes place. Ambient intelligence is the artificially intelligent way of how to render a specific environment aware and responsive to a human being within that same environment. In this paper, we present a case of how the engagement of ambient intelligence within a classroom can be apportioned into three basic aspects that collectively can change the way we visualise classical teaching spaces. Three contextual dimensions of ambient intelligence are presented and espoused within an academic framework to shed instrumental insights and strategic directions on the future of ambient intelligent classrooms.

Introduction

The use of technology within an educational environment has proved to increase learner engagement levels as well as enhance the learning process in general (Oakman, 2016). Nowadays we find classrooms that are overflowing with technology that not only enhances the learners' engagement levels, but also ameliorates the learning process as it is able to adapt to the diverse learning styles of the same learners. Ambient Intelligence (AmI) is a digital technology that employs Artificial Intelligence (AI) to manage an electronically controlled and enclosed environment in a way that it responds and adjusts to the specific needs and characteristics of a person within that environment. This paper has been motivated by the ongoing research within the domain of intelligent learning environments where we exclusively focus on the academic and pedagogical connotations of AmI applied to the classroom, merging AI in education (AIED) with numerous other areas.

Ambient intelligence in education

The notion of personalisation has been applied to various domains especially when the goal is to enhance a service or a product that closely fits the corresponding requirements of a human user. Personalizing education is perhaps the goal of every educator to ensure that each learner experiences a learning scenario that perfectly fits the background, academic needs and interests of the same learner (Montebello, 2017). In order to achieve such personalisation capabilities, the use of artificially intelligent techniques are required, as a user profile needs to be generated in order to match the specific service attributes or product specifications to the intended user. The application of AmI to education is not abundant, comprehensive and coherent even though it can be traced back to prior to the millennium. A number of research studies investigated the physical aspect of the classroom (Ramadan, 2009; Winer & Cooperstock, 2002) that involves monitoring students and teacher occupying the classroom, and automatically controlling the lights, air-conditioning, multi-media displays and acoustics. Other AmI researchers (Antona, et al., 2010) investigated how to create a smart educational environment through the development of some kind of piece of furniture that sits in the classroom. Additional AmI projects, like those by Shen, Wu, & Lee, (2014) and Ramadan (2009) made use of wireless technologies, NFC (Near Field Communication) and RFID respectively, to be less intrusive and remain loyal to the covert nature of AmI while providing a context-aware environment. To some extent the above mentioned AmI research projects failed to focus directly on the academic content in a way that accommodates the unique learning needs of each individual student, which is what AmI in education should be focusing on. Leonidis, et al., (2010) offer a better insight in the way they tackle the application of AmI to education as they present a theoretical framework, called ClassMATE, that enables pervasive interactive and context aware instruction within a smart classroom. Apart from the indispensable contextual awareness and a technologically-enhanced classroom, is the need of adaptive educational content coupled with the learning profile of each individual student. What we propose in the next section is conceivably a deeper and thorough insightful analysis of what the key elements are as we investigate these factors within an academic context and substantiated within sound and established learning theories.

Case for the classroom

Applying AmI within a classroom presents a delicate situation due to the complex and sensitive nature of dealing with learners within an environment that is susceptible to major disruptions at the minimal change in the conditions. The fact that the same learners are the source of such changes, one has to keep in mind our responsibility towards each learner and their education, as it is imperative and indispensable that an AmI classroom is optimally designed and precisely devised. We propose a model made up of three dimensional aspects that collectively make up the AmI environment required within a classroom. The first of the three dimensions,

that we believe forms an essential part of the AmI paradigm when applied to education, is the human aspect. This aspect is obviously part of any AmI application as the enhanced environment is purposely boosted to add value to people's quality of life. However, we specifically chose to use the social concept rather than the human one due to the classroom's social connotations and the intricately dynamic complexities that occur within a traditional classroom. Group dynamics play an important role within the social aspect of a class, and the Connectivism learning theory, that was proposed in 2005 by Siemens (2004) and Downes (2005), is frequently associated with the use of social networks for educational purposes. This theory justifies how learners employ networked resources, as potentially those within an AmI classroom, to form connections and links to learn and share knowledge and ideas. The second dimension from the AmI paradigm within a classroom being proposed is the technological aspect that, apart from the physical instrumentation, incorporates the application of artificial intelligent technologies to personalize the entire process and match the respective profile of every learner. We propose the use of learners' academic portfolios as part of the learning profiling process and personalisation which are generated with the help of established machine learning techniques that AI researchers have employed over the years. Modelling the specific characteristics of a learner requires a direct mapping of the individual portfolio to the unique learner as they map the distinctive attributes and academic features including educational background, extra-curricular interests, personal preferences, and specific learning goals. Associated with this line of thought is the adaptive learning theory as it supports the personalisation and customisation of services, information, and products to the specific requirements and profile of each individual user. The final dimension of the proposed smart classroom paradigm is the educational aspect, that requires the support and adoption of relevant learning theories to which the researcher subscribes and associates his or her philosophical reasoning. In our third dimensional aspect, we apply the connectivism and adaptive learning theories as the basis of our pedagogical methodologies to address the education aspects of our proposed model. This model is based on the concepts of a personal learning environment whereby technology and social aspects come together within a classroom as learners and educator interact through electronic and face-to-face interventions. The educator is responsible of setting up the learning 'scene', providing potential resources, physical and/or electronic, give any required support, while facilitating the entire educational process. The students, on the other hand, have access to their personal portal, which acts as an arena for all of them to share resources and experiences, as each of them is individually assisted and supported through the smart environment. This support is manifested through classroom displays, interventions by the educator to a single student or the class, or through the networked peers themselves.

Conclusions

In this paper, we have presented a proposal on a systematic and thorough way on how to deploy an AmI classroom through the proper analysis and investigation of three basic aspects, namely: social, grounded within the connectivism learning theory; technological, grounded in the adaptive learning theory; and educational, that brings together the other two aspects. This has enabled us to ensure that a proper and structured process has been established to develop comprehensive and complete AmI classrooms in the near future.

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