Integrated Model for Comprehensive Digital Education Platforms

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***Abstract*—The trend towards generalized blended and active learning approaches in engineering education is redefining the requirements and the deployment schemes for digital education platforms. This paper presents a quadriptych techno-pedagogical model highlighting the features and the services an effective digital education platform should provide to accompany educators in their journey towards the creation of rich—and possibly open—educational resources, as well as their integration into blended and active learning scenarios. An implementation of this model for a novel digital education platform called Graasp is discussed and three use cases are detailed. These use cases show that a large variety of active pedagogical scenarios can be implemented, if easily accessible and comprehensive digital education platforms are available.**

Keywords—digital education, blended learning, active learning, open educational resources, pedagogical scenarios, learning management systems, learning experience platforms, design models, learning analytics

I. Introduction

The world of education has been profoundly affected by the COVID-19 pandemic. As the Organization for Economic Cooperation and Development (OECD) notes, "this crisis has exposed the many inadequacies and inequities in our education systems – from access to the broadband and computers needed for online education, and the supportive environments needed to focus on learning, up to the misalignment between resources and needs" [1]. Higher education institutions closed their premises but were quick to replace face-to-face lectures with online learning despite their lack of experience and time. This tremendous effort to strengthen education technology has shown the need for and the benefits of digital solutions that can support both on-campus and online activities.

Moreover, the trend toward generalized blended learning approaches in engineering education is redefining the requirements for digital education platforms. This trend is aligned with the digitalization of society and the broad availability of cloud and mobile solutions. The concurrent evolution of education from passive individual to active collaborative learning scenarios, as well as from mainly summative to broadly formative evaluation schemes, requires a new type of digital education platform. The latter needs a design supporting the development of transversal skills and more intrinsic educational values compared to traditional learning management systems [2]. Finally, the strong development of Massive Open Online Courses (MOOCs) has not only highlighted the actual benefits of digital education platforms but more specifically the educational resources they are offering, as well as the learning activities and the interaction opportunities they are supporting.

All these new constraints and expectations provide an opportunity to develop a new vision for digital education. More concretely, digital education platforms have to be redesigned not only to integrate this evolution in a more comprehensive way but also to support more agile blended and active learning implementations. This paper presents an integrated model highlighting the services that an effective digital education platform should provide in order to better serve the higher education community in general, and the engineering education community in particular.

The proposed model results from years of investigations, co-financed by the European Commission, in designing learning community support platform[1], personal learning environments[2], and active learning ecosystems[3,4,5]. It should help solution providers and developer communities to design and offer the next generation of digital education platforms, also referred to as *Learning Experience Platforms* in the professional learning context. Special attention is placed on supporting the educators in their digitalization journey and enabling them to design, learn, and personalize their teaching resources, as well as to share them with their peers. To begin, this paper presents a model-based design approach. It then introduces an enabling techno-pedagogical model, which supports the educators, engages the learners, and provides relevant data for stakeholders and researchers in education. It also explains the concept of rich open educational resources, as well as the implementation of the techno-pedagogical

[1] https://cordis.europa.eu/project/id/028038
[2] https://cordis.europa.eu/project/id/231396
[3] https://cordis.europa.eu/project/id/317601
[4] https://cordis.europa.eu/project/id/731685
[5] https://cordis.europa.eu/project/id/781012

model for the design of a new release of the Graasp platform. The adequacy of the model is finally illustrated through three use cases.

II. Model-Based Design Approach

The design of novel digital education platforms supporting blended and active learning, as well as the underlying didactical strategies and processes, can be achieved by relying on two complementary and integrated dimensions. First, there is a **technical** dimension related to the **services** that are to be integrated—as well as their user interfaces—to offer a holistic and effective teaching and learning experience. This technical dimension is defined for and validated by designers, developers, and interaction experts.

Second, there is a **pedagogical** dimension related to the **stages** to be supported for implementing effective teaching and learning processes or scenarios, as well as to trigger large-scale adoption and dissemination. This pedagogical dimension is defined for and validated by educators, learners, and other stakeholders in education. The techno-pedagogical model combining these two dimensions is presented in Section III, after introducing a typology of digital education platforms in Section II.A and the model elicitation approach in Section II.B.

A. Typology

Before detailing the proposed model, it is important to provide a **typology** of digital education platforms, highlighting their focus on *orchestration, production*, *consumption*, *dissemination*, and *reflection* on courses, activities, or resources, as well as on supporting summative or formative assessment, on the cloud or on instances deployed on-premise.

We can highlight three main types of platforms: 1) Learning Management Systems, 2) MOOC Platforms, and 3) Learning Experience Platforms.

1) Learning Management Systems (LMSs) have the dual function of providing course management support for the educators and the administrative staff, as well as providing a learning platform for learners [3]. However, LMSs are more focused on course management than course delivery and interaction. The vast majority focus on hosting the educators' documents and slides, relegating students to "the role of passive recipients of information" [4]. In this regard, they are closer to a "digital school bag" containing books, a class diary, homework, and take-home assessments.

LMSs also follow the quite rigid course structure associated with a predefined academic semester and are linked to administration systems handling enrolments and grades. They are therefore hosted locally in academic institutions and managed by their academic and IT services to protect sensitive personal data. Finally, they provide little support for content creation and collaborative activities, and no support at all for sharing resources among educators [2], each course container being a digital silo. In short, "[LMSs] are anything but flexible, open or dynamic" [4] Even if certain LMSs (e.g., Moodle) can be adapted through custom plugins [5] they are not designed to tackle all of the constraints and expectations highlighted in Section I. Instead, the main focus of LMSs is on the weekly *orchestration* of digital learning resources by educators, their local and class-oriented *dissemination* by the home institution, and their *consumption* by learners.

2) MOOC Platforms generally include: "lectures formatted as short videos combined with formative quizzes; automated assessment and/or peer and self–assessment and an online forum for peer support and discussion" [6]. They are closer to a classical lecture with the particularity of being online. In this regard, they share the same static structure of the lecture, which is rarely modified during the semester. According to [6], the evidence suggests that learning experiences *with MOOCs* are as effective as face-to-face lectures and, in some aspects, they may actually improve learning outcomes.

MOOCs also have the particularity to be open and free instead of being dedicated to a single institution. They are designed to handle a massive load of students and therefore use informal assessments (automated, peer, or self-assessments), which will not usually lead to a formal degree, but rather to a certificate. Furthermore, activities are sometimes simplified for ease of assessment, such as automatically gradable quizzes, which are incapable of giving personalized feedback. Peer assessment is also used because educators cannot give feedback to the massive number of submissions [7].

The main focus of MOOC platforms is on the module-based *orchestration* of online learning resources by educators, their global *dissemination* by institutions, and their *consumption* by learners. Regarding their management, MOOCs cannot be used without the support of technical and business teams, as the hosting platforms are offered by for- or non-profit organizations, or regional or national service providers.

3) Learning Experience Platforms (LXPs) are third-generation platforms that combine aspects of social media platforms with virtual learning environments. They function as a platform rather than a system with different building blocks such as an LMS [3]. They give greater freedom for the learners to follow their own interests compared to LMSs, where the path is laid out by the educators. In this way, LXPs are much more focused on the personalization of the learning experience. Learners can easily upload content with the integration of any number of applications. They can interact both with their peers and educators and contribute to "a social media type stream of information" as well as creating content [3]. Some LXPs are also gamified to encourage participation and motivation (e.g., Kahoot) [8].

Unlike in LMSs and MOOC platforms, educators do not need a technical team to create and manage their LXP. Some of them have such a simple design that educators who are not familiar with computers can use them after a few hours of basic training. Moreover, educators can create collaborative activities and share their resources with each other. This type of platform is, therefore, best aligned to tackle all constraints and expectations highlighted in Section I. More specifically, Learning Experience Platforms holistically target the *orchestration* and *production* of online learning resources by educators, their *dissemination* by educators or institutions, and their *consumption* by learners, while also promoting *reflection*, with respect to the learning process, across all stakeholders.

B. Model Elicitation Approach

The model provided in Section III is dedicated to platforms enabling educators to explore blended and active learning scenarios in order to fully embrace the potential of digitalization. The initial version of Graasp was elicited in a series of large European programs, including the 7th Framework Program (FP7) and Horizon 2020 (H2020) research and innovation programs on digital Science, Technology, Engineering, and Mathematics (STEM) education, as an ecosystem of loosely coupled platforms. It was then consolidated as a scalable and sustainable fully-fledged solution dedicated to accompanying educators in their digitalization journey.

Elements integrated into the Graasp underlying model were elicited and regularly revised through participatory design with all digital education stakeholders. They were then implemented as integrated features and services with dedicated user interfaces, taking into account their essential utility, usability, and acceptability dimensions.

Data protection and privacy enforcement to comply with the European General Data Protection Regulation (GDPR) were also taken into account in the elicitation and design approaches. The main impact of GDPR is the integration of a comprehensive solution handling personal data and learning outputs in a single place. This solution prevents their exchange between platforms and services without the explicit consent of the users.

III. The Techno-Pedagogical Model

A. *Educators' Path Towards Digital Education*

Nowadays, digital education platforms need to support **educators** in an agile way. Indeed, educators are aggregating, creating or co-creating, implementing, and sharing educational resources. Their adoption **path** towards the implementation of blended and active learning strategies and resources includes many **steps**. This path starts with the development of their digital and pedagogical skills, continues with the production of digital content, and the digital delivery of this content to learners, culminating with the collection of the digital traces and learning outputs created during learners' interactions with the educational content.

Depending on the skills and the needs of the educators, the path and the resources involved can be either simple or elaborate, as detailed in Table I. On this digitalization journey, educators can stop wherever applicable (from the most basic level *A* to the most advanced level *H*), depending on their objectives and confidence in their digital skills.

TABLE I. Educators' Path in their Digitalization Journey

Level	Activities and Resources	Objectives and Achievements
A	In-Person or Online Training Modules (for Educators)	Developing Digital Skills
B	Orchestrating and Using Digital Learning Resources (Learners using Computers or Tablets without Network Access)	Implementing Enriched Traditional Learning Scenarios (and Summative Assessment)
C	Orchestrating and Using Online Learning Resources (Learners using Computers or Tablets with Network Access)	Implementing Blended Learning Scenarios
D	Personalizing, Creating or Co-creating Digital or Online Learning Resources	Collaborating with Colleagues and Implementing Blended Learning Scenarios
E	Designing Rich Educational Resources for Individual or Collaborative Activities	Implementing Active Learning Scenarios (and Formative Assessment)
F	Implementing Learning Analytics Apps and Dashboards	Supporting Awareness and Reflection for Both Educators and Learners
G	Sharing Rich and Open Educational Resources	Providing Digital Education and Resources with all Stakeholders
H	Collecting and (Pseudo-) Anonymizing Digital Traces and Learning Outputs	Promoting Open Educational Science for Research and Impact Assessments

B. *Quadriptych Techno-Pedagogical Model*

To achieve all the steps of the educators' path detailed in Section III.A and to design innovative digital education platforms, four core services have to be provided and combined. They are the four elements of the proposed **Quadriptych Techno-Pedagogical Model** detailed in Table II. In addition to its four techno-pedagogical elements, the model also highlights the associated actors and the core digital affordances on which it relies.

The **Builder** element enables the integration, personalization, the creation or the co-creation of learning resources, and their orchestration in learning activities by educators. It covers the *orchestration* and *production* features associated with the typology described in Section I.A and is aligned with steps B to E of the educators' journey described in Table I. Resources and activities designed can integrate rich components and target individual or collaborative learning activities. The "Builder" is for interactive online learning resources what the PowerPoint presentation *editor* is for slides. The "Builder" service should be so intuitive that it does not require the intervention of software or educational specialists in the design process, as it is known to impair spontaneity and creativity.

The **Player** element enables the usage of learning resources by educators (for presentation purposes) or by learners (for interaction purposes). Hence, the "Player" should be able to collect (if explicit consent is given) activity traces and learning outputs. It embeds the *consumption* feature and is aligned with steps B to E of the educators' journey described in Table I. The "Player" also enables learners to discover, explore, and experience rich educational content, as well as consolidate and construct or co-construct their own knowledge, while also developing transversal skills. The "Player" service is to interactive online learning resources what the PowerPoint *presentation* is to slides, with the additional features of having components being stateful and able to hold contributions from learners between sessions.

The **Explorer** element is an **open library** enabling the sharing and the discovery of open educational resources to cope with the scarcity of relevant digital content available to educators and proposed to learners or other stakeholders. It embeds the *dissemination* feature associated with the typology described in Section I.A and is aligned with step G of the educators' journey described in Table I. The journey to reaching the point where educators are ready to share resources openly can be lengthy. Before arriving at that point, resources can be used independently. Then at some point, educators can start sharing them with trusted colleagues and even adapt them collaboratively. When educators believe that their resources have reached a good level of quality, they can decide to share them openly.

Most domain-specific libraries for educational resources currently enforce a complex validation process or commercial scheme before publishing a resource. This is not only impairing free and large access to knowledge, but it also explains why most educational resources are currently shared through YouTube, alongside a plethora of useless content (from an educational point of view). Libraries for educational resources should be well referenced to facilitate search. Moreover, popularity and quality should be elicited from the users following appropriate enforcement schemes, requiring less top-down moderation.

The **Analyzer** element enables learning analytics (LA), exploiting traces and learning outputs produced by contextual activities. This element embeds the *reflection* feature associated with the typology described in Section I.A and is aligned with step H of the educators' journey. Taking into account the GDPR—which states that personal data cannot be shared with third parties without explicit consent—a trusted platform should have such a LA service built-in. From an ethical perspective, data are not for the sole usage of the service providers. They should be made available to the end users to support their own awareness and reflection, and also offer formative assessments. With learning analytics based on activity traces and learning outputs, educators can refine their resources and activities from usage patterns and learners' achievements. Learners can reflect on their own learning, as well as compare (if relevant) their progress against that of their peers. When comparisons within cohorts are provided, personal data should be protected. Hence, only averaged and anonymized analytics of peers should be provided. Learning analytics can be shown in contextual dashboards (i.e., dashboards related to specific activities) or integrated directly into components of the learning resources.

TABLE II. QUADRIPTYCH TECHNO-PEDAGOGICAL MODEL OF INNOVATIVE DIGITAL EDUCATION PLATFORMS (ELEMENTS WITH THE ASSOCIATED ACTIONS, ACTORS, AND AFFORDANCES)

Builder Creating and Personalizing *Educators* Educational Resources and Learning Activities	**Player** Presenting and Interacting *Learners* Activity Traces and Learning Outputs
Explorer Sharing and Discovering *Providers* Open Library with Resource Collections	**Analyzer** Reflecting and Assessing *Stakeholders* Dashboards with Learning Analytics

In our model, the "Builder" and the "Explorer" are clearly related to the constructivist theory, because they enable the creation and the sharing of educational resources and learning activities for educators. Parts of the "Player" are related to the objectivist model by enabling learners to explore their own learning activity. This can lead them to individualize or not their learning path. The "Analyzer" gives feedback to all stakeholders but can be experienced differently by the educators and the learners. Depending on their results, these "cold" learning analytics can be interpreted positively or negatively, which can trigger positive or negative reinforcement, exactly like the rating system of the resources posted on the platform.

IV. RICH OPEN EDUCATIONAL RESOURCES

It is important to detail the concept of rich open educational resources introduced in the previous section in order to really grasp the importance of facilitating their creation and personalization. This is especially true for advanced digital education scenarios in which educators are interested to go beyond mere slides and videos—which are often the core learning resources—to better support blended and active learning.

In general, educational resources are simple resources like slides, documents, videos, paper, or digital books. When we refer to **open educational resources** (OERs) for digital and online resources, they include the following additional unique features:

- They can be composed, orchestrated, and integrated with LTI[6] (Learning Tools Interoperability) or other standards.
- They can be accessed using a single URL.
- They can be reused or modified freely.
- They are shared with Creative Commons licenses[7].

It is clear that educators are not forced to share their resources openly, especially if they are not confident enough to do so, or if there are intellectual property issues or for-profit educational contexts. Fortunately, in our European context, there is an increasing consensus for promoting the open sharing of resources. So, when referring to **rich open education resources**, we consider resources that are integrating, in addition to digital documents and multimedia content, interactive components and services, such as:

- links to external online resources and services;
- interactive apps (e.g., games, simulations, AR/VR tools);
- support apps (e.g., quiz, notebook);
- collaboration support;
- learning analytics for educators and learners;
- pedagogical structures mapping pedagogical scenarios.

When **links** to external resources and services are integrated, an additional and dynamic dimension of composition and orchestration is achieved. It provides the

[6] https://www.imsglobal.org/activity/learning-tools-interoperability

[7] https://creativecommons.org

ability to better personalize the resource or the embedded learning process to its users. It also provides advanced navigation opportunities between learning phases or resources.

When delivered as Web tools, **interactive apps** strongly contribute to the educational added-value that digital resources can bring to effectively support learning. It is interesting to note that professional and commercial software packages are often offered in engineering education, but their licensing schemes are generally detrimental to effective technical and pedagogical integration, and definitely incompatible with a philosophy of sharing. Therefore, it is better, whenever possible, to replace them with online and open alternatives, such as H5P[8] tools.

Support apps are integrated to offer some scaffolding or additional services to learners. These apps can be quizzes like those encountered in LMSs or MOOC platforms, but also more advanced services that can collect contributions (text, notes, documents) and enable communication (chat or chatbots).

Learning analytics (LA) should be provided at least to both educators and learners. They can be related to the usage of a platform. In the agile and versatile context of blended and active learning, it is more interesting to tighten the learning analytics to the usage of an open educational resource itself and its components and services. In this sense, LA that are useful from a teaching and learning point of view are contextual and actionable, in the sense that they can trigger further personally-driven actions. Furthermore, tools supporting LA can be broken down into individual components, which can be composed to support bespoke, interoperable LA [9].

The ability to embed a **pedagogical structure** mapping a pedagogical scenario with learning phases within educational resources opens a new realm of opportunities. For instance, a resource could embed inquiry learning phases with content and support tools to carry out an experiment. But it can also just integrate placeholders that can be fully populated by the learners themselves, individually or collaboratively. Section 5.2 illustrates a case where a resource, with placeholders structuring a collaborative design thinking activity, has been implemented.

Considering that most of the above-described components and services are stateful and rely on personal or collaborative actions and data, they cannot be exploited without being associated with a digital platform managing users' identities, credentials, and access rights, as well as the storage of activity traces and learning outputs. This is why open educational resources are fully part of the techno-pedagogical model and often rely on single sign-on schemes (when used in cloud platforms) or unique identities delivered at the national or supranational levels.

V. Implementation of the Techno-Pedagogical Model

The techno-pedagogical model proposed has been used by the authors to implement a new version of the Graasp digital education platform developed together by the École Polytechnique Fédérale de Lausanne (EPFL) and the nonprofit Graasp Association.

[8] https://h5p.org

Graasp [9] does not require the intervention of any administrator to be used by educators and learners. Anyone can register and start creating, using, and sharing rich open educational resources. Users can invite peers or colleagues to their own personal online folders. These folders are analogous to folders on cloud storage services (e.g., Dropbox, Google Drive). However, in addition to files and subfolders, they can host external web pages (as iframes) and interactive web apps, as well as dedicated apps to display LA. As such, these folders can become instinctively a collection of resources or a rich open educational resource.

Any folder can then be easily be turned into an educational resource by sharing it, using its unique URL and, selecting a sharing scheme. Folders can be shared with two different user interfaces (another difference with traditional cloud storage platforms). The first interface is the **Builder** enabling (co)-creation and personalization. The second interface is the **Player** enabling presentations, interactions between users, and rich learning components. Each interface has a dedicated URL.

There are four sharing schemes for folders and educational resources, which are both referred to generically as *items* (Table III). The first scheme is **Private**, providing access only to registered users explicitly invited to the selected item. This setting also provides access to all sub-items and their embedded components (if any). When inviting a user to access an item, one of three different access rights can be selected:

1) *admin*, which enables editing the item(s), viewing the item(s) analytics, and inviting other users to access the item(s);
2) *write*, which enables editing the item(s);
3) and *read*, which enables access to the item(s).

The second sharing scheme is **Public**, providing access to anyone, even to people not registered on the platform.

The third sharing scheme is **Pseudonymized**, a unique feature enabling learners to actively use and populate a resource without disclosing personal information, while still being able to reconnect at any time and find their previous contributions and stateful resources.

The fourth scheme is **Published**, which makes the resources available on the open library integrated into the platform. When an item is published, categories and tags can be provided and exploited for search and recommendation. A Creative Commons license can also be selected.

TABLE III. Graasp Sharing Schemes

Private For creators and invited users only (with rights to *admin*, *write*, or *read*)	**Public** For anyone with the link to the item (folders or resources)
Published Makes the item (folders) visible on the public open library as a collection of resources (items or subfolders)	**Pseudonymized** Enables anyone with the link to access the item, providing a pseudonymous identifier is provided

[9] https://graasp.org

VI. Use Cases

Use cases based on the proposed techno-pedagogical model are provided in this section to show the broad range of blended and active learning scenarios that can be covered and implemented.

A. *Inquiry Learning Activity*

Let us consider a physics educator and another colleague interested in providing a one-hour session, also referred to as a blended learning activity, to their students in order to observe the absorption of various greenhouse and non-greenhouse gases in the Earth's atmosphere. The educator invites the colleague to a dedicated online folder called "Radiation Absorption" that will host all of the necessary components for this session and be turned into an open educational resource. This folder has been created from an inquiry learning template available publicly in the open library and copied with its subfolders into the home space of the educator.

The subfolders predefined as scaffolding for the creation of the resource correspond to the traditional inquiry learning phases, namely the *Orientation* phase to introduce the objectives of the activity, the *Conceptualization* phase to let students define their own hypotheses and plan their experiment, the *Investigation* phase offering an interactive experimentation tool to the students, and finally the *Conclusion* and *Discussion* phases to let them reflect on their findings individually or collaboratively. An additional subfolder called *Dashboard* is added to display selected learning analytics.

Introductory videos and documents are shared by the educator in the *Orientation* subfolder. An interactive app designed to let the learners write their own hypotheses is added to the *Conceptualization* subfolder. The educator found an interactive simulation to analyze the impact of greenhouse gases in the open library and added it to the *Investigation* subfolder. An app to let the students submit a short report on their findings is added in the *Conclusion* and *Discussion* subfolders in which the built-in chat is also activated.

Finally, a couple of LA apps are added in the last subfolder, which becomes a dashboard. Once ready and validated with the colleague, the *Pseudonymized* sharing scheme is selected and the URL of the *Player* interface is sent to the students (Fig. 1). Unlike LMSs, the platform provides access to students as long as the educator keeps the sharing scheme activated. Access is not limited to the validity of their institutional ID or the duration of an academic year.

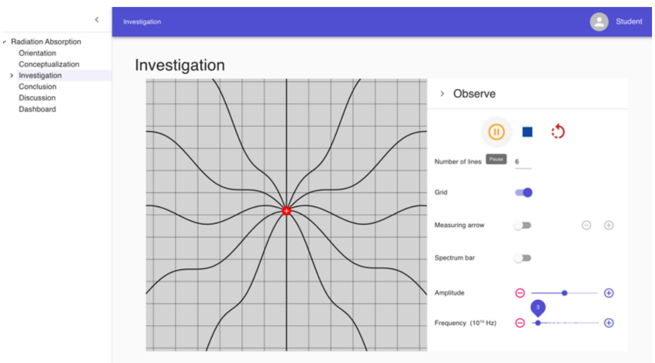

Fig. 1. *Player* interface of the inquiry learning activity on *Radiation Absorption* showing the various phases on the navigation tab (left).

After a few semesters of usage, the educator and the colleague feel comfortable enough to share their resource with the world. Hence, they make a copy and set its sharing scheme to *Published*. It is immediately available to everyone in the open library.

B. *Collaborative Design Thinking Activity*

In Section VI.A, the open educational resource created has content predefined by the educator. However, in active learning scenarios, it is also interesting to offer collaborative learning activities to students in which they can create and organize their own content individually or collaboratively.

In the framework of a class on social media taught at EPFL, students are required to carry out a collaborative design thinking activity [10]. To support this activity, the educators ask the students to create their own shared online folders to carry out the five sessions dedicated to design thinking. They use the design thinking template available on the open library (Fig. 2).

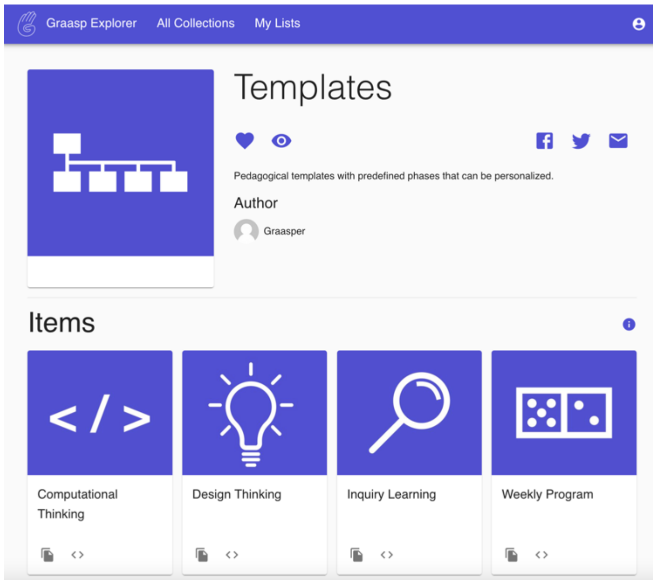

Fig. 2. List of pedagogical templates available on the digital library (explorer.graasp.org), including the *Design Thinking* template.

Subfolders corresponding to the typical design thinking phases are already available, namely *Empathize*, *Define*, *Ideate*, *Prototype*, and *Test*. These subfolders can be freely modified by the students (Fig. 3).

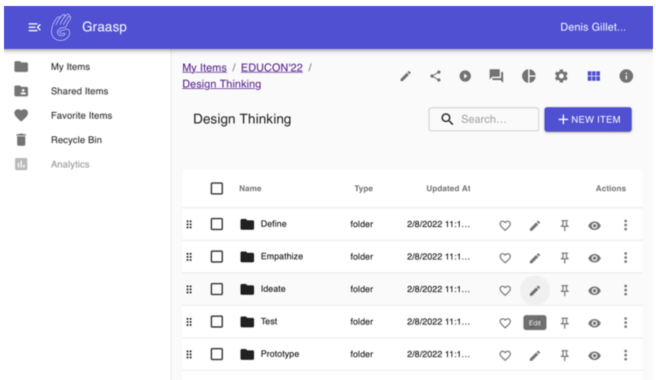

Fig. 3. Folder shared between teamates for carrying out their design thinking activity (*Builder* interface).

A collaborative app enabling teammates to fill a value proposition canvas (Fig. 4) is added by the students and used successively in face-to-face synchronous and online asynchronous sessions to reach a consensus within each team. For these interactive sessions, the *Builder* interface is used. Once finalized, this subfolder is shared privately and temporarily with the educator to get preliminary feedback. For the final presentation to peers, the team uses the *Player* interface to show only the final outputs of their project, without the need to create a slide deck.

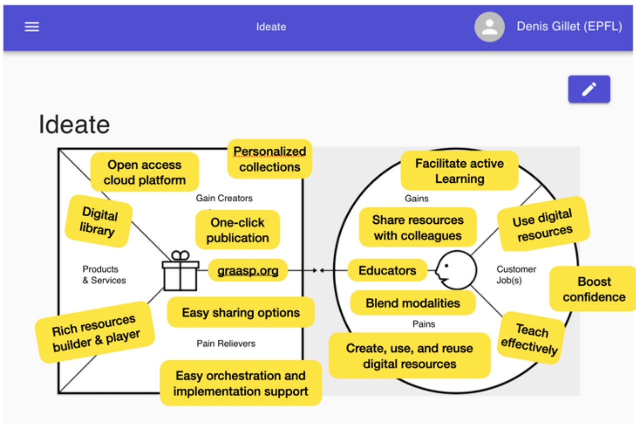

Fig. 4. Collaborative value proposition canvas app shown to an audience using the *Player* Interface.

C. MOOC Production and Publishing

The third use case deals with the creation and the publishing of a MOOC, still using the same unique digital education platform.

Three educators working together have decided to prepare a MOOC for a class they are teaching for bachelor students, each delivering part of the lectures [11]. After recording video capsules in the studio of their institution, they decided to create an open educational resource combining the multimedia content and summaries as thematic modules. The videos were openly published on YouTube and integrated as links into Graasp capsules.

Each year, various instances of the MOOC are created for the targeted student cohorts in two different universities (EPFL and University of Neuchâtel). For each instance, a different discussion app is used to debate in face-to-face sessions, following a flipped classroom approach. Having different instance enable to provide learning analytics relevant to the various cohorts of students.

VII. Conclusions

This paper first presents the current trends towards an effective digitalization of education and—with this perspective in mind—a typology of current and emerging digital education platforms. A quadriptych techno-pedagogical model is then proposed and discussed in details. This model follows the steps of the educators' digitalization journey and aims to enable the design and the development of novel digital education platforms to facilitate the future implementation of blended and active learning scenarios. The implementation of these pedagogical scenarios relies on educational resources developed by experts, teacher trainers, or educators and consumed by educators and learners.

The proposed model addresses the main challenges educational institutions are facing to achieve the necessary digitalization of education, i.e., strengthening the availability of:

- platforms enabling blended and active learning scenarios;
- open educational resources to support such scenarios;
- evidence, such as LA, showing the effectiveness of both blended and active learning scenarios, as well as digital resources.

The focus of the model is on the educators' journey toward the effective digitalization of education. Nevertheless, learners are following a parallel path requiring platforms with the same elements as the educators and the corresponding services. The proposed framework highlights the importance of accompanying educators in their digitalization journey with simple and comprehensive digital education platforms for orchestrating, producing, consuming, disseminating, and reflecting on learning activities and educational resources.

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