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# Comparative analysis of frequently used e-learning platforms

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An online e-learning platform known as a learning management system (LMS) provides an interface between trainers, students, and administrators toward a common objective of learning. In the market, diverse LMSs with extensive functionalities are available to facilitate e-learning. In this article, we selected some popular LMSs majorly used by most schools and institutions for their teaching–learning process. We compared these LMSs in a discussion based on their technical specifications, technical features, administrative features, general features, and course management-related features. This comparative analysis could help users decide which LMS suits them best, according to their requirements. We also attempted to identify the limitations of these learning management systems so that users and organizations can determine which one is best suited to their needs.

## KEYWORDS

e-learning, online platform, LMS, specifications, features

## 1 Introduction

E-learning or virtual learning is accomplished through the means of computers/laptops connected to the Internet. The instructor in this mode of learning sits remotely and connects with learners through an online platform. It is a new form of learning that overcomes the limitations of geographical distance. A traditional or conventional learning methods require a teacher to take the class face-to-face with students in a closed classroom environment. Authors of a previous study (Oblinger and Hawkins, 2005) defined e-learning as the use of technology to deliver a complete course or part of it independently without the limitations of time and place. In addition, in 2001, the European Commission defined e-learning as the integration of the Internet and multimedia technologies to create easily accessible learning facilities. Any method of learning conducted through electronic means or digital technologies is called e-learning (Chawla et al., 2024). Keller et al. in 2002 refined the above definition by stating that learning that is web-based or Internet-enabled is termed e-learning (LaRose et al., 1998; Liaw and Huang, 2003). Liu and Wang (2009) defined e-learning on the basis of its characteristics. According to the authors, e-learning is a multimedia environment that incorporates several kinds of information collaboratively and the hardware only needs a network for the Internet, as it is independent of an operating system (OS). In Gotschall (2000), Liu and Wang reviewed the definition of e-learning through its features. Distance learning, sometimes used as a synonym for e-learning, is the transmission of lectures either through videos or live sessions (Ally, 2004). Different terminologies have been used by various authors to define e-learning (Ajayi, 2008; Ouadoud et al., 2016).

The various components of e-learning are teachers, participants, platform, course design, and the Internet for connectivity. Hence, e-learning can be considered the latest form of distance

learning enabled by the Internet and the World Wide Web. Apart from being an online training or a computer-based training model, it has been proven to be an exceptional medium for the dissemination of knowledge and provides performance support through electronic means. The essential characteristic that makes e-learning more appealing and expedient when compared with conventional distance learning paradigms is the interactive feature, which dispels all prevailing myths surrounding these educational models. E-learning programs, although virtual, still hold the potential to ignite interest by offering interactive features such as online conferences, group communications, and discussion chat platforms.

## 1.1 Online platform

An online and e-learning platform is a type of software that assists an instructor in communicating with students during the online lectures of their courses. The e-learning platform uses a computing device that collaborates with numerous other tools to meet educational objectives (Dimet, 2006). Figure 1 shows the current model of an e-learning platform used nowadays. In this model, a particular course is delivered using an online platform as an interface between the teacher and the students. In the last few decades, e-learning platforms have changed a lot. Many authors have compared different online platforms in Menasri (2004); Dogbe-Semanou et al. (2007), and Rana et al. (2014), but these comparisons are no longer relevant as the platforms have evolved a lot with time. Detailed study conducted, results in listing down different features that must be part of an ideal e-learning platform, as shown in Figure 2. The main features that an online platform must include are as follows: a user-friendly environment, provision of both synchronous (live sessions) and asynchronous (uploading all resources so that students can learn at their own pace) modes of learning, customizability, facilities for assessments, and the capability for generating and analyzing results. All study materials are uploaded to the cloud using the Internet; hence, learners can access the uploaded data anytime and anywhere throughout the world (Reyes et al., 2007; Islam et al., 2015).

## 2 Methodology

The authors used the methodology shown in Figure 3. The methodology was divided into four major steps: research design, data sources, data analysis, and finally, data triangulation. First, the research objective was to compare the features of various e-learning platforms, and then, the decision regarding the quantitative and qualitative methods was made. Data for the analysis were collected from various reports, case studies, technical documentation of platforms available on the official websites, and an extensive literature review. After collecting the data, a quantitative data analysis was carried out, and the combined findings are tabulated in Tables 1 and 2.

## 3 Comparison of online platforms

Currently, a wide variety of online platforms are available in the market. Table 1 shows the most widely used online platforms mentioned by some authors (Kaware, 2015; Quadoud and Eddine,

2016; Cavus and Zabadi, 2014; Saeed, 2013; Pappas, 2015). E-learning platforms have now become a necessity in both secondary and higher education due to their various advantages, such as accessibility at anytime and anywhere, flexibility, and personalized learning experiences. These platforms, such as Moodle and Blackboard, can support a hybrid mode and increase student motivation (Schaffhauser, 2011). Other platforms, such as Coursera, Udemy, and Khan Academy, offer different features for self-paced learning and different pricing models to cater to diverse learning needs (Kurteva et al., 2023). When comparing e-learning platforms, factors such as navigability, scalability, applicability, accessibility, security, privacy, instructional structure, and interactivity are crucial (Ahmad and Härdle, 2008). As e-learning continues to grow, it is essential to assess its effectiveness in improving the quality of education and the self-study abilities of students. We chose only six platforms as they are preferred and widely used by the majority of universities (Schaffhauser, 2011). The various e-learning platforms were selected based on their technical specifications, popularity among educational institutions, and the availability of key features relevant to online learning. This analysis included a review of both open-source and proprietary platforms, considering factors such as user interface, accessibility, and administrative tools. The data collection is tabulated in Tables 1 and 2 for this research, which was carried out through a detailed comparison and evaluation of various e-learning platforms. Specific attention was given to the features that support synchronous and asynchronous learning, as well as to assessment and reporting tools. The data were collected from multiple sources, including previous comparative studies and technical documentation records of the platforms.

The overview of the information provided in Tables 1 and 2 is as follows:

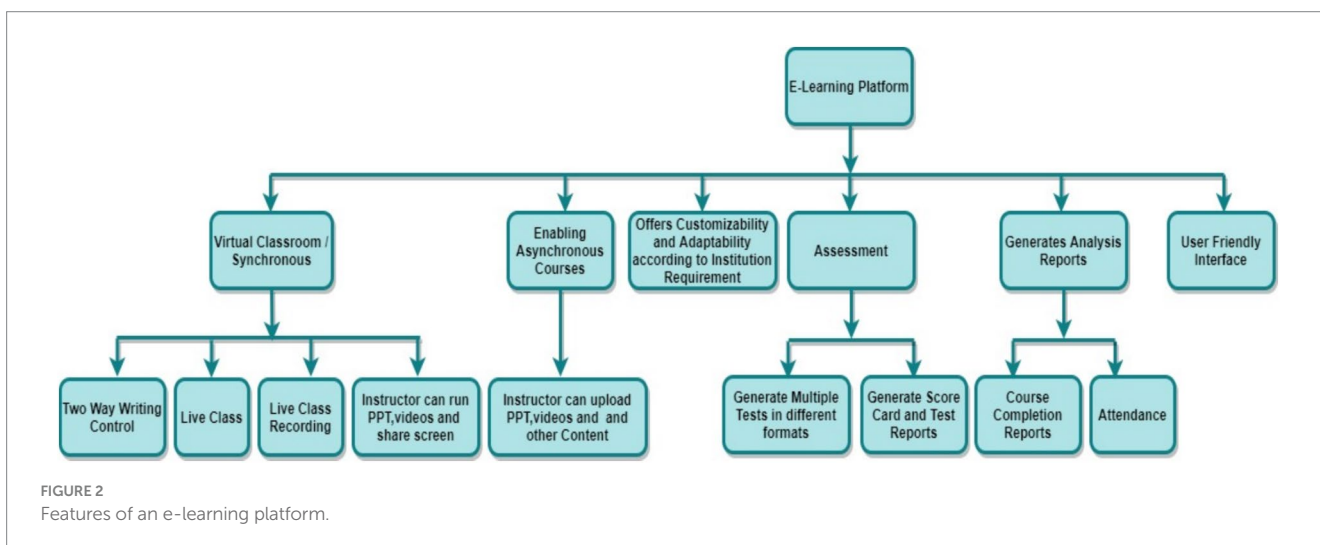
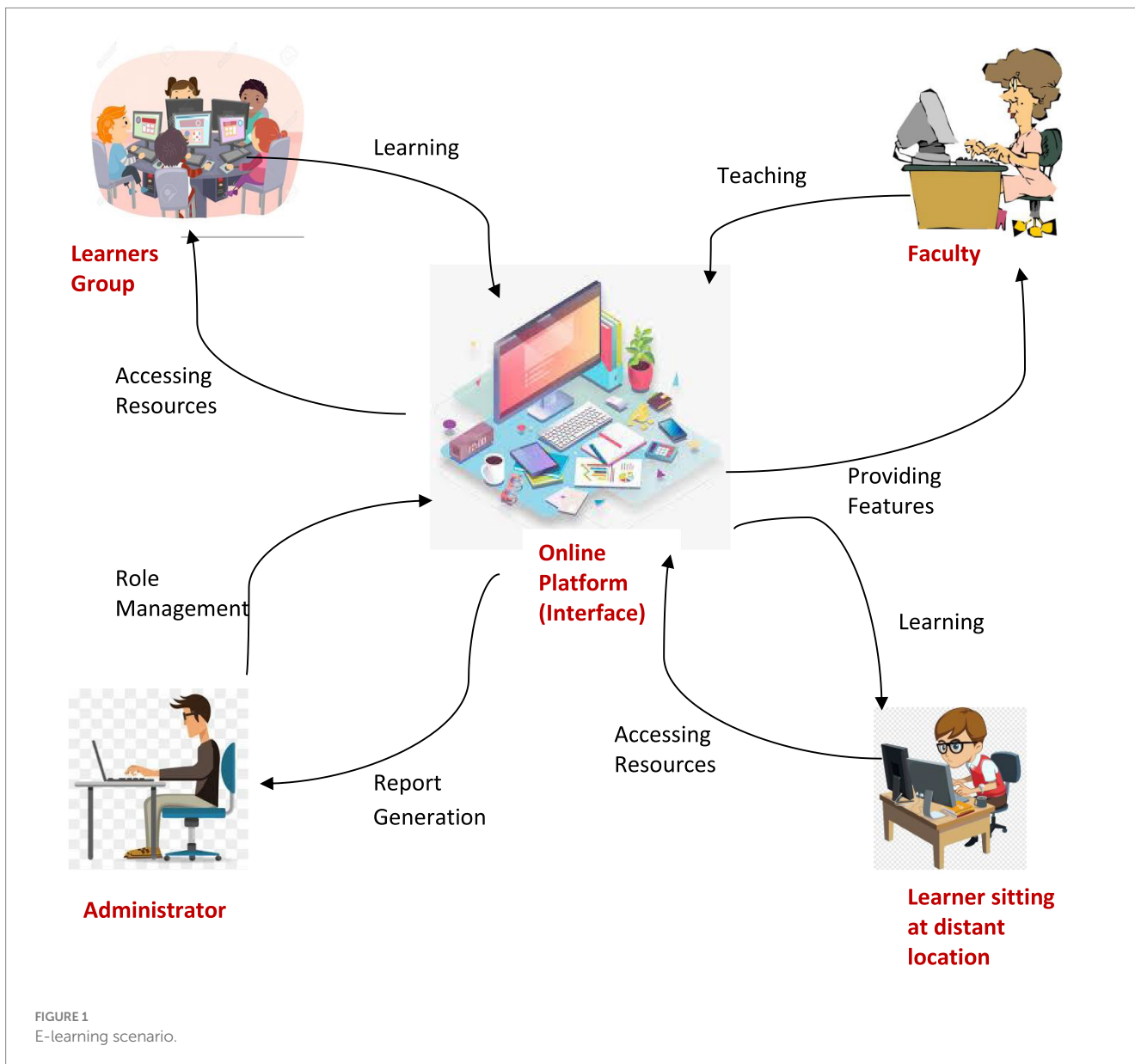
General features:

- Ease of Setup: all platforms in the discussion are easy to set up, with simple installation and customization options.
- Tracking Student Progress: all platforms have robust tracking tools for monitoring progress. However, only Sakai and ILIAS have limitations or lack tracking tools.
- Content and Collaboration Tools: almost all platforms mentioned in the discussion section provide content uploading options and collaboration with Wiki-like tools.

Administrative features:

- Customization: Blackboard and Moodle offer extensive customization to meet the specific needs of institutions. Sakai, while flexible, has fewer customization features compared to others, and ILIAS does not have any customization.
- Multi-language Support: Moodle leads with 73 language options, while other platforms also support a broad range of languages, offering global accessibility. ILIAS provides the least support, with only eight languages.
- Role Management and Reporting: All platforms offer role management, allowing institutions to assign roles such as student, instructor, and admin.

Course Management (Content and Group Management): All platforms facilitate the easy upload of course materials and



management of groups. However, only ILIAS has limitations in course authoring and advanced group collaboration.

- **Communication and Assessment Tools:** Blackboard and Moodle offer advanced communication tools (forums and chats) and extensive assessment features such as quizzes and online exams. In contrast, ILIAS and Sakai have basic or limited tools.
- **Privacy and security**
- Blackboard has limited security features, which is its only drawback. Other platforms offer strong security features, including privacy controls and data protection, which make them a reliable tool for institutions handling sensitive information.
- **Cloud integration and plugin management:**
- Many platforms integrate cloud storage (Google Drive and OneDrive) and allow flexible plugin management.

The incident that happened in spring 2020 during the coronavirus pandemic deserves special attention. The Fairfax County Public Schools, a renowned school division and the largest chain of schools in the United States, with an enrollment of 189,000

students, were using Blackboard. The students faced challenges such as hacking of live instructions due to security issues and slow connectivity, which made it difficult for them to connect to the system (Natanson, 2020). Based on the discussion in Tables 1 and 2, it is clear that almost all e-learning platforms comprised of all general features, except for Sakai, which lacks the feature of tracking student progression on the e-learning platform. Administrative features such as the customization of a tool according to customer requirements, course, content, and the role of user management are present in all platforms. Sakai lacks the feature of customization, which leads to difficulty in the operational flow of institutes. The most important feature of any learning management system (LMS) is related to its course delivery features. Communication tools in the form of chat windows, forums, and online assessment tools, along with rubric creation, privacy, and security, are the most important features of an LMS. In addition, Sakai lacks online assessment tools and rubric creation. ATutor and Caroline have online assessment tools, but they lack rubric creation. Based on the different features discussed, one could easily determine which LMS is preferable according to institutional requirements.

### 4 Conclusion

The use of e-learning platforms in educational approaches, especially in the era of the coronavirus pandemic, has increased significantly. Although we understand that there is no replacement for classroom teaching, e-learning platforms have become indispensable. In this context, an experiment is required to validate what has been summarized in this article. The experiment should incorporate the findings of a well-detailed comparative and evaluative study of the analyzed platforms and many other platforms. This will help us present our findings in the form of a recommendation system for e-learning platforms, which we envision to implement to assist in choosing the best-suited e-learning platform according to institutional objectives and specifications. This article emphasizes the importance of selecting the right Learning Management System (LMS) according to institutional requirements, especially in the context of increased e-learning adoption post-pandemic. In addition,

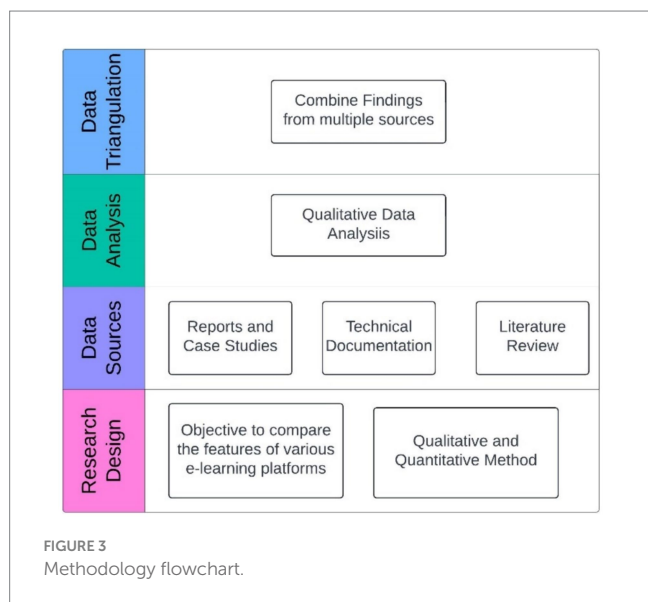


FIGURE 3 Methodology flowchart.

TABLE 1 Technical specifications of the online platforms in the discussion.

Platform name	License	Link	Operating system	Applications server	Database	Web server	Programming language
Blackboard	Not open-source	<a href="https://blackboard.com">Blackboard.com</a>	Any	TOMCAT	SQL Server	Apache	Java
Moodle	Open-source	<a href="https://www.moodle.org">www.moodle.org</a>	Any	PHP 4.3.3 +	MYSQL, Oracle, Postgres	Any	PHP 4.3+
ATutor	Open-source	<a href="https://atutor.github.io">https://atutor.github.io</a>	Linux, Mac	PHP 4.3.0+	MYSQL 0.2+	Apache	PHP 4+
Claroline	Open-source	<a href="http://www.claroline.net">http://www.claroline.net</a>	Linux	Apache	MYSQL	Apache.ES	PHP
Sakai	Open-source	<a href="https://www.sakailms.org/">https://www.sakailms.org/</a>	Unix, Windows	TOMCAT	MYSQL, Oracle	Apache	Java
ILIAS	Open-source	<a href="http://www.ilias.de/">http://www.ilias.de/</a>	Linux, Unix, Solaris	Apache	MYSQL 4.1.x	Apache	PHP 4.4+

TABLE 2 Comparison of the technical features of the online platforms in the discussion.

Evolution of the platforms						
	Blackboard	Moodle	ATutor	Claroline	Sakai	ILIAS
References	Schaffhauser (2011), Harlin (2010), Blackboard Inc (2011), Blackboard (2011), Natanson (2020), Wicentowski, (2020), Mohd Kasim and Khalid (2016)	Dougiamas and Taylor (2020), Costello (2013), Krassa (2013), Horvat et al. (2015), Gavin and Porter (2013), Mohd Kasim and Khalid (2016), Kaupp et al. (2013)	GitHub, Inc (2020), Mohd Kasim and Khalid (2016), Korcuska and Berg (2009), Dutta et al. (2023)	Lebrun et al. (2009), FAO (2011), Korcuska and Berg (2009)	Berg and Dolphin (2011), Severance (2013), Martinez et al. (2011), Kunkel (2011)	Korcuska and Berg (2009), ILIAS (1998), Kurteva et al. (2023)
Establishment year	1997	2002	2002	2000	2005	1997
Version	V 9.1 (April, 2010)	V 3.9 (May, 2020)	V 2.2.4 (June, 2018)	V 1.11.10 (February, 2014)	V 20.0 (May, 2020)	V 5.4.2 (May, 2019)
Designer	Blackboard Inc.	Moodle HQ	Inclusive Design Research Centre, OCAD University, ATutorSpaces	UCLouvain/IPM, ECAM	Mellon Foundation	ILIAS open-source e-learning
Pedagogical model	Constructivist	Social constructivist	Traditional pedagogy	Social constructivist	Constructivist	Traditional pedagogy
Countries using the platform	US, Asia, Australia, and Europe	UK, Australia, US, and Europe	US, Canada, Australia, Europe, and many more	India, Canada, Spain, Belgium, and other 100 countries	US, Canada, Australia, Africa, Asia, and Europe	Germany, France, and Europe
<b>General features</b>						
Ease of setup	Yes	Yes	Yes	Yes	Yes	Yes
Calendar	Yes	Yes	Yes	Yes	Yes	Yes
Announcements	Create and view announcements within individual courses	Yes	Yes.	Post notifications through mail	Schedule information for students	Yes
Tracking progress of students	Yes	Yes	Yes. “My Tracker”	Yes	Yes. “Statistics”	No
Collaborative tools	Yes. “Wiki”	Yes	Yes. “EWiki”	Yes	Yes	Yes
Content management	Yes. Can upload and share resources	Yes. Can upload files to a course	Yes. Can upload files in most available formats	Yes	Yes	Yes
<b>Administrative features</b>						
Customization facility	Yes. Can be customized according to institutions	Yes. Easily customizable	Yes	Yes	Yes	No
Multi-language support	Languages such as English, German, Korean, Chinese, and many more are supported. It supports approximately 30 languages	A total of 73 language translations are available as plugin packs only	More than 25 language packs	Available in 35 languages	Available in 19 languages (ar, ca, de, en, es, eu, fr, it, ja, ko, mn, nl, pl., pt., ru, sv, tr, vi, and zh)	Available in only 8 languages
Role management	Yes	Yes	Yes	Yes	Yes	Yes
Course management	Yes	Yes	Yes. Administrators can create, manage, and delete courses.	Yes	Yes	Yes
Content management	Yes. Can post assignments and videos	Yes. Can upload documents	Yes	Yes	Yes. Post, store, and organize resources and assignments	Yes

(Continued)

TABLE 2 (Continued)

Evolution of the platforms						
	Blackboard	Moodle	ATutor	Claroline	Sakai	ILIAS
Group setup and management	Yes	Yes	Yes	Yes	Yes	Yes
Course authoring	Yes	Sharing courses among groups and aiding teamwork	Yes	Yes	Yes	Limited
Authentication	Yes. Login credentials for students and faculty	Users can be added and enrolled to the platform, and more than 50 enrollment and authentication options are provided	Yes	Yes. Manual login	Yes. Easy and quick permission access	Yes
Reporting tools	Yes	Yes. View and generate reports on activity	Yes	Yes	Yes	No
Plugin management	Yes	Admin can install and disable platform plugins.	Yes	Yes. Plugins available	Yes	Yes. All plugins are available
Attendance tracking	Yes	No	No	Yes	Yes	No
cloud storage integration	Yes	Yes	Yes	Yes. SaaS	Yes. OneDrive and Google Drive are integrated	Yes. SaaS
Course management						
Communication tools	Yes. Chats, discussion forums, notifications, and mail options	Yes. Discussion forums, journals, databases, lessons, chats, glossaries, Wiki, workshops, and choice polls	Yes	Yes. Forums, chats, and internal messaging	Yes. Blogs, mail, notifications, forums, messages, and Wiki	Yes. Forums, discussions, blogs, glossaries, and Wiki.
Online assessment tools	Yes. Online quizzes and exams	Yes.	Yes	Yes. Limited	Yes. Create and deliver formative and summative evaluations	No
Privacy and security	Yes. Limited security features	Yes. Private space is provided to share the material.	Yes. Private class	Yes	Yes. Privacy and security are enabled	Yes. Privacy and data protection
Outcomes and rubrics	Create rubrics within courses or at the system level	Yes. Rubric creation flexibility and mapping with outcomes are available.	No	No	Create, manage, and share rubrics	No

Ar, Arabic; ca, Catalan; es, Chinese (including localized versions for the People’s Republic of China and Taiwan); eu, German; de, Dutch; En, English (including Australia, Great Britain, United States, New Zealand); fr, French (including localized versions for Canada, France); nl, Indonesian; it, Italian; ja, Japanese; ko, Korean; mn, Mongolian; pl, Polish; pt, Portuguese (including localized versions for Brazil, Portugal); ru, Russian; zh, Spanish (including localized versions for Spain, Mexico); sv, Swedish; tr, Turkish; vi, Vietnamese.

this article proposes further experiments for developing a recommendation system that simplifies the selection process according to institutional needs.

### Author contributions

SJ: Writing – original draft, Writing – review & editing. CP: Conceptualization, Writing – original draft, Writing – review & editing. DN: Formal analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. SB: Writing – review & editing.

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