

## Competencies for STEAM areas: a focus on teacher

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**Keywords**— **Competencies, STEAM, teachers.**

**Abstract**— This article aims to present a mapping of teaching skills for STEAM areas. Society is constantly changing, and Education needs to make changes that enable the formation of the subject integrally. From this perspective, STEAM areas are increasingly present in classrooms, intending to prepare future professionals for this connected and technological world. Thus, to embrace this new society, it is pertinent to build new teaching skills that can contemplate the integral formation of the student. Methodology: The research had a qualitative approach of the interpretive type, of an applied nature, being exploratory regarding the objectives and using the case study as a procedure. The instruments were the productions of the participants of an online course and participant observation. Results and conclusions: In this study, 80 teachers participated, and the data presented denote a concern of teachers to build pedagogical competencies in the pedagogical perspective, with methodologies and action strategies, as well as technological ones, from basic training in the use of technologies. Thus, in total, 11 teaching competencies were mapped to work in STEAM areas. In addition, it was possible to glimpse suggestions of educational and digital tools that can be used in pedagogical practices, as well as active methodologies that apply in the presented context.

### I. INTRODUCTION

Society is constantly changing, whether cultural, technological, economic, or social. Thus, to accompany the uncertainties in the new scenarios, Education needs to make changes that allow the formation of the subject integrally.

From this perspective, the STEAM areas (Science, Technology, Engineering, Arts, Mathematics), that is, Arts, Sciences, Technology, Engineering, and Mathematics, are increasingly present in the curriculum of Basic Education and Higher Education, to prepare future students. professionals for this connected and technological world.

STEAM education is not a method or a tool, it is a strategy that impacts the entire education system. It is currently considered an important teaching strategy for the development of skills of professionals of the future, as it uses science, technology, engineering, arts, and mathematics as axes to support the educational development of students. Therefore, it is the union of different subjects in a way that they relate to each other and the real and business world, in a combination of practical and interdisciplinary learning methods that offer the opportunity to engage and enable students in formal education in a fun and interactive [14][15].

Thus, to embrace this new society, it is pertinent to build new competencies that can contemplate integral

formation, in a perspective of enabling innovation and problem-solving in the various fields of knowledge. In this bias, the purpose of this article is to present a mapping of teaching competencies for the STEAM areas. Competencies are considered a set of elements (Knowledge, Skills, and Attitudes) that, when mobilized, can help to solve different problem situations [9].

Given this context, education should enable the construction of skills for the STEAM areas, considering that the subject who goes through this process can apply it in their professional life. In this sense, the mapping of competencies will allow teachers to have this basis to think about actions and methodologies that focus on these needs in classes, whether in Higher Education or Basic Education [14][15][16].

In this way, the next section will present a brief theoretical overview of STEAM competencies and areas. Then, in the next election, a methodology will be pointed out with the characterization of the study. The results will be presented next, pointing out the digital competencies for the STEAM areas mapped. Finally, final considerations are presented. [14][15][16]

## II. SKILLS AND STEAM AREAS: A NECESSARY INTERLOCUTION

The term competence has changed mainly in the area of Education. The new discussions allowed a different view and use that was considered not only as an evaluative instrument but also for the construction of knowledge, skills, and attitudes.

Education adopted in the National Common Curricular Base (BNCC) the use of competencies, with 10 main ones: Knowledge; Scientific, critical and creative thinking; Cultural repertoire; Communication; Digital culture; Work and life project; Argumentation; Self-knowledge and self-care; Empathy and cooperation; Responsibility and citizenship (Brazil, 2018).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) was one of the first to discuss the subject and its application in education, bringing historical milestones such as DigComp and DigCompEdu that specifically bring digital skills.

“Competence is a polysemic word. One of the reasons for the variability of its meanings is the diversity of contexts and fields of knowledge in which it is used” [7]. Complementing the definition, Behar et al [2], mention that “[...] the individual is competent when he can “know”, “know how to do” and “know how to be”, which are associated with the elements of the CHA”.

The CHA is the acronym used for Knowledge (it is associated with the knowledge of a subject and in which it can be constructed); Skill (it is related to “knowing how to do it”, therefore, it is “[...] an automated action, an already built procedure, something of the operational order, not requiring a deeper reflection” [2] Attitude (it is the “knowing how to be”, being necessary the mobilization to face situations that may arise to the subject).

Thus, it is pertinent to build competencies with students, but mainly with teachers through constant training, both in the use of digital technologies and in new practices based on innovative methodologies.

Concerning competencies for the STEAM areas, there are no studies on which teachers could build in the classroom to foster a deeper understanding of the subject. However, there are some publications linked to how these areas can develop skills in students, as is the case of Diego- Mantecón et al [6] and Benites, Barzallo [3]. In addition, Perignat, Katz- Buonincontro [10] cite that the main objective of STEAM is to engage students, develop creativity and improve problem-solving skills in real-world environments. Therefore, the concepts of STEAM and competencies are similar, since your key point of yours is to provide a theoretical-practical basis for the student to solve problem situations.

However, it is pertinent to highlight that “STEAM Education is not characterized as a teaching methodology, but a pedagogical approach that is linked to different proposals for active learning” [8]. It emerged in 2007 and, over the years, new reflections began to be carried out, mainly on how to apply it in the classroom of educational institutions.

STEAM can assume different dimensions in the educational context: approach or methodology; expansion of the Science curriculum; public policy and educational model [11]. Therefore, as popularity grew, scholars proposed a variety of pedagogical models and approaches to develop and integrate [10].

Thus, the perspectives and applications can be varied, which instigates the training of teachers to act or promote these areas.

## III. METHODOLOGY

The investigation had a qualitative approach of the interpretive type, of an applied nature, being exploratory regarding the objectives and as a procedure, a case study was used. The target audience was professors who participated in a distance extension course offered in 2021 at a public university in Santa Catarina in Brazil.

Thus, the productions carried out in the Virtual Learning Environment of the course by the participants were used as a data collection instrument, as well as participant observation in the classes and interactions in the environment. The competence mapping methodology was based on Brandão [4]. For analysis, the steps of Bardin (2010) were used, since this technique allows a general reading and analysis to then categorize the information.

Thus, to meet the main objective of the research, the study had four stages, as shown in Figure 1.

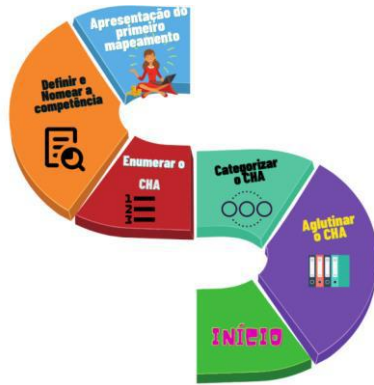


Fig. 1: Research Stages

Stage 1 - Agglutinate the CHA: This first stage aimed to carry out the initial mapping of the knowledge, skills, and attitudes that must be built with the students for the STEAM areas. For this, he used a course called "Digital Skills for STEAM areas". In it, activities and lives were carried out (totaling 4 on YouTube from [omitted for review]) to discuss and reflect on skills, Knowledge, Ability, and Attitudes, in addition to pedagogical strategies focusing on the areas of Arts, Science, Technology, Engineering, and Mathematics.

The participants, in the end, shared their experiences reporting the application in the STEAM areas in an authorial video. In the course, a Virtual Learning Environment (VLE) was used (figure 2) so that the participants had access to the contents and activities, as well as pointing the CHA to the STEAM areas.



Fig. 2: Organization of the course topics

Thus, each participant listed the elements of the CHA, defining the public and interspersing with specific

knowledge of the areas in which they worked. These were presented individually in the AVA.

Stage 2 - Agglutinate the CHA: The second stage consisted of grouping similar knowledge, skills, and attitudes to check for repetitions and inconsistencies. Thus, it was possible to verify traits of competencies and their possible definitions.

Step 3 - Enumerate and categorize the CHA: The third consisted of classifying knowledge, skills, and attitudes into two groups: pedagogical use and technological use. After this process, it was possible to enumerate each CHA and, therefore, perform the competence categorization.

Step 4 - Define and name the competence: Finally, a critical reading of the information was carried out to standardize the verbs used, as well as adjust each element of the competence. Then, it was possible to name them according to the knowledge (knowing, knowing how to do, knowing how to be) indicated by the participants.

IV. RESULTS AND DISCUSSION

The present study aimed to present a mapping of teaching competencies for the STEAM areas. Thus, 80 teachers participated, 38 male and 42 female. The training was varied, as well as the performance that went from Basic Education to Higher Education. However, in the course of the discussions, it was possible to perceive little knowledge about the STEAM areas, but greater depth about the competencies, which made it easier to know and point out the knowledge, skills and attitudes questioned during the process.

Regarding the CHA, the participants pointed out a total of 375 elements, as shown in Table 1. It is worth noting that, despite knowledge about the definition of competence, pointing out knowledge, skill and attitude is a complex process, as participants had no experience in categorizing such elements. Thus, it was necessary to reorganize them, according to the definition of the mentioned literature [9], as well as to remove those that did not agree with the conceptualization.

Table 1 - Organization of the CHA

Elements	cited	reorganized	withdrawn	Final
knowledge	109	0	4	105
Skills	137	4	two	141
Attitudes	129	10	4	114
TOTAL	375	14	10	360

The knowledge obtained was outside the context of "knowing", but linked to the name of competencies or

action outside the requested, as can be seen below: Digital fluency; Digital literacy, choosing which technology(s) to use; Offering better opportunities for teacher training; Ensure better physical infrastructure; Promote technological solutions that take the school routine and day-to-day challenges.

The skills removed were not specifically related to the proposed theme, as can be seen below: You need to take a course on digital skills in education; Many digital tools promote new ways of carrying out pedagogical practice and exploring different skills and competencies. The attitudes taken from the list were related to actions and not necessarily motivations: Overhead projectors; High-quality sound system; The game can create competition between teams.

Therefore, it can be observed that the participants had a lot of difficulty in categorizing each element, and made a little confusion among them, especially between skills and attitudes. Behar et al [2] mention that there is always a difficulty in classifying knowledge, skills, and attitudes, as they are elements closely related to each other.

Thus, after categorizing the CHA, it was possible to list 11 competencies divided into two large groups: Technological use in STEAM areas; Pedagogical use in STEAM areas (figure 3).

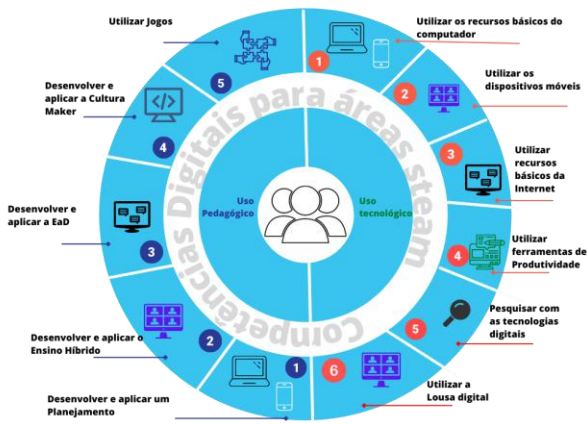


Fig. 3: Competencies for STEAM areas

The complete mapping of the eleven competencies, as well as their elements (CHA), are presented below.

**Competence - Use basic computer resources:** This competence is related to the ability to use the computer (software and hardware) autonomously to use it for educational purposes.

Competency Knowledge, Skills, and Attitudes: Using basic computer resources		
Knowledge	Ability	Attitude

Computer.	Handling of information technologies.	Be resilient.
Basic Computing.	Turning the computer on and off.	To be organized.
Computers.	Make use of the tools.	Empathy.
Knowing how to turn on the desktop and learn to use Jamboard on the computer and cell phone to share with students.	Know the commands and tools to run the software.	Proactivity.
computing.	Know the shortcuts accepted by the software.	Be methodical/organized.
Know how to perform the basic procedures for handling files on computers (create, save, rename and delete files).	Know how to represent the schemes via software.	Be proactive.
Fundamentals of Informatics and Computing.	Become familiar with the software and equipment involved.	
Know what software is.	Handle a computer.	
Know what a computer is.	Turn on the computer.	
Digital technologies.	Create and edit files and folders.	
Technology.	Know how to handle the computer/notebook.	
Digital communication.	Know how to use the tools and computing resources.	
You need to know how to deal with computers.	Know how to turn on the computer.	
Operating a computer	Turn on the computer.	
software.	Use a computer.	
Basic computing.	To communicate.	

Knowledge about the possibilities of the software.	Store data.	
Know the commands of the equipment involved.	Know how to use the computer and/or other machines.	
Know the hardware and basic procedures for using a computer (keyboard, mouse, webcam, microphone, etc.).	Install and keep up-to-date data protection software.	
Know basic system operation procedures (open and save files; install software).	Turn on the computer.	
Understand the functioning of the computer and the internet (digital literacy).	Use mouse and keyboard.	
Find information on how to use the text editor of the operating system it uses. (Win; MAC; Linux; IOS; Android)	Knowing about technologies.	
Learn how to download and install software by looking at your operating system.	Know how to turn on the computer.	
Computers, Windows, Internet.	Access the equipment frequently.	
Observe the necessary conditions for its use (basic settings; online or offline).		
Computer knowledge.		

**Competence - Using mobile devices:** This competence is related to the ability to use the basic features of mobile devices (smartphones, tablets) such as applications, touch screens, etc.

**Competency Knowledge, Skills, and Attitudes: Using mobile devices**

Knowledge	Ability	Attitude
What are the main functions of a tablet or cell phone?	Download apps on mobile or tablet from app stores.	Be committed.
Tablets.	Share computer/mobile/tablet screen or web browser tab in video calling apps.	Be flexible.
Cell phones.	Use smartphones, notebooks, and tablets.	Be creative.
Game of questions and answers in real-time using tablets or smartphones.	Use tablet.	Autonomy.
Operating a tablet.	Know how to handle tablets/smartphones.	Have Motivation.
Know what is smartphone.	Construction of active activities using the application.	Take the initiative to get to know the equipment that will be used and become familiar with it.
Cell phone operation.	Handle the application.	After observing the difficulties he went through, having empathy and motivating the student that it is possible to overcome the difficulties and that he had to learn.
Download and use the app.	Know how to connect mobile.	Search and watch app usage tutorials.
Applications for creating and editing videos.	Know how to send WhatsApp.	
Installing apps via app stores (such as Google Play,	Know how to use messaging apps, images, and/or videos.	

Apple Store, and Microsoft Store).		
Use of video calling apps (such as Google Meet and Zoom).		
applications.		
Knowledge of applications (apps) and their educational uses.		
The teacher needs to know how to use such an application or program so that he can introduce the student.		
Apps for interaction with students.		
Know about using cell phones and notebooks in the classroom, if there is wifi if there are machines available and in good working order in the multimedia room, and if there is enough space and capacity to run the chosen tool. Anyway. KNOW about the facilities and difficulties of the school environment for the adoption of interactive		

strategies using digital tools for their content in the classroom. Choose the tool, find out if it is freely accessible if it has a translation into Portuguese if it needs to be downloaded, logged in, and how long it takes to register students.		
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**Competence - Using basic Internet resources:** This competence is related to the ability to critically and safely use Internet resources such as the means of communication, research, and content production.

<b>Competency Knowledge, Skills, and Attitudes: Using Basic Internet Resources</b>		
<b>Knowledge</b>	<b>Ability</b>	<b>Attitude</b>
websites.	Know how to use the internet.	Respond quickly.
Internet.	Download.	Be proactive.
Email.	Log into websites.	Organized.
Know what the internet is.	Use a browser.	be ethical.
Know how to access the Internet and perform searches in browser software.	Access a website.	Organization of materials.
Know how to search for information.	Use a web browser.	Proactivity to learn new things.
Internet and Web.	Access a website.	Resilience to persist in learning.
Browsing the web through the most common internet browsers (such as Google Chrome and Internet Explorer).	Use hyperlinks.	

Installation of programs via internet browsers.	Know how to send an email.
Know how to browse the internet	Open an email.
Image reading.	Connect to the internet.
	Use social networks for communication.
	Use the internet as a source of knowledge.
	Know how to get on the internet
	Know how to access websites
	Know how to access a web page.
	Download programs to your computer from web pages.
	Locate on the computer where the installation files of programs downloaded from the internet are saved.
	Use social networks.
	Surf the Internet.
	Access the browser.
	Know how to save the explanations and send them by email.
	Use a browser to access the internet.
	Use electronic mail.

**Competence - Using Productivity Tools:** This competence is related to the ability to use productivity tools, being possible to become the author of your material, through text editors, images, presentations, spreadsheets, videos, animations, etc.

Knowledge, Skills, and Competency Attitudes: Using Productivity Tools		
Knowledge	Ability	Attitude
Text Editor (Drive).	Turn data show on and off.	Proactivity.
Powerpoint.	Connect cables to	Have Resilience.

	Data show.	
You need to know how to use electronic equipment to make your job easier.	Use office software.	Encourage class participation and engagement.
What is a data show?	Content development and creation.	Create groups and moments for interaction between students.
Know that there are various risks associated with using digital technologies.	You need to master some digital tool that helps in the presentation of your classes.	Encourage autonomy and self-assessment.
Acquire knowledge of the operation and manipulation of the chosen tool.	Know how to turn on the data show.	
Choose a digital tool, canvas.	Using the computer and the internet to read and select content (digital literacy) and then produce the content itself (digital fluency) making connections between the virtual world and the real world.	

**Competence - Research with digital technologies:** This competence is related to the ability to use internet research resources, contemplate the choice of search words, analysis, select, and criticality the information.

Knowledge, Skills, and Competency Attitudes: Research with digital technologies		
Knowledge	Ability	Attitude
Know how to search the internet.	How to search on Google and YouTube.	Proactivity.
Knowledge of	Compare	Resilience.

commonly used search engines on the internet (Google, Bing, Yahoo, etc.).	information.	
Know how to search for solutions online.	Conduct research on the internet.	Patience.
Know how to search for online guides.	Conduct internet searches.	Be curious.
Master the use of the equipment and the internet to research.	Know how to handle information: summarize, compare and verify.	Have critical thinking.
Search for information about the desired tool.	Treat data in different formats, and organize it.	Creativity.
Acquire knowledge of how to do web searches.	Information search.	Proactivity.
	Know how to use search engines available through internet browsers.	Be Investigative
	Know how to search the internet.	Organization.
	Searching the Internet.	Be critical and reflective.
	Searching the Internet.	Be polite and have patience.
	Practice using the tools and surveys. (repeat this process until you are confident in the results presented).	Be in a good mood.
		be selfless.

**Competence - Using the Digital Whiteboard:** This competence is related to the ability to use the digital whiteboard to present, interact and share materials produced in an authorial way.

<b>Knowledge, Skills, and Competency Attitudes: Using the Digital Whiteboard</b>		
<b>Knowledge</b>	<b>Ability</b>	<b>Attitude</b>
Learn about using the digital whiteboard	Know how to handle a digital whiteboard.	Proactivity.
Know about tools available on the digital whiteboard.	Know how to connect the computer and digital whiteboard.	Organization.
Innovative Digital Whiteboards.	Know how to move, change colors and erase when necessary.	Have Resilience.
Digital board.	Know how to write definitions with the digital pen.	Seek practicality in the use of technology.
		Simplicity and objectivity in the explanation.
		Consistency with the student's level of understanding.
		Availability to serve students.
		Organization.

**Competence - Develop and apply a Plan:** This competence is related to the ability to plan classes, linking the STEAM areas as the main guide.

<b>Competency Knowledge, Skills and Attitudes: Developing and Applying a Plan</b>		
<b>Knowledge</b>	<b>Ability</b>	<b>Attitude</b>
Educational Technologies.	Select and know how to use software, OVAs, and educational games.	Look for alternatives, solutions, and ideas for use.
Active Teaching Methodologies.	Apply active methodologies in conjunction with educational digital resources.	creative.



Study basic concepts and terms by applying what you know about technologies in the classroom.	After studying and taking courses, apply what you learned about technologies with your students using applications such as Kahoot, Google forms, mind maps, and others.	Try different alternatives and solutions.
Information management.	Once you know your school environment to use digital tools and the possible tools to be used, plan your class and test it with the tool. Anticipate possible errors, and doubts, see the time (remember that the student does not have the same ability as the teacher).	Don't be afraid to try or fail.
Know how to schematize the content.	Design the instructional model, which methodology would be more assertive in this practice, and create the problem or problems that should permeate the activity. Always start with the WHY of it. Students engage and learn what they believe they know the meaning of, why, and not just because it has to be studied.	Organization.
Know some basic software in the area of operation.	Enhance knowledge.	Interdisciplinarity.

Assess students' learning levels.	Create a lesson plan aligning the digital tool, the programmed content, and the chosen methodology.	You need to be willing to learn technologies you may not be used to.
Adapt the class theme to the use of the chosen tool.	Have an alternative plan if you depend on an internet connection.	Practice.
Integration of knowledge of Arts, Sciences, Technology, Engineering, and Mathematics.	Create a lesson plan aligning the digital tool, the programmed content, and the chosen methodology.	Take initiative.
Integration as the center of didactics: knowledge of the basic curriculum to choose ways to present concepts to students in an integrated way.	Simulate the application of the proposal for previously trying to find possible errors using the tool. (repeat this process until you have confidence in using the tool).	Be curious and be connected with world reality.
	Have an alternate plan. in case the ICT stops working	Be up to date with digital tools.
	Make interdisciplinary and collaborative partnerships.	Valuing the particularities of each student.
	Be the mediator, challenging students to understand how to learn by doing.	Foresee possibilities for the student to prepare for challenges as a citizen and also for the job market.
	Point out new ways to solve the same issue.	-Development of socio-emotional skills, through group exchange work, as empathy and cooperation

		are necessary to reach an answer.
	Creation of workshops: divide students into groups and propose that they find a practical solution to a given problem.	
	Elaboration of activities that provoke and stimulate the solution in several fronts of the areas that are part of STEAM.	
	Classroom debates lead students to questions in which they arrive at different hypotheses and share the how of the solution.	
	Bring real problems to the classroom, involving issues, and problems that affect the daily life of the community, family, and school, that is, the context of students.	
	Use of different platforms such as computer rooms, maker environments, implementation of games, use different platforms, not being so stuck	

	only with notebooks and books.	
	Plan and build learning experiences and pathways (teaching and lesson plans).	
	Use the correct teaching method according to the chosen technological tool.	
	Use different forms of learning assessment.	
	At first, take a digital literacy course and then other courses to learn how to use technologies with your students inside and outside the classroom.	
	Explain the Why, the objective at the beginning, to lead the student to understand the strategy that was designed and planned for his learning, for light and incredible moment, which is this class. Explain the methodology, HOW this will all happen, and what is expected at the end. Show the entire course, but	

	allow the speed and manner of traversing this course to be the student's choice.	
	Knowing which technological device students find interesting Knowing what they would like to learn or master when it comes to technology.	

**Competence - Develop and apply Hybrid Teaching:**

This competency is related to the ability to plan classes focused on the hybrid modality, considering innovative educational practices.

<b>Knowledge, Skills, and Competency Attitudes: Developing and Applying Blended Learning</b>		
<b>Knowledge</b>	<b>Ability</b>	<b>Attitude</b>
Knowledge about blended learning.	Prepare an activity using the chosen tool(s).	Autonomy to decide what to do.
Digital devices (cell phone, tablet, etc.).	Make slides, and presentations to make student learning the best experience.	Be positive.
Technologies.	Adapt and present the information correctly in its context (public and media).	Flexible.

Notions of technology.	Use learning environments.	Patient.
Virtual Learning Objects (OVA).	How to produce videos, photos, podcasts, slides, and blogs.	Open to learning new things.
Collaborative learning process.	Pay attention during the activity. Watch the groups. There will be groups that will not be motivated. Help them, motivate them. Play the role of Tutor at this time. Listen to the debate between them, the doubts, when they stopped. This is your assessment of the day: you will know exactly which gap to fill! Do a self-assessment socialization at the end. Listen and motivate to always improve, yourself and the class. There's no mistake!	Organized.
Knowledge of educational software.	Look for new materials to aid in learning.	Try to be optimistic even if the learning process is complicated.
		Always seek to update in the use of digital tools.
		Do not get discouraged when you have problems in the processes inherent to your main objectives.

		If it doesn't work, or rather when it doesn't work, try again. (repeat ad eternal ).
		Autonomy.

**Competence - Develop and apply distance education:**

This competence is related to the ability to plan classes focused on the Distance Education modality, considering innovative educational practices and online interaction.

**Knowledge, Skills, and Competency Attitudes: Develop and apply distance education**

Knowledge	Ability	Attitude
EAD _	Use Google Meet.	Purpose.
Interactive material.	Know how to present and share the class through Jamboard for collaboration.	Good relationship.
Know how to use computers or others.	Use online collaboration tools.	Commitment.
Educational Software.	Access course content.	Organization.
Virtual Learning Environments Learn about interactive tools available online.	Perform and submit tasks.	Empathy.
	Watch videos and read texts.	Good relationship.
	Help the student to use digital tools when solving problems.	Encouraging.
	Log in to the course platform.	animator.
		Autonomy.
		Collaboration.
		Encourage student interaction.
		Set goals and

		propose challenges.
		Humility to ask for and accept help.
		Be a good listener.
		Have a good relationship with students.
		Arouse student interest.

**Competence - Develop and apply the Maker Culture:**

This competence is related to the teacher's ability to plan pedagogical practices based on the maker culture ("hands-on").

**Knowledge, Skills, and Competency Attitudes: Developing and Applying the Maker Culture**

Knowledge	Ability	Attitude
Software, simulators, research tools.	Record and edit a video.	Use quick thinking.
Digital labs.	Projections in 3 dimensions.	Persistent.
Maker Culture.	Knowing and knowing how to apply experiments in digital laboratories.	creative.
Remote labs.	Know the commands to access materials and/or practical activities.	Curious.
Technology.	Know what tools will be needed.	Have Resilience.
Observe the necessary conditions for the use of your access ICT.	Build and transform information.	Know how to work in a team.
3D printing devices.	Watch tutorial videos.	interpersonal.
Know how to use the tools interactively.	Watch tutorial videos.	Flexibility.

Pedagogy laboratory (toy library). Knowledge related to the laboratory and the area of pedagogy.	Use video tutorials.	Commitment.
	Instructions for access to the laboratory, usability, and operation of the laboratory. Doing related to the laboratory (toy library).	Mediator.
	When choosing to start the manipulation of this move in canvas identify its functions.	Critical.
	Observe and practice before taking it to students, trying to predict what difficulties students will have when using the tool suggested and chosen by the teacher for practice.	Be dynamic.
	Relate the discipline of pedagogy with the purpose of the laboratory and experience games and play to value play and children's culture.	Be perceptive and adapt.
		Apply the proposal with enthusiasm.
		Trying to motivate students in the learning process.
		Stimulate students' curiosity the

		process.
		Resilience.
		Curiosity.
		Adaptation to changes.
		Be active, and persistent, and do it as often as it takes.

**Competence - Using Games:** This competence is related to the ability to plan lessons using games as a basis for pedagogical practices in STEAM areas.

<b>Competency Knowledge, Skills, and Attitudes: Using Games</b>		
<b>Knowledge</b>	<b>Ability</b>	<b>Attitude</b>
Educational Games.	Create the game.	Empathy.
Adapt the course content to the game format.	Share the game link with students.	Commitment.
Know how to search, use and use online games.	Explain how to play and how to pass the level.	Proactivity.
	Reward who completes the mission (the reward is common in games: trophies, medals, lives...).	Organization.
	Introduce the game to students.	It becomes fun and dynamic causing interest in learning.
		Motivate them to log in and play.
		Leadership.
		Flexibility.

In this way, it can be observed that the participants had a concern regarding the pedagogical use and technology when it is built with the students (Figure 4). The inclusion of other modalities in addition to face-to-face was also pointed out included in the mapping, mainly Distance Education ( EdD ) and Hybrid. It was also possible to

observe that the participating teachers perceive the need for actions to introduce technologies, considering the basic use of digital tools, as well as becoming the author of their materials. The games, as well as the maker culture, proved to be issued in the participants' notes.

The digital whiteboard was a surprise in the notes, however, when observing the Brazilian reality in which many public schools and universities obtained or won this governmental action tool, it becomes pertinent to consider this competence so that the teacher himself knows how to use the resource to build, dialogue, reflect and present their productions.

Thus, when analyzing the data, it was also possible to identify educational tools mentioned to be used in the construction of competencies, highlighting remote laboratories as recurrent, as is the case of the Remote Labs Learning Environment (RELLE) (<http://relle.ufsc.br/>) (figure 5). RELLE is a platform that provides 20 remote laboratories, with 26 instances, for use in practical activities in the classroom. Therefore, the platform allows the teacher to integrate the STEAM areas, and, according to the participants' testimonies, it is essential to understand its functionality and applicability in pedagogical practices.

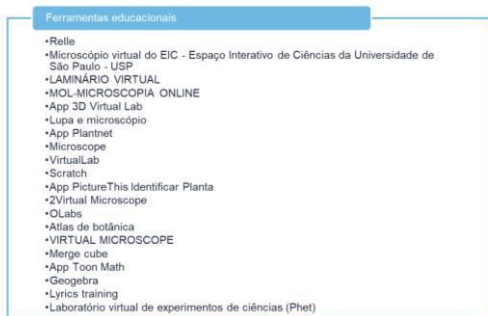


Fig 5. Educational tools cited to build competencies for STEAM areas.

Other tools, not necessarily for educational purposes, but which can support teaching and learning processes, were also mentioned, mainly gamification ( Kahoot, Quizzes, H5P, etc.) (figure 5). Gamification in the context of learning is understood through different prisms, since, although gamified learning and game-based learning have overlapping research literature, they do not have the same definition. Game-based learning implies the design of complete (serious) games. Gamification is a design process of adding game elements to build learning [12]. Therefore, many tools and games are used in gamification, which impacts the skills for the STEAM areas, since it can help the student to reflect in the course of the knowledge construction process.

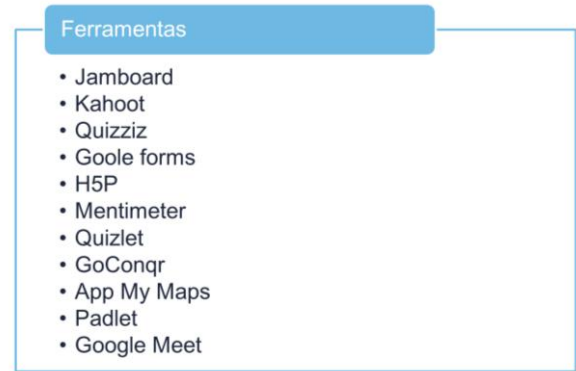


Fig 5. Tools cited to build competencies for STEAM areas.

In addition, the participants were concerned about considering methodologies that can help in the construction of competencies, pointing out five methodologies that can be applied (figure 7).



Fig 7. Methodologies aimed at building competencies for STEAM areas.

The aforementioned methodologies are considered active since there is an "interrelation between education, culture, society, politics, and school, being developed by active and creative means" [1]. Therefore, it can be highlighted that they are linked to the authorship and production of the students, mainly considering the STEAM areas that need practical actions, and applying theoretical knowledge daily. Maia, Carvalho, and Appelt [8] denote that in STEAM the student must become the center of the process, being possible to experiment, build, interact and collaborate with colleagues, being pertinent to the use of active methodologies such as those mentioned above. Thus, it can be seen that the participants understood more deeply the importance and how to carry out the construction process in these areas.

Thus, the research made it possible to understand the importance of teacher training that includes knowing the STEAM areas, since an "approach to pedagogical work that favors the development of creative and active learning

is necessary, allowing students to make decisions and evaluate results, through of interdisciplinary projects that seek to solve real-world problems” [8]. In this bias, training that encompasses the use of digital technologies as support for pedagogical practices is also necessary, since these resources are already part of the student's reality and must be integrated into classes. In addition, little knowledge of the participants on this topic can be observed, and new training based on the skills presented in this study is relevant.

## V. CONCLUSION

The present research aimed to present a mapping of teaching competencies for the STEAM areas. Thus, 80 teachers who work with different audiences and teaching modalities participated in the research.

The data presented show a concern on the part of teachers to build teaching skills from a pedagogical perspective, with methodologies and action strategies, as well as technological ones, based on basic training in the use of digital technologies. From this perspective, in all, 11 teaching skills were mapped to work in the STEAM areas: Using mobile devices; Using the digital whiteboard; Using basic computer resources; Using basic Internet resources; Research with digital technologies; Using productivity tools; Developing and apply the Maker Culture; Develop and apply distance education; Develop and apply Blended Learning; Develop and apply a Plan; Use Games. For each competence mapped, the knowledge, skills, and attitudes that must be built with the teacher were also presented.

In addition, it was possible to glimpse suggestions of educational and digital tools that can be used in pedagogical practices, as well as active methodologies that apply in the context in question.

It is worth noting that other teaching skills for STEAM areas must exist, as well as the importance of evaluating and validating these, as well as their CHA in different contexts and teaching modes. In this sense, this study aimed to present a first version of the mapping of teaching competencies for STEAM areas, and this theme is relevant to the current society that needs critical training and subject.

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