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Un compromiso social

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RESEARCH-BASED LEARNING ENHANCED BY TECHNOLOGY IN HIGHER EDUCATION: A COMPARATIVE ANALYSIS OF TOOLS

APRENDIZAJE BASADO EN LA INVESTIGACIÓN ENRIQUECIDO POR TECNOLOGÍA EN EDUCACIÓN SUPERIOR: UN ANÁLISIS COMPARATIVO DE HERRAMIENTAS

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Keywords

Research-based Learning, Higher Education, Tools Evaluation, ICT Tools, Technology-enhanced Learning Environments.

Palabras clave

Aprendizaje basado en la investigación, educación superior, evaluación de herramientas, herramientas TIC, entornos de aprendizaje enriquecidos por tecnología.

Línea temática

Innovación educativa, Escenarios con Tecnología.

Abstract

Research-based Learning (RBL) is an approach that is gaining attention as a didactic method in undergraduate studies in higher education, as a way of emphasizing students' active role and engagement in learning, and simultaneously, fostering the development of key skills. By implementing this didactic strategy, students are expected to assume the role of researchers, starting with the exploration of a topic and identification of a research problem until the presentation and reflection on the obtained results. Each of the phases of the RBL can be accompanied by the use of a variety of digital tools, since they address a range of purposes connected to the research processes. However, studies related to how different digital tools can be didactically used in RBL scenarios have not been found so far. Therefore, the aim of this study is to identify the didactic possibilities of digital tools to support RBL scenarios in higher education. The method is based on a tools evaluation and the development of functional

maps to offer an overview of the tools fit to the specific RBL phases. The first round of results includes the evaluation of 36 tools and their functional maps. Next phases will include other tools catalogues for evaluation and the publication of the evaluations and functional maps. Finally, the conclusions highlight the contribution of the study regarding the future design and development of blended learning scenarios in RBL approaches.

Resumen

El aprendizaje basado en la investigación (ABI) es un enfoque que está emergiendo como método didáctico en los estudios de grado en educación superior como una forma de poner énfasis en el rol activo de los estudiantes y su implicación en el aprendizaje, y al mismo tiempo, promover el desarrollo de destrezas clave. Al implementar esta estrategia didáctica, se espera que los estudiantes asuman el rol de investigadores, comenzando con la exploración de un tema y la identificación de un problema de investigación hasta la llegar a la presentación y reflexión sobre los resultados obtenidos. Cada una de las fases del ABI se puede apoyar a través del uso de una variedad de herramientas digitales, ya que cubren un abanico de propósitos conectados con los procesos de investigación. Sin embargo, no se han encontrado hasta ahora estudios sobre cómo pueden ser utilizadas didácticamente diferentes herramientas digitales en escenarios de ABI. Por ello, el objetivo de este estudio es identificar las posibilidades didácticas de las herramientas digitales para apoyar escenarios de ABI en educación superior. El método se basa en una evaluación de herramientas y el desarrollo de mapas funcionales para ofrecer una visión general de las herramientas apropiadas a las fases específicas del ABI. La primera ronda de resultados incluye la evaluación de 36 herramientas y sus mapas funcionales. Las siguientes fases incluirá otros catálogos de herramientas para evaluar y la publicación de las evaluaciones y los mapas funcionales. Finalmente, las conclusiones señalan la contribución del estudio en cuanto al futuro diseño y desarrollo de escenarios de aprendizaje mixtos con enfoque de ABI.

1. Introduction / Framework

Research-based Learning (RBL) in Higher Education, also known as (Undergraduate) Student Research or Inquiry-based Learning (IBL), is defined by Brew, (2013, p.2) as a student-focused way of bringing research and teaching together. A broader definition of RBL considers Research-based Education as a cluster of teaching and learning approaches (e.g., Project-based Learning, Problem-based Learning, Case-based Learning) in which students engage actively in inquiry or research activities (van der Rijst, 2017). These concepts fit well with the student-learning approach that the universities aim to put forward, which includes a shift from teaching to learning and the encouragement of students to become self-directed and engaged learners (Justice et al., 2007). In addition, RBL seeks to emphasize student engagement, participation and inquiry and, at the same time, aims at developing epistemological aspects (e.g., dealing with challenges) and ontological aspects (e.g., developing personal and professional capabilities) (Brew, 2013). The RBL approach is considered coherent with the pedagogy in any discipline, since it promotes the acquisition of skills and knowledge through

research activities (O'Mahony & Woodcock, 2017) Such activities include the construction of students' own knowledge based on practice, autonomous or collaborative work, and discovery learning, all of them skills that are desirable for lifelong learners and future professionals (Peñaherrera León, Chiluiza García, & Ortiz Colón, 2014).

Whereas different authors offer theoretical frameworks and models regarding the implementation of RBL, there is a lack in the literature regarding the role of technology for each of those phases in higher education and in relation to the didactic possibilities of digital tools for RBL for any field. Therefore, this study is addressed at dealing with that literature gap and follows the work started in the university teacher training offer of the University of Oldenburg (Germany) regarding RBL supported by digital tools (Marín & Schirmer, 2018), as further described in section 1.3.

1.1 The Phases of the RBL

According to the main phases of the synthesized IBL framework developed by Pedaste et al. (2015, p. 54) and the RBL phases by Sonntag, Rueß, Ebert, Friederici and Deicke (2016), the RBL is constituted by the following steps:

1. Orientation, which aims at stimulating curiosity about a topic and addressing a learning challenge through a problem statement.
2. Conceptualization, which considers the exploration of related literature and the generation of research questions and/or hypothesis.
3. Investigation. Here three subphases can be clearly differentiated: the selection of methods and the development of the research design (before conducting the research), the exploration to obtain data related to the research question or experimentation in order to test a hypothesis (conducting the research), and the data interpretation (during and after conducting the research).
4. Conclusion, which is the process of drawing conclusions from the data in relation to the hypotheses or research questions.
5. Discussion. Here two phases that are separated in the model by Sonntag et al. (2016) are deployed: the presentation and discussion of the results though a communication process, and the reflection on the results and the whole research process.

1.2 Digital Tools for RBL

The link between the research and technology has been claimed by some authors through the concept of augmented research or the research personal learning environment (PLE), which also connects to the development of self-regulated learning skills -basic ones for research activities. In this sense, different authors support the idea of the students' use of technology for self-regulated learning (Carneiro, Lefrere, Steffens & Underwood, 2011; Salinas, 2004, 2008), which is defined as the skill where students must know to set goals, what is needed to achieve

those goals, and how to actually attain these goals (Dabbagh & Kitsantas, 2012). Concretely, the concept of augmented research involves the enhancement of research with processes and tools that aim at a better knowledge management, based on the digitalization and public and open access of knowledge (González Calatayud & Román García, 2016; Peña-López, 2013). The same authors propose different tools for some of the research phases, though emphasizing the role of the postgraduate researcher and without the specific focus on the RBL.

RBL processes may be enhanced by Web 2.0 tools in a way that enables learners to be producers instead of merely consumers of content, while at the same time enhancing collaboration between them (Conole & Alevizou, 2010; Hilzensauer & Schaffert, 2008). Existing literature reviews of empirical research show evidence regarding the potential of Web 2.0 tools for educational use in higher education (e.g., Novak, Razzouk, & Johnson, 2012; Wang & Meiselwitz, 2015), though there is still a need for supporting teachers in design RBL scenarios with these tools and for scaffolding students in using these tools for their learning in RBL settings.

1.3 e-Didactics for RBL in the University of Oldenburg

The University of Oldenburg (Germany) has set as a goal to establish and promote RBL in all the faculties of the university through the innovation-teaching project "Research-Based Learning in Focus Plus" (FLiF+)[1]. Students should go through all the phases of a research during their undergraduate studies.

Within the project, the Department for Teaching in Higher Education of the University supports teaching staff in implementing research-based teaching and learning. The Department coordinates and organizes methodological workshops, offers individual and group support and helps establishing networks and guiding exchange among teaching staff.

One of areas is the e-Didactics[2], which supports teachers in the design and development of their RBL courses with digital media. Therefore, the e-Didactics area is focused on the support of active learning forms (self-regulated, constructivist and student-centered learning) by the use of digital tools. With the premise that students work often in groups and teachers have a guiding role in that process, activities like writing together and giving feedback, publishing results or the scaffolding of collective process can be supported using digital tools and, hence, considered by teachers within the learning design of their RBL courses. The offer of the e-Didactics team for teachers includes workshops on teaching in higher education with the use of digital tools in RBL (Marín & Schirmer, 2018), monthly exchange meetings on different topics regarding teaching and learning with digital tools, individual or group support for the

1. Education profil of the University (forschen@studium): https://uol.de/en/lehre/qualitaetspakt-lehre/forschenstudium/
2. The e-Didactics area in the Department for Teaching in Higher Education of the University: https://uol.de/en/lehre/qualitaetspakt-lehre/forschenstudium/designing-researched-based-teaching/

learning design in their course and some other information services, e.g. a Blog[3] addressed to the teachers with ideas on the didactic use of digital tools.

The main idea behind the e-Didactics area is to create a community of practice (CoP) (Wenger, 1998), consisting of a group of teachers –always growing- who share a concern or a passion for teaching though a mainstream use of technologies (domain) and learn how to do (practice) it better as they interact regularly (community).

2. Objectives and Research Questions

The main objective of this exploratory study is to identify didactically suitable digital tools for individual and group RBL scenarios in higher education.

The research questions are the following:

- Which digital tools are suitable for individual and group RBL scenarios in higher education?
- How didactically suitable are those tools for each of the RBL processes according to their main functionalities?

3. Method

The method used in this study is the comparative analysis of tools. In order to conduct this analysis, two matrix tables with different criteria were designed. First of all, the phases and subphases of the RBL process according to the combined phases from Pedaste et al. (2015) and Sonntag et al. (2016) and the possibility to work individually and/or in-group with that tool were part of a first matrix table.

On the other hand, the technical characteristics were also regarded in a second matrix table, insofar as they influence their didactic use in higher education settings and enable teachers and instructional designers to prepare instructions to work with the tools towards the RBL-related objectives. Concretely, issues such as, e.g., tool category, the compatible platform (Web/ Desktop/ Mobile/ Cross-platform), the availability of the tool in different languages, the existence or non-existence of a cost for the software, the type of the license for the tool, the possibilities of connecting with other tools, or the type of data that the tool uses, were examined. These criteria are integrated in the search filter or classification that other recognized tools databases and catalogues use, e.g., the DiRT Directory for digital research tools (http://dirtdirectory.org), the Directory of Learning & Performance Tools (DLPT) (http://c4lpt.co.uk/directory-of-learning-performance-tools/) or Edshelf (https://edshelf.com/search/).

The initial selection of tools for their evaluation in a first round was based on the proposal of different tool categories for RBL group tools that was presented in Marín and Schirmer

3. The eDidactics Blog (English version): http://wp.uni-oldenburg.de/edidactics/en/

(2018), which at the same time took into account catalogues as the previously mentioned. In order to evaluate the functions of the tools according to the phases of the RBL process, functional maps were developed (as in Salinas, de Benito, Marín, Moreno, & Morales, 2010). Next evaluation rounds will include other major tools catalogues like DiRT, DLPT and Edshelf.

4. Results

The first round of evaluation was focused on the small selection of tools showed in Figure 1, except the institutional tools that were part of the core of the Learning Management System (LMS) of the University (Stud.IP) or only allow institutional access, which groups 36 Web 2.0 tools (all the tools with white background and Wordpress from the ones with gray background).

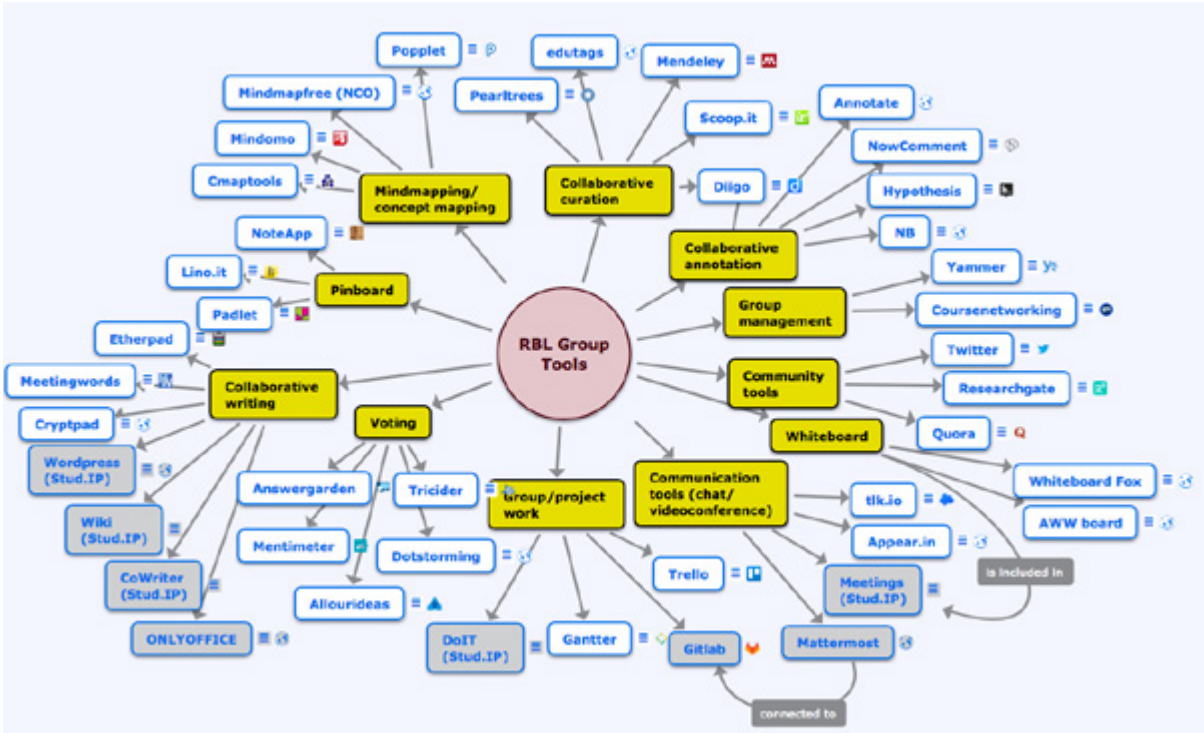

FIGURE 1. RBL TOOLS EVALUATED IN THE FIRST ROUND. SOURCE[4]: HTTPS://BIT.LY/2SUE5WS

4.1. Evaluation of the Suitability for the RBL Phases and Functional Maps

Since this first selection of tools was already proposed as group RBL tools, here we do not focused on their suitability to work in-group. However, we can mention that tools that are meant for communication, group management in private groups or voting do not have their meaning in individual work.

4. In the interactive map, users can navigate through the official links of the tools and click on the notes to read some general characteristics.

The categories of tools analysed were the following: pinboard tools, mindmapping/ concept mapping tools, collaborative curation tools, collaboration annotation tools, collaborative writing tools, group management tools, community tools, whiteboard tools, communication tools, group/project work tools and voting tools. Functional maps for one tool of some of the previous categories are presented in the following figures, along with their brief description for didactic purposes regarding RBL:

- Online pinboard tools (e.g. Linoit):

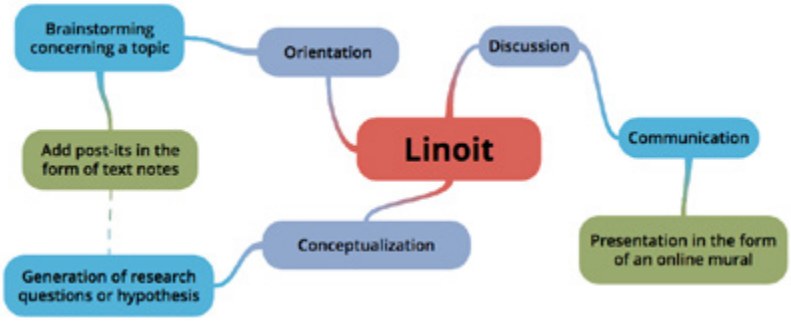

Figure 2. Functional map of Linoit (Online pinboard tool).

The functions of the online pinboard tool Linoit (Figure 2) are connected to different phases and subphases of the RBL, though it is especially useful in the first phases: in the orientation phase, by exploring and stimulating curiosity about a topic via brainstorming, and the conceptualization phase, in which different ideas for research questions or hypothesis could be generated, in both phases in the form of text notes or post-its. Linoit could be also considered for the phase of discussion, especially regarding the process of communication, by designing an online mural that includes notes with different web elements (video, images, audio, documents, links, etc.).

- Mindmapping/concept mapping tools (e.g. Cmap):

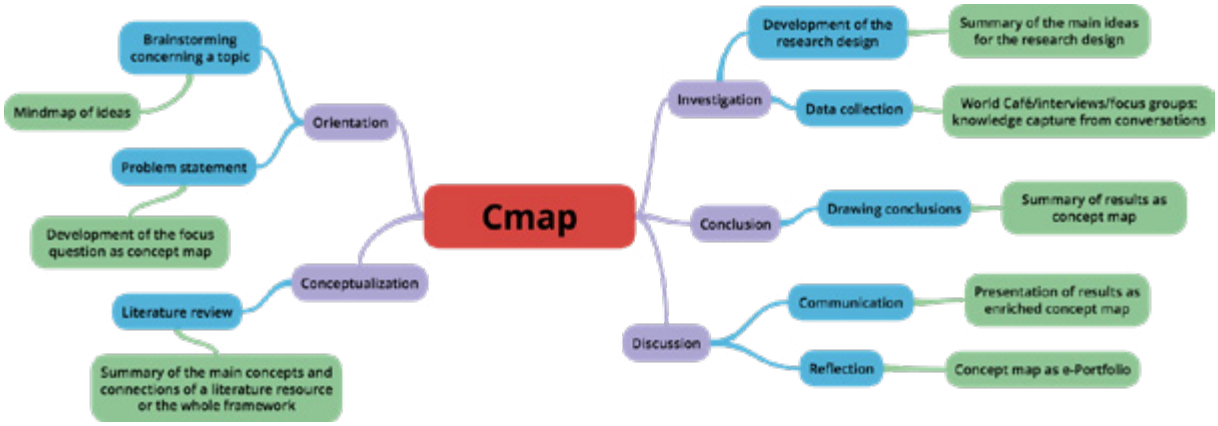

Figure 3. Functional map of Cmap (Mindmapping/concept mapping tool).

The concept mapping tool Cmap (Figure 3) is quite multifaceted and may be used in many of the phases and subphases of the RBL. In the orientation phase, Cmap can be utilised as a mindmap for brainstorming around a topic of interest but also to support the development of a focus question as a concept map in the subphase of problem statement. During the conceptualization phase, Cmap could be useful in the literature review for summarising the main concepts and connections that concern the problem to be investigated, either of specific literature resources or of the whole framework. In the phase of investigation, Cmap may be helpful to highlight the main ideas and procedures regarding the research design that is being developed, but also as instrument for data collection, especially when using qualitative methods such as interviews, focus groups or World Café sessions (Trujillo, 2012), in which knowledge can be represented derived from the conversations (De Benito, Lizana, & Salinas, 2017). As in the previous case, Cmap could be used to summarise the results and conclusions and present them in form of enriched concept maps (navigable, with attachments, links, etc.). Another possibility could be Cmap as a reflection tool in the form of e-Portfolio.

- Collaborative curation tools (e.g. Pearltrees):

Figure 4. Functional map of Pearltrees (Collaborative curation tool).

This kind of tools is basically oriented at collecting links, documents, files, etc. that could be helpful for the research. In this sense, Pearltrees (Figure 4) could be mostly used in the conceptualization phase in order to collect links and documents and add notes as summaries or highlights within them as part of the literature review of a research. It could be considered as well in the phase of investigation to collect data, by supporting the storage and documentation of the research including notes, images, documents, etc. in collections.

- Collaborative annotation tools (e.g. Nowcomment):

FIGURE 5. FUNCTIONAL MAP OF NOWCOMMENT (COLLABORATIVE ANNOTATION TOOL).

As in the previous case, collaborative annotation tools are especially addressed to the phase of conceptualization, though other phases could be also considered. Nowcomment (Figure 5) can be used for doing the literature review by discussing and adding notes in different parts of the files related to the framework, but also this discussion through questions related to the literature review could lead to the generation of the own research questions or the formulation of hypotheses. Concerning the investigation phase, Nowcomment could be utilised for data interpretation, by working with the files related to the research (e.g. transcriptions of interviews) through coding and creating memos. The conclusion phase could also benefit from Nowcomment by drawing conclusions from the data interpretation with notes.

- Collaborative writing tools (e.g. Wordpress):

FIGURE 6. FUNCTIONAL MAP OF WORDPRESS (COLLABORATIVE WRITING TOOL).

As Cmap, Wordpress (Figure 6) is a multifaceted tool that could be employed in different RBL phases, even considering just the core elements of the system. To start with, in the orientation phase, Wordpress blogs could be used both for brainstorming and the problem statement by writing blog posts over time to annotate and describe ideas. In the phase of investigation, pages and blog posts could be used to describe how the research design is going to be developed and to incorporate the documentation that concerns the study as data storage. As in previous phases, Wordpress could be also used to drawing conclusions by describing them in blog posts or pages, eventually also with comments. Finally, the discussion phase could be covered by Wordpress as communication means by presenting research in a well-structured and desig-

ned blog, and also as reflection means by the use of blogs as e-Portfolio with reflections of the study over time in the form of blog posts.

4.2. Evaluation of the Technical Characteristics

Here an overview to the findings of the evaluation of the second matrix is presented:

- All the digital tools are free, but some of them offer more possibilities if paying for a licence or a subscription (freemium model).
- All of them have a web version, some of the tools have additionally a smartphone application and only a few have also a desktop cross-platform version.
- License of the Web 2.0 tools is diverse. There is a broad range of formats, from open source tools to propietary software. Some of them do not have any distinguishable license.
- The main and only language for most of the tools is English. Some of them are multilingual.
- Many offer possibilities of connection with other tools, by giving the chance to register to the application using others, including contents from the other applications to be usable or sharing information from one tool to another.
- Most of the tools give the possibility to export the data created with them in different formats, depending on the type of data that is generated. Few of them do not offer any form of data export.

5. Conclusions

This study represents a first step towards assisting university teachers in developing didactic strategies that combine the RBL approach and the use of digital tools, in order to foster the students' development of a variety of 21st skills, which include the resolution of problems, dealing with complex situations and the abilities concerning digital competence.

Derived from this first analysis, some didactic possibilities for RBL have emerged. From the functional maps, suitable support for different individual and group RBL phases in Web 2.0 tools has been identified, though only the evaluation in real learning scenarios would enable us to enhance those maps, considering more possibilities or making amendments in the functions already described. Teachers and students may decide upon the tools, according to the required RBL functions in each case. The technical characteristics of tools may be considered as the second step in that decision. Here aspects regarding data privacy, institutional availability of software licenses and/or possibility for the institution to host open source, software availability in the own language, the possibility of exporting data in a format compatible with other tools in the institution or the connection with other available tools could play a relevant role.

5.1. Future Work

Future work includes the further development of the RBL tools catalogue and functional maps, and especially, the description, development, implementation and evaluation of blended learning scenarios in higher education in which digital tools to support RBL are included, in a form that they could be openly reusable.

Teachers will then be invited to give their opinion on the scenarios, put them into practice and inform on their empirical experience in class. Students would also be involved in evaluating the scenarios through their courses.

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