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weSPOT: a personal and social toolkit for inquiry-based learning

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weSPOT: A Personal and Social Toolkit for Inquiry-Based Learning

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Abstract—Personal Learning Environments have recently emerged as a novel approach to learning, putting learners in the spotlight and providing them with the tools for building their own learning environments according to their specific learning needs and aspirations. This approach enables learners to take complete control over their learning, thus becoming self-regulated and independent. This paper introduces a European initiative for supporting and enhancing inquiry-based learning via a personal and social toolkit. This approach aims at supporting students in developing their self-regulated learning skills by conducting scientific inquiries in collaboration with their peers.

Index Terms—Personal Learning Environment, Inquiry Based Learning, Personalised Learning, Social Learning

I. Introduction

The Personal Learning Environment (PLE) is a facility for an individual to access, aggregate, manipulate and share digital artefacts of their ongoing learning experiences. The PLE follows a learner-centric approach, allowing the use of lightweight services and tools that belong to and are controlled by individual learners. Rather than integrating different services into a centralised system, the PLE provides learners with a variety of services and hands over control to them to select and use these services the way they deem fit [1].

Inquiry-Based Learning (IBL) follows the PLE paradigm by enabling learners to take the role of an explorer and scientist as they try to solve issues they came across and that made them wonder, thus tapping into their personal feelings of curiosity [2]. IBL supports the meaningful contextualization of scientific concepts by relating them to personal experiences. It leads to structured knowledge about a domain and to more skills and competences about how to carry out efficient and communicable research. Thus, learners learn to investigate, collaborate, be creative, use their personal characteristics and identity to have influence in different environments and at different levels (e.g. me, neighbourhood, society, world).

weSPOT[1] (Working Environment with Social, Personal and Open Technologies for Inquiry Based Learning) is a European project, aiming at propagating scientific inquiry as the approach for science learning and teaching in combination with today's curricula and teaching practices [3]. weSPOT aspires to lower the threshold for linking everyday life with science teaching in schools by technology. weSPOT supports the meaningful contextualization of scientific concepts by relating them to personal curiosity, experiences and reasoning. In short, weSPOT employs a learner-centric approach in secondary and higher education that enables students to:

1. Personalise their IBL environment via a widget-based interface.
2. Build, share and enact inquiry workflows individually and/or collaboratively with their peers.

This paper presents the weSPOT approach for supporting and enhancing inquiry-based learning through mashups of personal and social inquiry tools. The remainder of this paper is structured as follows: Section 2 introduces the personal and social approach of IBL in weSPOT, followed in Section 3 by a description of how this approach has led to the development of the weSPOT toolkit. Section 4 presents initial evaluation results acquired from piloting the weSPOT toolkit to different stakeholder groups. The paper is concluded in Section 5.

II. Personal and Social Inquiry in weSPOT

As we have learned from the European project ROLE[2] (Responsive Open Learning Environments), what is often missing from the PLE is not the abundance of tools and services, but the means for binding them together in a meaningful way [4]. weSPOT attempts to address this issue by providing ways for the integration of data originating from different inquiry tools and services. Most importantly though, weSPOT enables the cognitive integration of inquiry tools by connecting them with the student's profile, as well as her social and curricular context. Individual and collaborative student actions taking place within different inquiry tools update the learning history and learning goals of the student, thus providing them and their tutors with a cohesive learning environment for monitoring their progress.

The Web 2.0 paradigm offers new opportunities for social learning by facilitating interactions with other learners and building a sense of connection that can foster trust and affirmation [5]. Social learning, according to Hagel, et al. [6], is dictated by recent shifts in education, which have altered the ways we catalyze learning and innovation. Key ingredients in this evolving landscape are the quality of interpersonal relationships, discourse, personal motivation, as well as tacit over explicit knowledge. Social media offer a variety of collaborative resources and facilities, which can complement and enrich the individual's personal learning space.

weSPOT provides students with the ability to build their own IBL environment, enriched with social and collaborative

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[1] http://wespot-project.eu

[2] http://www.role-project.eu

features. This IBL environment offers tools for orchestrating inquiry workflows, including mobile apps, learning analytics support, and social collaboration in the context of scientific inquiry. These offerings allow students to filter inquiry resources and tools according to their own needs and preferences. Students are able to interact with their peers in order to reflect on their inquiry workflows, receive and provide feedback, mentor each other, thus forming meaningful social connections that will help and motivate them in their learning. From a learner's perspective, this approach offers them access to personalized bundles of inquiry resources augmented with social media, which they can manage and control from within their personal learning space.

It should be noted though, that there is a significant distinction between the user-centric approach of the Web 2.0 paradigm and the learner-centric approach of weSPOT. This is because a social learning environment is not a just a fun place to hang out with friends, but predominantly a place where learning takes place and it does not take place by chance but because specific pedagogies and learning principles are integrated in the environment. Quite often, what students want is not necessarily what they need, since their grasp of the material and of themselves as learners, is incomplete [7].

In order to transform a Web 2.0 environment into a social learning environment, students need to be constantly challenged and taken out of their comfort zones. This raises the need of providing students with the affirmation and encouragement that will give them the confidence to proceed with their inquiries and investigations beyond their existing knowledge. weSPOT addresses this issue through a gamification approach, by linking the inquiry activities and skills gained by learners with social media. In particular, this approach is defining a badge system that awards virtual badges to students upon reaching certain milestones in their inquiry workflows. This approach aims at enhancing the visibility and accrediting of personal inquiry efforts, as well as raise motivation, personal interest and curiosity on a mid-term effect.

III. The weSPOT Inquiry Space

The weSPOT inquiry space[3] is a personal and social IBL environment that reuses and extends the Elgg open-source social networking framework[4]. The weSPOT inquiry space has been built based on the following requirements:

- A widget-based interface enables the personalisation of the inquiry environment, allowing teachers and students to build their inquiries out of mash-ups of inquiry components.
- Students can connect with their peers and form groups in order to build, share and perform inquiries collaboratively.

Inquiries in the weSPOT inquiry space follow the weSPOT pedagogical IBL model [8]. According to this model, an inquiry consists of the following 6 phases: (i) Question/Hypothesis, (ii) Operationalisation, (iii) Data Collection, (iv) Data Analysis, (v) Interpretation/Discussion, and (vi) Communication.

The weSPOT inquiry space enables its users (teachers and students) to create mashups of their preferred inquiry components, assign them to different phases of an inquiry, share them with other users and use them collaboratively in order to carry out an inquiry. When creating a new inquiry, users are provided with a set of recommended inquiry components for each phase of the inquiry. They can then customise these sets of components by adding, removing and arranging inquiry components for each phase of the inquiry.

The weSPOT inquiry space offers a variety of inquiry components to teachers and students, enabling them to create, edit and share hypotheses, questions, answers, notes, reflections, mind maps, etc. Some of these components communicate with the APIs of REST web services offered by external tools. Examples of such external tools are mobile apps that allow students to collect different types of data (photos, videos, measurements, etc.) with their smartphones and share them with other inquiry members via the weSPOT inquiry space. A Learning Analytics dashboard visualises all the activities taking place within an inquiry, enabling teachers to monitor the progress of their students and students to self-monitor their progress. Teachers also have the ability to create and award badges to the students that have reached certain milestones in an inquiry. These badges are displayed in the profiles of the students.

Figure 1 shows an example mashup of inquiry components for a particular phase of an inquiry that explores the everyday uses of batteries. The phase is labelled "Discuss the findings" and corresponds to the "Interpretation / Discussion" phase of the weSPOT IBL model. In this phase, the members of the inquiry use collaboratively three inquiry components in order to discuss and interpret their findings. They use the "Inquiry discussion" component to exchange their views asynchronously in discussion forums. They also use the "Questions" component in order to provide answers to the key research questions of this inquiry and vote for the best answers. Finally, they create and share mind maps containing interpretations of their findings via the "Mind maps" component.

Additionally, users have access to external resources and widgets and can use them in their mashups together with the inquiry components offered by the weSPOT inquiry space. These resources and widgets originate from external Learning Management Systems (LMSs), such as Moodle or Blackboard, or from external repositories of widgets, such as the one offered by the European project Go-Lab[5]. In order to integrate external resources originating from LMSs, we have implemented the IMS Learning Tools Interoperability (LTI) specification[6], thus allowing teachers to include in their inquiries either course components from LMSs, such as discussion forums or quizzes, or entire LMS courses.

[3] http://inquiry.wespot.net
[4] http://elgg.org
[5] http://www.golabz.eu/apps
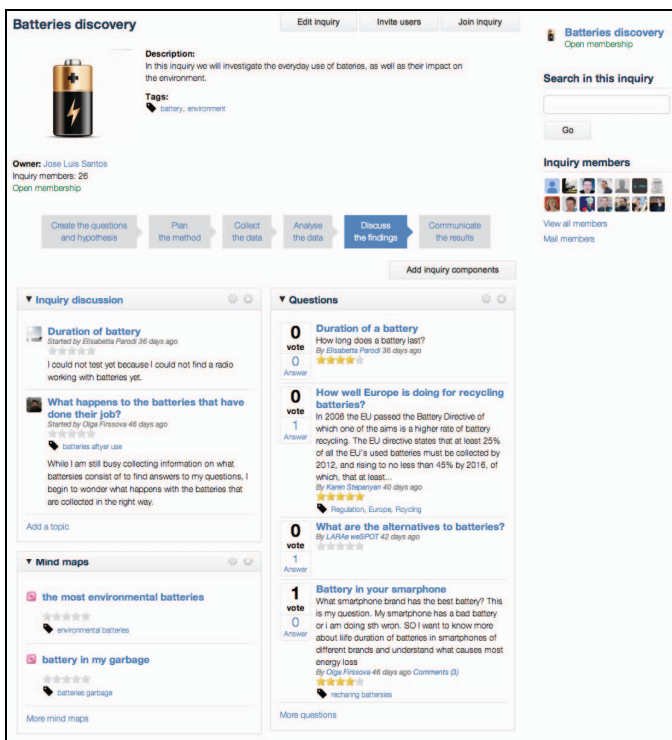[6] http://www.imsglobal.org/lti/index.html

Figure 1: A mashup of inquiry components for discussing and interpreting the findings of an inquiry.

IV. Initial Evaluation Results

A participatory approach has been followed in the development of the weSPOT toolkit. This means that stakeholders, i.e. educators, students and researchers, have been involved throughout the design and development process by specifying requirements, reviewing mockups, as well as testing and evaluating software prototypes of the weSPOT toolkit. In this section, we present the evaluation results obtained in two consultation sessions with two different groups of stakeholders.

The first session took place at the Joint European Summer School on Technology Enhanced Learning (JTEL) in Malta, in April 2014[7]. Participants were 10 postgraduate students from universities across Europe. The JTEL Summer School is an annual event and offers an opportunity for PhD students, in different subject areas, in TEL to meet, exchange knowledge and develop their research skills whilst engaging with the active TEL community of practice. The second session took place at the PLE conference in Tallinn, Estonia in July 2014[8] and was attended by 14 participants. The PLE conference brings together researchers, educators and practitioners for a lively exchange of ideas, practices and visions. Participants in this session were primarily researchers and educators.

A similar hands-on workshop format was used in each session. After a short introductory presentation about IBL and the weSPOT toolkit, a short question and answer session followed. The main hands-on section of the workshop was then delivered in the form of an activity. During this activity, participants were asked to access the weSPOT inquiry space in order to use collaboratively a pre-made mashup of inquiry components, as well as create their own inquiry mashups. Participants were also given the opportunity to use an Android mobile app[9] in order to collect data and share them via the weSPOT inquiry space. However, the use of this app was optional, as not all participants had access to an Android device.

Whilst the basis of the introductory materials used in both sessions was the same, the hands-on activity was tailored for the different audiences. More specifically, in the first session, where the stakeholder group consisted of students, emphasis was given on the collaborative use of a pre-made mashup, whilst the second group of educators and researchers were given more time to explore the inquiry space and create their own mashups. This is consistent with the roles of the stakeholders in the weSPOT inquiry space, according to which the teacher initiates the inquiry and prepares the inquiry mashups. The student can then configure these mashups and use them together with his/her team members in order to carry out the inquiry.

At the end of each session, a group discussion was held with the participants contributing their experiences of using the weSPOT toolkit. Additionally, participants were asked to answer a short online questionnaire[10]. The purpose of this questionnaire was to gather user feedback both specifically about the weSPOT toolkit, as well as more generally about components and functionalities that can potentially facilitate IBL.

The results of both sessions were recorded in a number of formats. Quantitative data was collected primarily from the questionnaire, whilst the majority of the qualitative data was collected in situ during the group discussions and when the facilitators circulated amongst the participants. It was for this reason that the facilitators at each session collated notes of what they observed and heard during each session. It is important to note that the questionnaire also contained a number of semi-structured questions permitting free text individual responses.

In the first session, the audience consisted of PhD students all of whom were aged between 21 and 40. There was an even split between the genders. Most participants declared that they had some knowledge of IBL (56%) whilst the majority also indicated that they had good knowledge of PLEs (56%). Figure 2 depicts the Arithmetic Mean (AM) and Standard Deviation (SD) of the recorded quantitative responses to the questionnaire. The answer options to these questions were 5-point Likert scales ranging from "Not at all" (1) to "Very much" (5). As it can be seen, the toolkit was positively received but the responses were mostly neutral regarding the toolkit's efficiency, helpfulness and ease-of-use.

The second session was attended by an audience aged 31-50 with a 60:40% male:female division. Their knowledge of IBL invited a wider range of responses, in that 20% recorded

themselves as "experts", with 40% stating "good knowledge", alongside 20% saying that they had "some knowledge" and 20% saying they had no knowledge at all. 60% of the participants recorded a good level and 40% an expert level in respect of their PLE knowledge. As it can be seen in Figure 2, the quantitative questions invited more positive responses about the toolkit's efficiency, helpfulness and ease-of-use, compared to the first group. Both groups were neutral as to whether they would use the toolkit for their own purposes.
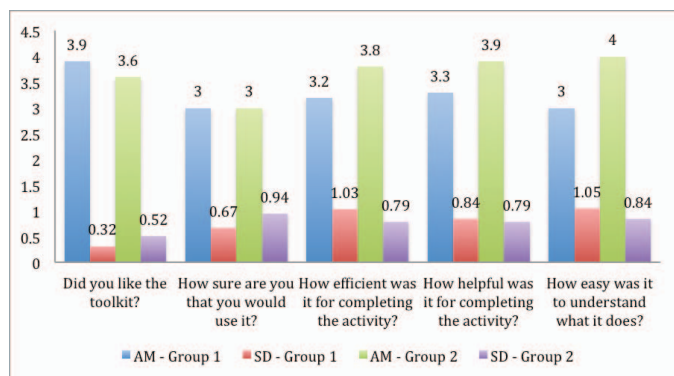

Figure 2: Summary of quantitative responses collected from the stakeholder groups.

Useful qualitative feedback was recorded in both sessions during the group discussions and via the qualitative responses to the questionnaire. The collected qualitative feedback varied according to the roles of the two stakeholder groups and their interests in the use of the toolkit. In particular, while the first group (i.e. the students) was more focused on the use of the offered tools for performing collaborative scientific inquiries, the second group (i.e. the researchers and educators) were more interested in potential extensions to the toolkit with additional functionalities, as well as the interoperability of the toolkit with other educational technologies, such as LMSs.

Discussions and qualitative questionnaire responses among the first group were centred around usability improvements of the existing tools, as well as connecting them in more meaningful ways, e.g. by linking a hypothesis with key research questions and data collection tasks. The second group showed more interest towards extending the weSPOT toolkit, e.g. by allowing teachers to integrate their own data collection instruments, such as surveys. Another recurring theme among the second group was the use of APIs, like Tin Can[11], for importing/exporting data from/to other systems. Additionally, participants in the second group discussed the usefulness of grouping together students that have complementary inquiry skills, as well as potential ways of measuring the development of inquiry skills through the use of the weSPOT toolkit.

V. Conclusions and Further Work

The weSPOT project is investigating IBL in secondary and higher education, in order to support students in their scientific investigations via a personal and social inquiry toolkit. The weSPOT toolkit enables students to build their inquiry mashups with support from their teacher and use them collaboratively in order to perform scientific investigations together with their peers. As the project is in progress, the research and technological work presented in this paper will be continued towards lowering the threshold for linking everyday life with science teaching and learning. The specific added value in lowering this threshold will be investigated through a variety of pilots in real-life learning settings and different inquiry domains within secondary and higher education.

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