End-User Development for Smart Educational Devices

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ABSTRACT
Allowing people to customize and manage the features of their smart devices is crucial, especially in educational settings where personalized learning paths are necessary for every student. End-User Development using trigger-action rules presents a promising method to empower teachers in accomplishing this objective. However, End-User Development systems must support non-programmer users in adopting effective mental models and reasoning strategies, especially for handling intricate scenarios. We present a research project aimed at developing and exploring effective solutions that can be adapted to teachers’ needs and mental representations to empower and guide them in an incremental adoption of educational technologies.

CCS CONCEPTS
• Human-centered computing → Human computer interaction (HCI).

KEYWORDS
End-User Development, Mental Models, Educational Technology

1 THE STUDIES
The project aims to explore and develop EUD solutions based on TAP for guiding teachers in defining the behaviors of and interacting with their smart educational devices. Specifically, we want to investigate teachers’ reasoning strategies and mental representations of math teachers during EUD tasks to customize an educational IoT system [1, 9]. Specifically, we want to explore teachers’ attitudes, interpretations, and strategies toward personalizing educational smart devices to support math education in primary school. We aim to understand how to guide teachers in assuming appropriate mental representations and reasoning strategies that facilitate their interaction with the system, as well as TAP-based platforms in general.
SmartGame [9] a gamified [7] web app designed to support teachers in the personalization of learning paths and motivate children in math learning. By placing tiles on SMARTER, students can complete exercises on SmartGame, gaining points and completing missions. Following the first two studies with SENSATION, we developed a second EUD interface that tries to link our results with the possibility of personalizing also the gamification aspects in SmartGame [3].

We planned four studies. In the first two online studies, five primary school math teachers were asked to interpret, create, and debug trigger-action rules through the EUD interface SENSATION employing the thinking-aloud protocol [4] to elicit their mental models. The results of these pilot studies highlighted the existence of different composition [2] and debugging strategies [13]. Some of these strategies seemed to be more effective than others in creating functioning and accurate rules and identifying errors.

In a third study, a group of 28 primary school math teachers engaged in the composition and debugging of trigger-action rules to develop math games on SMARTER. The focus was on deeply understanding their mental models and reasoning strategies during their interaction with the system through a thinking-aloud protocol [4]. The main findings revealed four distinct metaphors used by the teachers to conceptualize the functioning of SMARTER, with varying degrees of appropriateness. Interestingly, the participants’ mental representations of computers (“smart” or “mindless”) influenced their metaphors and performance on the task.

From these studies, we identified some guidelines to support teachers in the assumption of effective mental representations for dealing with TAP-based EUD systems. In the next study, we will engage teachers in a training experience based on our results to guide them in assuming effective mental representations and reasoning strategies during EUD tasks. Teachers will participate in a longitudinal study in which they will be asked to create and use the system in real-life contexts (e.g., in class). We will ask them to interact with the new version of the EUD interface [3], which enables them to personalize both the task logic on SMARTER and the game elements of SmartGame.

2 CONCLUSIONS

We presented a research project to develop EUD solutions designed to support math teachers in using and personalizing a tangible IoT educational tool. We conducted three studies examining participants’ spontaneous mental representation of the system, as it was their first interaction with the devices. We identified the mental representations that better guided participants in the creation of trigger-action rules, and others that hindered a successful interaction with the system. In the future, we will investigate the effectiveness of our results by implementing them in a structured training for guiding teachers in long-term interactions with the system. We believe that our findings might contribute to the literature on EUD by informing the design of more effective learning paths to train teachers and empowering them with the skills of adapting and personalizing digital educational tools.

REFERENCES