Evaluation of Free Software Use in Learning Environments

Laura Cristina Piñón-Howlet [1], Alma Lilia Sapién-Aguilar [1], Humberto Chávez-Acosta [1]

[1] *Autonomous University of Chihuahua, Nuevo Campus Universitario, Circuito Universitario #1, Campus UACh II, 31125, Chihuahua, Mexico*

Abstract **– Open-source software in the educational field aims to contribute to rethinking a different learning strategy model. The goal was to assess whether the use of open-source software can contribute to improving learning environments in a higher secondary education institution in Mexico. A quantitative, non-experimental, transactional, descriptive, and correlational research method was employed. The results showed that open-source software is a valuable support in developing new didactic strategies. The findings revealed confidence among teachers in using open-source software as a didactic strategy, and students considered starting to use open-source software from the first semesters. This research is original as open-source software supports the development of new didactic strategies. The limitation was that teachers use proprietary software, and it is likely more challenging for them to use open-source software.**

Keywords **– Free software, upper secondary education, learning environment, teachers, students.**

DOI: 10.18421/TEM134-50
https://doi.org/10.18421/TEM134-50

Corresponding author: Alma Lilia Sapién-Aguilar,
Autonomous University of Chihuahua, Nuevo Campus Universitario, Circuito Universitario #1, Campus UACh II, 31125, Chihuahua, Mexico
Email: lsapien@uach.mx

Received: 11 June 2024.
Revised: 19 September 2024.
Accepted: 12 November 2024.
Published: 27 November 2024.

1. Introduction

Information and Communication Technologies (ICT) have become a crucial element for students in their daily educational tasks. In fact, many institutions and governments have developed strategies to integrate ICT with pedagogical methods. In this context, the adaptation of pedagogical systems and the incorporation of ICT innovations are essential for the survival of many educational institutions. Regarding the adoption of Open Source Software (OSS) in education, there are three main drivers for OSS: 1) reduced acquisition costs; 2) more flexible licensing agreements; and 3) interoperability. In this sense, OSS is one of the ICTs with the greatest growth potential in the field [11].

Thankachan and Moore [17] mention that personalizing teaching and learning to adapt to students' needs using ICT can generate a competitive advantage in the educational field. However, the cost associated with technology, including software acquisition, represents a significant barrier to its implementation. A possible solution to mitigate the high costs of software would be the use of Free and Open Source Software (FOSS), as it provides the fundamental freedom to use, distribute, modify, and redistribute modifications made to the software released under this modality. Additionally, the availability of FOSS without license fees and with access to the source code has driven governments, businesses, and academic institutions to make the switch from proprietary or commercial software to FOSS.

Consequently, the incorporation of ICT in the educational sphere can contribute to generating and expediting teaching-learning processes, aiming to awaken, maintain, and foster interest in learning. The goal is for learning to acquire meaning for the student and promote the connection between acquired knowledge and its relevance for personal development [2].

Educational institutions must adapt to the demands of the digital knowledge era by integrating appropriate plans and programs. These institutions are places of learning and have the responsibility to ensure relevance to maintain, be recognized, and be competitive at an institutional level. Challenges include, on one hand, the efficient management of the organization, focusing on improving human resources dedicated to teaching to guarantee a comprehensive learning process and meet the global demand for training, transformation, and updating of human resources to adapt to the needs of the global community [1].

According to Criollo's statements [5], the concept of free software refers to the freedom that users must use, copy, distribute, study, modify, and improve the software. When applied in the educational sphere, this type of software favors the teaching-learning process by adapting to recipients, needs, and level of education. It is possible to modify and adjust the software according to the interests and objectives pursued in the educational context.

Open-source software, due to its nature, promotes collaboration and cooperation among users. This is manifested through user communities that contribute to and update projects that are of interest to them or meet their needs. These updates and the development of new programs are characterized by free distribution, copying, and modification, which opposes the controlled authorship model. This, to some extent, helps combat piracy since the product is available to all those who need it. Additionally, these elements combine with advancements and deepening in the computer field, leading to the improvement and experimentation of new functionalities in various open-source programs [18].

The technology adoption process can be considered as a form of adaptation, composed of several stages. Firstly, there is the appropriation phase, which involves access to necessary technological resources. Next is the objectification stage, where technology becomes a common part of the environment and is integrated into the individual's reality. The third phase is incorporation, where technology begins to be part of daily activities and practices. Lastly, there is the conversion phase, where technology is modified to solve problems different from those for which it was originally designed [13].

According to Barajas and Olvera [8], among the internal challenges affecting upper secondary education in general, the low graduation rate, high rates of failure and dropout, as well as insufficient educational levels, stand out. These problems are largely attributed to social and economic factors, as well as high rates of failure.

However, dropout is also due to the lack of programs that guide and motivate students to continue and complete this educational level.

The new educational reforms and agreements developed in recent years by the Federal Government aim to raise the quality at all educational levels, from preschool to professional. These reforms are focused on student attention as the main axis. The current government's policy through the new educational reform is to continue strengthening educational programs in upper secondary education (EMS), which, in some way, obliges both teachers and administrators to design innovative proposals for formal education aimed at the student population to ensure that the student is capable of problem-solving, critical, and reflective thinking, as well as working collaboratively [16].

From the above, the importance of using open-source software in upper secondary education in Mexico as an innovative strategy is derived, as it can adapt, focus, and develop perfectly in most generic competencies, leaving open the possibility of acquiring others according to the regional, work, and academic context. Unfortunately, the adoption of open-source software in educational institutions, particularly in upper secondary education, has not been considered by educational authorities as a valuable tool for the educational work of students and teachers. The objective of the present research was to evaluate whether the use of open-source software can contribute to the improvement of learning environments in an upper secondary education institution in Mexico.

2. Methodology

The nature of the present research was quantitative. With this approach, it was intended to establish whether the qualities of programs developed with free software allow for the improvement of learning environments in upper secondary education, as well as whether they can contribute to the development of innovative didactic strategies by the teacher.

The research was applied in nature since, based on the results obtained, it was possible to determine whether the characteristics of free software allow for the improvement of both the development of students' competencies and the adoption by teachers, enabling them to better develop their educational practice at a given time.

The research design was non-experimental, descriptive, and correlational, as inferences about relationships between variables were made without direct intervention or influence, and these relationships were perceived as they occurred in their specific environment.

It was cross-sectional because data were collected at a single point in time, in a unique timeframe; it was descriptive as the study variable was identified and measured. It was correlational, as a relationship between the indicators of the study variable was established.

The mode was field with bibliographic support, as in this research, information was gathered and analysed regarding the adoption of open-source software in the educational sector as a means of improving upper secondary education.

The research was conducted within the facilities of the upper secondary education institution, commencing in November of 2020, and concluding in December of the same year.

The population of interest comprised the students and teachers of an upper secondary education institution in Mexico.

The sample frame was developed considering the information provided by the High School Education Services System (SISEEMS), which was provided by the Ministry of Public Education to each upper secondary education institution in the country. Thanks to this system, it was possible to find and identify the students and teachers of the upper secondary education institution. Once identified, they were selected, and the measurement instrument was applied. A total of 2800 students were identified, distributed among 58 groups, 29 morning groups and 29 afternoon groups, which are attended by 101 teachers in both shifts.

The unit of analysis comprised all those students and teachers of the upper secondary education institution who had the following characteristics: 1) were studying or teaching in the professional component of the computer equipment support and maintenance career; and 2) were studying or teaching in the first, third, and fifth semesters in both shifts.

Based on the above, 200 students and 19 teachers with these characteristics were identified. The sample selection was census as all individuals within it were interviewed.

Due to the health contingency caused by the COVID-19 coronavirus, it was impossible to administer the questionnaire to the total student sample (200) since 35 of them fell into the category of those who did not connect to online classes, allowing a survey of only 85% (175) of them. On the other hand, regarding the teacher sample, the survey was administered to 100% (19) of them.

The study variable evaluated was the use of tools and systems based on open-source software by the students and teachers of the upper secondary education institution.

The questions for the teachers in this study were grouped into the following dimensions: I) level of skills, knowledge, and adoption; II) degree of perception; and III) degree of implementation.

The questions for students were grouped into the following dimensions: I) level of skills, knowledge, and adoption; II) degree of perception; III) characteristics of the students; and IV) degree of availability.

Data collection was carried out through the application of two questionnaires, one for teachers and one for students at the educational institution, which had 27 questions for the former and 25 questions for the latter. For this purpose, form templates were used through the Google Forms platform for data collection. Once the information gathering instrument was prepared, the questionnaires were sent to the subjects of the selected sample for the research.

The Likert scale was used to carry out this process. Everyone was asked to express their opinion by selecting one of the five points or categories available on the scale. A numerical value was assigned to each point. The reliability of the instruments for each of the dimensions was calculated using Cronbach's internal consistency coefficient, which reported acceptable results ($\alpha \geq 0.823$) for the teacher instrument and ($\alpha \geq 0.772$) for the student instrument.

Once the participation of all respondents was completed, the spreadsheet with the collected information was downloaded and subsequently exported to a statistical analysis program. Afterward, a Pearson correlation analysis was conducted using the statistical package for the social sciences (SPSS).

3. Results

A Pearson correlation analysis was conducted on the instrument applied to the students, determining the independent variable (IV) referring to dimension II, degree of perception. The dependent variable (DV) refers to dimension I, level of skills, knowledge, and adoption.

Table 1 shows the results of the correlation, which yielded a value of 0.797, indicating a very strong and positive association between the variables. This demonstrates that there is a high level of knowledge and adoption, as well as an excellent perception among the students about the possibility of using and implementing open-source solutions in their educational activities. This could lead to the development and appropriation of learnings that can be integrated into the students' cognitive structure.

Table 1. Pearson correlation coefficient between the variables degree of perception (students) and level of skills, knowledge, and adoption

		IV Perception	DV Level of Skills, Knowledge, and Adoption
IV Perception	Pearson Correlation	1	.797
	Sig. (2-tailed)		.000
	N	175	175
DV Level of Skills, Knowledge, and Adoption	Pearson Correlation	.797	1
	Sig. (2-tailed)	.000	
	N	175	175

Table 2 shows the correlation analysis between the independent variable (IV), which refers to dimension IV, degree of availability, and the dependent variable (DV), which refers to the use of tools and systems based on open-source software.

Table 2. Pearson correlation coefficient between the variables degree of availability (students) and the use of tools and systems based on open-source software

		IV Degree of Availability	DV Use of Tools and Systems Based on Open-Source Software
IV Degree of Availability	Pearson Correlation	1	.513
	Sig. (2-tailed)		.000
	N	175	175
DV Use of Tools and Systems Based on Open-Source Software	Pearson Correlation	.513	1
	Sig. (2-tailed)	.000	
	N	175	175

The correlation results showed a value of 0.513 (Table 2), indicating a strong and positive association between the variables. This suggests that open-source software will, at some point, foster collaborative work and research among students. Most students indicated that using these types of tools and open-source solutions provides them with the opportunity to collaborate with their peers through debate, experimentation, and the generation of new ideas that contribute to solving specific problems.

Table 3 presents a correlation analysis of dimensions I and III. The dependent variable (DV) is dimension I, which refers to the use of tools and systems based on open-source software. The independent variable (IV) is dimension III, which refers to the degree of implementation.

Table 3. Pearson correlation coefficient between the variables degree of implementation (teachers) and use of tools and systems based on free software

		IV Degree of Implementation	DV Use of Tools and Systems Based on Free Software
IV Degree of Implementation	Pearson Correlation	1	.074
	Sig. (2-tailed)		.762
	N	19	19
DV Use of Tools and Systems Based on Free Software	Pearson Correlation	.074	1
	Sig. (2-tailed)	.762	
	N	19	19

The correlation analysis revealed a value of 0.074, indicating a very weak relationship between the variables, as depicted in Table 3.

This suggests that, presently, free software does not significantly support teachers in devising didactic strategies to cultivate new skills in students. Although there seemed to be an initial inclination towards positive trends in skill levels, knowledge, and adoption, as well as in the integration of free software within classroom settings, there still exists some resistance or hesitation among educators regarding its utilization. This reluctance could stem from misconceptions, such as the belief that certain open-source applications may pose challenges in installation or operation, feature confusing and unfriendly user interfaces, or lack compatibility compared to proprietary solutions.

Table 4 displays a Pearson correlation test between the independent variable (IV), which refers to dimension II, the degree of perception in teachers. In this case, the dependent variable (DV) was determined for dimension III, the degree of implementation. The correlation results yielded a value of 0.316, which, although positive, indicates a moderate association between variables. This suggests (in contrast to the previous correlation) that free software will enable the teacher, at a certain point, (and based on the development of materials, promotion of research, and collaborative work in the classroom) to individualize teaching based on students' prior knowledge.

Table 4. Pearson correlation coefficient between the variables degree of perception (teachers) and degree of implementation

		IV Degree of Perception	DV Degree of Implementation
IV Degree of Perception	Pearson Correlation	1	.316
	Sig. (2-tailed)		.000
	N	19	19
DV Degree of Implementation	Pearson Correlation	.316	1
	Sig. (2-tailed)	.000	
	N	19	19

According to the results obtained in the research, it was found that most surveyed students in the educational institution learn through visual stimuli, accounting for 46.9% of the sample, while 32% process information through sensory stimuli (touch, smell, and taste), and the remaining 21.1% do so through auditory stimuli, respectively.

4. Discussion

According to the results obtained, which included both teachers and students from different semesters of upper secondary level, there was a generally positive acceptance of open-source software. Research by Zúñiga [19] on the importance of adopting open-source software revealed that resistance is linked to potential decreases in skills and productivity in tasks, limited time to assimilate new knowledge, and lack of resources for training. This explains why high school students, instead of using open-source software, may prefer proprietary software. However, in the educational realm, besides the evident economic advantages, the adoption and integration of open-source software as part of the implementation of free information technologies (FIT) in education bring numerous benefits.

Developed by a broad community of individuals scattered geographically, with diverse customs, ideologies, and thoughts, it fosters cooperation, collaboration, and recognition of differences as a means of enriching and mutually reinforcing the values that should be transmitted from educational institutions [4].

On the other hand, it is important to note that despite the obtained results, if a teacher has been using proprietary software for a considerable period, they are likely to find it somewhat challenging to teach using this type of software. This was demonstrated in the results where most teachers stated that the learning curve for teaching with free solutions would increase. Similarly, surveyed teachers considered that free software is currently not a supportive tool for teachers in creating didactic strategies to develop new skills in students.

However, it is advisable to provide training to technology and computer science teachers so they can acquire skills in software usage, aiming to integrate it into the classroom environment. In this way, they will have access to a tool that offers significant benefits in the students' learning process and in their educational practice [15].

In their research on assessing teachers' digital competencies for the adoption of open-source software technologies, Trejo and Perales [13] highlighted that the lack of teacher training is the main obstacle to acquiring the necessary digital competencies for their professional development and educational work. Therefore, they suggested the implementation of a digital training program for teachers, which would establish objectives and course content with a theoretical-practical approach tailored to specific subjects. This would enable the effective use of software applications in the classroom.

Building upon the previous statement and based on the results of a study [3], the effect of technology use in university education was investigated. The findings revealed that knowledge acquisition can be achieved both individually and collaboratively through the utilization of software and virtual tools based on free software, which are readily available for both teachers and students, prior to learning assessment.

Technological appropriation is another important aspect that should not be overlooked. A percentage of surveyed teachers considered that it will eventually enhance their educational practice. This result aligns once again with the findings of Zúñiga [19], where it is concluded that, more than just access to technology, the true value of free software lies in its appropriation by the community. For this to be possible, technology must be able to sustain cognition in individuals beyond technological reach within the market, and furthermore, it must ensure that such knowledge truly remains in the hands of the community, without any restrictions.

Likewise, more than half of the surveyed teachers agree with the quantity of media and software provided by the educational institution in laboratories and classrooms as support for teaching their subjects. Similarly, the infrastructure is currently being frequently utilized, as just over two-thirds of the respondents mentioned using them, both for material development and teaching delivery. Altamirano [7] examined the impact of utilizing Web 2.0 resources, based on free software, as educational tools to enhance students' academic performance. The results obtained demonstrated that the use of digital tools based on free software not only improved students' academic performance but also provided teachers with an active, motivating, and critical pedagogical approach, allowing for significant learning in the educational environment.

The interviewed teachers have highlighted that the main advantage of using open-source tools is the ability to access new technology.

It is interesting to note that most respondents consider technological appropriation as the most important aspect that could help improve teaching practice. In turn, Ramírez *et al.* [12] conclude that the development of technological skills in teachers allows the possibility of generating, modifying, and adapting educational content automatically in teaching processes.

Most students consider it crucial to explain and begin using tools or solutions based on open-source software from the early semesters. According to Duque Méndez et al. [9], one way to reduce the large digital divide is by providing the academic community with access to technology in institutions such as schools, colleges, and universities. Regarding the availability and confidence teachers have when using open-source solutions for their academic and/or personal activities, having such infrastructure within the institution will greatly enable them to incorporate open-source software into these activities. This is supported by the fact that most teachers expressed great confidence in this type of software when considering it as part of their teaching strategies.

This is because most teachers expressed great confidence in this type of software when considering it within didactic strategies. It is worth mentioning that if teachers choose to use this type of software at any given time, most respondents believe they have the skills or competencies to work with open-source solutions. In a study [3], the effect of technology use in university education was investigated. The findings revealed that knowledge acquisition can be achieved both individually and collaboratively using software and virtual tools based on open-source software, which are readily available for both teachers and students before learning assessment.

Many surveyed teachers highlighted the importance of being able to access software that does not have any licensing issues. This will significantly contribute to reducing the downloading and use of illegal software within the institution. This can be compared with the results of the study [6] on the use of open-source software in secondary education in Catalonia, where most of the surveyed teachers agreed that it is precisely in this regard that the use of illegal copies is detrimental to open-source software. As schools and their stakeholders opt to use them, they are overlooking Open-Source Software as an alternative for the educational environment.

On another note, it cannot be asserted that open-source software cannot be incorporated as an alternative within learning environments, as there was identified a very positive acceptance by students regarding its use as support in strengthening cooperative and collaborative environments in the classroom, through the development of teamwork and group work.

Similarly, in a study [14], the potential effect of virtual learning objects (modules) developed on a digital platform based on open-source software in the learning process of university students was investigated. The results revealed a positive impact on student learning when using this platform as a complementary resource in their academic activities.

Furthermore, many students expressed agreement that there is a myriad of tools based on open-source software available for both general and specific tasks, which developers make accessible to users (documentation and firsthand assistance). On the other hand, it can be said that there is a certain confidence that users can directly reach out to developers and/or the user community, who are willing to help in case of any issues with the software. In this regard, Quezada and Pérez [10] point out that, with the openness and adaptability features of open-source software, it is possible to enrich students' comprehensive education, as professionals with greater job opportunities should possess extensive knowledge in information technologies. However, it is crucial that they also have skills that enable them to provide additional value to their employers, thus enhancing their resume.

Likewise, a good number of students believe that open-source tools could aid in their development and study by incorporating them into the various subjects they study. Therefore, students' willingness to use this type of software in collaborative environments within the classroom is perceived as positive. Considering this, in a study [9], open-source software is positioned as a valuable tool to support education at various levels and through various pedagogical strategies, surpassing even the capabilities of teaching systems based on proprietary products.

5. Conclusion

A statistically significant association was found between the most important features of open-source software, such as the ability to be freely studied and applied in different contexts, and the motivation and development of meaningful learning in students. This indicates that the most important features of open-source software motivate and develop meaningful learning in students.

There is a positive correlation between the use of open-source software and collaborative work and research among students. Therefore, open-source software promotes collaborative work and research among students.

There is no relationship between the use of open-source software and its use as a support tool for teachers in creating didactic strategies.

Therefore, open-source software is not a support tool for teachers in creating didactic strategies that allow for the development of new skills in students.

The use of open-source software can be adapted to the prior knowledge of the student, allowing the teacher to individualize instruction. This indicates that it will allow the adaptation of the student's current technological knowledge, thereby gradually achieving an understanding of how an open-source software solution works. Based on this, the use of open-source software can be adapted to the student's prior knowledge and work pace, allowing the teacher to individualize instruction.

The adoption of open-source software in upper secondary education is a valuable support in developing new didactic strategies, creating learning and cooperation scenarios and environments through the application of strategies, methods, techniques, and activities centered on learning that favor the generation, appropriation, and application of professional and generic competencies in various contexts. Consequently, the use of open-source software can help improve learning environments in the upper secondary education institution.

References:

[1]. Aguirre Mejía, E. T., & Canibe Cruz, F. (2020). Análisis de competencias clave, como factores para transferencia del conocimiento. *Investigación administrativa, 49*(126). Doi: 10.35426/iav49n126.05

[2]. Gómez, O. Y. A. (2018). Las TIC como herramientas cognitivas. *Revista interamericana de investigación, educación y pedagogía*, *11*(1), 67-80. Doi: 10.15332/s1657-107X.2018.0001.07

[3]. Ávila, A. A., Chamba, D. F., Paucar, R., & Tulcán, J. M. (2020). Software libre en el proceso de enseñanza aprendizaje de la educación superior. *Convergencias y divergencias en investigación,* 366-373.

[4]. Cordovilla, F., Salvatierra, L., & Lara, A. (2020). El software libre como una herramienta para una educación de calidad en Latinoamérica. *Revista Inclusiones,* 303-318.

[5]. Criollo, L. J. P. (2019). Las bondades del software libre en el proceso de enseñanza–aprendizaje en la educación media. *Revista Interamericana de Investigación, Educación y Pedagogía*, *12*(2), 139-156. Doi: 10.15332/25005421.5011

[6]. Costa Silva, F. de A., & Escofet, A. (2013). Un estudio de caso sobre el uso del software libre en la enseñanza secundaria en Cataluña. *Campo Abierto. Revista De Educación, 32*(2), 71-95.

[7]. Díaz Altamirano, G. V. (2020). *Análisis de la incidencia en el uso de recursos web 2.0 en software libre como recursos didácticos en el proceso enseñanza-aprendizaje* [Tesis de maestría, Escuela Superior Politécnica de Chimborazo]. Repositorio Institucional de la ESPOL.

[8]. Díaz Barajas, D., & Ruiz Olvera, A. (2018). Reprobación escolar en el nivel medio superior y su relación con el autoconcepto en la adolescencia. *Revista Latinoamericana de Estudios Educativos, 48*(2), 125-142.

[9]. Duque Méndez, N. D., Uribe Hurtado, A. L., & Tabares Morales, V. (2016). Software libre para apoyo a los procesos educativos. *Teknos Revista científica*, *16*(1), 28–36. Doi: 10.25044/25392190.804

[10]. Quezada, A. M. V., & Pérez, C. C. (2018). Software libre en la educación de profesionales del diseño. *Tipeé*, *1*.

[11]. Racero, F. J., Bueno, S., & Gallego, M. D. (2020). Predicting students' behavioral intention to use open source software: A combined view of the technology acceptance model and self-determination theory. *Applied Sciences*, *10*(8), 2711. Doi: 10.3390/app10082711

[12]. Celaya Ramírez, R., Lozano Martínez, F., & Ramírez Montoya, M. S. (2010). Apropiación tecnológica en profesores que incorporan recursos educativos abiertos en educación media superior. *Revista mexicana de investigación educativa*, *15*(45), 487-513.

[13]. Rocha Trejo, E. H., & Hernández Perales, J. A. (2020). Valoración de las competencias digitales en docentes para la adopción de tecnologías de software libre. Proyecto Kids on Computers. *E-Ciencias de la Información*, *10*(2), 1-22. Doi: 10.15517/eci.v10i2.40774

[14]. Rossetti López, S. R., García Ramirez, M. T., Rojas Rodriguez, I. S., Morita Alexander, A., & Coronado García, M. A. (2020). Objeto virtual de aprendizaje creado con plataforma de software libre H5P y su impacto en el aprendizaje. *Revista Cubana de Ciencias Informáticas*, *14*(2), 1-14.

[15]. Salazar, L. G. (2023). Aplicación con software y hardware libre Arduino como eje facilitador del aprendizaje de competencias stem. *Academia y Virtualidad*, *16*(1), 69-88. Doi: 10.18359/ravi.5900

[16]. Secretaría de Educación Pública (2020). *Programa Sectorial de Educación 2020-2024.* Gobierno de la República, México.

[17]. Thankachan, B., & Moore, D. R. (2017). Challenges of implementing Free and Open Source Software (FOSS): Evidence from the Indian educational setting. *International Review of Research in Open and Distributed Learning*, *18*(6), 186-199. Doi: 10.19173/irrodl.v18i6.2781

[18]. Valenzuela Urra, C., Reyes Lillo, D., & Oliveros Castro, S. (2018). Introducción: Software libre y código abierto: experiencias innovadoras en bibliotecas y centros de información. *Palabra clave*, *8*(1), 1-2. Doi: 10.24215/18539912e054

[19]. Zúñiga, B.L. (2006). *Voces libres de los campos digitales*. Bellanet Internacional.