Towards an Automated Adaptive Learning Web Platform Through Personalization of Language Learning Pathways

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Abstract. Adaptive learning is increasingly gaining ground thanks to the rise of digital tools which are becoming more accessible to teachers. Indeed, the possibilities of adaptive learning are growing and can now vary according to the implemented digital tools and (most importantly) the needs of teachers and the often-heterogeneous profiles of students. This article presents the interactive platform GamesHUB, designed to promote Universal Design Learning (UDL) in Swiss French-speaking classrooms. GamesHUB is a full Web platform that allows the customization of teaching pathways depending on didactic goals and the needs of teachers and students. As part of the European "PEAPL" project, GamesHUB aims to assist teachers in pathways customization through an automation of this process, in partnership with the LIRIS computer science laboratory (France). This automation will be relying on a suggestion system based on the calculation of competency profiles from the learning tracks analytics. The article will describe the current functioning of GamesHUB, namely the adaptable pathways. In a second step, we introduce the principle of automation while mentioning the problem of trust and the need for transparency when it comes to artificial intelligence. Therefore, we present the learner and domain modeling underlying to the profile of competences.

Keywords: Adaptive learning · Inclusive learning · Gamification authoring tool · Learning pathways

1 Introduction

1.1 The Adaptive Issue in Technology Enhanced Learning

The issue of adaptive learning environments has been addressed from different angles and in different educational contexts. It concerns face-to-face or distant learning, academic

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or vocational training, and has been implemented in environments as varied as Intelligent Tutors, Serious Games, Adaptive Hypermedia, MOOCs and other online courses [1, 2]. It is aimed at "classical" or special needs learners, at a learner working alone or at learners working in groups, and has multiple pedagogical objectives, including the promotion of autonomy and self-regulation of learning.

In this paper, we address adaptive learning of the schooling language for learners with or without learning disabilities (L2 speakers, dyslexic learners, students with language impairment…) through personalized learning pathways.

Indeed, in order to facilitate the adaptation of technology-enhanced learning (TEL) to the learner, many artificial intelligence techniques have been used [3]. These different techniques make it possible to better identify the learner's characteristics and needs to improve the personalization provided. They can also help to enable learners to carry out a reflective activity on their learning, when it comes to adaptable learning pathways with personalized activities, trying to change the role of the learner from a passive receiver of information to a collaborator in the educational process.

Personalization can be desired by several actors (the learners themselves, the educational teams), and the approaches proposed may vary, leaving the control of personalization sometimes to the learner, sometimes to the educational teams, sometimes to artificial intelligence techniques [4, 5]. Personalization can include contextual recommendation of resources, the use of adapted materials or taking into account the affective and cognitive state of the learners [6].

1.2 Paper's Structure

In the above-described context, we introduce the European Platform for Personalized Language Learning (PEAPL). Project PEAPL is funded by the European Erasmus fund within the online platform GamesHUB, maintained by the University for Teacher Education of Fribourg (HEP) in partnership with the Fribourg Vocational School (EMF).

Therefore, in this paper, we firstly present the GamesHUB platform and its features. Secondly, we describe how the PEAPL project outcomes take place on GamesHUB platform.

2 GamesHUB Platform with Adaptive Learning

2.1 Purpose

GamesHUB[1] is designed for students aged 6–12 in French-speaking Swiss schools, using game-based learning and customized learning pathways. Its purpose is to allow every student, including those with learning disabilites, to develop skills if they can interact with the computer. The platform provides learning games related to various learning areas within the framework of the Plan d'Études Romand[2] (PER) which is the official competency framework in the context of GamesHUB implementation. It also supports the teacher in the continuous improvement of teaching and learning by recording tracks

[1] https://hep3.emf-infopro.ch/
[2] https://www.plandetudes.ch.

of students' activities in compliance with the European GDPR (General Data Protection Rules). The data of each learning game played is recorded and can then be visualized and analyzed by the teacher to identify difficulties of students.

2.2 Features

Customized Pathways. Currently, the GamesHUB platform provides access to learning games on various themes, mainly learning French as the schooling language. This access is possible in a "self-play" mode and in the "custom pathway" mode. Indeed, the "self-play" mode provides game sessions for exploration, training, evaluation, and content creation, each time for a single learning game. However, the "custom pathway" mode allows to have specific sequences of different game levels and to track the overall progression of a student through these pathways.

As mentioned in our related work [7], the concept is to create a learning pathway targeting some specific skills and pieces of knowledge (from the PER, for example). Then, it requires to access all the learning games corresponding to these target pieces of knowledge and skills with different levels of difficulty. The principle also consists in creating mandatory steps in the scenario and optional steps (that we call remediation steps) from these different levels of difficulty (see Fig. 1). The remediation steps will only be triggered when the student has failed certain mandatory steps.

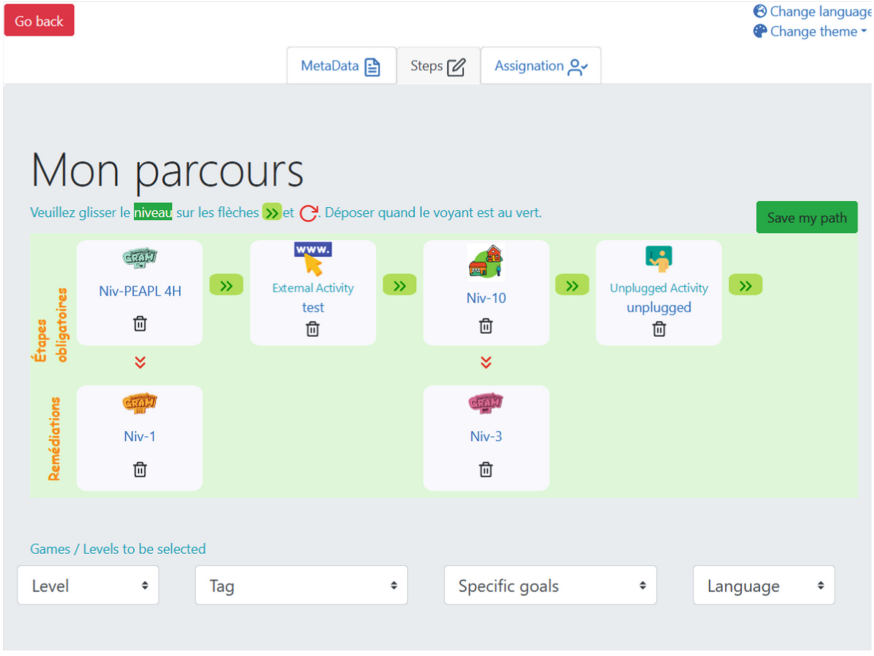

Fig. 1. A pathway being created, combining mandatory and remediation steps

Once the pathway has been created, it can be assigned to one or more students or directly to one or more classes as shown in Fig. 2.

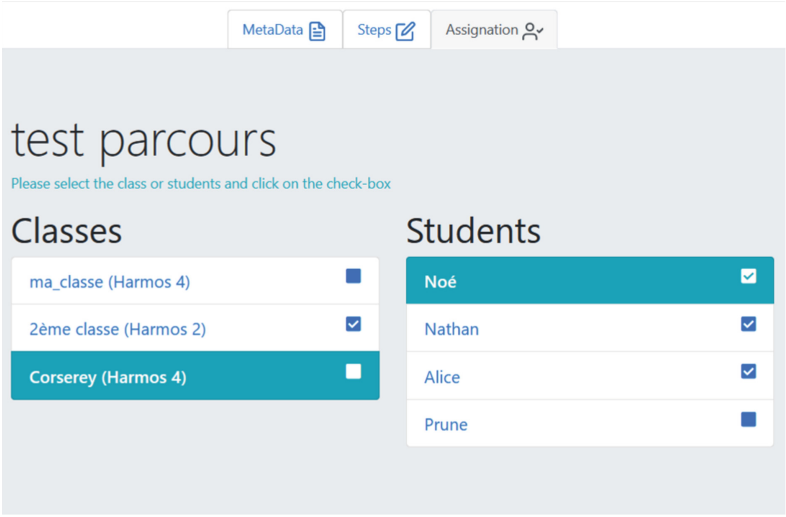

Fig. 2. Assigning a learning pathway to a group of students on GamesHUB

2.3 Automating the Generation of Personalized Pathways

The operations described above certainly allow a better adaptation of each student's path according to his/her needs and to the teacher's estimation. However, this process can be tedious if the teacher must target each task or each pathway to every pupil in the class.

Indeed, when the hand is given to teachers to implement adaptive learning, two approaches are possible: (1) to let teachers describe the sequence of activities and learning sequences provided to learners, by providing them with authoring tools, or (2) to acquire their knowledge as experts and teachers to help them via more automated processes. For example, the PERSUA2 model [8] allows a pedagogical team to express a personalization strategy describing which activity could be proposed to the learner according to the content of his profile. This strategy, expressed in the form of rules, can then be exploited by a process that adapts to each learner.

The aim of the PEAPL project is to use artificial intelligence to assist teachers in this tedious process by generating personalized pathways for students based on an automated calculation of their competency profile. However, we believe that, in these approaches including automatic processes that take decisions in place of human actors, the latter do not have sufficient knowledge of AI techniques to understand and trust the recommendations coming from these systems. Therefore, the acceptability and appropriation of these systems necessarily require more transparent processes, in which the user can understand the knowledge and reasoning implemented by the system, with the aim of obtaining an explanation of the decisions suggested [9]. We explain in the following section the learner modeling principle used to calculate the competency profile.

2.4 Modeling the Domain to Model the Learner

When the aim of personalization is to propose resources or activities on concepts adapted to the learner's pieces of knowledge/skills and the teacher's pedagogical objectives, the competency-based approach makes it possible to model the subject area [10, 11]. Modeling the learner then consists in determining the pieces of knowledge and skills acquired by the learner, based on the analysis of the marks and data of his/her activity. The personalization strategy implemented by the system can then be based on a double modeling of the domain and the learner. Modeling a domain according to the competency-based approach consists in defining a set of competencies for this domain, this set of competencies being proposed by researchers in didactics or by teaching teams. In these competency frameworks, a competency is defined by a set of pieces of knowledge and skills that can be linked altogether by different kinds of relationships (for example, *requires/is required by*), leading to an ontology modeling.

For example, a first competency framework used in GamesHUB is the Plan d'Études Romand (PER) as already stated (Sect. 2.2). It allows to choose the general objective of the pathway through the general competences expected in the national program for French-speaking Switzerland. The second competency framework is the PEAPL competency framework which models skills and pieces of knowledge involved in the reading-comprehension in primary school. It has been developed using the COMPER project meta-model of framework[3]. It is used to guide the teacher in his or her choice of progression and articulation of specific objectives within the pathway. The pedagogical resources (games and levels of games) are associated with skills and/or pieces of knowledge (specific objectives) constituting the target competence (general objective). The PEAPL competency framework[4] has been published[5], as well as an excerpt from the praxeological organization that underpins this framework[6].

Technically speaking, this step relies on sending data from GamesHUB to the external Learning Record System of the LIRIS (Lyon Computer Science Laboratory). The data sent is in xApi format. It mainly contains information about the actor, the activity, the submitted answers, and a score between 0 and 1. The latter defines a percentage of success which will also be used for the calculation of the competence profile.

3 Future Work

As mentioned in Sect. 2.3, teachers must understand AI techniques used by their TEL environments so that they can trust the recommendations coming from these systems. Therefore, our future work will be focused on two main research questions:

(1) How do teachers understand, adapt, and perceive the adaptable pathways based on their knowledge of their students' needs and their use of the platform?

[3] https://comper.fr/en/productions/wp1.
[4] https://traffic.irit.fr/comper/repository/viewframework_public?name=92.
[5] https://zenodo.org/record/4462850#.YmEik9PP2Uk.
[6] https://zenodo.org/record/4001381#.YmEi7NPP2Uk.

(2) How can we implement system-generated explanations that allow teachers to take ownership of the adaptive system and its settings?

Thus, our future work consists in starting a series of experiments with teachers to have elements of answers to the two questions above. In addition, this would be our opportunity to understand how teachers perceive the adaptive features.

For all these assessments, we will use semi-structured interviews, participant observations and the tracks collected on GamesHUB, during gameplay within the learning pathways sessions and during the processes of pathways adaptation.

4 Conclusion

In this paper, we presented the GamesHUB platform designed with adapting learning paradigm, toward a universal design for learning thanks to TEL, and intended to learners with or without learning disabilities. We introduced the manual personalized learning pathways allowing the setup of a personalization adapted to the teachers' different objectives and the students heterogenous profiles. Then, we presented the automation concept of personalized pathways, within the PEAPL project. Our future work consists in experimenting the GamesHUB platform with all these features to gather feedback from teachers and students on both manual and automated personalized learning pathways.

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