STEAM And Hackathon As Learning Strategies

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Abstract— *These The application of the STEAM-PBL Methodology in a Hackathon have been really successful, the achievements of collaborative groups of students are highly efficient; Students learn in situ, carry out action research, research with ICT in addition to testing the knowledge of different disciplines such as STEAM that contribute to the innovative sustainable solution. Therefore, it is concluded that the Hackathon together with the methodology with STEAM and PBL are powerful strategies for the construction of learning.*
Index Terms— *STEAM Methodology, Hackathon, Active strategies, Learning Strategies, Education*

I. INTRODUCTION

In this era where more and more activities of daily life are carried out using technology, where the Internet is required for multiple activities of companies and people, we now talk about smartphones, Artificial Intelligence, the Internet of Things (IoTs).), of Simulation to understand new scenarios and in the industry the concepts of Automation, Additive Manufacturing, Horizontal and Vertical Integration Systems, Cybersecurity, Augmented Reality, Cloud Computing, Autonomous Robots among others are becoming more constant.

Education has evolved in each era, in this digital and technological era where students will have jobs closely related to technology because the Industry is in its fourth revolution, locating it as Industry 4.0 due to its digital, technological and interconnection emphasis which are moving towards Industry 5.0. We also classify current education as Education 4.0, which has the objective of training students with knowledge, technological, digital and socio-emotional skills to constitute Talent 4.0. Education 4.0 has the urgent need to use active strategies that allow the development of knowledge and skills that provide the opportunity for new ways of learning, recognizing new learning spaces where students are the makers and creators of knowledge accompanied by teachers who guide and design the learning experience. The STEAM Methodology and the Hackathon offer a different opportunity to learn through transdisciplinarity to generate sustainable solutions in a short time; These events also contribute to collaborative work, as well as the management of other strategies such as in situ learning, learning with ICT, among others. The design of these STEAM experiences and the Hackathon provides a different space for the development of technological, digital and socio-emotional skills. These spaces are conducive to collaborative work, the application of knowledge, the design and development of sustainable creative solutions. Teachers will be an indispensable factor in the design of these experiences; they will be the mentors who can guide the students to bring them closer to a form of work that is very similar to the experiences in the industry and in the workplace where Talent 4.0 must solve the challenges. complex in a short time and will be able to succeed depending on the training and skills of future collaborators Hackathon as an academic event in conjunction with STEAM provides enriching educational experiences, provides the opportunity to build knowledge, develop skills, ecological and social awareness when managing the SDGs as part of the training of Talent 4.0

II. THEORETICAL FRAMEWORK

Education as a social phenomenon has evolved to respond to the needs of each era, in time it is no exception. Education 4.0 is based on competition in order to prepare students for their future jobs in Industry 4.0, this industry has the characteristic of the great influence of digital technology such as Big data, Simulation, Additive Manufacturing, horizontal and vertical integration systems, Cybersecurity, Augmented Reality, Cloud Computing, Autonomous Robots, Industrial Internet of Things IIoT. Boston Consulting Group mentions it [1] and [2] mentions that these technologies are recognized as the Pillars of I4.0. These pillars and other technologies are integrated, giving rise to new technologies such as Additive Manufacturing, which is a concept that encompasses different technologies, including 3D printing, rapid prototyping, direct digital manufacturing, layered manufacturing, among others due to the technological boom. This is why [3] defines the Fourth Industrial Revolution (I.40) as the revolution that takes advantage of information technologies, robotics and sensors, which results in the Internet of Things (IoTs). and other Technologies. Witnessing this advance, education today is in an adaptive process, leaving

behind unidirectionality, generating strategies in order to achieve the development of competencies, which is why it is called Education 4.0. According to [4] Education 4.0 which integrates the trends in learning strategies that respond to these needs of Industry 4.0. The IPN developed Education 4 (E 4.0) in order to train Talent 4.0, which is defined as those people who demonstrate outstanding aptitude (in terms of ability and attitude) or eminent competence in one or more domains associated with industry 4.0 (especially digital attitude, creativity, innovation and STEM skills). [5]And Soft or Socio-emotional Skills are those that allow us to achieve personal and social growth of people. [6] Currently, the term socio-emotional skills (HSE) or socio-emotional learning is used, referring to them as skills that have the connotation of the possibility of their educability or training. [7] In the article by [8] it mentions that several socio-emotional skills are also known as the Competencies or skills of the 21st century established by [9]*The training requirements of the students of (E 4.0) demand new skills and competencies that will be developed in the classroom, as well as in other spaces that allow them to live integrative and more enriching experiences, students take a fundamental role in the teaching process. ┴learning no longer expect to be given a traditional class or to be given a single procedure. Comprehensive training is intended that includes the development of socio-emotional skills, as well as the application of values for the common good, for a sustainable world.*

A. Active Learning Strategies

Active strategies are the set of actions whose main objective is to ensure that students develop their abilities, acquiring skills. Teaching-learning strategies respond to these new demands; strategies have also evolved and are based on the constructivist model. [10] defines the term Active Strategies as a series of methodologies that allow the development of competencies, which means putting into play a series of skills, abilities, knowledge and attitudes in a given situation and in a certain context. It is also understood as Active Strategies in which students carry out learning actions, which allows students to develop knowledge, skills and competencies. According to [11] Active Strategies focus more on the student's activity than on the content, breaking with the orthodox schemes that for many years have prevailed in the way of teaching and learning. Fortunately, active strategies are proliferating, we find: cooperative work, team-based learning, problem solving or problem-based learning (PBL), case analysis, flipped classroom, learning and service (A+S), role plays, concept maps and projects. [12] Likewise, the following authors also mention Cooperative work or team-based learning, Expert conferences (CE), Visits to museums (VM), - Peer learning [13] -Inquiry-based methodology, as well as -Engineering design methodology [14] Project-based learning, Cooperative work or team-based learning, Competency-based learning [15. These methodologies are favorable for the construction of new knowledge, as well as for the development of skills. STEAM and PBL Project-based learning are active strategies that seek the integration of the knowledge necessary to generate a solution from a project, as mentioned by [16] Project-based methodology: it is a central strategy in STEAM education, since through it the key concepts of the associated disciplines are valued within the framework of a problematic situation.

B. STEAM

It is a methodology that favors in a different and innovative way to train Talent in its multiple aspects, it not only builds knowledge but also develops technological, scientific and socio-emotional skills in students. The STEAM methodology is what promotes transdisciplinary creativity that is achieved in a collaborative work group that achieves innovative solutions. Out of concern to increase the number of students for science careers [17], the National Science Foundation creates the STEAM program to promote the study of science and guarantee new professionals who solve and create innovative solutions.This methodology develops STEM skills, which means having skills in science and technology among other skills, as well as the knowledge of the different disciplines required to achieve new solutions [18]. STEAM promotes Soft Competencies that will allow the individual to relate adequately form teams, self-direct, regulate and manage their knowledge. [19] STEAM promotes the development of critical thinking and develops or strengthens the required work skills: the research process, diagnosis and proposal of solutions, work methodology, definition of objectives, prevention, conflict resolution, team management, coordination of activities. STEAM is the acronym corresponding in English to the acronyms S- Science- Technology, E- Engineering, A- Arts and M- Mathematics. This Methodology proposes, through established roles, to develop a project collaboratively with scenarios similar to those experienced in the working world.STEAM allows different disciplines to integrate trying to create a solution. Technology is understood not only as the learning and use of tools, but also as a technological education adapted to today, a current in which robotics, learning codes (programming) and coding are essential [20]. The integration of mathematics allows it to be considered central elements in scientific and technological work, always present in real life. [13] In this same sense, other disciplines have been present, such as [21] mentions the natural sciences and technology has also been integrated into engineering, which is part of technology. dedicated to the production of artifacts. Thus, the integration of Art became important to provide harmony to what was designed and promote creativity, which is why the incorporation of art became essential [22] This inclusion is a commitment to highlight the importance of artistic training and develop creative skills, opening innovation to the fourth industrial revolution by promoting an area that plays a fundamental role in the scientific

field [23] STEAM is the opportunity to apply knowledge of advanced technologies and the ability to use the transversality of the subjects. [24]STEAM as a methodology aims to develop sustainable innovative solutions, aiming to contribute to the UN Sustainable Development Goals (SDGs) [25] The 17 SDGs set out the world's problems that must be resolved by the entire society before 2030.

Fig. 1. Sustainable Development Goals (SDGs) Fuente: [25]

C. Hackathon

It is an academic event where a challenge is posed that must be solved as a team by creating an innovative and sustainable solution. [26] Hackathons are events that are a kind of application or project development marathons, lasting between 24 and 48 hours, which became increasingly popular as a method to learn quickly and lead people to carry out creative projects in a short space of time. In these events, knowledge is used and generated, technological and digital skills and socio-emotional skills are applied and developed [27] by working in collaborative teams. The term "Hackathon" integrates the concepts of "hacker" and "marathon", being a methodology that has been spreading over the last two decades among companies and organizations of all types [28]. Hackathons are also known as "hackfest", "codefest" or "hack day", and their success has been increasing year after year. [29] The field of programming has not been the only one currently applied in almost any discipline with great success and truly surprising results, due to the transdisciplinary and collaborative work with great results, as mentioned [30]. The format of these meetings, and the terminology, is used to define the events that bring together people with multidisciplinary profiles and that must provide a solution to the proposed challenges in a short period of time (generally 24-48 hours).The main methodology supported by Hackathons is project-based learning, with the participants being the proactive protagonists of their own training [31] In the development of Hackathons, learning knowledge has the same importance as acquiring skills and attitudes. In particular, the promotion of teamwork is one of the greatest value propositions of this methodology: the knowledge and integration of different professional profiles developing collaborative and inclusive work generates positive synergies for the development of projects [32]The Hackathon, according to [33] emerges as a diversified education option, through the experience of project-based learning, promoting the development of collaborative work skills in students and the search for solutions to common problems by implementing analysis tools. , design and prototyping to create valid products.The possibilities of the Hackathon are diverse and powerful due to its learning achievements and the scope of its proposals. In that same sense [34] mentions that the Hackathon is a rising trend that allows the exchange of information and experiences, learning and creating knowledge collectively, solving problems and responding to the needs of society. [35] defines the Hackathon as a method to learn quickly and lead people to carry out creative projects in a short space of time. Another author commented [36] These events are true learning days, as well as opportunities to test the skills that students have. He also comments [37] Carrying out Hackathons allows students to participate in independent and active cognitive activities.

III. RESEARCH OBJECTIVES

Identify the advantages and disadvantages of the STEAM application and Hackathon as a Learning strategyDemonstrate the benefits of the application of the STEAM-PBL Methodology as an effective learning strategy
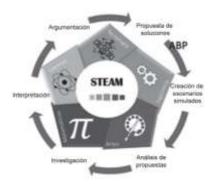
IV. METHODOLOGY

The STEAM-ABP methodology was selected to implement in the Hackathon due to its advantages in carrying out this event. This combination of STEAM-ABP methodologies and in the Hackathon gives the unique opportunity

for accelerated learning and creation of innovative sustainable solutionsThe STEAM methodology allows the integration of the necessary disciplines that contribute to the generation of the proposal for a sustainable innovative solution, as well as providing the roles of the participants, which helps to distribute tasks, as well as taking advantage of the talent and skills of each of the participants. of the teams. Project-Based Learning PBL allows the structuring of the research process. This methodology allows us to easily know what the next step is for the creative process. It also allows an analysis of the background, which is equivalent to the technological floor of what already exists. carries out an evaluation of the proposals and provides feedback with the possibility of going through this cycle on several occasions. The Hackathon proposes the challenge of the situation to be solved and the STEAM-ABP methodology provides the method to follow to build the solution. Below is the outline of the STEAM-ABP methodology.

Fig. 2. STEAM-ABP Methodology Source: [27]

The STEAM-ABP methodology, as can be seen in the diagram, has the following phases: Research, Interpretation, Argumentation, Proposals for solutions, Creation of simulated scenarios and Analysis of Proposals. For the Hackathon event, the call is published where the theme, the days of the event, the age ranges and educational level, as well as the type of the event and the registration dates are announced. Days before the event, the event agenda and meeting instructions to begin are announced.The day of the event begins with the welcome meeting which can be followed in person or online from each location. From this moment on, the agenda is followed, which considers training moments.The application of the Methodology begins with the formation of work teams, which are integrated according to the talent of the participants to cover the role proposed in STEAM. All participants collaborate in the research and contribute their experiences, knowledge and skills to generate ideas and prototypes. Once the team has been formed and the roles have been established, it is time to start with the PBL methodology with its phases, which will lead to the integration of the knowledge of the different disciplines with the sustainable approach that is planned in STEAM.

V. RESULTS

The objectives of this research are to identify the advantages and disadvantages and to demonstrate the benefits of the application of STEAM and Hackathon, so after the application of STEAM and Hackathon it is conclusive to conclude that STEAM and Hackathon are the strategies that provide the opportunity to build learning. effective in a short time in addition to providing the opportunity to develop the skills of the participants and the generation of viable sustainable proposals. The results of the implementation are described below. STEAM offers a valuable opportunity to include and recover knowledge from different disciplines in order to propose a comprehensive sustainable solution. Participants work in a collaborative environment very similar to the way they work in the company through multidisciplinary teams from different areas. The Hackathon offers the opportunity to experience the challenge of the situation to be solved in a short time, provides resources, facilities and with the application of the STEAM-ABP methodology, how to build the solution is provided.The combination of the STEAM Methodology is reinforced with PBL Project-based learning that provides order to the development of research, with the objective of motivating others, who are far away, in learning STEAM areas [38]. Students are active agents who develop projects collaboratively, being supervised by teachers or educators in these areas. The latter are normally passive agents etc.) to help students understand and complete the tasks proposed in each phase of the project. With STEAM, relevant sustainable contributions are achieved because it is a methodology based on environmental projects, developed in groups. [39] The results of these events demonstrate that students learn, collaborate, innovate, design, assemble, create technological inventions, social interventions among other innovations.STEAM and Hackathon are the two great strategies that provide the opportunity to learn quickly, in a real way and give the possibility of bringing together other strategies to contribute to the learning and development of the skills of the participants.

During the Hackathon, when developing research through STEAM-ABP, it proposes the path where learning is built, skills such as digital, technological and socio-emotional skills are developed, as well as the opportunity to use active strategies that the student takes as resources to create. the possible solution. The development of research through the STEAM-PBL methodology is carried out with the PBL structure of Project-Based Learning, supported by the following strategies mentioned below:

Learning with ICT, research is carried out through digital means, which presents the opportunity to analyze, synthesize and create their own knowledge, in addition to digital media not only as a source of information through the management of search engines, repositories, etc. ICTs are also tools for programming such as the use of Turbo C, Python, C++ programs, among others. As well as for Design with programs like Vision, Project, even AutoCAD for your prototypes. Presentations to explain your proposals in CANVA, Prezzi etc. in addition to Video Editing with CapCut, or Image editing with Adobe Photoshop Express, for Photoshop, Corel or Procreate drawing among others. For data analysis during the Hackathon, the management of the databases is carried out, initially allowing the use of Excel, Macros to robust databases, performing data mining even forays into Data Science. These are just some examples of Technology to which circuits, sensors, displays, mini robots and robots could be added that are even designed using 3D printers for their prototypes.

Research in Action The participants find information that they convert into knowledge when applying it, thus they also find answers to possible solutions to the challenge and finally the knowledge acquired through research, they adapt to the design of the solution, they adjust Therefore, it can be said that research is put into action in addition to developing awareness and critical thinking with the acquired knowledge that is developed.

In situ learning, during the Hackathon, participants build their learning in different ways, acquire and at different times share theoretical knowledge, apply it, achieving greater meaning. They investigate, analyze and apply, converting information into knowledge. They learn to interact between participants with different talents and knowledge, also managing to integrate knowledge from different disciplines. In terms of technology, the Hackathon allows you to learn from the tools provided by the organizers, which are often databases or programs. The participants learn to use the program and get the most out of it, achieving favorable results, so without a doubt the Hackathon is a unique accelerated learning opportunity. It should be noted that it also allows them to engage in collaborative learning, as well as the development of socio-emotional skills to achieve compliance with the agenda and the generation of the proposal.

Another of the successful results of the application of STEAM and Hackathon as learning strategies is the generation of Sustainable Innovative Proposals that contribute to the solution of the Sustainable Development Goals SDGs, in this way the participants demonstrate their learning and the application of this to design the proposals by applying their knowledge in addition to generating sustainable awareness.

There are also other really successful results from the application of the STEAM-PBL Methodology in a Hackathon, the achievements of collaborative groups of students are highly efficient; integration of different disciplines such as STEAM that contribute to the innovative solution. It is worth highlighting that the advances in technological skills are very notable when applying programming, data science, as well as other applications that use the Internet and of course the development of Socio-emotional Skills is relevant.

Below, the achievements of the students are listed in terms of the development of Socio-emotional Skills, such as critical thinking, leadership, resilience, assertiveness, empathy, social awareness, among others, as well as developing Communication Skills that are very valuable for solving problems. problems and for the implementation of improvements.It is worth mentioning that according to the experiences lived in different STEAM and Hackathon events, only two young people out of 300 participants have presented some type of anxiety and expressed discomfort due to the accelerated and exhausting pace of the event, while the majority, 96% to be exact, He feels motivated and expresses that he prefers to work under pressure with the challenge of achieving the goal and being rewarded for his contribution.It is evident that STEAM and the Hackathon together are powerful strategies for building learning, as well as developing skills and creating innovative sustainable solutions.

VI. DICUSSION

Some of the challenges of the application of STEAM and the Hackathon are the management of resources, the organization of the event, the spaces as well as the planning that it implies, as mentioned [40] the difficulties when implementing education STEAM in school such as: resistance and problems in the organization of the educational system; provision and access to the resources necessary to carry out the projects and teacher training. Likewise, [24] mentions that the teacher profile must be very specific in addition to the knowledge of advanced technologies and the ability to use the transversal nature of the subjects.It will be an obstacle to overcome the training of teachers who serve as mentors and accompany the participants whose training in STEAM is expected, which includes management of Technology and Sciences, as well as knowledge of the SDGs and it would be desirable that the

participants mentors had different disciplinary profiles in order to nurture the participants, they are also required to have a passion for science to accompany the students in the 48 hours that the event lasts and a very good management of Socio-emotional Skills to contain, motivate, support and accompany the participants.

CONCLUSION

STEAM and Hackathon are powerful strategies of Education 4.0 for the construction of effective and accelerated learning, as well as an opportunity for the development of STEM skills, technological, digital, and socio-emotional skills, thereby developing Talent 4.0, which responds to the demands of Industry 4.0STEAM and Hackathon can undoubtedly be considered as active strategies where students are the creators of the activities where they achieve the design, elaboration, presentation, argumentation and improvement of innovative proposals for sustainable solutions.These strategies provide the opportunity for transdisciplinary work with the contribution of different disciplines through STEAM in addition to collaborative work very similar to the current reality in the workplace. The participants live an enriching experience at different levels, including the staff, having the opportunity to recognize what they can create with their knowledge and skills, which generates an increase in confidence in the participants and improves their self-concept, which motivates them to continue learning in order to apply their knowledge.STEAM and the Hackathon manage to develop Talent 4.0, which has high demands in such a technological era where it is required that in a short period, they apply their knowledge and solve it efficiently in the workplace.The application of the STEAM-PBL Methodology in a Hackathon, the achievements of collaborative groups of students are highly efficient; Students learn in situ, carry out action research, research with ICT in addition to testing knowledge of different disciplines such as STEAM that contribute to the creation of innovative sustainable solutions. ICT-based learning is very notable when observing the advances in technological skills when applying programming, data science, as well as other applications that use the Internet. Development of socio-emotional skills such as emotion management, stress management, frustration, development of critical thinking, assertiveness, empathy, social awareness, in addition to communication skills for conflict resolution and the development of sustainable awareness, which is so necessary.

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