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Current university, from traditional teaching to learning through STEAM

Universidad actual, de la enseñanza tradicional al aprendizaje a través de STEAM

Universidade atual, do ensino tradicional ao aprendizado através da STEAM

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Abstract

This article was developed at the Polytechnic School of Chimborazo in the city of Riobamba, Ecuador, in order to determine the students' perception of the teaching model through STEAM approach to academic achievement in today's university. The materials and methods are in the context of the positivist paradigm, a quantitative investigation has been carried out, and an instrument with a Likert-type scale was applied to a sample of fifty (50) people. Students of the Graphic Design degree, namely: Fifth, Sixth and Ninth semester. In two moments: a pre-test phase, which involved the traditional teaching model and a post-test phase, through activities under the STEAM approach with tools made possible by the STEAM Thinking Lab. The results obtained indicated that the students preferred the activities that involved inquiry as a means of learning with the use of digital development devices such as those found in the STEAM Thinking laboratory in 66%. In addition, they showed preference for teaching techniques such as those applied through the STEAM teaching model by 54%. Finally, 60% to 90% of students were approved in the post-application evaluations of the inquiry education scheme.

Keywords: Teaching Model; STEAM; perception; approach.

Resumen

Este artículo fue desarrollado en la Escuela Politécnica de Chimborazo en la ciudad de Riobamba, Ecuador, con el fin de determinar la percepción de los estudiantes sobre el modelo de enseñanza a través del enfoque STEAM del rendimiento académico en la universidad actual. Los materiales y métodos se encuentran en el contexto del paradigma positivista, se ha realizado una investigación cuantitativa y se aplicó un instrumento con escala tipo Likert a una muestra de cincuenta (50) personas. Alumnos de la carrera de Diseño Gráfico, de Quinto, Sexto y Noveno semestre. En dos momentos: una fase de pre-test, que involucró el modelo de enseñanza tradicional y una fase de post-test, a través de actividades bajo el enfoque STEAM con herramientas posibilitadas por el STEAM Thinking Lab. Los resultados obtenidos indicaron que los estudiantes prefirieron las actividades que involucraban la indagación como medio de aprendizaje con el uso de dispositivos de desarrollo digital como los que se encuentran en el laboratorio STEAM Thinking en un 66%. Además, mostraron preferencia por técnicas de enseñanza como las aplicadas a través del modelo de enseñanza STEAM en un 54%. Finalmente,

del 60% al 90% de los estudiantes fueron aprobados en las evaluaciones posteriores a la solicitud del esquema de educación de indagación.

Palabras claves: Modelo de enseñanza; STEAM; percepción; enfoque.

Resumo

Este artigo foi desenvolvido na Escola Politécnica de Chimborazo, na cidade de Riobamba, Equador, a fim de determinar a percepção dos alunos sobre o modelo de ensino através da abordagem STEAM para o desempenho acadêmico na universidade de hoje. Os materiais e métodos inserem-se no contexto do paradigma positivista, foi realizada uma investigação quantitativa e aplicado um instrumento com escala do tipo Likert a uma amostra de cinquenta (50) pessoas. Alunos do curso de Design Gráfico, a saber: Quinto, Sexto e Nono semestre. Em dois momentos: uma fase de pré-teste, que envolveu o modelo tradicional de ensino e uma fase de pós-teste, através de atividades sob a abordagem STEAM com ferramentas possibilitadas pelo STEAM Thinking Lab. Os resultados obtidos indicaram que os alunos preferiram as atividades que envolviam investigação como meio de aprendizagem com a utilização de dispositivos de desenvolvimento digital como os encontrados no laboratório STEAM Thinking em 66%. Além disso, mostraram preferência de 54% por técnicas de ensino, como as aplicadas por meio do modelo de ensino STEAM. Por fim, 60% a 90% dos alunos foram aprovados nas avaliações pós-aplicação do sistema educacional de inquérito.

Palavras-chave: Modelo de Ensino; STEAM; percepção; abordagem.

Introducción

Improving teaching processes in the university education stage has represented a goal for many of the vocational training institutions. As Guitert and Pérez (2013) affirm, collaborative processes in the educational field are not new. Yet, it is a fact of constant study for the specialized sciences in teaching to be able to appropriately enable instructional models, which allow the consolidation and achievement of learning. The role of the teacher and the teaching methodology at the university level has often been overlooked, however, the role of the teacher is essential for the development of knowledge at this level, a recent study by Columbia University (USA) shows that, out of 200 words per minute that a teacher can speak, the student captures about half; students retain 70% of what is explained in the first ten minutes of class and only 20% of what is explained in the last ten minutes, remaining attentive only about 40% of the time that the class

lasts (Tourón and Santiago, 2015). Therefore, the need to strengthen teaching schemes has been urgently seen, a topic that requires a lot of attention in universities and higher education or university level training centers. According to Sinchi and Petrona (2018) Ecuador's higher education has undergone transformations since the last decade, the current constitution guarantees the right to it, observing the principle of equal opportunities and permanence through the Organic Law of Higher Education (LOES). Due to the academic innovations developed for this purpose, aim to improve the teaching-learning processes and the demonstration of an educational instruction scheme that is favorable for the largest number of students, it has been sought to determine the modifications of teaching plans, the contents taught and the means of communication of the subjects of instruction, which must be reviewed, updated and in some cases eliminated. Therefore, much has been studied in various spaces in order to promote the implementation of pedagogical models that promote the progress of teacher action at these levels.

Thus, the elements that indicate when an instruction method is being adequate in a given academic or instructional space have been demonstrated in various investigations, university students are usually the ones who tend to drop out and repeat courses. According to Torres et al. (2015), repetition is an indicator of deficiency of educational systems, especially university, since the efforts of governments in terms of investments per student in each school period are doubled. Therefore, research on the needs of university institutions in practice is becoming increasingly incipient. In Latin America, the incorporation of government programs focused on reducing dropout and repetition rates, in part have increased the efficiency of educational systems mainly in three ways: (1) strengthening attendance, (2) increasing approval rates and (3) reducing disapproval (García et al. 2010; Acevedo et al. 2015a; & Acevedo et al. 2015b). For this reason, it is important that teaching schemes at all instructional levels, but above all in the university context, are analyzed and studied directly from the perception of the student body.

In this sense, Vallet et al. (2017) warn that one of the elements to consider in many of the instructional schemes, especially in university spaces, are the effects of cooperative learning, most of them have focused on the comparison of results between cooperative learning contrasted with competitive and the individual learning. Due to cultural heritage, it has been believed that the student should be passive in the teaching process. La Madriz and Mendoza (2018), on the other hand, maintain that the educational model of the industrial era, with typical values of said organization: hierarchy, planning, control and standardization, consisted of training individuals to

be incorporated into the work field, hence the structuring of the study plans focused on the traditional class, where students attend the classroom to listen to the exposition of theoretical knowledge that is transmitted by a teacher, in which their participation is minimal and is encouraged constantly the passive listener attitude. However, this theoretical precept has emerged after a large number of investigations show weaknesses in general, since students obtain greater achievements when they feel supported or strengthened by other classmates, according to studies such as that of Vallet et al. (2017), one of the foundations of cooperative learning is positive interdependence among team members, where everyone cares and feels responsible, not only for their learning, that is, the student's commitment to cooperative learning , but also from the work of others. The motivation to commit arises from the fact that the success of each one is linked to the success of the others or that the individual difficulty can be mitigated by the help provided by the rest. Thus, as the teaching models that adapt in an ideal way to each of the precepts described above, where spaces are enabled to share ideas, create models, experiment collectively, are the responses to variables such as the need to feel strength In the case of individual weaknesses, therefore the requirement of having these innovative and flexible teaching models arises.

Carranza and Caldera (2018) affirm that one of the most important challenges for educational research in recent years has been to know how ICT and the teaching strategies used by teachers impact on the significant learning of students, though constant pedagogical actions are being carried out to combine ICT with traditional training. Thus, the implementation of the STEAM methodology is conceived as an alternative for solving problems of disinterest and the demotivation of subjects in a given context, it is therefore a tool that emerges as a choice for the consolidation of meaningful learning in students. Prolongo and Pinto (2019), describe the (acronym in English of the areas of knowledge: Science, Technology, Engineering and Mathematics) with the addition of some artistic disciplines. The term used refers to an important subset of university study specialties that are considered important and essential for the development of modern societies, more properly for the construction of the current era in which technology is increasingly necessary, for the development of learning processes and consolidation of knowledge at all levels.

Initially, Prolongo and Pinto warn that the STEAM term used today derives from STEM, which was used in North America to describe those least demanded jobs due to the lack of inclusive

learning, which motivated people to join in the required workspaces. A primary aspect with the use of the methodology for learning through the STEAM model is that it promotes the incorporation and conjugation of different disciplines of knowledge, which converge in the same environment and context, with the aim to achieve learning and promote the consolidation of new knowledge in the area where it is necessary. According to Zamorano, García and Reyes (2016) the education through the STEAM methodology is based on the constructionist theory of learning of Seymour Papert, learning is understood as a continuous, variable and particular process, which is built and rebuilt as the individual interacts dynamically with the physical, social and cultural world in which he is immersed and in the construction of objects that address the need to solve a problem through research and design processes, being the interaction and construction the keys in the production of knowledge, conceived as product of own work and the result of the set of experiences of the person from birth.

In such a manner that, the benefits of a teaching alternative that corresponds to the implementation of a different learning model, in which science, technology, engineering, art in its various expressions, as well as mathematics are present to clearly transform the traditional teaching environment. One of the aspects worth highlighting of Ecuador's recent reforms in education are the academic progress made by students. Given the variety and breadth of the reforms implemented in Ecuador, and in the absence of impact studies of continuous training initiatives, it is not possible to attribute to them exclusively the progress observed (Chiriboga, 2018). For this reason, within the education of today in the first levels and also in universities, means of implementing STEAM are being created, due to the institutions during remembered times were characterized by the rigor of traditional models, especially in content of greater difficulty, such as the basic or elementary sciences (Physics, Chemistry and Mathematics), mostly typical of the specialties of engineering faculties, which are presently contrasted with a subset of non-traditional teaching methodologies, novel in many cases where they are used, in addition to representing a relevant element for the efficiency they can have in understanding laborious content to solve; the closeness to society of the current moment, as well as the variable that also promotes collaboration for learning, makes these factors verifiable in the case, for instance, extensive exercises proposed which, the students with great tension, had to solve in a certain time under the eye of the teacher or tutor.

With STEAM, teaching models are altered and modified in an opportune and accurate way, according to previous studies such as that presented by Yildirim (2016), STEM education includes different disciplines in various subjects, therefore, one of the most important roles of this methodology is that it ensures that teachers are investigating, questioning and criticizing individuals, which helps their own professional progress as researchers, such as that developed by the OAS (Organization of American States) (2016) and its team of specialists who collaborate in the educational portal of the aforementioned body, who affirm that "it is necessary that basic and higher education promote interest so that the number of students who choose professions in the STEAM areas and have the necessary skills to continue with his advanced studies increases. The professions at STEAM are rapidly growing and have the greatest influence to boost innovation and economic development in the countries, as well as endorsing individual and social economic success ", for this reason the promotion of this form of teaching is increasingly diffused, since among its advantages there are aspects inherent to the current technological and scientific progress and appropriate to the collective and personal needs of each student.

The OAS (2016) describes, this teaching model called STEAM at Higher Education level, promotes "inquiry as a pedagogical strategy" and didactics. In this way, inquiry is conceived as a practice that is closer to the way in which science and technology are developed; so, it is relevant to the way these projects are handled within STEAM topics. Therefore, one of the most necessary aspects in the present is to adapt according to Prolongo and Pinto the controversies concerning its effectiveness and doubts about how to put it into practice. To complete this perspective and attempting to serve as a source of inspiration for other colleagues, regarding some STEAM tools, such as, for example, STEAM thinking laboratories, which have been designed and implemented by the authors of this referred work in recent years. In addition, from project resources called Scientix, a European initiative that strongly promotes STEM education by offering an array of contrasted educational tools.

In this way, STEAM and the set of tools derived from it become a novel element within the conglomerate of traditional education, which many of the university students are used to, for years they have been experiencing the rigor of study that do not allow any flexibility in the teaching and learning processes in most cases, according to Kelton & Saraniero (2018), STEAM education promotes collaborations to combine disciplines such as art and mathematics, as an intelligible way to overcome the multi-referential barriers that impact the collaborative generation

and promotion of learning, catalyzing shared professional growth. In this order, the Laboratories of Inquiry or STEAM Thinking Lab, which have been working in developed countries such as the United States of America, become a reference for the teaching model that is promoted in Ecuador at the moment in the scheme of efficient University that seeks to establish through new researches in teaching and academic achievement.

According to Carreño and Lozano (2019), with this set of strategies it is intended to strengthen STEAM skills at all levels in which it has been applied so far, with creative products demonstrated in scientific articles which have been presented at national and international conferences. Therefore, at Ecuadorian University it is considered that this will be possible through the STEAM Thinking Lab, as it has been developing in some regions since in Ecuador at the moment (2019) 8 Fab Labs have been registered, 5 in Quito, 1 in Ibarra, 1 in Guayaquil and 1 in Cuenca, also another one has been recently implemented in the facilities of the School of Computer Science and Electronics of the Polytechnic of Chimborazo (from its initials ESPOCH). With the aforementioned laboratory, the digital fabrication of technological development projects by students is sought, with a more professional use than just academics, through the production of physical objects on an external scale order. To do this, this proposal has been linked to the Fab Labs model (English acronym for Fabrication Laboratory). The latter are a global network of local laboratories that foster creativity by providing individuals with digital manufacturing tools.

Due to the aforementioned, this article aims to know the perception of the students of teaching models of the current university and the feasibility of the application of the STEAM model in the Ecuadorian university students from the School of Computer and Electronics of the Polytechnic of Chimborazo, as an alternative and innovative method of viable teaching for the achievement and consolidation of individual and collective academic goals, due to it has been shown that in subjects with a higher level of difficulty and in the content of other theoretical subjects cognitive gaps are noticed in students, it is mandatory to know if there is a link with the teaching method that such aspects are becoming evident in higher education levels, as these changes occur, the generation of specific pedagogical configurations becomes necessary to allow the development of prepared individuals (Leong, 2017), as well as knowing if there is acceptance of the implementation of this set of tools through the incorporation of a STEAM Thinking Lab, in higher education processes at the current University of Ecuador, in order to expand the inquiry

levels, production of real solutions for the same subjects and search of the own knowledge on the part of the university students in the referred country.

Materials and methods

Design

A quasi-experimental quantitative study was carried out, in which the traditional teaching methodology was applied to the groups of students in four study sections, from three different semesters. A series of classes were prepared with conventional methods for a week, in which each of the usual teaching tasks was completed and the students recorded the scheduled activities as part of the evaluation, taking into account a population that is enrolled and taking four different subjects, the teacher was instructed that the instructional material should be applied in class with the same teaching scheme, for every day of the week; it is why the course of actions was done in a normal way, with the teaching of the class and the strategies that are regularly applied in the classroom. Subsequently, in an initial phase, the "pre-test" was applied, an instrument designed to measure the degree of acceptance or preference and the opinion that the people surveyed have regarding the traditional teaching methods used by the teacher of the subject. After a week of traditional classes, there was a week of intermission in which the students presented their evaluations contained in the study plan of the course taken. Thus, the following week, after completing the previously planned tasks and exams, the STEAM method was applied in class, where an activity plan that was fully executed during five consecutive days of teaching was structured, obtaining the respective interaction of the students. Then, the appropriate evaluations of the content were carried out, involving actions with collective dynamics to evaluate individual and group progress. Finally, the survey was repeated using the same data collection instrument applied in the pre-test phase, to assess the students' appreciation of the teaching model used in this second phase called "post-test".

Variables studied

In this process of investigation, the independent variable was the teaching methodology, with two types: the traditional and the STEAM, and the dependent variable was the academic achievements of the university students, after applying the teaching model and the respective evaluations.

Process

For the development of the research presented in this article, a previous selection of the subjects who carry out academic life within the Polytechnic of Chimborazo was made, punctually in the Faculty of Informatics and Electronics, students of the Graphic Design Career, it was determined, according to the statistical data of the institution and the register of the teachers; that the greatest difficulty for the process of pursuing studies occurs in the semesters: Fifth, Sixth and Ninth with the subjects Statistics, Research, Entrepreneurship and Thesis Design respectively. Following Andueza (2014) suggests that before starting the intervention, the material should be disclosed to the collaborating teachers so that they could become familiar with it and make suggestions for modifications. Therefore, the proposed strategies material within the STEAM scheme was delivered to the teachers in order to prepare for the set of activities that they had to carry out in the week of classes with this instructional focus.

Reason why a Likert scale type data collection instrument was developed with a series of questions referring to the way in which students perceive the teaching techniques used by teachers of different subjects in the university context Therefore, the instrument sought to learn from the study subjects themselves: their difficulties, liking and preferences regarding the form of instruction currently used in the university, the evaluations and study techniques that are promoted by the professors of the subject that they take.

Sample

The subjects of the sample are people who are studying graphic design career, which are distributed as follows: thirty (30) women and twenty (20) men, who maintain similarity in terms of age, socioeconomic status and prior knowledge of the subject. The ages are between 19 and 23 years, and belong to a lower middle-social condition, a total of fifty (50) subjects.

Inclusion criteria

Students duly enrolled in the semester (period, April 2020 - September 2020).

The subjects: Statistics, Research, Entrepreneurship and Thesis Design take place in the Fifth, Sixth and Ninth semesters respectively.

Exclusion criteria

Students who are not studying the subject even if they are matriculated (enrolled) in any of the four described in Table 1.

Table 1: Semesters and Subjects of the students taken as a sample

Level / semester	Subject	Number of students
Fifth	Statistics	18
Sixth	Investigation	11
Nineth	Entrepreneurship	10
Nineth	Thesis Design	11

Source: Santillán (2020)

Sampling Strategies

A type of intentional sampling was applied with said population, since only the set of students who were relevant for the data collection were selected, these are the students who met the inclusion criteria previously defined by the study author. The total of the elements of the universe were fifty (50) people, thirty (30) women and twenty (20) men respectively, which constitute the population sample selected for the research, these are all enrolled in the course of any of the mentioned curricular units.

Reference to the type of statistical analysis used

A statistical analysis based on the descriptive and inferential aspect of the data was applied, using count measures such as the pre-test and post-test average of the students taken as a sample, as well as the standard or standard deviation for the evaluation of the main criteria of the evaluations in the two moments in which knowledge tests were applied within the research. The T-student was also used to compare the results.

Information processing and analysis

- Design of collection instruments directly from primary information sources (selected sample) (data collection).
- Apply data collection instruments to the representative sample of the population under study.
- Registration of the initial results of the investigation (pre-test stage)
- Application of the instrument for data collection after the implementation of the STEAM methodology (post-test)
- Analysis of the main elements found.
- Tabulate the information from the data obtained.

- Analyze and interpret the information and represent them numerically and graphically.

Data Collection Instrument designed

The data collection instrument designed in this investigation was structured as a closedresponse questionnaire, with the characteristics of a scale based on the Likert model, which had five response options: 1: Strongly agree, 2: Agree, 3: Neither agree nor disagree, 4: Disagree, 5: Strongly disagree. With a total number of six proposed criteria, which were exposed in the form of items that, according to their preference, the respondents responded in a unique way in two research moments (pre-test and post-test).

Possible limitations

Among the possible limitations, it is possible that not all the enrolled students and students of the subjects are present in the classroom, in the two data collection processes within the Polytechnic of Chimborazo, both in the pre-test and post-test stage. However, these elements will be controlled by anticipating and notifying the students of the two moments in which the data inherent to the ongoing research will be collected.

Analysis and results

After the data collection process was developed, the collected data analysis phase proceeded, which occurred at two points in time. The first one corresponded to a pre-test in which the instrument formulated under the Likert scale was applied to know the preferences and opinions of the surveyed students, who corresponded to three (3) semesters of the Graphic Design degree at the Polytechnic of Chimborazo in Ecuador. This survey was answered by all the students, during a period of one week in the spaces of the classrooms during the course of their subjects as usual.

Table 2: Distribution of the sample of students by semester

Semester	Number of students per semester
Fifth	18
Sixth	11
Nineth	21

Source: Santillán (2020)

In this order, the most significant results have been collected and expressed in contingency tables, showing by criteria the values of the scale adopted, both for the pre-test stage, in which only the traditional teaching model was implemented, including the predefined evaluations in the class plan, as in the post-test stage in which the data collection was based on the STEAM model, in the class scheme that was carried out during the week after the learning evaluation, previously planned with the conventional teaching method from a constructivist approach, in which students had a limited participation in obtaining answers through research and cooperative work, so it was specified that students do not agree with the model implemented in a 54% (See Table 3). On the other hand, the most significant post-test values are shown, which refer to the acceptance of the teaching method or of lecture utilized by university professors through inquiry learning promoted by STEAM education.

Table 3: Acceptance of Teaching Techniques

Instrument Measurement Scale	**Pre-test**	**Post-test**
	% of Absolute Fr.	**% of Absolute Fr.**
Strongly disagree	0	0
Disagree	8	2
Neither agree nor disagree	34	8
Agree	54	24
Strongly agree	4	66

Source: Santillán (2020)

Regarding the criterion of pertinence in the classroom of the implementation of individual and collective evaluative activities within the classroom, according to the teaching model adopted, the values obtained are those expressed in the two moments of data collection (pre-test and post-test), are in Table 4, which show that there are more than 50%, properly 56% of the students in the post-test after implementing both teaching models (traditional and STEAM) which indicate that "strongly agree" with the criterion activities used in individual and collective classes for the

evaluation of learning are the most suitable. It can be seen that they are totally different from the applied consultation time.

Concerning the mentioned above, the differences in the responses and values they take on the adopted scale are notable, between the traditional model and STEAM. This is due to the fact that in addition to the classroom activities during the instruction process corresponding to the phase of use of the STEAM scheme, teachers were told to use the STEAM Thinking Lab that has been implemented at the Faculty of Computer science and Electronics. Which seeks digital manufacturing for more professional than just academic use by producing physical objects at external scale orders. To do this, this proposal has been linked to the Fab Labs model (English acronym Fabrication Laboratory). With this tool creativity is encouraged, providing individuals with digital manufacturing tools.

Table 4: Pertinence of individual and collective evaluative activities in all academic objectives

Instrument Measurement Scale	**Pre-test**	**Post-test**
	% of Absolute Fr.	**% of Absolute Fr.**
Strongly disagree	0	0
Disagree	16	4
Neither agree nor disagree	24	6
Agree	42	34
Strongly agree	18	56

Source: Santillán (2020)

On the other hand, when consulting students about the motivating elements that occur from the role of the teacher of the subject, in the conventional teaching method used, the results contrast when compared with the STEAM model, being the most significant values those found in the scale of the alternative "Agree" of 46% in the traditional method, being the latter 72% when measuring the opinion of the students on the motivation that represents the role of the teacher based on the implemented teaching method, such aspects are expressed in Table 5.

Table 5: Students' motivation towards the role of the teacher who implements the teaching method

Instrument Measurement Scale	Pre-test	Post-test
	% of Absolute Fr.	% of Absolute Fr.
Strongly disagree	4	2
Disagree	16	6
Neither agree nor disagree	22	12
Agree	46	72
Strongly agree	12	8

Source: Santillán (2020)

According to the students surveyed as part of the research, the perception that the students have about the influence of the teaching method and the relationship of collaborative activities with the improvement of the academic goals, is another element that contrasts widely in the two types of schemes of instruction in the university currently, considering that after the implementation of education under the STEAM method the academic goals are improved as a result of collaborative activities in the classroom, this response was obtained in the option "Strongly agree" with 78%. Such values are collected in Table 6.

Table 6: Perception of improvement in academic goals and their relationship with collaborative activities as a result of the teaching method used in the classroom

Instrument Measurement Scale	Pre-test	Post-test
	% of Absolute Fr.	% of Absolute Fr.
Strongly disagree	8	4
Disagree	2	0
Neither agree nor disagree	22	2
Agree	60	16
Strongly agree	8	78

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Source: Santillán (2020)

The criterion that was analyzed in the following section was the preference of cooperative activities of the subject and extra-subject for the consolidation of learning in the classroom. This quantitative value was variable, when consulting at the two moments both in the pre-test and in the post-test of the investigation, due to the result obtained from the examinees were remarkable and variable, passing from the alternative of "Agree" of 60 % to 82%, they are expressed in Table 7 in a comparative way. From which it can be deduced that the students prefer research activities that allow collective work with common goals of achievement that benefit the learning of all the members of a certain study team.

Table 7: Preference for the cooperative activities of the subject and extra-subject for the consolidation of learning

Instrument Measurement Scale	**Pre-test**	**Post-test**
	% of Absolute Fr.	**% of Absolute Fr.**
Strongly disagree	8	2
Disagree	0	0
Neither agree nor disagree	24	8
Agree	60	82
Strongly agree	8	8

Source: Santillán (2020)

Finally, the aspect evaluated about the perception of the teaching model adopted currently by the teachers within the University in general areas of study was also another relevant element, since the instruction model has incidence in the way in which students adapt to the institution and therefore their learning is consolidated in a better way. According to the results obtained in the measurement carried out for this criterion, in the pre-test phase 34% of the students declared to be in "Disagreement" around the proposition that the study schemes implemented by the university teachers of the Polytechnic of Chimborazo are appropriate to the needs, 52% were neutral to this premise, responding in the "Neither agree nor disagree" category, however, in the post-test phase when applying the STEAM model and after two weeks different results were obtained, in which

48% of the respondents claimed to "Agree" with the instruction model, representing this an indicative element of the level of acceptance and preference that the STEAM teaching scheme adopted by teachers during a week of formal classes represented. Therefore, the wide incidence on the results of academic evaluations was also better than those evidenced by the traditional teaching model. All these aspects allow us to infer that the teaching strategies and the methodology adopted in the classroom by the teachers can be linked to the achievement of the University's objectives regarding the professional training of the students. The results of this criterion are shown in Table 8, at both moments of the study.

Table 8: Acceptance of the teaching model adopted by teachers within the university in general areas of study

Instrument Measurement Scale	**Pre-test**	**Post-test**
	% of Absolute Fr.	**% of Absolute Fr.**
Strongly disagree	6	4
Disagree	34	48
Neither agree nor disagree	52	40
Agree	8	8
Strongly agree	0	0

Source: Santillán (2020)

In order to respond to the research in the Faculty of Computer science and Electronics of the Polytechnic of Chimborazo on the implementation of the STEAM model as opposed to the conventional teaching method, the results of the evaluative activities applied in the pre-test and post-test stage of the study, in which individual exams were carried out on the thematic contents of the units studied in class, in the week prior to the application of the data collection instrument used in the present investigation. Obtaining results with important values for the developed research, which are shown in Table 9. With a passing average of 42% of the students from the three semesters with the monitoring of activities within the scheme of the traditional teaching method, while with the implementation of the activities that involved the STEAM the approved

ones were 90% of the evaluated students. Data that represent an indication that the academic goals planned by the teachers of the respective subjects were achieved in a broad context.

Table 9: Assessment results by semester with teaching methods

Semester	**Pre-test (Traditional teaching method)**					**Post-test (STEAM method)**		
	"Approved" Absolute Fr.	**% Approved Absolute Fr.**	**"Failed" Absolute Fr.**	**% Failed Absolute Fr.**	**"Approved" Absolute Fr.**	**% Approved Absolute Fr.**	**"Failed" Absolute Fr.**	**% Failed Absolute Fr.**
Fifth	7	39	11	61	12	67	6	33
Sixth	4	40	6	60	7	70	3	30
Nineth	10	48	11	52	19	90	2	10
Avrg. (mean)	**7**	**42**	**9,33**	**58**	**12,67**	**76**	**3,67**	**24**
Stat. Dev. (σ)	**3**	**-**	**2,9**	**-**	**6,0**	**-**	**2,1**	**-**

Source: Santillán (2020)

Discussion and Conclusions

The research presented in this article allowed us to conclude, after reviewing the results presented in the previous section, that in the present it is important and relevant both the educational action management and the teaching model as well as the instructional content taught in the university careers of the Polytechnics of Chimborazo, the process of updating the teaching schemes, is evidenced in the results related to the pre-test and post-test, 34% and 48% respectively of perception of acceptance of the instructional model used by teachers were obtained, This is interpreted as the way in which the teaching method adopted from the figure and role of the teacher, is currently seen, the variation of the values after the implementation of the STEAM model even more of a neutral perception about the instructional scheme is indicative,

representative and binding with the achievement of academic objectives as it was possible to demonstrate when obtaining the perception of the students around the criterion of Perception of improvement of the academic goals and its relation with collaborative activities as a result of the teaching method used in the classroom with 70% of students who gave the answer "Strongly agree" before the premise of whether said tasks together with other classmates could be considered relevant for the improvement of teaching purposes. Likewise, after applying the intervention, 67% of students passed in the applied evaluations, in the context of the subjects of the fifth semester of the Graphic Design course that involved the strategies with the STEAM teaching scheme, in the case of the approved in the sixth semester the value was 70% while in the ninth semester 90% of the students passed the knowledge activities that involved collective and individual inquiry as a means of learning. In addition, of course, the use of STEAM laboratory tools to which mentioned students have access in the facilities of the Polytechnic of Chimborazo in Ecuador.

These aspects allowed us to conclude that a change in the teaching models of the current University will indeed allow the progress of professionals with a better performance profile in the working and professional field logically. Which is indicative of a need for modifications in the instructional schemes that are currently used in the country's higher education institutions.

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