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Analysis of the Functionalities of Open-Source Social Media for Academic Use

Mauricio Mejía-Lobo
Universidad Internacional de la Rioja, Spain, *mauricio.mejia975@comunidadunir.net*

Raquel Gil-Fernández
Universidad Internacional de la Rioja, Spain, *raquel.gilfernandez@unir.net*

Diego Calderón-Garrido
Serra Húnter Fellow, Universitat de Barcelona, Spain, *dcalderon@ub.edu*

Social media spaces nowadays have millions of users around the world and have become essential tools for analysis at different levels and in different fields, including education. With several open-source options for a social media platform, it is difficult to choose one for an academic environment. Therefore, this study was conducted to analyse open-source social media of an educational nature, making a comparison of some functionalities. For this purpose, a broad search for open-source social networks for academic purposes was conducted, using selection criteria. Subsequently, a mixed methodological approach with an explanatory scope was used in an analysis of the 10 selected open-source social networks, in which 25 functionalities were analysed. The functionalities were those that generated the most interest and knowledge in the academic community. The functionalities were established as variables and grouped into six categories to facilitate the comparison of the social networks, which is an additional result for this study. Finally, considering the results of the comparison of the different functionalities, the network that was found to be the most advisable was HumHub.

Keywords: social media, learning, higher education, academic social network, open-source software

INTRODUCTION

Social networks are defined as a variety of networked tools or technologies that emphasise social aspects of the internet, acting as a channel for communication, collaboration, and creative expression. Social media platforms support group interaction to establish communities and create and exchange content, such as Facebook, Instagram, and X (former Twitter), and the massification of these platforms has prompted a growing interest in research on how social networks are used by university students and professors (Rebhi et al., 2022; Arnal-Palacián, 2023; Carpenter et al., 2020; Acun, 2020).

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The strong interest in the use of new technology for learning is one of the greatest challenges facing professors in higher education (Wang & Han, 2021; Iredale et al. 2020). Although generic social networks could be used for educational purposes, there have been several projects in recent years to create specialised social networks for education (Meza-Cano et al., 2022; Nini, 2015; Bassole et al., 2021).

This leaps to the concept of Educational or Academic Social Networks, that are defined as private community networks in which the members give each other support, communicate, and exchange educational information, ideas, and points of view, where members can harness ubiquity to expand their circle of knowledge (Ganjoo et al., 2021; Gil-Fernández et al., 2023; Hussain et al., 2018; Kolmykova et al., 2018). In this way, networks designed specifically for educational purposes are ideal for developing the professional or academic curriculum, as demonstrated by Cozma and Dimitrova (2020). Regarding the learning of university students, Gewerk et al., 2014 and Rodríguez-Groba et al. (2014) evidenced the effectiveness of ELGG in favouring self-regulated learning. Durak (2017), referring to EDMODO, considered that being a network designed exclusively for educational use, it eliminated any type of distraction. Trust (2017), alluding to the same network, showed that the academic network itself boosted motivation and improved innovative practices.

The creation and use of educational social networks can help educators better understand new means of communication and how students exchange information, because the way in which they use these networks can affect their perception of the education they receive and their sense of community within the institution in which they study. These experiences may directly influence the likelihood of students persisting in their education by achieving better outcomes and accomplishing professional goals.

However, despite the interest in using social networks in education, the academic community still faces the problem of choosing a suitable tool or platform that has the main features of a social network, allows the integration of different content for professors and students, and is also easy to manage and affordable for institutions (Akçayır, 2017; Bassole et al., 2021; Calderón-Garrido & Gil-Fernández,2023; Gil-Fernández & Calderón-Garrido, 2022; Krutka & Carpenter, 2016; Martínez-Gil et al, 2023).

Due to the panorama described above, it is appropriate to conduct the present research, the purpose of which is to analyse existing open-source social media and discern the functionalities they offer the community, specifically in terms of educational work, with a view to identifying the best option. For this reason, the objectives set out herein are:

GO- To analyse the existing open-source social networks.

- SO1- To determine the functionalities they offer to the educational community.
- SO2- To identify the best option that offers the most popular functionalities in the academic community that spark the greatest interest and are best accepted by students.

Context and Review of Literature

Social media use in education

Considering education mediated by social networks, it is important to bear in mind that students' "learning is located in contexts and relationships rather than merely in the minds of individuals" (Greenhow et al., 2009, p. 248). From the social ecological perspective, learning encompasses the notion of a reciprocal relationship between the student and the learning environment, in which the intrapersonal setting is moulded at the same time as the self is transformed (Greenhow et al., 2009). It is also worth mentioning the social constructivist theory, which is consistent with the idea that "information technologies and communications prompt a significant change in the methodological and didactic order within an educational institution or organisation, giving rise to methods like *e-learning* and *b-learning* which, based on pedagogical theories such as constructivism and, more recently, connectivism, have revolutionised education, placing greater emphasis on autonomous, meaningful learning" (Montoya-Acosta et al., 2019, p. 252).

Learning and knowledge acquisition represent a social presence process. It consists in the degree of connection that individuals feel when they communicate by any means, in any space or time (Wang & Han, 2021). Therefore, academic social networks could be crucial in helping institutions provide university students with a social connection perception and greater satisfaction with their teaching-learning processes (Denis et al., 2014; Ng et al., 2022), which in turn enhances their academic education.

In relation to this latter aspect, students report that they feel more committed to learning when they use a variety of web technologies (Abdullah et al., 2021; Dabbagh & Castañeda, 2020; Suslova, & Grebenshchikova, 2019), which makes it important to understand the experiences of university students and their attitudes toward the implementation of social networks for academic activities, while also helping educational directors to understand the potential of these tools in the educational social construction.

According to Kong et al. (2019), efforts in empirical research must be aimed at generating knowledge about three fundamental issues: how to create educational social networks, how students are using these academic networks and what impact they have on the university learning experience.

The available studies on the topic show that social media tools support educational activities by fostering interaction, collaboration, participation, the exchange of information and resources, and critical thinking, thus promoting the students' teaching-learning process (Almousa, 2018; Gil-Fernández & Calderón-Garrido, 2021; Kara et al., 2020).

Reinforcing the idea that social media play an important role in education, Meza-Cano et al. (2016) researched students' perceptions on the use of academic social networks, highlighting their usefulness as an accessory to education. Their study found that 75 % of students preferred academic social networks to virtual classrooms. In turn, Akçayır (2017) pointed out that 64.99 % of professors felt that networks were a useful tool for contacting students and offered educational benefits. Similarly, in their systematic

review, Gil-Fernández & Calderón-Garrido (2021) found several projects offering evidence that social media have generated synergies between formal, non-formal and informal settings in learning.

Other authors, such as Mercado-Borja et al. (2017), have reached conclusions about the importance of technological learning environments in education, highlighting aspects such as virtual education, which has seen significant and growing acceptance within the communities. Marín-Díaz & Cabero-Almenara (2019) showed the predisposition of young students and digital natives to using Web 2.0 tools to meet their educational needs and desires. In addition, research by Bouton et al. (2021) highlighted the importance of creating study groups that attract more users to academic social media, which significantly contributes to the creation of the network and its outreach.

Within this context, due to the importance of social media and their increasingly strong ties with learning, educational networks have been created everywhere. While there are currently numerous educational networks, the idea arisen in 2008 with Vicki A. Davis, who proposed the idea of using social networks for educational purposes in an online debate about network technologies in education organised by *The Economist*, as explain Akçayır, (2017).

Benefits of using open-source software

Open source (OSS – Open-Source Software) social media development practices promise tremendous advantages such as reduced development costs, simplified teamwork, and enhanced software quality. While commercial software companies prevent developers and external customers from accessing the source code of their products, OSS has source codes that can be modified and freely shared under "open source" licenses and are written, developed, and debugged primarily by volunteers around the world (Evans, 2020).

The success of open-source social networks has been attributed to the effective composition of the project and the efficient coordination of mechanisms, given that the source code is open to inspection and participation is open to anyone who is interested (Evans, 2020). OSS communities are some of the most successful high performance collaboration groupings on the internet and had generated a large quantity of software products used extensively in our society.

Using technological tools that enable innovation in education and, specifically, tools of a social nature such as social networks, which have certain open source features or even fall fully within this software licensing category, are more adaptable to young people because they represent means of expression that are closer to their daily reality and they also offer educators more tools to benefit their students, making their work more flexible and effective (Nie et al., 2022).

METHOD

In order to achieve the objective, a mixed methodological approach was used, which makes it possible to quantify variables with a high educational impact in functionalities of academic social networks and, additionally, to assess student concepts in order to define them in actions and elements contained in the social network. This study is

descriptive in scope, given that it aims to describe students' use of the tool to detail its implications on the effects achieved in teaching-learning processes mediated by social networks.

The work was broken down into the following steps:

Step 1. A broad search for research using social networks for academic purposes was conducted, along with a standard internet search for open-source social networks, which resulted in the detection of 26 social networks.

Step 2. These social networks were then analysed in detail in this step, based on the following two premises: 1) the networks analysed had to be open source, so as to ensure that the premise of being able to adapt them for customisation purposes or to create or modify social networks was met 2) they had to include academic functionalities in their vision or have additional modules containing these functionalities. Following this filtering process, a total of ten open-source academic social networks were found to strictly meet the conditions.

Step 3. Based on the literature, the conditions valued most highly by the academic community in terms of the functionalities that the social networks should have, were established. This was achieved by analysing the specialised literature, in which studies were found that discussed satisfaction and effectiveness ratings of use of social networks in academic components. Thus, 25 elements were established, to be validated for each of the selected social networks.

Step 4. A taxonomy of attributes of open-source social networks was created and their characteristics were defined, classifying the 25 elements into six groups with their corresponding variables. This was made subdividing the set of elements into non-redundant partitions.

Step 5. The 10 open-source academic social networks were analysed according to the factors and their functionalities of the created taxonomy, and then the network was selected that, considering the results, was the most appropriate.

FINDINGS

Identification of educational open-source social networks.

Based on a standard internet search for social networks and the application of criteria (the two premises presented in the Method section), the following open-source academic social networks or open-source social networks with educational functionalities were selected for this study:

Table 1.
Selected open-source social networks.

ID	Social network name	ID	Social network name
1	Anahita	6	Elgg
2	Mastodon	7	Open Source Social Network
3	Pixelfeld	8	Minds
4	Diaspora	9	BuddyPress
5	HumHub	10	Friendica

Source: Author

Attributes for a taxonomy of open-source social networks.

A taxonomy is commonly considered a hierarchical classification, adopting a top-down approach, and subdividing the set of data types into non-redundant partitions. The process is repeated until all the data types are classified (Pertegal-Vega et al., 2019).

The attributes to be found in the comparison to create a taxonomy of academic social networks are:

Table 2
Attributes for the comparison of social networks

Attribute	Description
It has a social media algorithm	Niño-Barón & Ordóñez-Salinas (2013) points out the importance of social media algorithms, designed to automatically identify preferences and suggest new connections to users.
It has educational or academic functions	Not all social networks are designed to support learning processes and therefore, according to Rojas-Cáceres (2018), having functions that support this process generates a substantial difference.
It has customisation functions	According to Perez-Rey (2021), the ability to customise social networks is a tool that motivates students to actively participate in education.
It allows the creation of groups	This functionality allows interested parties to be grouped into specific topics. Leal-Ríos et al. (2018) highlight the importance of creating theme-based interest groups in social networks.
It has functionalities like chats, workspaces, reactions, notifications, hashtags, mentions	Fuster-Guillén et al. (2020) explain that interaction features are key to the development of the topics on social media. These include functionalities such as chats, stories, messaging, reactions, and hashtags, to name a few.
It has search options	Urbano & Gascón-García (2021) highlight the importance of achieving assertive searches that do not leave a broad margin for random discovery of information that is important to users.
Geolocation is possible	Martí-Climent & García-Vidal (2018) use geolocation tools that are included in the Instagram network within the educational field, in addition to features such as QR codes and augmented reality.
It can share information with other social networks	This functionality allows the spread of information to reach a larger audience. Its use is reflected in the research by Zurita-Polo & Monge-Moreno (2018), enabling them to post events, share and comment on statuses.
It offers different types of profiles (student, professor)	By using profiles, users can be identified in detail, in addition to offering the possibility of controlling activities carried out, as proposed by Barba-Téllez & Palacios-Trujillo (2018).
It has an App or PWA (Progressive Web App)	Rodríguez et al. (2021) emphasise how important it is for social networks to have an app or PWA development, given that users increasingly use mobile devices for access.
It has technical documentation and support	According to Giraldo-Ospina et al. (2021) the absence of technical support when using technology tools may become an obstacle in encouraging their use.

Source: Authors

One way of classifying social networks is the method proposed by Meza-Cano et al. (2022), who implemented the open-source social network Mastodon, categorised as a Disciplinary Social Network (DSN). The study they disclosed asserts that a "bubble effect" is created, in which the university students grouped together and showed positive attitudes toward the use of this social network in academic activities.

Another type of social networks for education has been classified as "federated social networks" because they can be adapted for educational use; the name stems from the decentralised way in which they are run, so that each educational institution can manage its own network, creating a "Fediverse", which supports integration between social networks (Meza-Cano et al., 2022).

In addition, the use of open-source software is advocated with a view to encouraging creation, development and moderation and promoting self-management and self-governance in the Disciplinary Social Networks used by educational institutions (Meza-Cano et al., 2022).

A group of professors (Gewerc-Barujel et al., 2014; Nini, 2015) defined some of the characteristics and elements that educational social networks must have, including:

- Good member profiles with identification fields such as school, department, etc.
- Easily managed contacts and convenient ways to search for and add people.
- Individual and group chat.
- Messaging system with an excellent text editor.
- Options for posting polls, surveys, and announcements.
- Group spaces in which students collaborate and share files, ideas, and activities.
- Privacy and security.

In relation to the social media algorithm or model, academic social networks are built on software applications that can be divided into two groups: applications based on predictive modelling and applications based on recommendation models. Both groups feature data collection, site construction and control/monitoring. The key difference between the two is that applications based on predictive modelling need to build regression models or classifiers, whereas applications based on recommendation models calculate and classify the similarity of contents for this purpose (Dermentzi et al., 2016).

Taxonomy created.

Based on the literature reviewed, on the attributes and functionalities, 25 elements were selected, and classified into six groups:

- Functionality and basic tools (five elements): whether the network has educational functions, whether it has a social media algorithm (either predictive or recommendation), whether it has a search engine, whether polls can be conducted and whether it has geolocation.
- Adaptive capacity (four elements): whether it can be customised, whether groups can be created by areas of interest, whether there are workspaces and whether

different profiles or roles are available, such as administrator, professor, or student, with their respective permissions.

- Possibility of expression (four elements): whether reactions (such as "likes") are possible, whether the content posted can be commented on, whether it has notifications and whether hashtags are allowed.
- Tools for posting (five elements): whether it has stories or short-term posts, whether sharing with other social networks (like Facebook, Instagram, or Twitter) is possible, whether users can post contents, whether longer texts (more than 3000 characters) are possible and whether rich-text tools are available for postings.
- Tools for expression (three elements): whether it has mentions whether it has chats and whether different types of files can be uploaded.
- Technical support (four elements): whether there is a mobile device application (native or a PWA), whether there is sufficient technical documentation for proper use and customisation, whether there is development community help for questions or errors and whether there is technical support as such.

Analysis of functionalities for the selection of an open-source social network.

Each open-source social network was analysed for compliance with the 25 identified elements and the results are presented in the following tables, one for each group of the taxonomy.

The assessment of how each network meets the criteria related to functionality and basic tools is shown in Table 3, where Anahita meets all five elements, Pixelfeld, Elgg and Open Source Social Network meet three elements, Minds and BuddyPress meet just two elements, and the rest meet four.

Table 3
Analysis of the networks' basic tools

ID	Educational functions?	Social media algorithm?	Search engine?	Polls?	Locations?
1	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	X
3	X	✓	✓	X	✓
4	X	✓	✓	✓	✓
5	✓	✓	✓	✓	X
6	✓	✓	✓	X	X
7	X	✓	✓	X	✓
8	X	✓	✓	X	X
9	X	✓	✓	X	X
10	✓	✓	✓	X	✓

Source: Author.

The assessment of fulfilment of the adaptive capacity criteria is shown in Table 4, with HumHub matching four elements, Pixelfeld and Diaspora matching just one, and the rest, two.

Table 4
Analysis of the networks' capacity to adapt

ID	Is it customisable?	Can groups be created by areas of interest?	Does it have workspaces?	Can different profiles be created? (professor, student...)
1	✓	✓	**X**	**X**
2	✓	✓	**X**	**X**
3	✓	**X**	**X**	**X**
4	✓	**X**	**X**	**X**
5	✓	✓	✓	✓
6	✓	✓	**X**	**X**
7	✓	✓	**X**	**X**
8	✓	✓	**X**	**X**
9	✓	✓	**X**	**X**
10	✓	✓	**X**	✓

Source: Author.

The assessment of fulfilment of the expression possibility criteria is shown in Table 5, with the majority matching four elements, except Pixelfeld, Elgg, Open Source Social Network and BuddyPress, which meet three elements.

Table 5
Analysis of the networks' possibilities for expression

ID	Does it have reactions?	Does it have comments?	Does it have notifications?	Does it have hashtags?
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	**X**
4	✓	✓	✓	✓
5	✓	✓	✓	✓
6	✓	✓	✓	**X**
7	✓	✓	✓	**X**
8	✓	✓	✓	✓
9	✓	✓	✓	**X**
10	✓	✓	✓	✓

Source: Author.

The assessment of fulfilment of the criteria related to posting is shown in Table 6, in which Diaspora and Minds meet four elements, Mastodon meets just one, Pixelfeld and BuddyPress meet two elements and the rest meet three elements.

Table 6
Analysis of the networks' posting tools

ID	Does it have stories? (short-term postings)	Can posts be shared with other social networks?	Is it possible to post contents?	Is it possible to post long texts? (more than 3000 characters)	Does it have rich text for posts?
1	✓	**X**	✓	✓	**X**
2	**X**	**X**	✓	**X**	**X**
3	✓	**X**	✓	**X**	**X**
4	**X**	✓	✓	✓	✓
5	**X**	**X**	✓	✓	✓
6	**X**	**X**	✓	✓	✓
7	**X**	**X**	✓	✓	✓
8	**X**	✓	✓	✓	✓
9	**X**	**X**	✓	✓	**X**
10	**X**	**X**	✓	✓	✓

Source: Author.

The assessment of fulfilment of criteria on tools for expression is shown in Table 7, with HumHub, Mastodon and Friendica matching three elements, Diaspora, Elgg and BuddyPress matching one element, and the rest, two.

Table 7
Analysis of the networks' tools for expression

ID	Does it have mentions?	Does it have chats?	Are different types of files for posts supported?
1	✓	**X**	✓
2	✓	✓	✓
3	✓	✓	**X**
4	✓	**X**	**X**
5	✓	✓	✓
6	**X**	**X**	✓
7	✓	✓	**X**
8	✓	✓	**X**
9	**X**	✓	**X**
10	✓	✓	✓

Source: Author.

The assessment of fulfilment of the technical support criteria is shown in Table 8, in which HumHub meets four elements, Pixelfeld does not meet any, Diaspora and BuddyPress each meet one, Elgg and Friendica meet two elements and the rest, three elements.

Table 8
Analysis of the networks' technical support

ID	Does it have a mobile application or PWA?	Is there sufficient technical documentation?	Does it have community help for questions or errors?	Does it have technical support?
1	**X**	✓	✓	✓
2	✓	✓	✓	**X**
3	**X**	**X**	**X**	**X**
4	**X**	**X**	✓	**X**
5	✓	✓	✓	✓
6	**X**	✓	✓	**X**
7	**X**	✓	✓	✓
8	✓	**X**	✓	✓
9	**X**	**X**	✓	**X**
10	**X**	✓	✓	**X**

Source: Author.

DISCUSSION

To achieve the proposed goal, an important step is to identify open-source social networks with educational functionality that could be used in academic contexts. The ten networks identified in this study provide input for researchers and teachers who are looking for ways to integrate technology into academic processes and save the time-consuming effort of developing the software infrastructure, complementing proposals like the one of Bassole et al. (2021).

For the analysis, features such as providing contents, exchanging information, creating networks among peers, taking advantage of connectivity devices, software applications and students' ubiquity in their free time were considered, thus bringing together the studies of several authors. The taxonomy of features created could be applied to other scenarios, such as business or social ones. One of the groups created is "technical support", which, although not a popular feature, is necessary to integrate new features as they are needed, such as the artificial intelligence, that is so in demand today.

Regarding the "basic tools" of a social network, all the analysed networks have a connectivity algorithm and a search engine, but only five have explicit educational functions, and of these five, Mastodon and HumHub have polling functions, Friendica has location, and only Anahita has both polling and location functions.

The four social networks with more basic functions (Anahita, Mastodon, HumHub and Friendica) have all the functions in the "possibilities of expression" group: reactions, comments, notifications, and hashtags, which makes them well suited for a basic use of a social network in small groups of students. However, when it comes to features related to "capacity of adapt", Anahita and Mastodon don't have workspaces or profiles, which limits their use when there are larger groups of teachers and students.

Considering the "tools for expression" (mentions, chats, and file types), Mastodon, HumHub and Friendica meet all of them, while Anahita is lacking in chats. As for "posting tools", none of the networks meet all of them, and only two networks comply with four functions (share with other networks, post contents, long text, and rich text), but these are networks without explicit educational functions: Diaspora and Minds. Of the five that have educational functions, Mastodone is the most limited, with only the possibility to post content; Anahita also allows stories and long texts, and HumHub, Elgg and Friendica allow post content, long text, and rich text. Therefore, HumHub and Friendica are the ones with more advanced features to offer, which could be interesting for more complex or enriched activities in an academic environment.

Finally, regarding "technical support", only HumHub has all the features (mobile, technical documentation, community, and technical support), and Anahita has all but the mobile one.

CONCLUSIONS, IMPLICATIONS AND LIMITATIONS

As set out in the general objective of this study, it was possible to select and analyse ten social networks that met the required guidelines, including the fact that they were open source and had academic purposes or functionalities.

Subsequently, based on diverse research projects that evaluated the perceptions of students and of the academic community in general regarding the use and characteristics that academic social networks should have to function properly, the 25 most important functionalities or characteristics for this type of social network were identified, thus achieving the first specific objective in this study.

In addition to having features in common with general-use social networks, such as postings, comments, and tags, for example, other characteristics more specific to academic settings were identified, such as polls, workspaces, and profiles. The 25 characteristics were established as variables and grouped into six categories to facilitate the comparison of the social networks. Classifying the variables proved to be highly useful in the analysis of the academic social networks, given that it unified many of the previous studies conducted and facilitated the classification and selection of a network based on certain desired categories.

Finally, to achieve the third objective, the 25 characteristics were analysed in the ten selected open-source social networks for academic use, finding that HumHub is the social network that meets the greatest number of characteristics, with a total of 22. There are cases of use of this network at schools and universities, thus meeting the requirement calling for the selected tool to have an educational focus. Its architecture is intuitive, and it is built on current technology that is widely used in the software

development community. It should also be noted that it is easy to access its documentation and source code, making it possible to more effectively deploy, customise and build new functionalities. Finally, even though this social network does not have a mobile application, it can be installed as a Progressive Web App (PWA), which runs smoothly.

This study is limited to analysing scientific literature published on open-source social networks with some sort of academic aim or functionality, and therefore other types of social networks used in education and experiences discussed in other types of publications have not been included here. This research contributes to the knowledge-building and praxis of academic social networks that offer a new experience in terms of use, proposed functionalities focused on new tools and mediations for education and the construction of knowledge among university students. It also generates new lines of research such as examining the relationship between the identified characteristics and the outcomes and behaviours observed in students or establishing instruments to gauge the impact of the characteristics and their relationships in different educational settings.

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