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Virtual Embodied Agent for Attention Improvement in eLearning

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Problem Area Motivation

The paradigm of Internet of Things (IoT), "allows people and things to be connected anytime, anyplace, with anything, and anyone, ideally using Any path/network and Any service" [1]. Embodied cognition can be inserted in that context, including Artificial Intelligence (AI), placed in objects, avatars, robots, or space. That allows to understand the environment and allows objects to be able to interact in a human-like. A form of implementation of AI is by using embodied agents, i.e. a software agent that interacts with the environment through a body. That body, physical or virtual is necessary to interact with the environment and with human beings. An application scenario can be the eLearning environment in which students' attention is crucial since it is a facilitator of cognitive and behavioural performance. It is known that there are conceptual frameworks representing the knowledge that teachers need to know to introduce technology effectively in their professional context. However do not include the knowledge that teachers acquire when involved in technological research projects. Thus, there is a need of create a conceptual framework that involves an integration of those concepts.

Research Question

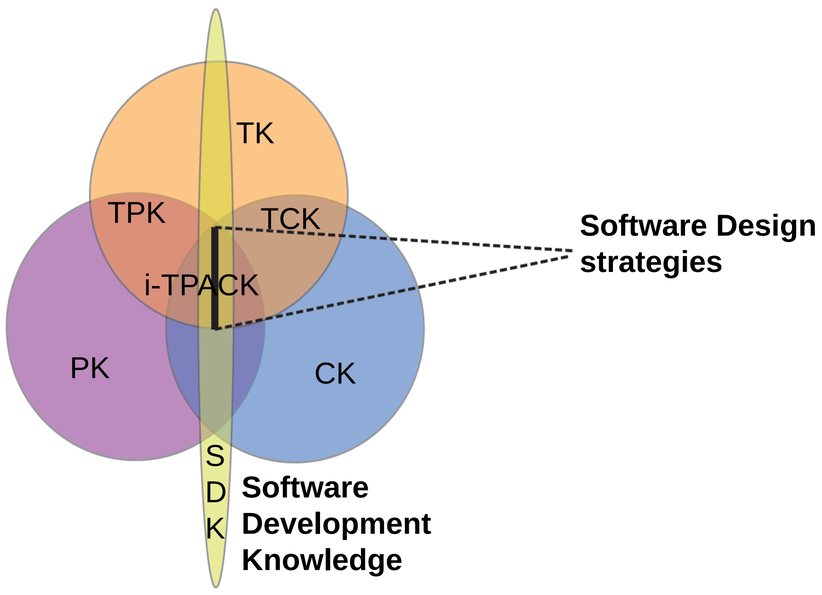
How to enhance student's attention in eLearning environment?

Hypothesis

H1: If it is possible to sense student's attention based on biosignals, the eLearning environment can be adapted for each student profile. The definition of an embodied agent contextualized under the paradigm of IoT could be an available solution.
H2: If a process of creating an eLearning solution with dynamic reaction to increase students attention can be supported by pedagogical experts (teachers) then it can effectively be improved.

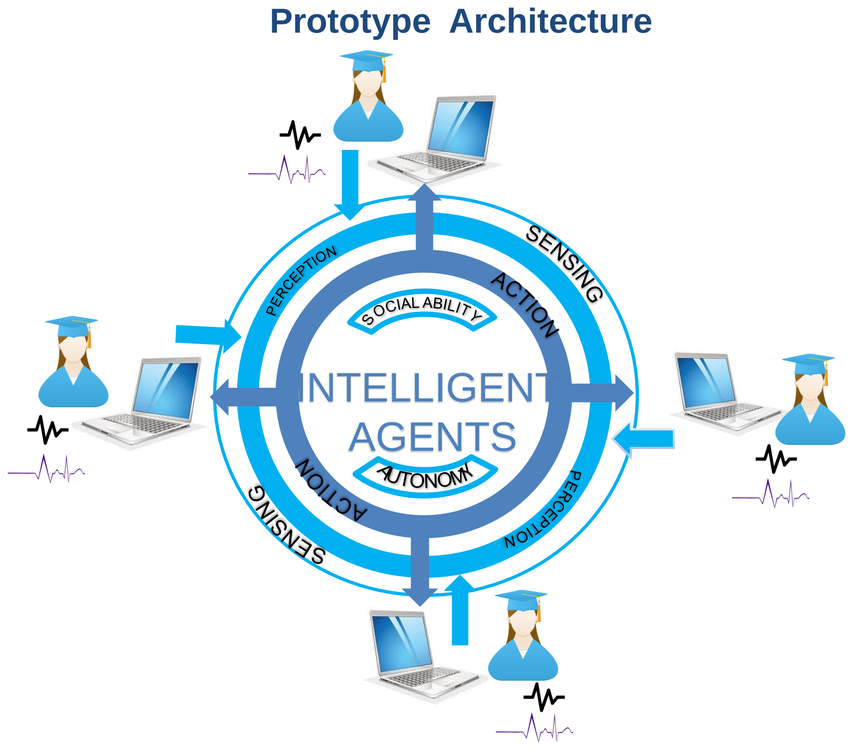
i-TPACK: Intelligent Technological Pedagogical Knowledge

i-TPACK is a framework that explains the set of knowledge teachers have when involved in technological research projects for education. It allows to contextualize the interdisciplinarity of such knowledge. i-TPACK framework is an extension of Technological Pedagogical Content Knowledge [2], specifically it represents teachers' knowledge required for technological integration with the representation of teachers´ knowledge acquired when are involved in technological research projects for education.



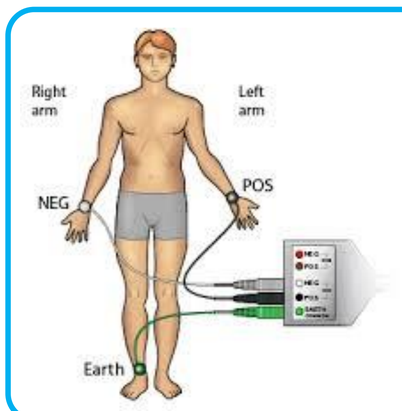
Thus, includes the symbolic representation of teachers' knowledge, specifically Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Pedagogical Content Knowledge (TPACK), that refers to the relation between technology, pedagogy and content; and i-TPACK which includes the representation of the teachers' knowledge when exposed to in some degree to Software Development Strategies knowledge..

Prototype Architecture

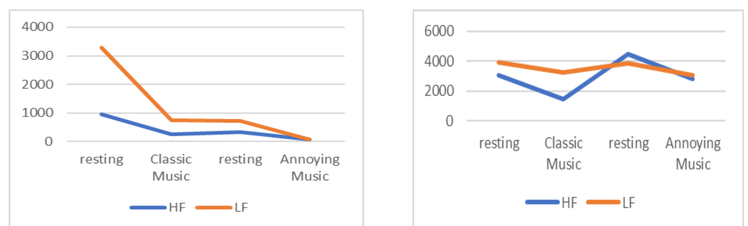


In the context of i-TPACK, it will be developed a prototype for a virtual embodied agent for attention improvement in eLearning. To accomplish the general architecture of the prototype, it is considered the principal characteristics of an agent. According to Padgham et al. [3] " an agent is a computer system that is situated in some environment, and that is capable of autonomous action in the environment in order to design its own objectives". Additionally, it was considered the properties of reactivity, proactivity and social ability [4]. Since agents must adapt appropriately to significant changes in environment and in a proper manner, it needs to be reactive. Furthermore, the possibility of the system to have goals over time endows it of proactivity. Finally the social ability refers to the fact that agents must be capable of interact with other agents.
The thesis validation will be framed in the scope of a proposed i-TPACK conceptual framework. That validation will reflect the integration of multiple knowledge focus of i-TPACK, thus includes for teachers: questionnaires, interviews, and observations; and for students' usability tests and questionnaires.

Student's Attention Supported by Physiological Measurements Analysis



The sensing module to be developed would introduce solutions that will analyse users' physiological signals such as electrocardiogram (ECG). That allows to perceive attention and to act concerning that. To perceive students' attention some studies have been developed in the eLearning setting using ECG [5]. Those studies revealed, according to [6], that when attention increases there is a decrease of LF and HF features of Heart Rate Variability extracted from ECG signal, which allows to perceive attention through the proposed sensing module.



Attention analysis through HF and LF features observation during attentional tasks.

Relation to the Conference's Main Theme

According to Hollnagel [7], a system with resilience property can be defined as having the ability to "adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions". Such system can respond to events, monitor ongoing developments, anticipate future threats and opportunities and learn from past failures and successes alike.
This work follows the principle that a resilient system should have the capacity "of surviving weaknesses in both machine and human functioning" [8]. A possibility to endow a resilient system in eLearning scenario is to give it the capability to sense human cognitive states such as attention, a facilitator of performance, detect its weaknesses and react appropriately. The student attention can be assessed based on biosignals since that there is a correlation between attention and physiological activity [9].

Literature Review of the Relevant Thesis Topics				Implementation of the Embodied Agent			Thesis Writing
Research Question Definition		i-TPACK framework definition		Agent Architecture Design		Validation	
	Prospective studies		Thesis plan writing		Agent Architecture Development		
	Progress Report		Progress Report		Progress Report		
1st year		2nd year		3rd year		4th year	

Publications

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