



**VOL.27, Nº1 (MARZO, 2023)**

ISSN 1138-414X, ISSNe 1989-6395

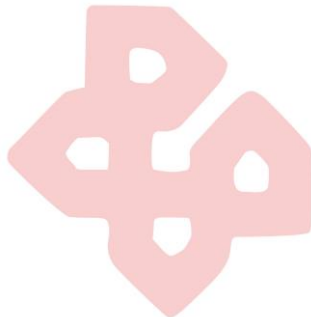
DOI: 10.30827/profesorado.v27i1.24050

Fecha de recepción: 01/03/2022

Fecha de aceptación: 28/06/2022

## **SCHOOL ENGAGEMENT AND ICT: A SYSTEMATIC REVIEW**

*Compromiso escolar y TIC: una revisión sistemática de literatura*



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### **Abstract**

It is remarkable the lack of interest and motivation that occurs during adolescence, especially in matters related to school, which generates later dropout problems and low academic performance, especially in developing countries. Regarding this, school engagement becomes a matter of great interest for educational researchers and practitioners, especially at a time when Information and Communication Technologies (ICT) conditions the relationship of adolescents with the school. To increase the understanding of this phenomenon, a systematic literature review was conducted with the purpose of identifying aspects of the use of ICT in school engagement strengthening. Results highlight the collaborative activities, active student participation and ICT pedagogy, and skills development as the main enablers of the increase of their confidence and learning goals achievement.

**Keywords:** *collaboration, ICT skills, interaction, school engagement, learning goals.*

## Resumen

Es notable la falta de interés y motivación que se produce durante la adolescencia, especialmente en asuntos relacionados con la escuela, lo que genera problemas de abandono escolar y bajo rendimiento académico, especialmente en los países en desarrollo. Al respecto, la participación escolar se convierte en un tema de gran interés para los investigadores y profesionales de la educación, especialmente en un momento en que las Tecnologías de la Información y la Comunicación (TIC) condicionan la relación de los adolescentes con la escuela. Para aumentar la comprensión de este fenómeno, se realizó una revisión sistemática de literatura con el propósito de identificar aspectos del uso de las TIC relacionados con el fortalecimiento del compromiso escolar. Los resultados destacan las actividades de colaboración, la participación activa de los estudiantes, la pedagogía ajustada a las TIC y el desarrollo de habilidades digitales como los principales facilitadores del aumento de la confianza en el estudiante y el logro de sus objetivos de aprendizaje.

**Palabras clave:** *compromiso escolar; colaboración; habilidades digitales; interacción; objetivos de aprendizaje.*

## 1. Introduction

Current education is increasingly mediated by Information and Communication Technologies (ICT) and this supposes the incorporation of a great number of theoretical and practical elements that in one way or another modify the development of teaching (Ferreira & Castiglione, 2018) and characterize in a very particular way the learning experiences in all educational levels (Homiakova et al., 2017).

Although the educational integration of ICT has been the object of practice and research for several decades, there is no consensus about its effects, both positive or negative on educational practices (Burns, 2013; Flórez Romero et al., 2017; Nkhoma et al., 2012). In this sense, on the one hand there are multiple studies that indicate positive effects on teaching (Papanastasiou & Angeli, 2008; Zheng et al., 2018), on curriculum (Camilleri & Camilleri, 2017; Dhakal & Pant, 2016) on assessment (Mukandutiye et al., 2014; Scheuermann & Pedró, 2010), among others, and on the contrary, there are other studies that emphasize inconvenient effects as a result of the poor-planned and inconsistently implemented processes of ICT in education (Alharbi, 2017; Pelgrum, 2001).

Taking into account both positions, it is recognized that technological mediation in education implies the existence of both advantages and risks (F. Wang et al., 2017), among which, on the one hand, flexibility, personalization and ease of use and access to information (Ignatova & Kurilovas, 2012; Nwaocha, 2014), and on the other, the distraction related to multitasking (Abramova et al., 2017; Junco & Cotten, 2011), procrastination (Rozgonjuk et al., 2018; Tani, 2017) and a marked disinterest in learning beyond the use of technological devices (Kim et al., 2018).

In relation to the above, some researchers such as Loayza (2015) point out the presence of a generation composed by apathetic teenagers and youngsters with almost none interest in social, cultural and, of course, school processes in which they participate. In this regard, some studies such as Beluce and Oliveira (2015) indicate that such apathy is largely related to the type of activities that typically students find

in the classroom, most of which put them in an inactive or eminently receptive position.

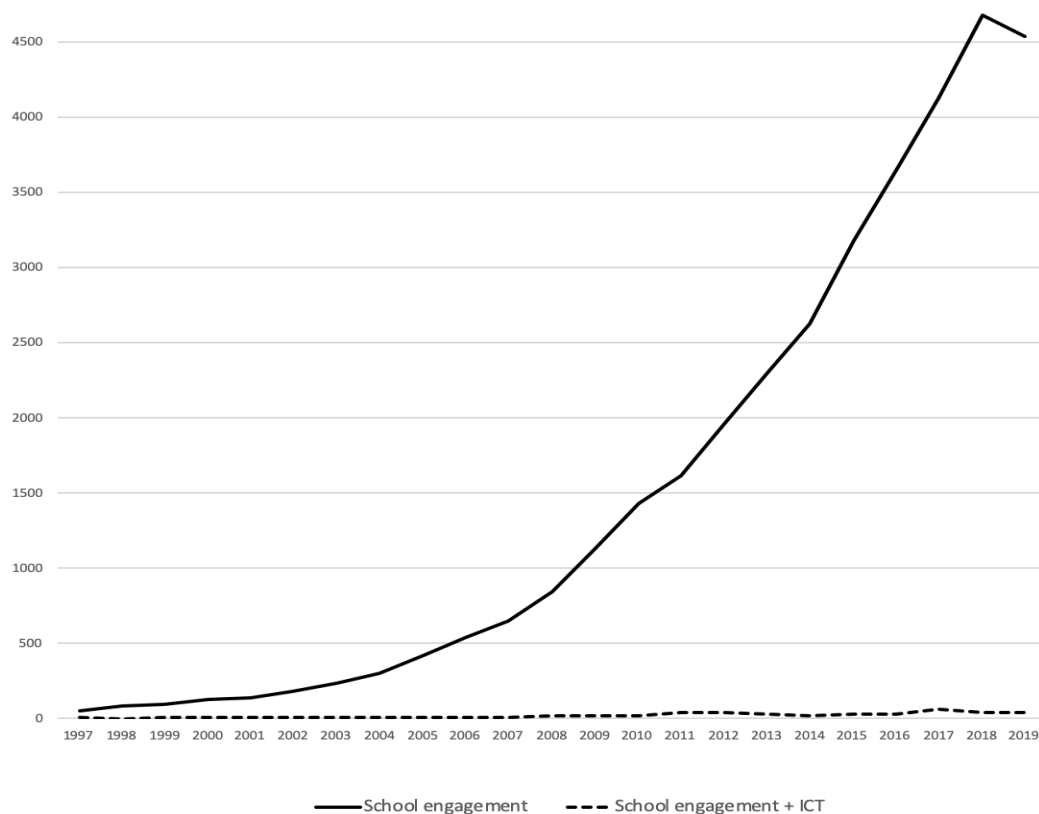
In addition to the above, despite the availability of access to numerous educational resources through the information networks, which would give the possibility of learning processes more personalized, active, flexible or collaborative, there are still high rates of attrition in all educational levels (Duran & Ballares, 2015; Fonseca, 2016), which is a multi-causal phenomenon, in most cases it takes low levels of motivation or school engagement as one of its main causes (Antelm Lanzat et al., 2018; Bonfert-Taylor et al., 2017; Román, 2013).

Considering this, a concept such as "engagement", understood as school commitment becomes highly relevant as a resource to recover the attention and motivation of students and increase the success of their school performance (Pineda-Báez et al., 2019).

According to Tomás, Gutierrez, Sancho, Chireac & Romero (2016, p. 120), engagement is defined as: "student participation in academic achievements, and is understood as a multidimensional construct". Traditionally it has been associated with three dimensions; the first of these is known as "cognitive dimension", which has to do with the conceptual developments and cognitive abilities of the student in order to achieve processes of self-regulation. A second dimension called "behavioral" has to do with aspects related to the generation of relationships and connections that are presented from the student's participation in school and social activities (Lawson & Lawson, 2013). For its part, the third dimension, called "affective", focuses on aspects related to the development of emotional and interpersonal intelligence (Gershon & Pellitteri, 2018; Maguire et al., 2017).

In addition to the previous dimensions, recently a new one has been added, the "agentic" dimension, associated especially with the proactivity of the student, that is, with the active and participative contribution of the student to the flow of interactions that he builds with his teacher and his environment (Cuevas et al., 2018; Montenegro, 2017). In the field of education, school engagement has a complex and multidimensional character and develops in relation to the involvement of students to achieve better academic performances.

With all its complexity, based on Scopus published studies, Figure 1 shows that school engagement is a research topic that has occupied the attention of practitioners and researchers over the last 20 years in a broad and growing way (Chen, 2017; Dufty, 2011; Issaka & Hopkins, 2017; Jones, 2013), not being like this the magnitude of the research on this subject when education is carried out through technological mediations (Balasooriya et al., 2018).



*Figure 1.* Comparison between research on engagement and engagement + ICT.  
 Source: own elaboration based on Scopus data

In this sense, the scarce production of research on this particular topic, especially taking into account the accelerated growth of the educational integration of ICT in all educational levels (Wastiau et al., 2013) becomes an indicator of alarm over the urgent need to understand the ways in which the use of ICT can favor school engagement, for which a systematic review of literature focused on studies published in the last 20 years on this subject has been carried out.

## 2. Method

According to Petticrew and Roberts (2006), literature reviews allow identifying specific ideas or patterns of ideas that help make sense of large bodies of information. This review was conducted by applying two complementary protocols, the first as an in-depth reading process and the second as a triangulation process through text mining.

The literature review process was carried out following the phases indicated by Barn, Barat and Clark (2017), the details of which are shown in Figure 2.

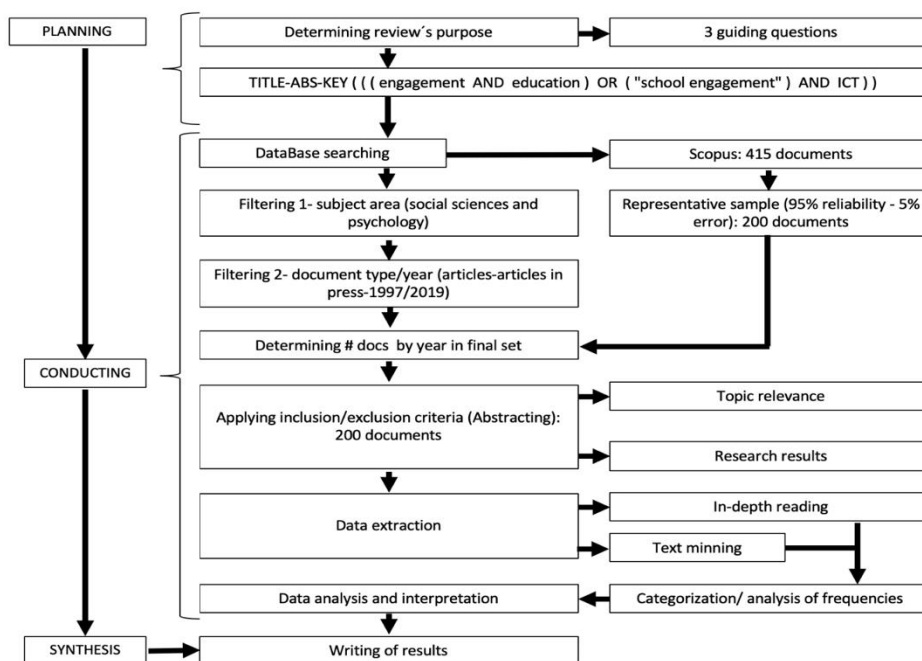


Figure 2. Phases of review method.  
 Source: Own elaboration based on Barn, Barat and Clark (2017).

## 2.1. In-depth reading protocol

### 2.1.1. Planning phase

This first phase began with the purpose of the literature review, which focused on finding the factors that trigger school commitment or "engagement" from the use of ICT. For this purpose, three guiding questions were posed: (1) What are the key ideas around engagement when information and communication technologies are incorporated? (2) How have such ideas evolved (or changed) through time? and (3) What is the current discussion on this issue?

Once these questions were defined, the next step had to do with selecting the appropriate sources of consultation for the review. In that sense, Scopus was selected as a peer-reviewed journal database, due to its wide coverage and diversity of journals and the quality of its review and editorial management processes.

To address the review questions, a string of descriptors was applied in Scopus, comprising the following terms: TITLE-ABS-KEY (((engagement AND education) OR ("school engagement") AND ICT)).

### 2.1.2. Conducting Phase

The initial search (application of the descriptor string in Scopus) generated the first set of documents (n=415). In order to generate a suitable set of documents for the next steps of the review, a probabilistic representative sample was calculated (n=200) with a reliability level of 95% and a margin of error of 5%.

Subsequently, a filter by topic was applied to the initial set of documents, refining the search to "Social Sciences and Psychology" understanding engagement as a psychological and educational phenomenon, not focusing its application exclusively from a specific area of knowledge. Then a second filter was applied by type of document and period of time, which allowed to delimit the search to "articles, conference papers and articles in press", published in indexed journals from 1997 to the present (time in which massification of the Internet begins as milestone), generating a final set of documents.

In order to delimit a final set of documents, an abstracting process was carried out through which two inclusion/exclusion criteria were applied: (1) selecting first the most cited articles for each year, proportionally, according to the total publication curve for the previously determined period of time, (2), selecting those that effectively refer to engagement, education and ICT and that they were articles with research results. The documents that met those criteria formed the set of documents that were read in depth (n=200).

In this regard, Table 1 shows the number of articles read in-depth for each year.

Table 1  
*In-depth reading articles by year.*

Year	# Articles	Year	# Articles
1997	1	2009	10
1999	1	2010	9
2000	1	2011	17
2001	1	2012	18
2002	1	2013	15
2003	1	2014	10
2004	1	2015	14
2005	2	2016	15
2006	4	2017	30
2007	4	2018	17
2008	7	2019	19

Source: Own elaboration.

To continue with the process, the extraction of data was carried out based on the in-depth reading of each selected article, which was recorded in a documentation matrix, where it was categorized. The analysis and interpretation of the extracted data were done through frequency analysis processes and qualitative categorization, using a QDA program.

### **2.1.2.1. Text Mining Complementary Protocol**

In addition to the in-depth reading process, a text mining process was carried out using VOSViewer as data analysis and visualization software.

The procedure was carried out to the same set of documents corresponding to the 1997-2019 time period (Filtering 2).

Before carrying out the loading of the texts in VOSViewer, a process of unification or disambiguation of terms was carried out using a WordReference service, since there are orthographic differences between some words in British, American or Australian English. Likewise, words were adjusted when extracted from the PDF files resulted in accidental separation scripts. Once these terms were unified, the abstract, the introduction and the discussion of all the articles published in the same year were copied and pasted in plain text files.

With a single unified file that was loaded in VOSViewer, the parameters requested for the analysis of this document were: (1) Counting method: Full counting, and (2) Minimum number of occurrences= 20. As a result, of the 10.068 processed terms, 192 meet the threshold. For each of the 192 terms, a relevance score was calculated and based on this score, the most relevant terms were detected (n=115), divided in 6 different clusters.

From those clusters the most relevant key factors were selected according to their combined weight occurrences, weight links connections and total weight link strength.

### **2.1.3. Synthesis Phase**

The final process of the review was developed as a synthesis, interpretation, and compilation of the results in a text, which were structured in a document following the IMRaD structure. These processes were conducted from 4 categories of analysis, which coincide with the dimensions of school commitment: cognitive, affective, behavioral and agentic.

## **3. Results**

In order to present comprehensively some possible answers to the review's guiding questions, the results have been organized around the main four dimensions of engagement after establishing the quality levels of the sources consulted, as follows:

### 3.1 Bibliometric results

The whole set of documents was published in 88 different journals and proceedings in a very homogeneous way. The quality level of the review’s sources is shown in Table 2 and Table 3, in which the top 10 of the journals that contributed the most articles to the review are presented.

Table 2  
Top 10 of consulted journals.

Journal	% articles	SJR ImpFtr	SJR quartile
Computers and Education	14,73%	2,626	Q1
Technology, Pedagogy and Education	6,31%	0,891	Q1
Australasian Journal of Educational Technology	3,25%	0,721	Q1
British Journal of Educational Technology	3,25%	1,339	Q1
Educational Technology Research and Development	3,25%	0,977	Q1
Research in Learning Technology	3,25%	0,582	Q1
Computers in the Schools	2,10%	0,389	Q2
Education and Information Technologies	2,10%	0,598	Q1
E-Learning	2,10%	0,296	Q2
International Social Work	2,10%	0,438	Q2
Procedia Computer Science	2,10%	0,281	Q2

Source: Own elaboration based on Scopus data.

### 3.2 Key factors of engagement

As a result of reviewing the selected studies in a period of 20 years, the Table 3 shows some relevant key factors that contribute the strengthening of school engagement were found, provided from in-depth reading and text mining processes.

Table 3  
Engagement key factors by category.

In-depth reading	Text mining
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Engagement category	key factors	% frequency	key factors (text mining)	# occurrences	# links	link Strength
Cognitive	Interaction	15,9%	Skill	163	111	1804
	Activities	12,6%	Classroom	144	106	1334
	Collaboration	8,7%	Teaching	132	104	1066
	Cognitive skills	7,8%	Computer	159	102	1828
	ICT skills	5,2%				
Agentic	Autonomy	9,1%	School	225	109	2468
	Feedback	8,7%	Development	133	109	1397
Behavioral	Participation	10,4%	Model	146	104	1616
	Interaction with the environment	8,7%	Outcome	107	106	1272
			Child	139	99	1539
Affective	Enjoyment	6,5%	Support	116	108	1470
	Satisfaction	6,5%				

Source: Own elaboration

A text mining map of terms related to the identified key factors is shown in Figure 3.

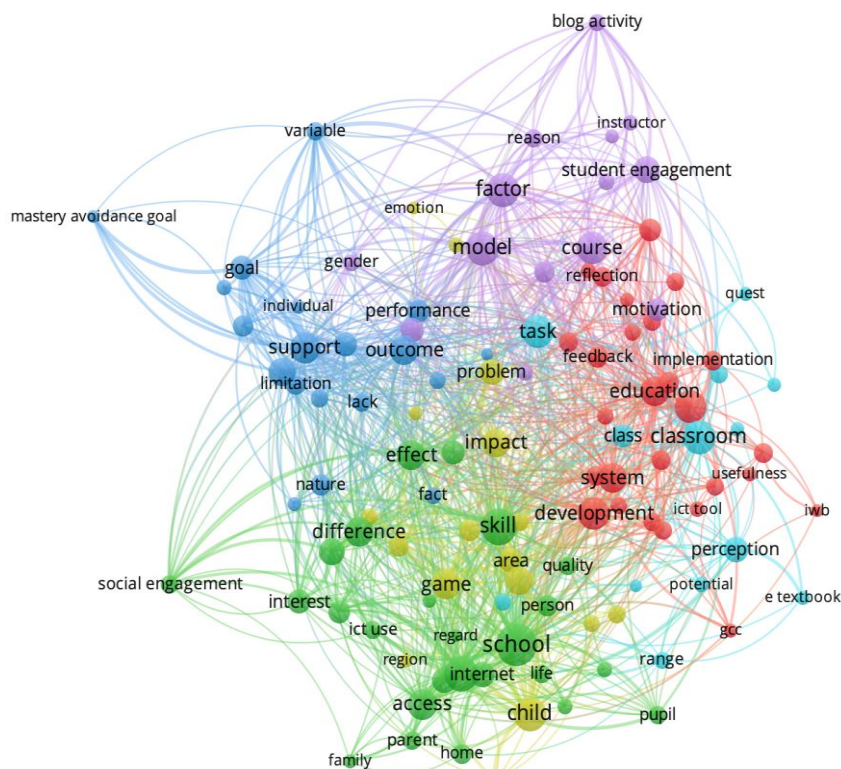


Figure 3: text mining map of identified key factors.  
Source: own elaboration based on VOSviewer data.

### 3.3 Results related to Cognitive Dimension

According to Annetta, Minogue, Holmes and Cheng (2009), cognitive commitment is defined as the student's mental investment in learning, the use of strategy, deep thinking and commitment to academic work. From this perspective, the cognitive dimension of engagement includes the use of effective and personalized strategies of students in learning and self-regulation (Reeve, 2012). This cognitive component includes the use of self-regulation strategies such as memorization, self-control or task planning, used in learning activities (Tomás et al., 2016).

#### 3.3.1 Interaction and engagement

Interaction is the subcategory most frequently and is understood from the different positions found in the review as a factor that favors the student's engagement, since as Wang (2010, p. 832) mentions that "It is widely recognized that the amount and the quality of the interaction among participants is an indicator of the success of online learning experiences, since it has been found that interaction contributes both to achievement and to student satisfaction".

On the other hand, interaction favors the acquisition and integration of learning as it is acquired, which is especially useful in the collaborative learning spaces of online courses. In this way, the interaction understood as the stimulus to achieve collaboration, must be previously and intentionally planned and structured (Austin et al., 2010; M.-J. Wang, 2010).

As shown in Figure 4, the text mining analysis shows that the stronger relationships of the term "interaction" are not presented in a consistent manner as identified in the in-depth reading. However, other terms arise that are especially relevant, and that could be related to collaboration, such as "skill", "classroom", "support", "task", "game", "problem" or "outcome". A strong relationship between these words suggests that the engagement would be generated if students can develop skills to interact in a game/problem-based class and in social interaction processes, in order to achieve a result related to a certain task. Also, it is important to generate a wide spread participation culture in educational institutions and into the classroom environment.

Examples of the above can be found in Guzdial and Turns (2000), Roblyer and Wiencke (2004) or Somekh and Saunders (2007).

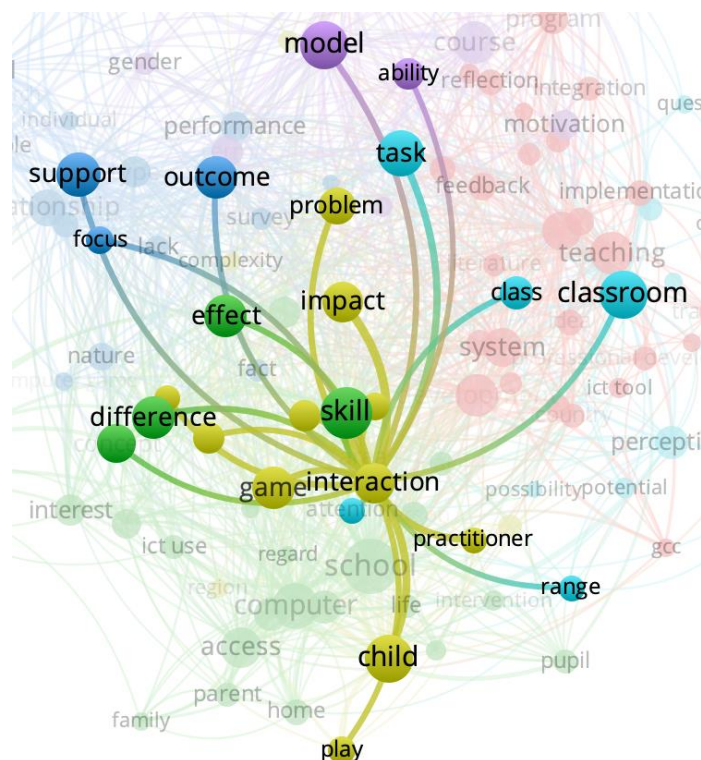


Figure 4. Relationship map of "interaction".  
Source: own elaboration based on VOSviewer data.

### 3.3.2 Activities and engagement

The activities acquired an important place as a result of the review due to the fact that, from its structuring, planning, and quality depends to a large extent, the interest students place in their realization. The activities must be designed in such a way that they attract the students because of the challenge implied in them. In addition to the above, the activities must be dosed in time and quantity and must be focused in a timely manner with the topics that are addressed (Sheard et al., 2010).

The variation of traditional activities by activities that integrate ICT motivate students to participate as they promote interactive learning. As mentioned by Mama and Hennessy (2010, p. 274) "The activities properly associated with a pedagogical goal can maintain the motivation, focus, and effort until their end".

An interesting pattern found in the reviewed texts shows that student interest is maintained by providing an important variety of activities such as creating web pages, surfing the Internet, online chatting, filming and editing digital movies and playing video games, etc. In that sense, Yong and Ping (2008) concluded that high school students experienced greater commitment when the challenge of homework and their own abilities were high and in balance.

As shown in Figure 5, the text mining analysis shows that the strongest relations of the term "activity" are generated through the term "blog activity", and its relation with the terms "school", "computer", "motivation", "reason", "instructor" and "variable", which has to do with what is mentioned in the previous paragraph and that allows inferring that the motivational power of the activities goes through the instructor's ability to accompany the student's active participation in varied and online activities related to a clearly identified reason: accomplish a learning goal.

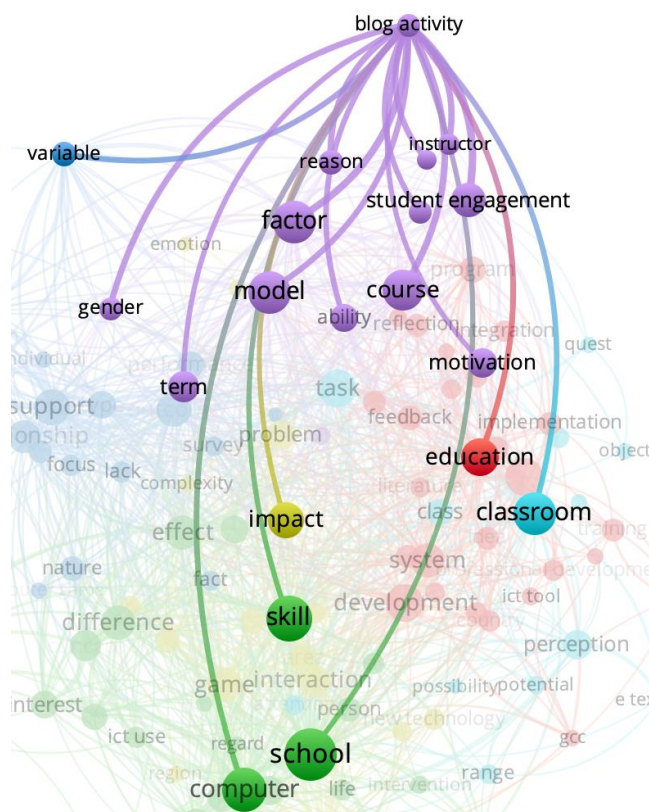


Figure 5. Relationship map of "activity".  
 Source: own elaboration based on VOSviewer data.

### 3.3.3. Collaboration and engagement

Collaboration is conceived as a learning strategy that stimulates interaction among students through knowledge sharing. According to Fu, Wu and Ho (2009, p. 550), "collaboration was the best learning strategy because competition and interaction stimulated different types of knowledge growth in the spiral of knowledge creation". Among the factors related to collaboration are those where co-creation processes are generated, the development of collective intelligence and active participation in communities of practice (CoP) and learning (CoL). In addition, special emphasis is placed on the use of social networks to produce engagement generating dialogues.

Other studies that mentioned collaboration as a factor to strengthen engagement were Coco and Short (2004), Pahinis, Stokes, Walsh and Cannavina (2007) and Cakir (2013).

### 3.3.4. Meta-cognition and engagement

The development of metacognitive skills is achieved when the student connects with activities that stimulate him in such a way that they lead him to develop thought processes that in turn allow him to generate answers according to his cognitive abilities. As mentioned by Lim (2007, p. 85), "Higher-order thinking skills are multi-step strategic processes, aimed at objectives, such as design, decision making and problem-solving that require analysis, evaluate, connect, imagine, elaborate and synthesize". From this perspective, school engagement is strengthened when this type of process is achieved, which generates a cognitive effort and full attention of students in the learning environment. Other studies that address meta-cognition as a key factor for strengthening engagement are Cakir (2013), Kirkwood (2009) or Eow, Ali, Mahmud & Baki (2009).

### 3.3.5. ICT skills and engagement

According to Binkley et al. (2012), ICT skills allow to think, work and live in a digitalized world and have to do with computer and information literacy and with the abilities related with computer-based communication, research and creation.

ICT skills favor the development of school engagement to the extent that they allow the student to develop their confidence in the proper management of the different tools available in their educational environment. Not having these skills and the lack of training in the use of tools strongly discourages students (Mama & Hennessy, 2010).

As mentioned by Lim (2007, p. 112) "Plan just-in-time ICT skills training sessions to provide the knowledge and skills necessary for students to use the respective ICT tools for learning. Very often, students need specific technical skills with ICT tools to perform the tasks assigned by their teachers".

For example, most students are motivated to use the Internet for educational purposes because they feel competent to search for information (Selwyn, 2008), in





being responsible for one's decisions and acting autonomously. In this sense, the agentic dimension refers to a way of behaving, feeling and thinking (Reeve & Tseng, 2011; Veiga, 2013; F. Wang et al., 2017).

The strengthening of new skills in the use of technologies allows students to develop autonomy, understood as a factor that allows independent apprentices to form, capable of learning due to their personal commitment and willingness to assume the challenges of such process (Selwyn, 2008; Sølvsberg, 2003; Taylor, 1999).

The development of autonomy to perform activities that involve the use of ICT leads to developing other factors such as confidence and effectiveness, given the ease in conducting multiple tasks that require minimal skills in the use of ICT-based tools. In this way, a certain degree of technological competence is acquired that leads students to be more efficient with the handling of information.

The analysis of text mining does not show strong relationships of the term "autonomy", however, two relevant terms are presented: "school" and "development", which address aspects related to the development of autonomy, recognizing it as a faculty of being human, which is developed within the framework of school interactions.

Studies that address autonomy as a key factor for strengthening engagement are Fu, Wu & Ho (2009), Howard, Miles & Rees-Davies (2012), or Buijs & Admiraal (2013).

#### **3.4.1. Feedback and engagement**

Feedback is an important learning factor since it provides information that accounts for the results of their performance and the level of achievement of the learning objectives. Likewise, it allows the students to identify in a timely manner, possible deficiencies that may be presented in the development of their learning process.

According to Yong & Ping (2008, p. 534), "Reward and recognition systems found in some learning environments play an important role in elevating students' efforts to achieve digital rewards", all this as a way of feedback for their learning.

In this sense, it is required constant supervision from the teacher on the student's work and evaluating their progress both in the use of technological tools and in the learning of topics (Mama & Hennessy, 2010).

Other studies that address feedback as a key factor for strengthening engagement are Shenton & Pagett (2007) or Hart & Rush (2007).

#### **3.5. Results related to Behavioral Dimension**

According to Tomás et al. (2016) the behavioral dimension of engagement, defined as student participation in the classroom and school activities, is measured by observable behaviors related to effort and achievement. This component is a key to

obtaining good academic results and the prevention of school dropout, is based on the student's active interactions with their academic environment, aimed at constructive and persistent goals. This behavioral engagement is accompanied by indicators such as effort, attention, concentration or persistence and focuses on active participation in school tasks and extracurricular activities.

### 3.5.1. Participation and engagement

As quoted by Lim, Nonis & Hedberg (2006, p. 213) "Studies have shown that student participation is fundamental to learning success". Based on the most frequent terms, in their relationships and in the formation of word clusters, is clear that the different definitions of engagement involve some kind of mindfulness, intrinsic motivation, cognitive effort and attention. Besides this, Kearsley and Shneiderman (1998) also highlight that although engagement can occur without the use of technology, it offers opportunities for participation in ways that might otherwise be difficult to achieve.

Moreover, Ahlfeldt, Mehta and Sellnow (2005) suggested that student participation is greater with more activities based on problem solving. On the other hand, competition motivates students to participate in uninteresting or routine educational activities and has been seen as a gamification-based factor to stimulate participation and interest (Suh et al., 2018).

As Figure 7 shows, the text mining analysis shows that the strongest relationships of "participation" are presented with terms like "social engagement", "relationship", "school" and "outcome", which allows recognizing the importance of socialization as a channel of participation for the achievement of learning objectives or results.

Studies that address participation as a key factor for strengthening engagement are Lennox Terrion & Aceti (2012) or Krause & Coates (2008).



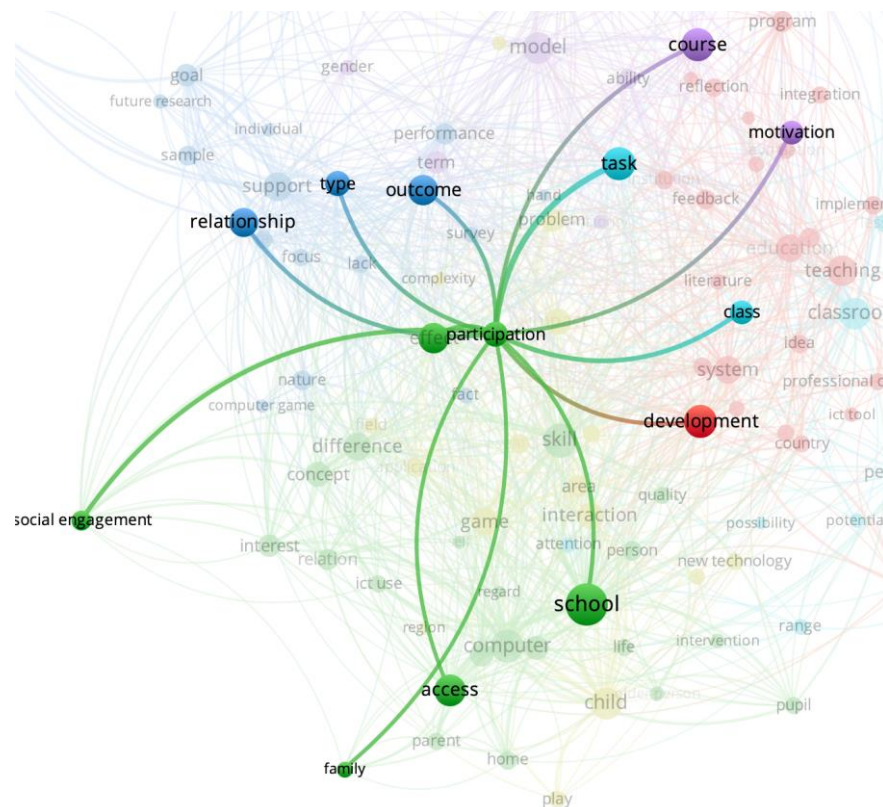


Figure 7. Relationship map of "participation".  
 Source: own elaboration based on VOSviewer data.

### 3.5.2. Interaction with the environment and engagement

According to Lim, Nonis & Oliver (2006), in virtual learning environments, interaction with the environment allows students to become active participants, rather than passive observers, which has been found to be a factor directly related to their learning performance. Motivation and cognitive engagement are influenced by the characteristics of learning environments, namely authenticity, research-oriented, collaboration and technology. Other researchers also suggest that the use of ICT carries its own motivational benefits that increase student participation (Annetta et al., 2009). The factors that stand out most in this group are those that lead to generating authentic learning, based on the intervention of real-world problems. In addition to the above, other relevant factors are those related with the creation of immersive and intelligent environments and a culture of innovation in the classroom and, where personalization and the generation of well-being are an important part of the educational process.

Other studies that address interaction with the environment as a key factor for strengthening engagement are Holley & Oliver (2010) or Meyer (2009).

### 3.6. Results related to Affective Dimension

Emotional engagement refers to the affective identification of students with the school, attitudes toward the school environment, their relationships with teachers, classmates, and other school professionals (Tomás et al., 2016).

According to Stephen and Plowman (2008, p. 647), "The practitioners also noted examples of children's evident pleasure during their engagement with ICT and of their enhanced interest, both aspects of children's pre-school experiences that are valued as promoting a positive disposition towards learning". Similarly, Fu, Wu and Ho (2009, p. 560) point out that "The results indicated that the different pedagogical designs create different degrees of social presence, which in turn contribute to different levels of enjoyment of learning, subjective self-evaluation and objective evaluation of learning performance".

Satisfaction is achievement-oriented and is essentially conceived as a motivational factor. It has been demonstrated a strong relationship between student motivation the achievement orientation and finally, the academic success (Dawson et al., 2009). In the same way, de Winter, Winterbottom and Wilson (2010, p. 265) mention that: "Also, she said that they were "really proud of what they had achieved", suggesting a positive effect on their self-esteem."

The text mining analysis does not show meaningful relationships with the terms "enjoyment" or "satisfaction".

Studies that address satisfaction as a key factor for strengthening engagement are Cakir (2013), Bhuasiri, Xaymoungkhoun, Zo, Rho, and Ciganek (2012) or Casuso-Holgado, Cuesta-Vargas, Moreno-Morales, Labajos-Manzanares, Barón-López and Vega-Cuesta (2013).

### 3.7. School engagement through time

The results that have to do with the last two review questions show that the factors related to engagement have varied over time, both in diversity and in interest for educational researchers. Figure 8 shows those factors that have shown the greatest interest over time and specifically those that are part of the current discussion on the subject.

#### 3.7.1. "Star" key factors

The factors that strengthen engagement and that stand out in this group are (1), those that have to do with the application of pedagogical methods or theories, (2) the use of ICT-based tools or services, (3) the interaction and active participation, (4), collaboration, (5) the social context and learning environments, (6) the evaluation of learning and finally, the expectations, conceptions and beliefs of both students and teachers regarding the processes of learning, the importance and commitment of application of the above factors. A characteristic of some of these factors, specifically

speaking of the use of ICT and pedagogy, is that they are transversal (affect) the 4 dimensions of engagement.

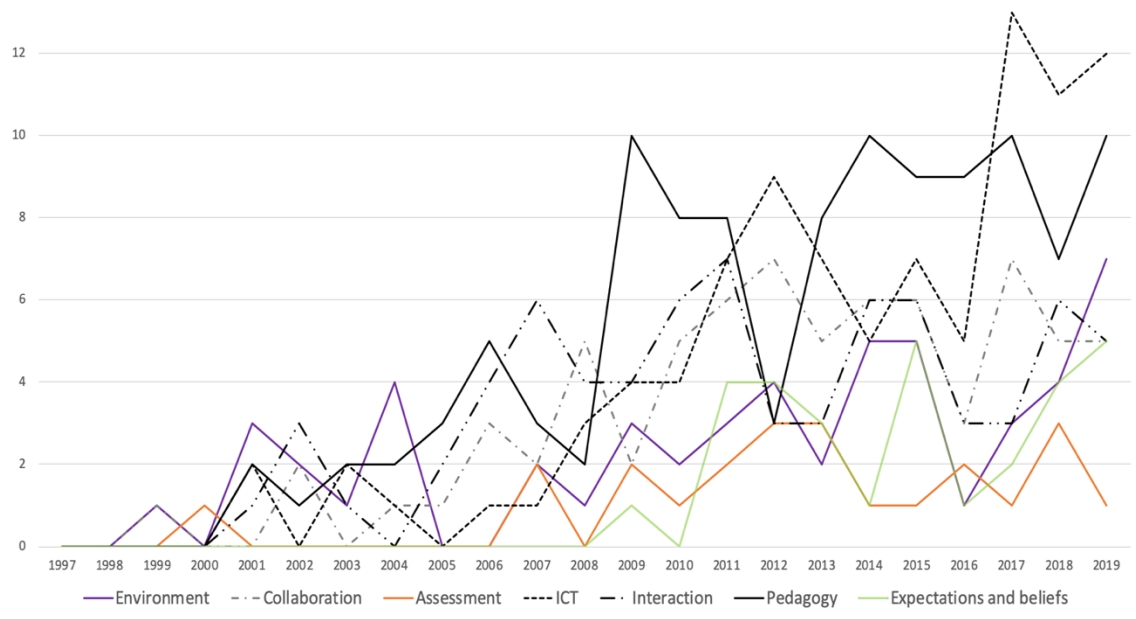


Figure 8. “Star” key factors of engagement strengthening. Source: own elaboration based on extracted data.

### 3.7.2. Rising Key factors

Another set of factors were identified as a trend of moderate growth over time with some ups and downs, as shown in Figure 9.

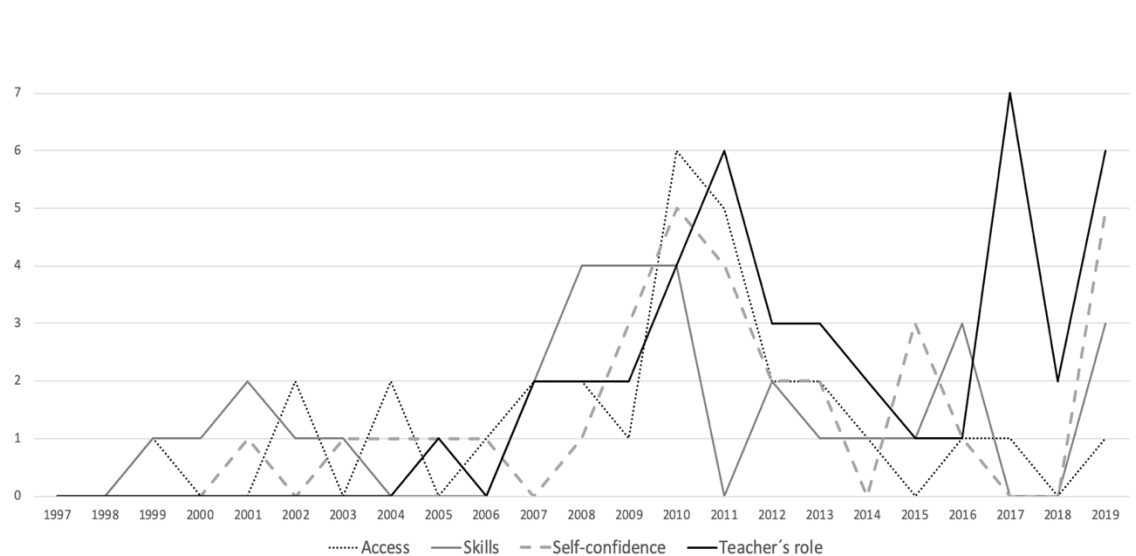


Figure 9. Rising key factors of engagement strengthening. Source: own elaboration based on extracted data.

The factors that strengthen engagement and that stand out in this group are (1), those that have to do with the effect that has the role of the teacher and the way he conducts learning experiences, (2) those related to personal conditions of self-confidence and self-control, (3) the development of previous skills and during learning experiences and finally, the factors related to adequate access to resources, tools, connectivity and inclusive learning designs.

### 3.7.3. Middle and low zone key factors

As shown in Figure 10, a third group of factors have been considered during the last decade in a moderate manner and some of them have ceased to be important for educational researchers. Figure 10 shows the most significant, among which are (1) communication factors, (2) the evaluation of learning, (3) feedback, (4) the enjoyment that students feel when participating in the learning experiences and (5), affinity or predilection for the topic of related knowledge in the learning process.

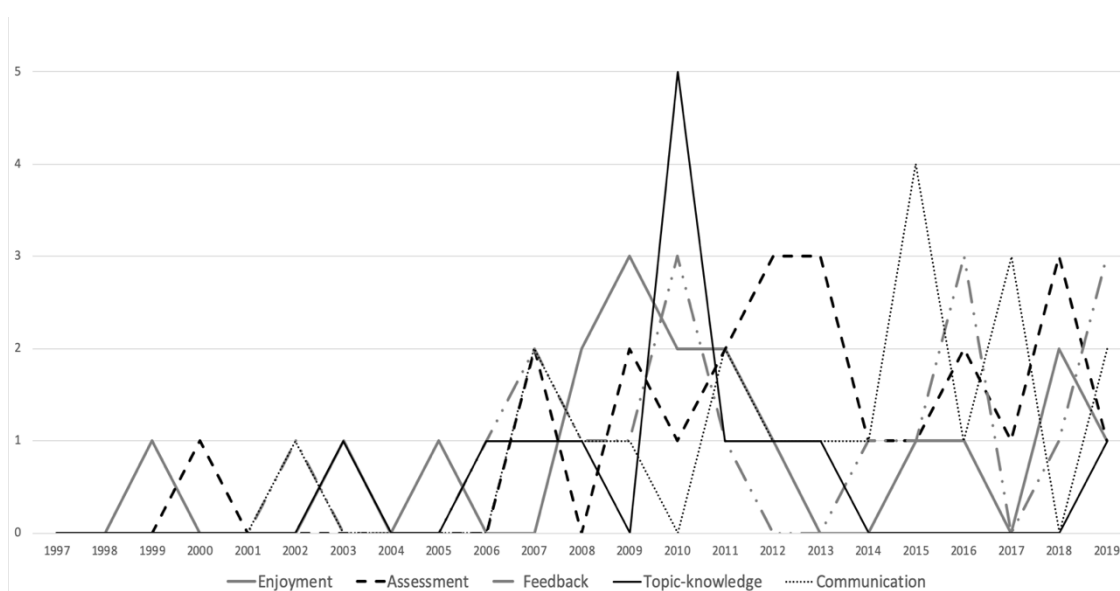


Figure 10, Middle and low key factors of engagement strengthening. Source: own elaboration based on extracted data.

## 4. Discussion

From the analysis of the results found, the specialized literature suggests that "ICT educational and communicational technologies were a factor in enabling changes to behavioural and cognitive engagement" (Sheard et al., 2010, p. 12). Learning strategies based on interaction, collaboration, and activities adjusted to student's needs, allow generating greater cognitive engagement in students and also, developing structured thinking processes, which generate greater self-control and self-regulation in their learning process. In this way, cognitive engagement is also associated with the generation of skills related not only to the process of cognition but also to students' abilities to use ICT tools, which gives them greater confidence when using them.

On the other hand, school engagement is favored to the extent that the students develop the ability to set their own goals, engaging in behaviors that allow them to control and verify for themselves how to achieve the learning objectives in a satisfactory manner.

In addition to the above, it is noteworthy that student participation is determined by the interaction that the student has with their environment as an enhancer of interactive processes. Likewise, it is important to mention that participation is reflected in the interest in carrying out activities in a way that allows them to fulfill their learning achievements. Therefore, bidirectional communication is also important, given by timely and effective feedback that allows students to have an immediate diagnosis of the effectiveness of their interventions in the realization of learning activities.

Regarding the students' attitudes towards their teaching and learning process, it is evident that the use of ICT generates a greater commitment in students because they enjoy its use since it gives them more opportunities for participation and autonomous development. They feel happy to achieve their learning objectives, based on the skills they have developed for the implementation of different ICT-mediated learning activities. It is worth mentioning that the literature on student attitudes in relation to the use of ICT in their educational processes is not only extensive but also addresses many more aspects than those that could be found within the component of school engagement. Indeed, in studies such as those by Arrosagaray et al. (2019), Erdogdu and Erdogdu (2022), Mantoro et al. (2017), Edmunds et al. (2012), Sillin and Kwok (2016), other aspects not directly related to school engagement appear, such as the expectation of usefulness of the use of ICT towards their future, the uses associated with entertainment, the fear of failure and the practical utility in communication and collaboration processes.

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**Author Contributions:** All authors have participated in the review, conceptualization, preparation, and writing processes of this article. M.E.T led the manual review process, J.O.P led the text mining process and A.CH led the final adjustment and consolidation process of the text.

**Funding:** This research did not receive external funding.

**Acknowledgments:** We thank the Universidad de La Sabana (Group Technologies for the Academia - Proventus (Project CTA-25-2016) for the support received in the preparation of this article.

**Conflict of interest:** We hereby declare that there are no conflicts of interest for the publication of this manuscript.

**Ethical statement:** We hereby declare that both the review process and the preparation and writing of this article have been carried out in accordance with the ethical principles established by the scientific community and unrestricted respect for copyright.

#### **Cómo citar este artículo:**

Rivera-Vargas, P., Jacovkis, J. Passerón, E. & Cobo, C. (2023). School engagement and ict: a systematic review. *Profesorado. Revista de Currículum y Formación de Profesorado*, 27(1), 471-501. DOI: 10.30827/profesorado.v27i1.24050