MAKER CULTURE AND STEAM IN BASIC EDUCATION: INNOVATIVE APPROACHES TO ACTIVE LEARNING

CULTURA MAKER E STEAM NA EDUCAÇÃO BÁSICA: ABORDAGENS INOVADORAS PARA A APRENDIZAGEM ATIVA

CULTURA MAKER Y STEAM EN LA EDUCACIÓN BÁSICA: ENFOQUES INNOVADORES PARA EL APRENDIZAJE ACTIVO

https://doi.org/10.56238/sevened2026.019-011

Alexandre Vidal de Sousa[1], Denilson Albano Portácio[2], Fábio Fares Marques da Silva[3], Fernanda Maria Diniz da Silva[4], Fernângela Diniz da Silva[5], Francisco José Lopes Cajado[6], Givanildo Ximenes Santana[7], Irene Mendes Fontes[8], Leni Oliveira da Silva Lima[9], Maria Antônia do Socorro Rabelo Araujo[10], Rickardo Léo Ramos Gomes[11], Roberto Augusto Caracas Neto[12]

ABSTRACT

Contemporary education has required the incorporation of pedagogical approaches that promote active student participation, the integration of knowledge, and the construction of more dynamic learning experiences in basic education. In this context, Maker Culture and the STEAM approach stand out as strategies that combine experimentation, interdisciplinarity, and problem-solving, contributing to the reorganization of educational practices in line with current demands in basic education. The general objective of this study is to analyze how Maker Culture and the

[1] Master's degree in History. Universidade Federal do Ceará (UFC). E-mail: avsvidal@gmail.com
Orcid: https://orcid.org/0009-0008-8225-7251
[2] Master's degree in Letters. Universidade Federal do Ceará (UFC). E-mail: denilsonap@seduc.ce.gov.br
Orcid: https://orcid.org/0000-0001-7481-2077
[3] Master's degree in Education. Facultad Interamericana de Ciencias Sociales (FICS).
E-mail: fmarques@fmarques.eti.br Orcid: https://orcid.org/0009-0006-5297-2532
[4] Postdoctoral Researcher in Education. Universidade Federal do Ceará (UFC).
E-mail: prof.fernandadiniz@gmail.com Orcid: https://orcid.org/0000-0002-3958-3077
[5] Postdoctoral Research in Letters (Comparative Literature). Universidade Federal do Ceará (UFC).
E-mail: fernangelasd@gmail.com Orcid: https://orcid.org/0000-0003-1017-2968
[6] Dr. in Agricultural Biotechnology. RENORBIO/UFC. E-mail: lopesbio@yahoo.com.br
Orcid: https://orcid.org/0000-0002-8824-9251
[7] Postdoctoral Research in Genetics, Conservation, and Evolutionary Biology. National Institute of Amazonian Research. E-mail: gxsantana@petrobras.com.br Orcid: https://orcid.org/0000-0001-8337-1082
[8] Postgraduate Degree in Criminal Law. Centro Universitário UniAteneu.
E-mail: irenefontesrc@gmail.com Orcid: https://orcid.org/0009-0002-3152-6649
[9] Master's degree in Emerging Technologies in Education. Must University.
E-mail: lenibraga2011@hotmail.com Lattes: https://lattes.cnpq.br/0514635169655372
[10] Master's degree in Business Administration. Universidade Federal do Ceará (UFC).
E-mail: socorro.rabelo2008@gmail.com Orcid: https://orcid.org/0009-0000-8828-472X
[11] Dr. in Biological Sciences (Honorary Degree), Master's degree in Crop Science. Universidade Federal do Ceará(UFC). E-mail: rickardolrg@yahoo.com.br Orcid: https://orcid.org/0000-0001-6101-9571
[12] Doctoral student. Academy of the National Institute of Industrial Property.
E-mail: robertocaracas2000@gmail.com Orcid: https://orcid.org/0000-0001-8484-411X

STEAM approach contribute to the development of innovative pedagogical practices aimed at active learning in basic education. Regarding methodology, the research is characterized as qualitative, based on a literature review, with the purpose of understanding educational phenomena through the analysis and interpretation of theoretical frameworks related to the theme. In summary, the study demonstrates that the integration of Maker Culture and the STEAM approach contributes to the promotion of active learning in basic education by fostering innovative, interdisciplinary, and student-centered pedagogical practices aligned with contemporary educational demands.

Keywords: Maker Culture. STEAM. Active Learning. Interdisciplinarity.

RESUMO

A educação contemporânea tem requerido a inserção de abordagens pedagógicas que promovam a participação ativa dos estudantes, a integração de conhecimentos e a construção de experiências de aprendizagem mais dinâmicas na Educação básica. Nessas circunstâncias, a Cultura Maker e a abordagem STEAM se destacam como estratégias que articulam experimentação, interdisciplinaridade e resolução de problemas, contribuindo para a reorganização das práticas educativas em consonância com as demandas atuais da Educação Básica. O objetivo geral deste estudo consiste em analisar como a Cultura Maker e a abordagem STEAM contribuem para o desenvolvimento de práticas pedagógicas inovadoras voltadas à aprendizagem ativa na Educação Básica. No que se refere à metodologia, a pesquisa caracteriza-se como qualitativa, fundamentada em revisão bibliográfica, com a finalidade de compreender fenômenos educacionais por meio da análise e interpretação de referenciais teóricos relacionados à temática. Em síntese, o estudo demonstra que a articulação entre Cultura Maker e abordagem STEAM contribui para a promoção da aprendizagem ativa na Educação Básica, ao favorecer práticas pedagógicas inovadoras, interdisciplinares e centradas no estudante, alinhadas às demandas educacionais contemporâneas.

Palavras-chave: Cultura Maker. STEAM. Aprendizagem Ativa. Interdisciplinaridade.

RESUMEN

La educación contemporánea ha requerido la incorporación de enfoques pedagógicos que promuevan la participación activa de los estudiantes, la integración de conocimientos y la construcción de experiencias de aprendizaje más dinámicas en la educación básica. En este contexto, la Cultura Maker y el enfoque STEAM se destacan como estrategias que articulan la experimentación, la interdisciplinariedad y la resolución de problemas, contribuyendo a la reorganización de las prácticas educativas en consonancia con las demandas actuales de la educación básica. El objetivo general de este estudio consiste en analizar cómo la Cultura Maker y el enfoque STEAM contribuyen al desarrollo de prácticas pedagógicas innovadoras orientadas al aprendizaje activo en la educación básica. En cuanto a la metodología, la investigación se caracteriza como cualitativa, fundamentada en una revisión bibliográfica, con el propósito de comprender fenómenos educativos mediante el análisis y la interpretación de marcos teóricos relacionados con la temática. En síntesis, el estudio demuestra que la articulación entre la Cultura Maker y el enfoque STEAM contribuye a la promoción del aprendizaje activo en la educación básica, al favorecer prácticas pedagógicas innovadoras, interdisciplinarias y centradas en el estudiante, alineadas con las demandas educativas contemporáneas.

Palabras clave: Cultura Maker. STEAM. Aprendizaje Activo. Interdisciplinariedad.

1 INTRODUCTION

Contemporary education has been marked by significant transformations that demand the revision of traditional pedagogical practices, especially in the context of Basic Education. In this scenario, the incorporation of approaches that encourage the active participation of students, the integration of knowledge and the use of technologies has gained space in educational discussions. The Maker Culture and the STEAM approach are inserted in this context as proposals that stimulate learning through experimentation, collaboration and problem solving, contributing to the construction of more dynamic and contextualized educational experiences.

The articulation between these approaches makes it possible to overcome fragmented teaching models, by promoting integration between different areas of knowledge and encouraging student protagonism. By valuing learning by doing and interdisciplinarity, both the Maker Culture and the STEAM approach favor the construction of more interactive learning environments, in which students take an active role in the construction of knowledge. This perspective dialogues with the current demands of Basic Education, by aligning the educational process with the needs of training critical, creative subjects capable of acting in complex contexts.

In this context, the general objective of this study is to analyze how the Maker Culture and the STEAM approach contribute to the development of innovative pedagogical practices aimed at active learning in Basic Education. To achieve this objective, the following specific objectives were established: (1) to understand the foundations, principles and potentialities of the Maker Culture in the context of Basic Education; (2) to analyze the STEAM approach as an interdisciplinary strategy for the promotion of innovative practices in Basic Education; and (3) to investigate how the integration between Maker Culture and STEAM favors the development of active learning in Basic Education.

Regarding the methodology, the study is characterized as qualitative, since it seeks to understand educational phenomena through the interpretation of meanings, actions and relationships established in the investigated context.

The article is organized into four sections: the introduction, which presents the contextualization of the theme and the objectives of the research; the methodology, which describes the approach adopted and the procedures followed in conducting the study; the theoretical foundation, which discusses the main concepts related to the Maker Culture, the STEAM approach and active learning; and the final considerations, which summarize the results obtained and indicate possibilities for future research.

2 METHODOLOGY

This research analyzes pedagogical innovation in Basic Education, focusing on the incorporation of Maker Culture to the STEAM proposal to promote active learning. They are used in education as alternatives to conventional methodologies, since they favor student engagement, interdisciplinarity and the strengthening of more active and contextualized learning experiences. The research is qualitative in nature, as it seeks to understand educational phenomena through the interpretation of meanings, actions and relationships within the studied context.

Pereira et al. (2018) argue that qualitative research investigates the subjective and situational dimensions, which leads to a deeper understanding of interactions in educational processes. According to Sousa and Santos (2020), this technique allows data to be organized and interpreted in a systematic way, which is essential to make consistent analyses.

The research was carried out, especially, through a bibliographic review, in which scientific productions relevant to the theme were selected and analyzed. For data collection, databases such as *Google Scholar* and *Scielo were consulted*, as well as journals indexed in academic databases, using the keywords Maker Culture, STEAM and Active Learning, in isolation and combination. As selection criteria, priority was given to articles published in scientific journals, works presented at academic events and books that presented a direct relationship with the theme, in addition to recent time frame and theoretical relevance to the educational field. For this, the pertinent theoretical literature was surveyed with great rigor, which was organized in the midst of illustrations and tables that synthesize important concepts and relationships, which enabled a clear organization and exposure of the analyzed data.

Themes related to pedagogical innovation in Basic Education were also explored, such as Maker Culture, STEAM methodology, educational robotics, agile methodologies and active learning. This thematic expansion allowed several theories to be intertwined, which favors a more holistic understanding of current educational practices.

3 THEORETICAL FOUNDATION

The theoretical foundation of this study was structured from three central axes that guide the proposed analysis. The first, entitled **3.1 Maker Culture in Basic Education: foundations, principles and pedagogical applications**, addresses the conceptual elements and practices associated with the insertion of Maker Culture in the educational context. The second, **3.2 STEAM Approach in Basic Education: interdisciplinarity and pedagogical innovation**, discusses the integration between areas of knowledge as a strategy for the promotion of more

articulated and innovative pedagogical practices. Finally, the third axis, **3.3 Active learning mediated by Maker Culture and the STEAM approach**, analyzes how the articulation between these approaches contributes to the development of more participatory and student-centered learning processes.

3.1 MAKER CULTURE IN BASIC EDUCATION: FOUNDATIONS, PRINCIPLES AND PEDAGOGICAL APPLICATIONS

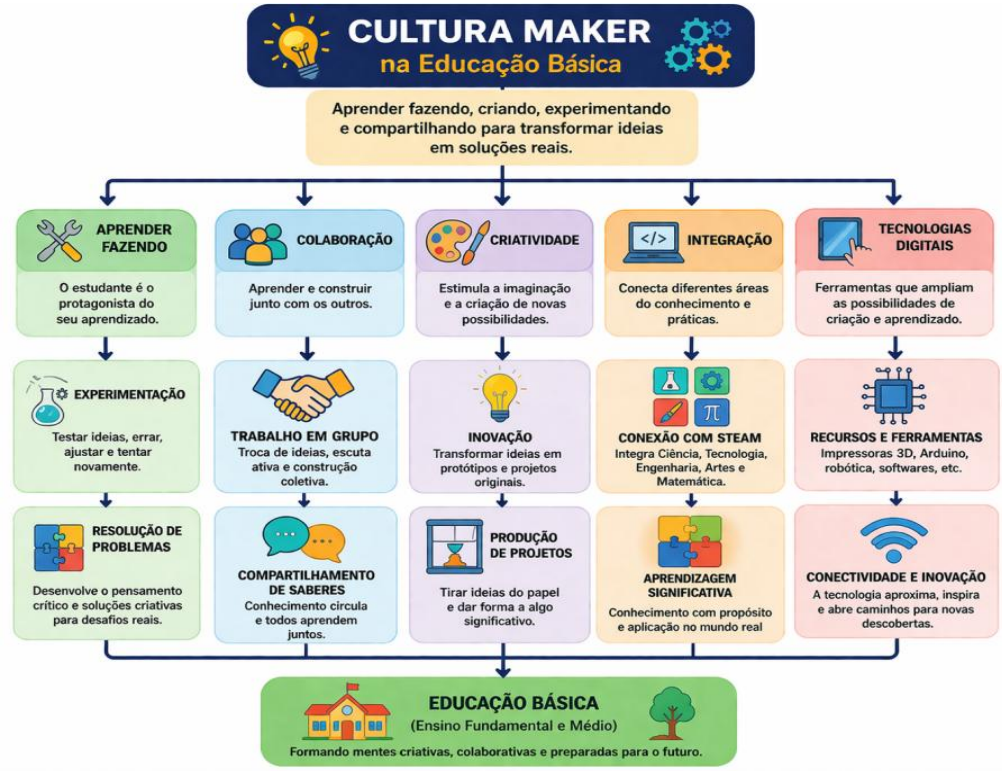
The Maker Culture, which can be defined as a movement that encourages and values learning through practice, experimentation, and creation, has been consolidated as an approach of great importance in the contemporary educational scenario. The emphasis on practical experience in the teaching and learning processes has proven to be increasingly important and influential in the way education is understood and implemented today. In this perspective under discussion, Carvalho and Bley (2018) highlight that the insertion of digital technologies in the educational space considerably expands the opportunities for knowledge construction. This is done by building more effective connections between the theoretical concepts addressed and the practices that are applied in real teaching and learning contexts. In this sense, the Maker Culture offers students a space that encourages them to be more protagonists and active in their learning. Thus, they are not limited to being "tabulas rasas", mere passive listeners who only absorb information, but, in another way, they start to have a more active and collaborative role in the creation of knowledge. It is, therefore, of paramount importance and great value that this occurs in the phases of Elementary and High School, which are so decisive in the school education of these young people.

Hatch (2013) also observes that the *maker* movement is based on three fundamental pillars: collaboration, sharing, and incessant experimentation. This set of principles contributes to making learning environments more challenging, dynamic, and engaging. In this context, mistakes are no longer seen as failures and are understood as an integral part of the learning process, allowing students to develop their skills and expand their understanding of the situations they experience. When the school incorporates this perspective, there is a reconfiguration of pedagogical practices, with greater appreciation of creativity, student autonomy, and the ability to face and solve real problems. Such a direction is in line with the demands of contemporary education, as it prepares students to deal with the challenges of today's world. Thus, this change in teaching approaches highlights the need to adopt more agile methods that are consistent with the dynamics of the twenty-first century. Before moving

forward, Figure 1 summarizes the main elements that structure the Maker Culture in the educational context.

Figure 1

Concept map of the Maker Culture in Basic Education



Source: Carvalho and Bley (2018); Hatch (2013); Marostica (2023); Oliveira et al. (2024)
Note: AI-generated illustration with content informed by the researchers from a study of the flagged sources: ChatGPT.

Along these lines, Marostica (2023) points out that the Maker Culture, when applied to education, provides the use of active methodologies, in which students assume a leadership role in their own learning. In these contexts, protagonism is enhanced and the exchange of knowledge happens collaboratively among students. Therefore, the idea of *maker* goes beyond simply applying new methodologies, as it allows students to become co-authors of their own learning and actively participate in the construction of knowledge.

In Basic Education, this expands the opportunities for enriching experiences. Students begin to interact with a variety of resources and media, which leads to more diverse learning, allowing for different forms of expression and communication. This produces a more contextualized education, relating what is learned at school to what happens on a daily basis, which helps to increase engagement and interest in the suggested activities (Marostica, 2023).

In addition to what has already been discussed, Oliveira *et al.* (2024) point out that Maker Culture, especially with regard to projects aimed at public educational institutions, brings a

series of benefits related to the strengthening of skills in the cognitive, social, and technological spheres. However, this perspective also faces a series of obstacles that can be classified as structural and pedagogical. Among the various challenges that can be mentioned, it is essential to highlight, especially, the training of educators and the adequacy of the infrastructure conditions of educational institutions. However, the implementation of this approach in the context of Basic Education is very promising, as it fosters and stimulates the creation of pedagogical practices that are more interactive and aligned with the social and technological transformations of the present. Being connected to innovations is essential to train students more efficiently for the challenges of today's world.

3.2 STEAM APPROACH IN BASIC EDUCATION: INTERDISCIPLINARITY AND PEDAGOGICAL INNOVATION

The STEAM methodology, which combines Science, Technology, Engineering, Arts, and Mathematics, is gaining prominence as an approach to integrate the various areas of knowledge. It works to promote innovative pedagogical practices aligned with Basic Education, aiming at more interactive and relevant learning. Therefore, by integrating these areas of knowledge, the development of skills in students is promoted, better preparing them to face the challenges of the contemporary world.

According to Pugliese (2020), STEAM is a global trend resulting from the intersection of these five disciplines: science, technology, engineering, arts, and mathematics. This perspective relates education to the needs of contemporary society, promoting a more cohesive and relevant education. By crossing the boundaries of knowledge, a greater opportunity is created for knowledge to be constituted in an integrated way, favoring a broader and more cohesive perspective of the contents that permeate education.

With regard to the implementation of this approach in the school context, Lorenzin, Assumpção and Bizerra (2018) emphasize that the progression and elaboration of STEAM curricula for High School generate significant transformations in the pedagogical organization and teaching practices. It is necessary to reconfigure the pedagogical practice and the way educators act in the classroom, so that the disciplines of Science, Technology, Engineering, Arts and Mathematics can be more effectively integrated. For this new process to be structured, it is necessary to implement practices that, more than flexible, are collaborative, with the educator acting as a mediator in learning, accompanying and guiding students in their journey of knowledge construction. Interdisciplinarity, in this sense, is an essential aspect, incorporated as a central axis in educational actions, which favors the generation of knowledge that is

interconnected and contextualized in certain situations. This methodology not only favors the construction of knowledge, but also makes the application of knowledge in the different areas of learning more pertinent and meaningful.

As Jia, Zhou, and Zheng (2021) demonstrate in their research, integrating the STEAM approach, which brings together science, technology, engineering, arts, and mathematics, with *maker education*, centered on hands-on practice and stimulating students' inventiveness, causes a significant increase in the motivation of those who participate in this teaching model. Such integration strengthens students' self-efficacy, that is, the confidence that each one places in their own ability to face and overcome challenges. In addition, it promotes a form of learning that articulates different disciplines in a collaborative and integrated way, making the pedagogical process more dynamic and consistent.

In this context, the need to adopt methods that position students as protagonists, actively involved in the construction of knowledge, is evident. This posture contributes to a more consistent assimilation of content and favors the development of student autonomy, resulting in a more participatory and dialogical school environment. Due to these characteristics, this approach is also effective in mediating conflicts and promoting mutual understanding between individuals (Jia; Zhou; Zheng, 2021).

When implemented, there is an improvement in communication and collective engagement, relevant factors for achieving group goals. In addition, it is a strategy that can be adapted to different educational contexts, which expands its application possibilities. In summary, its purpose goes beyond simple conflict resolution, by contributing to the construction of more consistent and harmonious relationships between the participants in the educational process (Jia; Zhou; Zheng, 2021).

Nascimento *et al.* (2024, p. 13), regarding the issue of comprehension, argue the following:

In this way, we understand that educating is to give meaning and formulate meanings to what is done and what is lived, it is to direct and broaden the gaze to new horizons, to stimulate the perception of the world - expanding its understanding, it is to provide fairer, more inclusive and integrative spaces for learning.

Before proceeding, Table 1 presents a synthesis of the main elements that characterize the STEAM approach in Basic Education.

Table 1

Structuring elements of the STEAM approach in Basic Education

Element	Description
Interdisciplinarity	Integration between different areas of knowledge, promoting an articulated view of the contents
Project-based learning	Development of practical activities aimed at solving real problems
Integration with technologies	Use of digital and technological resources in the teaching and learning process
Creativity and innovation	Stimulating the production of original ideas and solutions
Student protagonism	Active participation of students in the construction of knowledge

Source: Pugliese (2020); Lorenzin, Assumpção and Bizerra (2018); Jia, Zhou and Zheng (2021).

In addition, at times, especially with regard to pedagogical robotics, STEAM integration is noticeable. According to Gavazzi's (2020) research, this strategy is seen as an important tool to unite theory and practice, especially with regard to Elementary School. Pedagogical robotics makes it possible to put theoretical concepts into practice in a more palpable and dynamic way, which leads to more effective and captivating learning at this stage of teaching.

In this sense, the use of electronic waste in the development of educational robotics expands pedagogical possibilities by associating technological learning and socio-environmental awareness. According to Silva et al. (2016), this practice favors the expanded education of students, by stimulating creativity, critical thinking, and the responsible use of resources. In addition, it contributes to the reduction of social vulnerability, by engaging young people in meaningful activities in the school context. In this way, robotics with reuse of materials is consolidated as an educational strategy articulated with the principles of Maker Culture and the STEAM approach.

It is worth noting that, in the More Science at School Project, developed within the scope of UECE, the scholarship holder must have time for periodic meetings, both face-to-face and remote, in addition to dedicating 10 hours a week to the activities of the institutional project "Garbage: Global Problem. Local Solutions. Mining educational riches from electronic waste". The actions take place remotely, articulated with face-to-face visits and interventions in municipal and state schools linked to the *campuses* of UECE, UNILAB and URCA. This is a nationwide initiative, which has enabled relevant training experiences, such as the one experienced by students from public schools EM Santos Dumont and Sebastião de Abreu, in Fortaleza, who participated in a trip to Brasília from March 24 to 27, 2026, expanding their academic and cultural repertoires in the context of the project.

When robotics is used as a pedagogical tool in teaching and learning, it is possible to interconnect different areas of knowledge and students are able to build and improve skills that have everything to do with logic, problem solving, and collaborative teamwork. This is all in line

with the STEAM methodology, which aims to integrate science, technology, engineering, arts, and mathematics in a fun, practical, and interdisciplinary way. Thus, robotics not only integrates the disciplines in a more fluid way, but also creates a more engaging and interactive learning environment, in which the aforementioned skills are recognized and improved.

Finally, the authors Gomes *et al.* (2024) argue that active methodologies, aligned with educational movements and proposals such as STEAM, are essential to strengthen the autonomy of educators and to allow a new understanding and resignification of their conventional pedagogical practices. Therefore, interdisciplinary approaches become valuable tools to create learning environments that are more active and participatory. It is in these spaces that teachers and students collaborate, consolidating pedagogical practices that are in tune with the various changes that mark current education.

3.3 ACTIVE LEARNING MEDIATED BY THE MAKER CULTURE AND THE STEAM APPROACH

Active learning, the Maker Culture and the STEAM approach configure a dynamic and engaging learning process, in which the student assumes the role of protagonist both in the construction of knowledge and in the development of their skills. According to Sabbatini and Vieira (2025), the articulation between *maker* practices, computational thinking and the STEAM proposal constitutes an important resource for the construction of more fun, challenging, interactive and dynamic learning environments, especially in the early years of schooling, in which learning by doing is established as one of the pillars that support the educational experiences of students. These elements enable the active participation of students in the construction of knowledge, favoring the production of relevant knowledge in Basic Education, while expanding student motivation and involvement, providing a more meaningful formative experience.

Considering the organization of pedagogical practices based on this integration, Bacich and Holanda (2020) highlight that project-based learning is an appropriate strategy within the scope of the STEAM approach, in which students are encouraged to explore real-world problems, mobilizing knowledge from different areas in an articulated way, which favors active learning by stimulating student autonomy, decision-making, and effective participation in the proposed activities.

Interdisciplinarity is one of the foundations that sustain the connection between Maker Culture and STEAM (Machado; Júnior, 2019). The combination of different areas of knowledge is capable of overcoming the fragmentation of knowledge, favoring a broader understanding of

the contents within active learning. In this context, students begin to relate concepts in a more contextualized way, which favors a more solid construction of knowledge.

Another relevant aspect concerns collaborative learning mediated by technologies, a recurring element in *maker practices*. Pareschi, Silva, and Santana (2022) demonstrate that the exchange of experiences and the collective construction of knowledge are favorable results of collaboration among students, combined with the use of technological resources.

Geraldi, Holanda, and Bacich (2022) point out that STEAM education, when integrated with innovative pedagogical practices, contributes to the consolidation of more fun, flexible, and participatory learning environments. This movement strengthens active learning by promoting interaction between subjects and encouraging participation in activities that require cooperation, dialogue, and joint problem-solving. In these contexts, active learning manifests itself through the involvement of students in activities that require investigation, creation, and reflection. Thus, the integration between Maker Culture and STEAM presents itself as a consistent strategy for the promotion of educational practices aligned with the contemporary demands of Basic Education.

4 FINAL CONSIDERATIONS

The investigation in question was carried out in the context of pedagogical practices considered innovative and that are applied in Basic Education. The research focused mainly on the interconnection and correlation between the Maker Culture and the STEAM educational methodology, which covers the areas of Science, Technology, Engineering, Arts and Mathematics. The two approaches were selected due to their relevance in facilitating learning that is engaged and dynamic, aimed at both elementary and high school students. Considering the transformations that have been taking place in contemporary education, the research aimed to understand how these new approaches play a relevant role in the restructuring of teaching and learning methods, thus favoring an increase in student involvement and the articulation of knowledge in different school contexts. Such an analysis has become essential to recognize the contributions that such transformations offer to the educational context.

The results clearly and conclusively demonstrate that the research achieved all the previously established objectives, since it enabled a detailed and consistent analysis of the contributions of the Maker Culture and the STEAM approach to the conception and improvement of innovative pedagogical practices, specifically oriented to active learning. It is also evident that the investigation not only achieved its goals, but also highlighted the relevance of these methodologies for contemporary education, allowing the establishment of significant

relationships between the selected theoretical references and the pedagogical practices currently implemented, which reinforces the relevance of the theme in the scope of Basic Education.

Regarding item 1.1, the research indicated that the Maker Culture, by emphasizing learning by doing, collaboration and experimentation, helps to create more dynamic and collaborative learning environments in Basic Education. It is perceived that its insertion in the school environment stimulates the protagonism of students and expands the opportunities to develop skills related to creativity, problem solving and student autonomy.

With regard to item 1.2, it was observed that the STEAM methodology presents itself as an interdisciplinary strategy, favoring the joining of different knowledges and the strengthening of more connected and contextualized pedagogical practices. The analysis revealed that this strategy helps to combat the fragmentation of the curriculum, promoting the interconnection of knowledge and the practical application of knowledge, which enriches active learning in Basic Education.

Regarding item 1.3, it was observed that the union of Maker Culture with STEAM consistently enhances active learning, since it encourages students to participate in activities that involve investigation, creation and collaboration. This articulation allows for the creation of richer learning experiences, where students become protagonists of their learning process, which increases their engagement and understanding of the contents covered.

Based on these results, it is suggested that future research explore the empirical application of these approaches in other school contexts, especially with regard to educational outcomes, teacher training, and public policies aimed at pedagogical innovation. Studies that consider variables such as school infrastructure, evaluation practices, and curricular integration can contribute to a broader understanding of the challenges and possibilities of consolidating these strategies in Basic Education.

REFERENCES

Bacich, L., & Holanda, L. (2020). STEAM em sala de aula: A aprendizagem baseada em projetos integrando conhecimentos na educação básica. Penso.

Carvalho, A. B. G., & Bley, D. P. (2018). Cultura maker e o uso das tecnologias digitais na educação: Construindo pontes entre as teorias e práticas no Brasil e na Alemanha. Revista Tecnologias na Educação, 26.

Gavazzi, A. N. F. (2020). Robótica pedagógica como ferramenta para aplicação da metodologia STEAM (Science, Technology, Engineering, Arts and Mathematics) no ensino fundamental (Dissertação de mestrado). Universidade de São Paulo.

Geraldi, A. M., Holanda, L., & Bacich, L. (2022). Educação STEAM: Reflexões teórico-práticas do coorte da liga STEAM (1ª ed.). Tríade Educacional.

Gomes, R. L. R., et al. (2024). The relationship between active methodologies as teaching strategies and educators' autonomy. IOSR Journal of Business and Management, 26(8), 74–84. https://doi.org/10.9790/487X-2608097484

Hatch, M. (2013). The maker movement manifesto: Rules for innovation in the new world of crafters, hackers, and tinkerers. McGraw Hill Education.

Jia, Y., Zhou, B., & Zheng, X. (2021). A curriculum integrating STEAM and maker education promotes pupils' learning motivation, self-efficacy, and interdisciplinary knowledge acquisition. Frontiers in Psychology, 12, 725525.

Lorenzin, M., Assumpção, C. M., & Bizerra, A. (2018). Desenvolvimento do currículo STEAM no ensino médio: A formação de professores em movimento. In L. Bacich & J. Morán (Orgs.), Metodologias ativas para uma educação inovadora: Uma abordagem teórico-prática. Penso.

Machado, E. S., & Júnior, G. G. (2019). Interdisciplinaridade na investigação dos princípios do STEM/STEAM education: Definições, perspectivas, possibilidades e contribuições para o ensino de química. Revista Scientia Naturalis, 1(2), 43–57.

Marostica, L. (2023). Cultura maker, através das metodologias ativas e outros ambientes de aprendizagem para o compartilhamento de saberes na educação do século XXI (Dissertação de mestrado). Universidade Estadual Paulista.

Nascimento, C. H. M. de H., et al. (2024). Documento curricular referencial de Fortaleza: Incluir, educar e transformar (Vol. 1). Fundação Getúlio Vargas.

Oliveira, D. S. de, et al. (2024). Cultura maker na educação: Benefícios e desafios em iniciativas extracurriculares para escolas públicas. Revista Caderno Pedagógico, 21(10), 1–22.

Pareschi, C. Z., Silva, L. I. da, & Santana, M. C. de. (2022). Aprendizagem colaborativa na cultura maker: Mediação tecnológica na educação. In S. Corregio (Org.), Cultura maker e robótica: Criatividade, colaboração e sustentabilidade como possibilidades para a educação. V&V Editora. https://doi.org/10.47247/SC/88471.89.0

Pereira, et al. (2018). Metodologia da pesquisa científica. Universidade Federal de Santa Maria.

Pugliese, G. O. (2020). Um panorama do STEAM education como tendência global. In L. Bacich & L. Holanda, STEAM em sala de aula: A aprendizagem baseada em projetos integrando conhecimentos na educação básica. Penso.

Sabbatini, M., & Vieira, S. (2025). Cultura maker, abordagem STEAM e pensamento computacional nos anos iniciais do ensino fundamental. Redoc, 9(2), 1. https://doi.org/10.12957/redoc.2025.82852

Silva, C. C. de M., Silva, J. J. D. da, Jorge, E. M. de F., Santos, D. A., & Saba, H. (2016). A revolução da robótica utilizando lixo eletrônico no ensino básico: Formação ampliada e

menor vulnerabilidade de jovens à violência nas escolas públicas. Revista do Laboratório de Estudos da Violência da UNESP, 17. https://doi.org/10.36311/1983-2192.2016.v0n17.5973

Sousa, J. R. de, & Santos, S. C. M. dos. (2020). Content analysis in qualitative research: A way of thinking and doing. Pesquisa e Debate em Educação, 10(2), 1396–1416. https://doi.org/10.34019/2237-9444.2020.V10.31559