COMMUNICATION

Architectures of contemporary digital platforms in education: analysis of exclusion processes

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Abstract

The Internet is a wide, open and dynamic ecosystem of digital platforms where people and technologies contribute to the creation and consumption of digital information. The convergence of the Internet and the accelerated change of technological innovation have been the engines of society and its development, and all this has caused transformations in the social, economic and educational context. In this context, this work analyzes contemporary digital platform architectures and their influence on the processes of educational exclusion. To meet the objectives, the crucial changes brought about by digitally mediated life are studied; the conceptual and technological aspects that characterize contemporary digital platform architectures; and its influence on exclusion processes. This research is supported by qualitative research methodologies; the analysis and synthesis methods, the PRISMA model, and a meta-analysis of data extracted from the Scopus databases and the Web of Science-WOS is also carried out. The work shows changes in the social and educational context given the consolidation of the Internet through contemporary digital platform architectures and its influence on the processes of social, digital and educational exclusion. The need to promote equal opportunities, active participation and the capacity for professional insertion between women and men is visualized.

Keywords Contemporary digital platform architectures · Technological innovation · Modernity · Digitally mediated life · Digital change in educational · University

1 Introduction

The Internet configures its development and use in a contemporary society immersed in a digital world, which allows taking advantage of technological advances and incorporating them into people's daily lives [40, 41]. The Internet in exchange for the system of physical, socioeconomic and cultural relationships in the world for digitally connected relationships in a network has produced a dislocation of society, which substitutes the concrete space for the media space [9].

The ecosystem of digital platform architectures refers to extended and interconnected environments, where its own components exchange digital information. In this sense the Internet is a broad, open and dynamic digital platform ecosystem that people and technologies use to create and consume digital information. In the ecosystem of digital platform architectures, the production of social, economic, political and cultural life overlaps, that is, production is no longer a limited social sphere, the value is produced outside the factory by capturing the totality of the social life [23]. User interactions with contemporary digital platform ecosystems are easily implemented through complex algorithms that encode large amounts of data on tastes, affective states and preferences [13]. These infrastructures are based on a wide range of advanced technologies in constant evolution, such as cloud computing, analytical solutions for big data, among others.

The convergence of the Internet and technological innovation has been the driving force behind society and its development, causing profound transformations. In this sense, in the ecosystem of digital platforms architectures it captures the totality of social life, users co-create complementary products or services and the owner of the platform can incorporate this feedback to increase quality of existing services and access new markets [17, 33].

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In short, the development of the Internet through the ecosystem of digital platform architectures, and the rapid growth of technological innovation, allows us to trace a thread of continuity and change [18]. In this regard, there are several benefits that web technologies provide, namely reusability, ease of maintenance, promoting interoperability, high availability and increased reliability. A breakthrough can also be observed in various network technologies, namely great progress in various network technologies, such as new transport protocols, data center congestion control, reconfigurable data center topologies and network stacks. However, these changes are not architectural in nature, in this sense, the IP protocol is deeply embedded in the host network and application software, as well as router hardware and software [24]. Based on this analysis, it could be argued that there is a thread of continuity that refers to architectural foundations that face implementation barriers.

On the other hand, the change refers to the influence of these contemporary digital platform architectures that induce a change in the state of people different from the predictable one. Influence can be classified as a subjective concept and, as such, the perception of influence varies by observer [3, 35]. Some research suggested that the influence of contemporary digital architectures will have strong connections with the issues of social justice, equity, equality of results, equal opportunities, social cohesion and human capital [3, 9]. In that respect, it will be necessary to increase the study of equity, innovation, the concepts of social, digital and educational exclusion, as well as their opposite category [2].

2 Objective

In this context, this work analyzes contemporary digital platform architectures and their influence on the processes of educational exclusion. The following research questions were answered:

1. The resonance of modernity, what crucial changes did digitally mediated life produce?
2. What conceptual and technological aspects characterize contemporary digital platform architectures?
3. How to identify the epistemological gap related to contemporary digital platform architectures and exclusion processes from a co-occurrence analysis?
4. What characterizes the different exclusion profiles generated by contemporary digital platform architectures?

3 Theoretical framework

Q1: The resonance of modernity, what crucial changes did digitally mediated life produce?

The resonance of technological progress is given by the recognition of the crucial changes caused in the lives of people digitally mediated. It also refers to the consolidation of the Internet through an ecosystem of contemporary digital platform architectures, which exerts greater control over infrastructures and services by a small group of organizations, capable of easily reaching a large user market. In this sense, network effects affect the value of the service and this can lead to an asymmetry of power, which in turn can be reflected in various aspects of people's lives digitally mediated [3].

Corporations regulate multiple spheres of social life, giving rise to an immaterial biopolitical production, which monetizes social, emotional, political, family and phatic interaction in data, metadata, all captured and advertising companies [12]. This new trend, together with the large amount of data generated by digital platforms, points to a new business model that has spread from search and social networks to the entire economy, driving the growth of corporate giants [16]. Taking advantage of the advantages offered by the Internet, services are created that attract Internet users, some companies obtain information on their behavior, and this information is used in predictive artificial intelligence algorithms to obtain competitive advantages [5]. In this sense, the so-called platform leaders can use their dominant position in the market to further increase their market share [22].

New behaviors and approaches to the Internet have been widely criticized for inadequately treating the social conflicts surrounding the emergence of new digital oligopolies [15]. The problems derived from the concentration of ownership of the digital giants are the subject of international controversy. For example, the principle of net neutrality refers to the need for a new digital policy on the treatment of all data equally and the acceleration or slowdown of searches for profit [10]. In this line of analysis, there is international concern about the monopolization of the media and communication, the regulation of hate speech and toxic content on the Internet, the collaboration of these digital platforms in unrestricted and unjustified surveillance projects of the online activities [16]. The Techlash phenomenon emerges, which is the denial of the power and influence of the digital giants [45]. Governments recognize the need to increase the organizational transparency and accountability of information published on the Internet [25].

Q2: What conceptual and technological aspects characterize contemporary digital platform architectures?

Digital platform architectures need to enable and coordinate an ecosystem of users while being exposed to economic and structural components [1]. The three fundamental structural elements of ecosystems are: activities, users and architectures [32]. The economic components describe the type of products or services that complementors provide [29].

Another fundamental characteristic of an ecosystem is its generativity or general capacity to produce spontaneous changes driven by large, varied and uncoordinated audiences [26, 52]. Based on the digital possibilities provided by the platform owner, ecosystem actors feed generativity with individual innovation capabilities [38]. Activities determine how value is co-created in an ecosystem and include the development of new applications or the provision of services [6]. Users take on the role of complementors and consumers who carry out activities and produce different offers. The role of the complementor differs from traditional company-supplier relationships [32, 34]. In summary, the architecture of the digital platform is defined as the technological interactions that orchestrate the exchange between the supply and demand of an ecosystem, and it can result in a product-based platform or ecosystem [21, 48, 49]. These can be developed from three different building blocks: platform ownership status, value creation mechanisms in the ecosystem and autonomy of complementors (Fig. 1).

Platform ownership is a primary factor in the design and governance of digital platform architecture ecosystems [4]. It is not just about the legal entity that owns the digital platform, but also the distribution of power in the ecosystem, which can be centralized or decentralized, it also describes the relationships between partners in the ecosystem [11]. The most successful digital platforms provide the necessary value creation mechanisms for the provision of benefits that facilitate innovation [49]. The autonomy of complementors describes the degree of freedom that complementors possess when co-creating value with the digital platform [51]. The platform owner faces different levels of control, scalability, and flexibility [39].
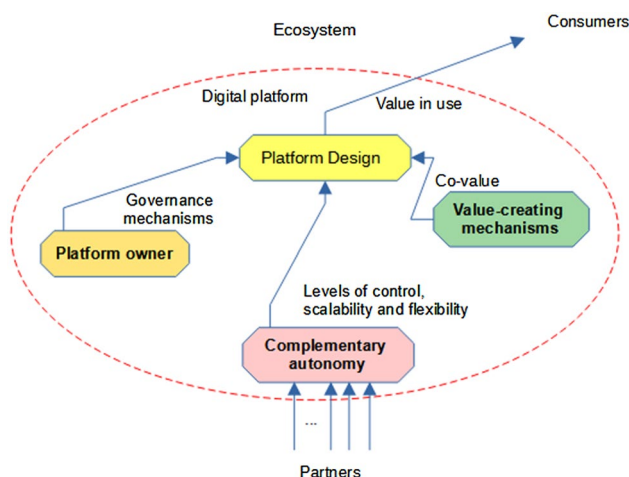
Fig. 1 Pillars of digital platform architecture ecosystems. Own elaboration from figure basic elements and characteristics of digital platform ecosystems in Hein et al. [24]

4 Methodology

This research is supported by qualitative research methodologies. From the methods of analysis and synthesis, a theoretical, conceptual and technological framework is built on contemporary digital platform architectures and their influence on exclusion processes [43]. To improve the consistency of the methodological information and supported by the PRISMA model [28], the Scopus databases and the Web of Science—WOS—were selected, which cover a large part of the serial academic publications in different areas of knowledge (Fig. 2; both platforms provide exceptional tools to extract data that will be used later for a meta-analysis with the VOSviewer tool (Fig. 3).

5 Results

Q3: How to identify the epistemological gap related to contemporary digital platform architectures and exclusion processes from a co-occurrence analysis?

The meta-analysis carried out in the VOSviewer tool and its text mining functionality allowed to build a network of co-occurrence of terms extracted from the body of the selected scientific literature; the extracted data are shown in "Appendix." From the previous results, the bar graph that appears in Fig. 3 is constructed, showing the labels that obtained the highest number of co-occurrences: intervention (743), virtual reality (691), education (636), social exclusion (449), industry (261), covid (215), architecture (163), commitment (160) and integration (155). These results confirm an epistemological gap related to these terms and, therefore, a recent increase in the literature to study these topics. In this sense, digital platform architectures related to exclusion processes have been little explored [2].
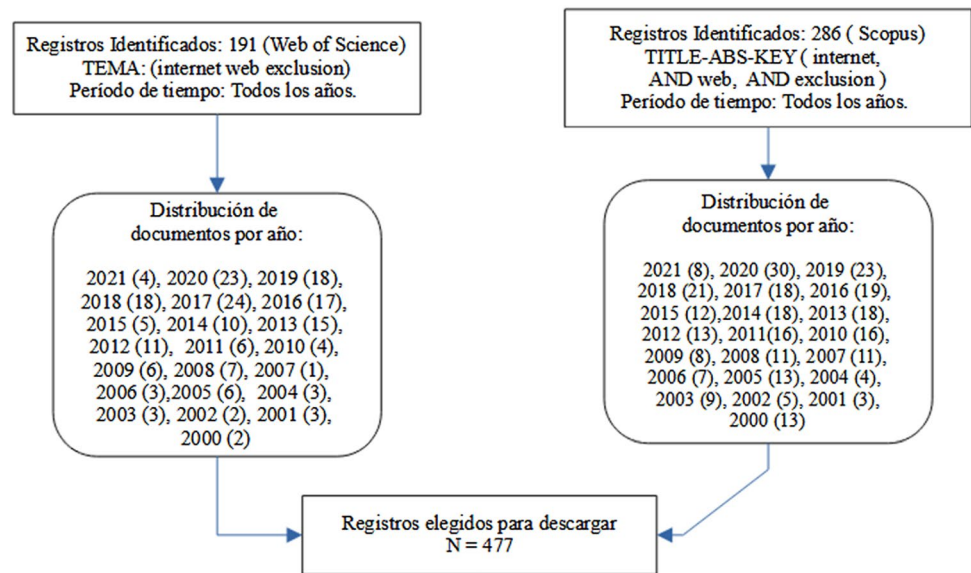
Q4: What characterizes the different exclusion profiles generated by contemporary digital platform architectures?

5.1 Educational exclusion profiles

From the educational point of view, innovation is a fundamental factor in the quality of organizations, together with the use of ICT as a means of training, as they constitute the most important elements to highlight in the educational processes of contemporary society. It is known that educational exclusion has strong connections with the issues of social justice, equity, equality of results, equal opportunities, social cohesion and human capital [2].

The COVID-19 pandemic reflected the profiles of students who do not have access to the Internet at home and presented difficulty in accessing virtual education; hence

Fig. 2 PRISMA model generated from data extracted in the Scopus and Web of Science—WOS—databases. Own elaboration

Registros Identificados: 191 (Web of Science)
TEMA: (internet web exclusion)
Período de tiempo: Todos los años.

Registros Identificados: 286 (Scopus)
TITLE-ABS-KEY (internet,
AND web, AND exclusion)
Período de tiempo: Todos los años.

Distribución de documentos por año:

2021 (4), 2020 (23), 2019 (18), 2018 (18), 2017 (24), 2016 (17), 2015 (5), 2014 (10), 2013 (15), 2012 (11), 2011 (6), 2010 (4), 2009 (6), 2008 (7), 2007 (1), 2006 (3),2005 (6), 2004 (3), 2003 (3), 2002 (2), 2001 (3), 2000 (2)

Distribución de documentos por año:

2021 (8), 2020 (30), 2019 (23), 2018 (21), 2017 (18), 2016 (19), 2015 (12),2014 (18), 2013 (18), 2012 (13), 2011(16), 2010 (16), 2009 (8), 2008 (11), 2007 (11), 2006 (7), 2005 (13), 2004 (4), 2003 (9), 2002 (5), 2001 (3), 2000 (13)

Registros elegidos para descargar
N = 477

Fig. 3 Bar graph of co-occurrence of terms. Own elaboration in libreOffice Cal from data of co-occurrence of terms obtained from the VOSviewer tool

Bar graph, co-occurrence values by terms
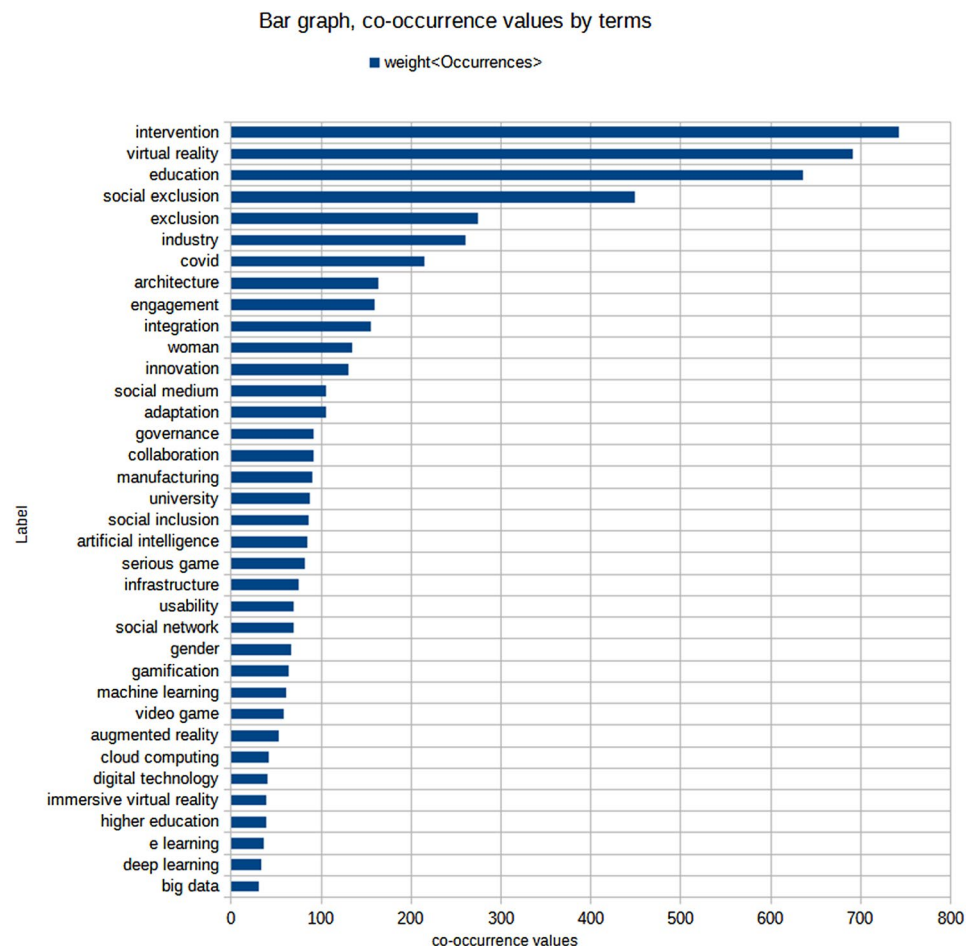
importance of the Internet connection at home and the daily use of digital devices is perceived [27, 50]. However, the literature identifies other profiles of students who consider they have insufficient technological skills, difficulties to effectively implement the instructions of the educational center and difficulty in catching up with the constant changes in ICT [42]

In this scenario, the relationship between the architectures of contemporary digital platforms and the processes of educational exclusion have a complex and multidimensional relationship; this relationship is favored with the increase in ICT and STEM skills, which are intrinsically linked to technological innovation [44].

Analyzing Human Capital from a training and educational perspective, the drastic variations in the needs of the labor market show an increase in the gap between education in STEM subjects (Science, Technology, Engineering and Mathematics) and the new skills and competencies required of Human Capital. This is because current university programs cannot be updated as quickly.

5.2 Social exclusion profiles

The countries of the European Union (EU) with higher levels of digitization manipulate a more significant reduction in poverty and social exclusion; however, this does not mean an accelerated reduction in the risk of poverty and social exclusion. This analysis suggests that the concepts of social inclusion can be better understood by examining the meaning and connotations of its opposite category, social exclusion [2].

Other recent studies, generated in times of the global COVID-19 pandemic, showed vulnerable population profiles were excluded from digital services because they have Internet access, or lack the devices or infrastructure for network connectivity, or because they do not have the skills necessary to interact with new emerging technologies [36]. Older adults constitute a sector or profile of social and digital exclusion. In this sense, the processes of social exclusion will also be reinforced by digital skills that are inherently linked to technological innovation [14].

5.3 Gender exclusion profiles

Despite the fact that some authors point out that the digital gender gap is narrowing in some contexts, other current research points to the existence of a pronounced gender gap in STEM fields at the educational and labor market level [31, 47]. Analysis of recent data showed that the most important cause of the gender gap in STEM profiles is the low rate of admission of women in universities to careers of this profile [8, 30, 37]. In this sense, the gender approach in education is constant.

6 Conclusions

1. The development of the Internet was analyzed through the ecosystem of digital platform architectures, in its relationship with the rapid growth of technological innovation, tracing a thread of continuity and change. The continuity refers to the architectural foundations that face implementation barriers and change refers to the influence of contemporary digital platform architectures that induce a change in the state of people different from the predictable one [1, 9, 18, 23, 24, 46, 48, 49].

2. It is a fact, resonance of modernity and the crucial changes brought about by digitally mediated life. This points to the consolidation of the Internet through an ecosystem of contemporary digital platform architectures; and the exercise of greater control over infrastructures and services by a small group of organizations, over a large market of users. All these are reflected in various aspects of people's lives digitally mediated [3, 5, 10, 12, 13, 15, 16, 22, 25, 45].

3. In reference to conceptualization, digital platform architectures are defined as the technological interactions that orchestrate the exchange between the supply and demand of an ecosystem. Regarding the technological aspects, the fundamental characteristic of an ecosystem is its generativity or general capacity to produce spontaneous changes driven by a wide, varied and uncoordinated public. Three fundamental structural elements of ecosystems were identified: activities, users and architectures [1, 4, 6, 11, 26, 29, 38, 39, 46, 51, 52].

4. Profiles of educational exclusion are recognized, within the framework of the impact of the Internet through the architectures of contemporary digital platforms in universities. The University can minimize the barriers caused by the technological impact, managing to update its study programs, and the scientific and technological skills of the students quickly, with a view to improving digital skills. In this sense, it is necessary to raise the level of skills in ICT and STEM, thus helping graduates to access an international labor market and at the same time making our programs attractive. In short, new institutional policies are required that consider integration modalities, a new vision of the teaching and learning process that integrates content with interdisciplinary methods [2, 27, 42, 44, 50].

5. This analysis suggests that the concepts of social inclusion can be better understood by examining the meaning and connotations of its opposite category, social exclusion. Profiles of the vulnerable population are visualized; the processes of social exclusion will also be reinforced by digital skills that are inherently linked to technological innovation. In this sense, digital public services and electronic government must explicitly consider different perspectives on citizens as service users, so it is necessary to explore new conceptualizations of the citizen as a user of digital public services within the literature on electronic government [2, 14, 36, 44].

6. Regarding the profile of exclusion according to gender, the existence of a marked gender gap persists in STEM fields at the educational level and in the labor market.

Some studies analyze the causes, such as the low rate of admission of women in universities to careers of this profile, among others. In this sense, the gender approach in education must be a constant [8, 47].

7. This work contributes to visualizing the importance of the study of digital architectures and their influence on exclusion processes. It also shows where the University should contribute to the formation of citizenship in an increasingly digitized world. The consolidation of the Internet in contemporary society, from the educational point of view points to the need to promote equal opportunities, active participation and the capacity for professional insertion between women and men, as well as professional development. In short, the need arises to make the university compatible with the world of work, to carry out training, research and development or knowledge transfer activities in an area of common interest.

Appendix

See Table 1.

Table 1 Co-occurrence of terms

ID	Label	x	Y	Cluster	Weight < links >	Weight < total link strength >	Weight < occurrences >
1	Adaptation	− 0.3823	− 0.3243	1	31	157	106
2	Anxiety	0.4805	− 0.5372	3	32	274	219
3	Architecture	− 0.7148	− 0.0024	1	33	250	163
4	Artificial intelligence	− 0.8677	− 0.2533	1	28	154	85
5	Augmented reality	− 0.604	− 0.6435	6	20	77	53
6	Big data	− 0.6843	0.0254	1	19	84	31
7	Case study	− 0.7891	0.3798	1	30	266	121
8	Cloud computing	− 0.9231	− 0.1438	1	18	61	42
9	Cognition	0.7226	− 0.4126	3	20	155	96
10	Collaboration	− 0.4908	0.3303	2	30	155	91
11	Computer	− 0.5631	− 0.4472	1	40	247	257
12	Control	0.4868	− 0.0458	4	51	752	523
13	Covid	− 0.2221	0.3138	2	28	167	215
14	Cybersickness	1.6476	− 1.4329	3	3	30	30
15	Data source	− 0.3868	0.1138	2	16	35	36
16	Database	− 0.2461	− 0.215	6	51	459	246
17	Deep learning	− 0.893	− 0.3794	1	9	17	33
18	Digital	− 0.2194	0.1093	1	21	47	35
19	Digital technology	− 0.0833	0.4956	2	26	131	41
20	E learning	− 0.017	− 0.8331	6	18	172	36
21	Economy	− 0.4895	0.6744	2	28	206	109
22	Education	− 0.043	− 0.1501	6	50	940	636
23	Engagement	0.3172	0.661	5	38	481	160
24	Exclusion	0.7121	0.3427	4	42	801	274
25	Exclusion criterium	− 0.2954	− 0.5447	6	24	122	85
26	Female	0.9852	0.4444	4	22	170	64
27	Financial inclusion	− 0.6904	0.8468	2	8	48	52
28	Framework	− 0.4816	0.1886	1	54	946	451
29	Game	1.0259	0.1404	5	39	746	292
30	Gamification	0.4567	0.7912	5	12	134	64
31	Gap	− 0.2818	0.1212	2	47	464	154
32	Gender	0.8146	0.0813	4	24	120	67
33	Governance	− 0.5629	0.5119	2	23	201	91
34	Higher education	0.3374	0.0807	3	17	87	39

Table 1 (continued)

ID	Label	x	Y	Cluster	Weight < links >	Weight < total link strength >	Weight < occurrences >
35	Human behavior	− 0.8395	− 0.5952	1	9	77	58
36	Immersive virtual reality	0.3925	− 0.3523	3	16	54	39
37	Inclusion criterium	0.0442	− 0.569	6	32	210	94
38	Industry	− 0.881	− 0.0718	1	34	692	261
39	Infrastructure	− 0.6373	− 0.0184	1	33	206	75
40	Innovation	− 0.5168	0.4636	2	39	351	130
41	Integration	− 0.339	0.2951	2	42	375	155
42	Intervention	0.6563	− 0.6413	3	50	1076	743
43	Machine learning	− 0.8231	− 0.2334	1	26	80	61
44	Male	0.9988	0.4733	4	19	139	61
45	Manufacturing	− 0.7944	− 0.0225	1	26	169	90
46	Meta-analysis	− 0.0265	− 0.5898	3	32	377	225
47	Methodology	− 0.9192	0.0926	1	36	353	182
48	Outcome measure	0.2709	− 0.8472	3	17	112	95
49	Science	− 0.2824	− 0.2036	1	48	356	254
50	Serious game	0.8522	0.8072	5	17	283	82
51	Sex	1.1982	0.4766	4	14	59	46
52	Significant difference	0.5047	− 0.4111	4	30	154	138
53	Social	0.0632	0.0209	1	12	21	30
54	Social exclusion	1.1164	0.2681	4	31	777	449
55	Social inclusion	0.4872	0.3349	4	30	230	86
56	Social medium	0.0593	0.195	1	26	161	106
57	Social network	− 0.0148	0.3429	2	26	113	69
58	Speed	0.1679	− 0.6019	3	22	124	92
59	Teacher	0.6501	0.075	5	24	157	52
60	University	− 0.2633	0.4716	2	28	225	87
61	Usability	− 0.0712	− 0.3068	3	26	158	69
62	Video game	1.0815	0.5978	5	19	180	58
63	Virtual reality	0.3298	− 0.5067	3	47	671	691
64	Virtual simulation	− 0.1989	0.8176	2	7	21	35
65	Woman	0.679	− 0.0484	4	28	189	134

Own elaboration in libreOffice Calc from data of co-occurrence of terms obtained from the VOSviewer tool

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