Engaging students with intellectual disabilities through location based games based learning

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ABSTRACT

Learning, is both an emotional and cognitive process and according to researchers and teachers worldwirde, when players are engaged in activities that are intrinsically motivating, they are more prone to demonstrate deep learning [1]. Since 1981 when Malone used digital games as a medium in order to analyze intrinsic motivation, digital games have been reported to stimulate the students' interest, while motivating them to deploy control, curiosity and imagination [2], [3]

Studies within our research grouping have shown that Digital Games Based Learning (DGBL) can have a positive effect on some of the core development needs of people with Intellectual disabilities and associated sensory impairments [4], [5]

One current are of interests is the expansion of DGBL activities on mobile platforms. The RECALL Project describes the development and evaluation of a novel route learning system for people with disabilities using locative based services (on the Android OS) and is the output of a EU award (504970-LLP-1-2009-1-UK-KA3-KA3MP). In the following paper we will present piloting findings from the piloting use of RouteMate application as well as an initial proposal of a playful locative DGBL integration in the educational experience of users with intellectual disabilities.

Recall Project

General Terms
Documentation, Design, Experimentation, Human Factors,

Keywords
Games based learning, intellectual disability, digital games based learning, locative based games, motivation

1. INTRODUCTION
RECALL Project describes the development and evaluation of a novel route learning system for people with disabilities using location based services (on the Android OS) and is the output of a major EU award (504970-LLP-1-2009-1-UK-KA3-KA3MP). Research has shown that route guidance systems suppress cognitive map development, and for a target audience described as having 'poor spatial skills' , systems that develop route learning rather than guidance are required. Recent qualitative evaluation of the application RouteMate across four testing centres in four EU countries has been overwhelming positive, leading to adoption in the UK, Bulgaria, Greece and Romania.

RouteMate is an accessible location based application developed to help people with intellectual and other physical disabilities to learn simple routes [6] It is designed for the Android Operating System from Google and provides the user with the option to create a new route through their mobile device or through a desktop console, as well as load and modify an existing route with the help of a parent, caretaker or trainer.

This was supported by structuring the software using principles of game based learning to scaffold the learning of new routes in order to ultimately promote independent travel. The application's intent is to promote independent travel to work and educational opportunities as well as the learning of new routes, by allowing the user to rehearse the route a number of times and in a variety of ways, accompanied by a trainer or teacher before moving on to independent travel, while still using the app to provide navigational prompts and an emergency contact mechanism.

Initially, the game based learning aspect was integrated in the project in the form of multiple choice photograph game, in order to combine location-based services with game based learning elements. However, during initial piloting research it was revealed that the application and its actual use by users with intellectual disabilities and additional sensory impairments, could be highly reinforced by the motivational and highly engaging qualities of narrative, gaming and play at the actual process.

The majority of testers with disabilities were very keen to be able to travel independently and welcomed the assistance that would be offered by a fully functioning system such as RouteMate. However, trainers and carers, were a little less enthusiastic regarding independent travel. This was for several reasons reported on a previous paper by Standen [7] such as practical IT skills and safety issues.

In light shed by these findings, a games based learning approach integrated in the tutorials to provide a review of the main features of the application was thought to be important for both people with disabilities and their carers and trainers and was ranked highly by members of the research group. Moreover, the integration of gaming narrative during the actual sessions as well as the use of game based learning elements in the design of the application could assist the carers to control the learning curve, scaffold the learning of new routes and trigger the intrinsic motivation of the users.

During the piloting sessions it became clear that the playful game narrative approach had a great importance to our users and a second version of RouteMate was developed, integrating playful icons thus providing the option of creating a fun scaffolding playful experience instead of a gamified training application. Thus piloting occurred through a playful methodology combining digital and non digital games based learning elements.

2. ROUTEMATE APPLICATION

Route Mate (the major route learning app of the project) is an accessible location based application developed to help people with intellectual disabilities and other sensory and physical disabilities to learn simple routes. It provides the user with the option to create a new route through their Android mobile device, as well as load and modify an existing route with the help of a parent, caretaker or trainer.

There are three modes of RECALL include Plan, Use and Challenge. Plan and Use allow the development of a new route and its practice. This system doesn't guide the user; rather scaffold their journey should they make navigational errors (time or geographical divergence) by comparing current progress with their first (ideal) use of a newly planned route. The Challenge Mode provides a range of playful activities to help people with disabilities understand the connection between map-based representations and their corresponding real world locations. The Plan and Challenge Setting mode are available via the 'Console'

The playful narrative approach takes the form of digital scavenger hunts, by ex-tending the landmark style and interactions in different ways, and using them to scaffold different phases of use of the application. This approach seeks to teach and reinforce the concept of maps and route learning, as well as promoting the connection between the map representation and its real world counterpart.

During the Plan mode and by using different icons that promote narrative, playful storytelling and safety, the facilitator can easily design playful games using many different narratives. For example: Pirates – associated with route planning and creation activities while locating treasure and possible enemies in an urban setting. Ninjas – a "scavenger hunt" to find as many treasure items as possible, easily associated with being road cautious and aware of ourselves, of other pedestrians and staying safe and on route while using Route Mate. Firemen – find fires and put them out – associated with developing independence confidence on a particular route and can be easily turned into a competitive game between users in a safe urban setting. Shopping Spree – locate all the latest shopping trends – associated with developing independence and taking care of ourselves. Street Smart – locate the next street trouble and stay safe – map and street signs association with real life settings.

3. PILOTING METHODOLOGY AND RESULTS

3.1 Playful Approach and Methodology

In order to evaluate the effectiveness of RouteMate when used by users with intellectual disabilities in order to create and learn new routes, a Case Study Methodology was adopted via a mixed qualitative and quantitative analysis for a period over two months.

Participants: 43 end users in four different countries, by five different research partners (UK, Greece, Romania and Bulgaria). Participants worked together with their caretakers and parents together with one or two researchers. Gender balance: 55.8% male, 44.2% female. Ages ranged from 8 to 68 years. Ethnicity: 15 were British, 1 Pakistani British, 9 Bulgarian, 7 Romanian and 8 Greek. 45.2% were beginners (refer-ring to technical knowledge), 45.2% were average users and 9.5% (4 out of 43) were described as experienced users. 34.9% experienced learning disabilities, 14% with autism and 4.7% communication problems. Cognitive, physical disabilities and sensory impairment were recorded in almost equal rates ranging from 25.6% to 27.9%.

Evaluation Tools: At this stage, three phases of evaluation were conducted. First, a Soft Outcome Star measurement tool was used [8] in order to gather and systemize qualitative observations focusing on eight basic areas (Confidence, Engagement, Self-esteem, Concentration, Attendance, Participation and Timekeeping), applied before and after user trials to establish a baseline and to measure the application's impact.

The second stage took place in real settings using qualitative methods of analysis. Routes were created with Route Mate in Caretaker or teachers/end user dyads. An observation checklist for six areas of interest (Satisfaction with usability/accessibility features, General attitude towards RouteMate, Verbal and non-Verbal expressions, Caretaker/teacher and end-user interaction and communication, User's progress, Impact/change after use), was used to order to organize the field notes. In depth analysis of selected cases was also included.

The third stage used a Likert-scale questionnaire to measure the carers' evaluation of Route Mate, comprising 19 items in three sub-scales. Two supplementary methods took places that are worth mentioning. "Recreating the Route" was a way to test the construction of cognitive maps through the use of mobile assistive technologies. After the end of a journey each group gathered around and with the guidance of the re-searchers and the help of the caretakers, recreated the trip using markers and a printed Google map copy of the general area. The aim was to recall the entire journey, stop-by-stop and draw them on the map. In this way the researchers could test whether or not the end-users could create a cognitive line of their trip and if Route Mate helped them to do so. The "Where-to-go-next" screen in Route Mate and the playful concept of choosing photos was also evaluated.

The "Ninja Game Route" was an example of a gamified user experience research method. The basic concept was to implement a game narrative structure in the session and create goal-orientated actions. The narrative here was a Ninja scavenger hunt game where participants had to "unlock" and thus collect hidden diamonds through digital elements and non digital props. The diamonds were "unlocked" each time a predefined stop was reached with safety avoiding non virtual villains (such as red traffic lights and cars) while diamond props were given to the participant. Combining digital with non digital elements, all diamond props were placed upon a wooden sword by the users who could recall a stop at the end of the session, creating a holistic and playful narrative. Incorporating game-like elements, such as these, made the journey not only more fun but also helped the users to concentrate and be more cautious while walking and could possible contribute to spatial map formation.

3.2 Results

The data analysis showed possible link between the level of satisfaction while using Route Mate and previous technological knowledge, while the reliability of the application - defined both as the actual problems that may occur during a test trial and as the negative expectation based on personal experience, seemed to

play an important role. Stress levels correlated with user's confidence and in turn became an encouraging/discouraging motivational factor for using Route Mate. During the piloting sessions, as the technical problems started to be resolved, stress levels decreased whilst participants' confidence increased and their intrinsic motivation to use Route Mate motivated them to learn new routes (see Figure 1). The stress levels of the more experienced users are significant lower. An interesting aspect was that in some cases getting to know and use the technology triggered the desire for self-improvement and learning other skills (independence, learning to read, finding similar programs and information about assistive technologies).
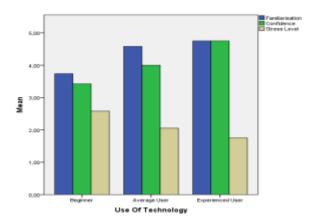

Fig. 1. Outcome Star Scores for participants with varying levels technology experience.

The role of Route Mate as educational tool was evaluated by caretakers and in some cases parents. 83,7% of the responders agreed that Route Mate is a useful tool for training disabled people, while the 79,1% answered that mobile assistive technologies can be a potential educational method. Finally, responses from users with intel-lectual disabilities show no qualitative differences in contrast with individuals with no intellectual disabilities (but with other kinds of impairments/disabilities) regarding usability/accessibility, impact and change after use and attitudes to use, providing an important indication that Route Mate can be an equally useful as a learning and assistive tool for both categories. Interestingly, preliminary qualitative results and focus groups at the end of each playful session concluded that users retained information much better when using Route Mate as a scaffolding game than when using it as an assistive route learning application. More research data is required in order to determine that the playful use of Route Mate improved the understanding of map based representations. An increase in self-determination, motivation and memory was also recorded in participants at the gamified piloting sites. Users required further RouteMate usage and expressed the desire to design their own routes, while caretakers and family members expressed unexpected positive results regarding IT skills, vocational training and academic achievements such as the following anecdotal case study.

According to case studies in various locations, an increased interest in using Route Mate associated with a positive future image of the self. For example, according to our subjects, Route Mate could support future plans like an independent trip or going to college. In general, an assistive technology like Route Mate

raised issues about independence and self-preservation and in more than one cases, the need to reassure their parents and their caretakers that one can function as a normal adult, even with the help of technology. Reaching a new destination and future planning became a new kind of discourse among the individuals who participated in our piloting sessions. Another interesting aspect was that in some cases getting to know and use a technology like Route Mate, triggered the desire to improve oneself.

A 25year old girl with mild mental and learning disabilities, unable to read or write, expressed a change towards academic goals. After the first session and the first journey, she confesses to her family that she would like to learn how to read. RouteMate as an assistive mobile application in the social context of our sessions helped her to confront herself and motivated her to evolve and probably start claiming her independence. In a second case, RouteMate's functionality motivated a young 19 y.o. individual who wasn't previously aware about the use of technology in an educational context, started to search the internet for similar programs and information about assistive technologies and locative applications towards his goal to apply for a job for the first time.

4. CONCLUSION AND FUTURE WORK

Combining games based learning elements with location based services has proven to be a successful methodological approach with high motivational qualities for participants and caretakers. After each session, participants made important progress in their IT skills and self-determination, and especially when combined with playful street game, research results, together with users' and caretakers' comments, showed that using Route Mate can lead to an increase in autonomous travel, producing at the same time the necessary motivation for further personal development.

According to the piloting results, RouteMate was perceived extremely positive by final users and caretakers while the playful approach augmented their motivation to re-use the application as well as learn new routes through a locative based system.

According to initial piloting testing, RECALL project has led to the development of a Console – a web based route planning device that can push routes to the Route Mate App; and the App itself that users can use to also plan and practice routes. A series of playful narrative have also been created to engage users in independent travel training.

In evaluating the route learning modes of the application, participants require significantly less help and make fewer errors in later stages of route learning than in earlier stages showing that it is an effective semi-independent route learning system. A qualitative evaluation showed the system's use can increase measures of self-determination, motivation and memory with high motivational qualities for participants with disabilities and their caretakers. There are also emergent indications that the gamified version promotes the development of better spatial mental models and further evidence to support or refute this finding will be pursed in the future. Future work will also expand the use of the playful narratives and to add haptic feedback to the Android interface to allow accessibility by people with visual impairments.

5. ACKNOWLEDGMENTS

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