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CREATIVE LITERACY: A HISTORICAL OVERVIEW OF THE USE OF APPROACHES FROM THE AREA OF DESIGN IN THE AREA OF EDUCATION

LETRAMENTO CRIATIVO: UM PANORAMA HISTÓRICO DA UTILIZAÇÃO DE ABORDAGENS PROVENIENTES DA ÁREA DE *DESIGN* NA ÁREA DA EDUCAÇÃO

ESCRITURA CREATIVA: UN PANORAMA HISTÓRICO DE LA UTILIZACIÓN DE PLANTEAMIENTOS PROVENIENTES DEL ÁREA DE *DISEÑO* EN EL ÁREA DE LA EDUCACIÓN

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Abstract: The central theme of this article is the development of creative capability in the field of Education through Design. It presents a historical overview of the use of approaches from the area of Design in the area of Education, by means of a qualitative methodology, of the descriptive type, with a literature review. The findings of this study were so satisfactory that it was possible to establish a global scenario of the main initiatives found both in the literature and on the Internet. To better understand the contribution of Education in Design, through the concept of Creative Literacy, it was necessary to understand the main currents related to Design and Education by means of a literature review in both areas. The results show that Design is the third area of knowledge, i.e., a line of reasoning based on a vision of human learning, which suggests that there are more than two polarities (humanities and sciences) that are expressed in the notion of cultures. Such an activity is described by Archer (1974) as a third area called Design. With regard to Education, it was

concluded that, in general, schools are focused more on the answer rather than on the question, and act predominantly in reproducing what is learned, rather than on reflection.
Keywords: Design; Education; Education through Design.

Resumo: O tema central do presente artigo versa sobre o desenvolvimento da capacidade criativa no âmbito da educação por meio do Design. Tem por objetivo apresentar um panorama histórico da utilização de abordagens provenientes da área de Design em Educação. A metodologia utilizada foi de cunho qualitativo, tipo descritivo, com revisão de literatura e os resultados se mostraram satisfatórios ao ponto que foi possível estabelecer um cenário global acerca das principais iniciativas encontradas, tanto na literatura quanto na rede mundial de computadores. Para melhor compreender a contribuição da educação em Design, por meio do conceito de Letramento Criativo, foi necessário entender as principais correntes relacionadas ao Design e à Educação a partir de uma revisão de literatura fundamentada em ambas as áreas. Os resultados registram o Design enquanto terceira área do conhecimento, ou seja, uma linha de raciocínio baseada em uma visão de aprendizagem humana, que sugere que há mais do que as duas polaridades (humanidades e ciências) que estão expressas na noção das culturas. Tal atividade é descrita por Archer (1974) como uma terceira área denominada Design. Com relação à Educação, concluiu-se que, de uma forma geral, as escolas são orientadas para a resposta e não para a pergunta e atuam predominantemente na reprodução e não na reflexão.
Palavras-Chave: Design; Educação; Educação pelo Design.

Resumen: El tema central de presente artículo versa sobre el desarrollo de la capacidad creativa en el ámbito de la educación por medio del Diseño. Tiene por objetivo presentar un panorama histórico de la utilización de planteamientos provenientes del área de Diseño en Educación. La metodología utilizada fue de carácter cualitativa, tipo descriptiva, con revisión de la literatura. Los resultados se mostraron satisfactorios al punto que fue posible establecer un escenario global sobre las principales iniciativas encontradas, tanto en la literatura como en la red mundial de computadores. Para comprender mejor la contribución de la educación en el Diseño, por medio del concepto de Escritura Creativa, fue necesario entender las principales corrientes relacionadas al Diseño y a la Educación a partir de una revisión de la literatura fundamentada en ambas áreas. Los resultados muestran al Diseño como la tercera área del conocimiento, o sea, una línea del raciocinio basado en una visión de aprendizaje humano, que sugiere que hay más de dos polaridades (humanidades y ciencias) encontradas en las culturas. Tal actividad es descripta por Archer (1974) como una tercera área denominada Diseño. Con relación a la Educación, se concluye que, de una forma general, las escuelas son orientadas para la respuesta y no para la pregunta y actúan predominantemente en la reproducción y no en la reflexión.
Palabras-Clave: Diseño; Educación; Educación por el Diseño.

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Introduction

This article addresses the concept of Creative Literacy, through the development of Design awareness for education. First, it is necessary to give the definitions of Design and Creative Literacy adopted in this study. Design is understood in the sense defined by the Professional Practice Committee of the World Design Organization (WDO), formerly the International Council of Industrial Design (ICSID), at its 29th General Assembly in Gwangju, South Korea, on October 17 and 18, 2015. For the WDO, Industrial Design (Industrial Design or simply Design with a capital "D") is a strategic process of problem solving that drives innovation, builds business success, and leads to a better quality of life through original products, systems, services, and experiences.

Industrial Design (ID) bridges the gap between what is, and what is not possible. It is a transdisciplinary profession that benefits from creativity, to solve problems and collectively create solutions aimed at improving products, systems, services, experiences, and businesses. At its core, Industrial Design provides more optimistic views of the future, reconfiguring problems and turning them into opportunities. ID connects innovation, technology, research, enterprises, and customers to provide new value and competitive advantage in the economic, social and environmental areas (WOOD, 1996).

Having determined the Design concept adopted in this article, it is necessary to define the concept of Creative Literacy, which has been previously unpublished in the literature reviewed and has its roots in Archer (1973), as detailed at the end of this introduction. Creative Literacy is a method for design awareness in education, composed of a set of tools aimed at contributing to the development of creative thinking.

Having presented Design, as defined by WDO, and Creative Literacy, which this article advocates as a novelty, it is worth noting that the contribution of drawing to humanity is ancient and dates back to prehistory, when men recorded their habits and experiences through rock paintings. Drawing predated verbal language and was the forerunner of writing. In the Middle Ages, artisans were responsible for the development of artifacts and tools, but it was not until the Renaissance that drawing received a more technical connotation. The construction of objects through reflection on Geometry, Physics, Anthropometry, and other areas of knowledge gave Design processes greater complexity. The precursor of this approach was one of the greatest geniuses of all time, Leonardo Da Vinci (SANTAELLA, 2001).

However, to develop a study about the contributions of Education in Design in the Brazilian education system requires a deeper understanding of its causalities and consequences. It is known that the evolution of Design, and its importance for humanity, are unquestionable. However, there are some determining factors that have enabled Design to develop.

The development of English industrial culture in 1851, which eventually inspired Rui Barbosa around 1880, aimed to use Design not only as a strategic element for economic development, but also as a powerful strategy of conscious training of the population by teaching drawing (BARBOSA, 1982). Rui Barbosa's devotion to drawing brought about positive consequences, though somewhat late, which were registered by Decree Law 4,244, dated 1942. This decree

included drawing and manual arts subjects in the curriculum of secondary education in Brazil, and teacher education courses for primary schools, which were regulated by the Lei Orgânica do Ensino Normal [Organic Law of Normal Education], dated 1946.

Thanks to the foundation of Escola Superior de Desenho Industrial (ESDI) [Industrial Design College], in Rio de Janeiro city, Education in Design began to spread to higher education. However, the Brazilian advance sought by Rui Barbosa ended when, in the early 1970s, the Lei de Diretrizes e Bases da Educação (LDB) [Law of Guidelines and Bases of Education] summarized specific activities of drawing, music, crafts, choral singing and arts. These were united in a single activity in the primary and secondary curriculum, called Artistic Education (BRASIL, 1999).

The methodology of this study is qualitative, of the descriptive type, with a literature review. A global scenario of the main initiatives in the literature and on the Internet was established. To better understand the contribution of Education in Design, through the concept of Creative Literacy, it was necessary to understand the main streams of thought related to Design and Education, by means of a literature review covering both areas.

The discussion in this article is justified by the gap created by the retrogression advocated by the LDB in 1971 regarding manual activities, including drawing, among others already cited. By means of a qualitative methodology, of the descriptive type, with a literature review and research on the Internet, this article provides a historical overview of the use of approaches from the area of Design in Education.

Development

The development section presents the scope of the literature review and addresses the three findings of the article. These relate to design as the third area of knowledge; education through design; and design in the world of education. There is a line of reasoning based on a view of human learning, which suggests that there are more than two polarities that are expressed in the notion of cultures, humanities and sciences.

The third area of knowledge

The British nation has produced an extraordinary social system, in which culture and education are valued in inverse proportion to their utility in everyday life. The feelings derived from this line of thought were crystallized in the movement Education for Capability, initiated by the Royal Society of Arts. The core of this argument leads to the conclusion that capability is inhibited by the current system of education. It stresses the importance of analyzing, criticizing and acquiring knowledge, and generally neglects not only the formulation of problems, but also doing and organizing of constructive and creative activities of all kinds.

From this perspective, it has been argued that there is a third area which has been little developed, especially in children's education. This area is able to assume a vital form of mental reasoning centered around activities that are expressed as doing, building, creating, preparing,

organizing, and perceiving, covered by the generic term Design. As professor Archer (1974) states, Design written with a capital D is used in a sense that goes far beyond the one used regularly by architects and engineers, and the one that other professional Designers attribute to it.

Therefore, Design is seen as an area of experience that is equated with science and the humanities, with its own language, vocabulary and syntax, through modeling, graphic communication and physical representation. The research project "Design in general education", of the Royal College of Art, sponsored by the Department of Education and Science, has done much to document and detail sub-disciplines of the theory, teaching and practice of the third area of the curriculum.

Through master's degree courses, professors and other professionals are currently investigating and helping to expand the project of the philosophy of Design education based on its teaching in workshops, schools and studios. Incidentally, current research in the field of neurology has supported the idea that analytical and critical thoughts are of a different order. Therefore, they are channeled differently, based on processes involved in synthetic and intuitive responses. This has been demonstrated, for example, in the work of Robert Ornstein of the Langley Porter Institute, California, USA.

There is a special concern for the National Association for *Design* Education: over the years, it has been the social and cultural dimension of Design and its importance for people's lives. Through Design education, students are expected to become more aware and sensitive to their responsibilities as members of society; more responsible for the environment made by mankind.

We live in a world dominated by buildings, products and systems that have been designed. Nevertheless, most people have little understanding of how Designers work, or fail to have any influence on the decisions of Designers through which their physical existence is formed. Historically, this is a relatively new situation with which education is only coming to terms. Until the early twentieth century, especially in rural England, much of what went into the houses was the product of the local artisan, who sought to meet the individual needs of his client, with whom he had personal contact. Mass production and the increasing pace of industrialization have removed the user from the manufacturer and created Design professions that are equally distant.

In terms of objectives, Design education aimed to allow the current and younger generations to understand something about the forces that shape their world. It is believed that this is best achieved not only by observing the actions of others – although this has its place – but through one's own actions. Through activity, children are able to learn something about themselves, their ideas, the ideas of others, and the needs of others. Thus, it is hoped that through Design education, it will be possible to help create a more responsible and agile society, in which users become better informed, and that design may become more affordable and democratic.

Perhaps this third line of argument is summarized, as anywhere in the query document that preceded the Design Council report, Design Education at the Secondary Level. Throughout the world people are becoming increasingly dependent on products and systems of all kinds. This reality not only happens to allow them to run their work more efficiently, but also to enable them to employ their leisure time in a fun way.

These products and systems influence the environment in which we live, which may lead to social consequences. Awareness of the nature and results of Design is necessary for responsible

adults to develop, and it is logical and fair that schools should cover this aspect of life for all their students (MASON, 1982).

Cross (1980) argues that Design should be considered a component of general education that may be subject to the usual meanings and general philosophy of such education. However, traditional Design education tends to focus on career preparation and social roles rather than on the subjective development of individuals. Since general education is, in principle, non-professional and non-technical, *Design* can only achieve parity with other subjects in general education if it is organized as an area of study that contributes to the self-realization of individuals and to their preparation for social roles.

Comparing Design and other well-established disciplines can be useful through the adoption of similar educational approaches. This includes, for example: an orientation regarding concepts and instructional methods suitable for lifelong learning; and fostering an understanding and appreciation of the contribution that Design activities and specializations make to the lives of individuals.

For development and progress in a particular field to occur, the interaction of three different levels of educational activity is necessary. These levels of activity are driven by: scholars and researchers who develop ideas and provide basic research; educators who absorb, translate and suggest ways to use this basic research; and teachers who apply and test methods and results, and provide feedback for further research.

The previously mentioned activity levels justify and point out the significant importance of the present research. In the domains of science and humanities, the interaction among these levels of activity is well established and its effectiveness is evident in all age levels of educational offer. In the area of Design, Archer's work (1974) supports the suggestion that the interaction among these levels has never been effectively developed.

Cross (1980) further argues that Design education or Design teaching allow an important legacy. A broader interpretation of the project and its development in an established area of education require educators who work at a higher level than schools do. Since the new area of Design has intellectual content, educators are responsible for working for the development and large-scale adoption of intellectual procedures to be applied in schools.

Education through Design

It is known that Design education is developed within higher education in Brazil, but not in primary education, except for a few initiatives aimed at reviving this strategy of social, cultural, economic, and technological development. One of them is called *Educação através do Design* (EdaDe) [Education through Design], and was developed by Fontoura in 2002. The Brazilian model proposed by Fontoura (2002) assumes that Design activities are effective means of teaching and learning in an active and interdisciplinary way.

The author points out 13 benefits of his approach. These include: developing skills applicable to the real world, such as critical and creative thinking in children and youth; sensitivity;

problem solving; measurement; written, verbal and graphic communication; negotiation and resolution of conflicts; leadership and teamwork; creation of opportunities for the construction of new knowledge and understanding; providing ideal situations for cooperative learning in the classroom; providing a practical means to test theories; providing meaningful learning; supporting and integrating learning from other areas; using everyday artifacts, products and objects as a means to understanding and interacting with material culture; preparing children and youth for the conscious use and consumption of products; introducing children and youth to the world of design and technology, and preparing children and youth to interact satisfactorily with technological changes in contemporary society (FONTOURA, 2002).

The characteristics pointed out by Fontoura (2002) are based on the statements of Baynes (1992) and Archer (1974) that highlight some macro principles that consolidate the educational philosophical orientation to promote education through Design. As an example, we mention the conscious transformation of the environment by meeting physical, emotional, cultural, and social needs, or the awareness that Design skills are inherent to human beings. Such an education can develop the ability to imagine; the ability to externalize; the ability to use tools and natural resources and, just as importantly, the ability to learn through experience – so-called action pedagogy. The authors further emphasize that work in Design strengthens personal and collective decision-making, which can affect one's life and that of the community.

As described by Mason (1982), throughout the 1970s there was a steady increase in Design in schools and the examination of the implications of a philosophy of design for children's learning and for educational practice. These manifestations take many forms, such as the creation of Design departments and educators in schools, or the development of in-service training courses for teachers.

Design awareness, as an educational concept, involves the development of cognitive, affective and motor skills in young people, which, in turn, requires intellectual content and the adoption of appropriate procedures with regard to method and teaching techniques. Because there is the idea that the "new Design" has intellectual content, it is difficult to reconcile this with the educational legacy in this area. Hindrances to applying research in schools, and the interpretation of the new Design in its broadest sense, are inherent to the contexts of existing schools. The traditional status of schools, teacher training procedures, teaching methods, and the content of these areas traditionally associated with Design are still maintained, despite attempts to reorganize the education system on a national scale.

Institutions provided for the teaching of Design disciplines have traditionally been concerned with teaching technical skills, handicrafts, and handiwork. They have often done it part-time, which results in associated teaching methods being more aligned to training processes rather than to education in general. The need for technical schools and technical courses has been the object of much educational research, and the subject of various reports (CROSS, 1980).

For parity of Design education with other areas, many traditional attitudes associated with its subjects, as well as many traditional attitudes associated with its learning, need to be adjusted. Its place in the school curriculum cannot simply involve reorganizing the discipline of arts and crafts into an amalgamated, redesigned department and giving it a new name.

In this scenario, talking about basic Design skills such as Design awareness, and assuming that such a concept is teachable – although it may have been neglected – does not help in the teaching situation. What exactly are these competencies and skills? In general, it is recognized that like Design, both literacy and numeracy are complex processes. These require a high level of integration and maturation of a wide variety of skills and competencies. Would it be possible to establish a set of assumptions of Creative Literacy capable of promoting Design awareness? A small shift in this direction has already occurred, for example, at the Royal College of Art and at the Open University. However, Design as a third area of education is still under development. Therefore, educators at professional levels have a great responsibility for the growth and development of Design.

Education through Design worldwide

As already mentioned, although the British approach may be subject to improvement, it has been adopted in other countries. One of the most notable statistics to support investment in education through Design is the establishment of more than 1,000 new Design Schools in China over the past ten years. In addition to the growth of Chinese manufacturing in recent decades, China's leadership predicts that innovation and creative thinking will be the keys to economic success in the future. And the development of Design education as part of a national policy not only occurring in China; it is also strong in other Asian countries, such as Korea, Singapore and Japan.

This is partially due to the realization that traditional forms of learning in many Asian countries, such as imitation, repetition, memorization, and absolute deference to teacher authority do not, at least by Western standards, promote the kind of creative thinking that these countries see as fundamental to their economic futures (LEE, BREITENBERG, 2010). The mayor of Seoul, Sae-Hoon Oh, is the first municipal leader to appoint a Design Director to his cabinet. The Ministry of Education in Singapore has opened not only a new university of Design, but also the first Design-based learning program for secondary education sponsored and created by government initiative. Few secondary schools have fully understood the consequences of this change.

This means that visual and spatial learning and holistic thinking, the need to work simultaneously in different media, and the importance of active learning over passive learning, are central for students' cognitive and learning processes. Educational methods that do not incorporate this change will not succeed in the education of students, either today or in the future (KRESS, VAN LEEUWEN, 2002).

Smith (2006) points out that when students are involved in the design process, they learn to observe, identify needs, seek and contextualize problems, work collaboratively, explore solutions, think about alternatives, and communicate their ideas verbally and visually (DAVIS; MOORE, 1992).

The intellectual processes involved in Design mean that the development of any of the cognitive processes – such as critical thinking and problem solving, or human processes and traits, such as creativity and self-confidence – are the focus of curriculum, rather than a structured discipline

or a sequence of tasks. The primary goal of this Design is to increase students' learning ability through the use of problem-solving activities, in order to transfer problem-solving skills to all areas of the curriculum and life (WICKLEIN, 1997).

In Northern Ireland, the subject Technology and Design was introduced in Key Phase 3 for all students, as a result of the Education Reform Order (NI), in 1989. At the heart of the process of introducing this new, compulsory mandatory subject, the government invested more than £167m to ensure that this discipline was taught in all post-primary schools. The results described by Gibson (2007) point out that Technology and Design is a discipline of extreme relevance to the educational experience of the students involved (GIBSON, 2007).

Gibson (2007) reports that the Technology and Design discipline is very useful in terms of outcomes for students, such as reinforcing self-esteem, promoting important attitudes, developing skills, and promoting employability. In particular, teachers believe that the problem-solving approach fostered by the discipline supports the development of students' self-esteem.

As students engage in problem solving, they are required to acquire the skills necessary to deal with uncertainty and, as a result, develop self-confidence – previous comments regarding students' difficulties in dealing with uncertainty should be taken into account, though.

Rarely is there a clear definition of when an acceptable solution has been reached. It can seldom be determined whether a Design product is the best answer to the needs. Any product of Design is the result of a range of value judgments. In this sense, Design shares similarities with science, which is also a poorly-defined problem-solving activity: "There simply is no fixed set of steps that scientists always follow; no one path that leads them unerringly to scientific knowledge" (AAAS, 2017, p. 4; FORTUS et al, 2004).

Given these issues, would it be reasonable to create a scientific pedagogy structured around the Design process? A scientific pedagogy based on Design could build a natural and intuitive student experience with Design. Just as the Design activity develops the cognitive modeling and representative capability of the mind, as described by Roberts (1995), a Design-based research pedagogy could also help students develop modeling and the capacities of representation needed in the scientific domains (NICKERSON, 1994). Several researchers and organizations have suggested incorporating Design activities into general education and into scientific education in particular (AAAS, 2017; CHIAPPETTA, KOBALLA, COLLETTE, 1998; DAVIS; MOORE, 1992; ITEEA, 2002; LAYTON, 1993).

The idea of combining science with Design in the classroom received a lot of attention in the UK (LAYTON, 1993). However, instead of using Design as a vehicle to support the learning of science, the British chose to teach science first, and then apply that knowledge to the solving of Design problems. Some scientific education programs that make use of Design activities were developed (KAFAI & CHING, 1998; KOLODNER, et al 1998; ROTH, 2001; TERC, 2000 apud FORTUS et al., 2004).

In Finland, craft education (also called "Educational slyod" in the Scandinavian context) has had an official and egalitarian position with other school subjects for over 150 years. At that time, Uno Cygnaeus introduced craft education as a compulsory school subject for early childhood, primary and secondary education. The 2004 National Curriculum for Basic

Education defines craft education as a school subject, and prescribes compulsory handicrafts, consisting of textile and technical work. Craft as a standard school subject is not an atypical phenomenon from an international standpoint. There are equivalent school subjects with the same types of objects, for example, Design and Technology, in the United Kingdom, sloyd, in Sweden, and a combination called "Design, carpentry, metallurgy, and home economics", in Denmark. In many countries, such as Estonia, Latvia and Japan, handicrafts are included in Home Economics (textile work) and Technology (technical work) (SYRJÄLÄINEN; SEITAMAA-HAKKARAINEN, 2014).

In Finland, craft education is a compulsory subject in primary education (starting in sixth grade, and continuing from ages seven to twelve years) and lower secondary education, in seventh grade. In eighth and ninth grades (ages fourteen to sixteen years), students can select craft education as an optional discipline. The basic curriculum for craft education emphasizes values and objectives related to creativity and problem solving, with technical and aesthetic skills, independent work skills and promotion of self-expression.

In addition, the holistic and repetitive nature of craft processes is emphasized; particular attention is given to ideation, testing and preparation, as well as to the reflective and evaluation aspects related to the production itself. However, many educators have expressed critical concerns that craft education in Finland puts more emphasis on production and practical processes than on artistic processes. (KARPPINEN, 2008; PÖLLÄNEN, 2011).

Craft education has special significance in promoting human creativity and innovation, especially when conceptual ideas and material aspects of the process support one another (KANGAS, SEITAMAA-HAKKARAINEN, HAKKARAINEN, 2013). The Design process is essentially included in craft processes, and handicraft is seen as the means to materialize Design thinking.

From an educational perspective, some significant aspects are taken into account to enable students to become more confident about their development and the visualization of Design thinking (SYRJÄLÄINEN; SEITAMAA-HAKKARAINEN, 2014). These aspects are described as follows:

Teachers need to become more aware of the character of Design and of the task in the holistic process of craft. Design and Design thinking is intellectually challenging (in comparison with easily understood craft) and requires special efforts, as well as pedagogy on the part of the teacher. Due to its demanding nature, Design also has a strong influence on student development;

a) In Design processes, the vast possibilities of solving the composition, construction and problems of restricted spaces appeals to the teacher's pedagogical kit. The ability to define and offer students reasonable size problems and, from them, to structure the learning process so that the students experience the process, as personally involving, and this is of vital importance;

b) The time and place of Design in the holistic craft process need a precise and careful determination regarding the learning objectives. The variety of processes and time management has a different impact on students. Teachers need to be aware of this diversity in order to use it purposely to ensure significant progress in design and construction;

Craft education should offer several Design contexts and tasks that require the solution of a

variety of aspects, from purely technological problems to user-centered, functional objects and even more art-related tasks of self-expression;
The provision of collaborative Design projects. The challenge for craft education in Finland is that the origins of design problems are often reduced to students' personal needs. The challenge is to provide design problems whose origins and priorities also reside outside personal contexts, in order to support collaborative and multidisciplinary work.

Final Thoughts

The central theme of this article was the development of creative capability in education through Design. We believe that the proposed objective of the article – to present a historical overview of the use of approaches from the area of Design in the area of Education – has been achieved due to the support generated by the literature review and Internet research.
In terms of the results related to Design as the third area of knowledge, it was possible to understand the roots of this approach, as well as the British influence on the consolidation of Design as a third element, alongside the humanities and sciences.
Regarding the result related to Education through Design, it was possible to highlight a significant Brazilian initiative with Fontoura's proposal (2002), which assumes that Design activities are effective means of teaching and learning in an active and interdisciplinary way. It was also possible to identify initiatives proposed by Baynes (1996) and Archer (1991), highlighting some macro principles that consolidate the pedagogic philosophical north to promote education through Design.
Finally, the result related to Design throughout the world has shown that although there are consolidated initiatives in some countries, Design education has still been little explored in terms of pedagogical potential. Would it be possible to develop a methodology capable of following the basic principles presented in this article, in terms of the development of the creative capability of young people through Design?

References

AAAS. **American Association for the advancement of Science**. New York, 2017. Available on: <https://www.aaas.org/>. May 22nd 2017.

ARCHER, B. **Design Awareness and Plannned Creativity in Industry.** London: Design Council, 1974.

ARCHER, L. B. **The Need for Design Education**. Wellesbourne: DATA, 1973.

BARBOSA, R. **O desenho e a arte industrial**: discurso no liceu de artes e ofícios em 23 de novembro de 1882. Rio de Janeiro: SPBA, 1982.

BAYNES, K. **Children Designing**: progression and development in Design and technology at key stage 1 and 2. Loughborough: DD&T / Loughborough University, 1992.

BRASIL. LDB – **Lei de diretrizes e bases da educação**: Lei n. 9.394/96/ apresentação de Ester Grossi. 2. ed. Rio de Janeiro: DP&A, 1999.

CHIAPPETTA, E. L., KOBALLA, T. R., COLLETTE, A. T. **Science instruction in the middle and secondary schools**. 4th edition. Upper Saddle River, NJ: Merrill/Prentice Hall, 1998.

CROSS, A. Design and general education. Reino Unido: Business Press. **Design Studies**, v. 1, 1980.

DAVIS, M.; MOORE, R. **Education through Design**: The Middle School Curriculum. Raleigh: School of Design. North Carolina State University, 1992.

FONTOURA, A. M. **EdaDe**: Educação de crianças e jovens através do Design. Florianópolis: Tese (Doutorado em Engenharia de Produção) – Programa de Pós-Graduação em Engenharia de Produção, UFSC, 2002.

FORTUS, D. et al. Design-Based Science and Student Learning. **Journal of Research in Science Teaching**, v. 41, n. 10, p. 1081–1110, 2004.

GIBSON, K. Technology and Design, at Key Stage 3, within the Northern Ireland curriculum: teachers' perceptions. Springer Science+Business Media B.V. **Int J Technol Des Educ**, v. 19, p. 37–54, 13 July, 2007. Available on <DOI 10.1007/s10798-007-9039-z>.

ICSID. **International Council of Industrial Design**. Available on: http://www.icsid.org/. February 11th 2010.

ITEEA. International Technology and Engineering Educators Association. 2002. Available on: <http://www.iteea.org/Conference/PATT/PATT26/Chin%20%26%20Chong.pdf>. January 17th 2015.

KAFAI, Y.; CHING, C. C. Talking science through design: Children's science discourse within software design activities. **Presented at the International Conference** of the Learning Sciences, Georgia Tech University, Atlanta, GA, 1998.

KANGAS, K.; SEITAMAA-HAKKARAINEN, P.; HAKKARAINEN, K. Design Thinking in Elementary Students: Collaborative Lamp Designing Process. **Design and Technology**, v. 18, n.1, p. 30-43, 2013.

KARPPINE, S. Craft-Art as a Basis for Human Activity. **International Journal of Art & Design Education**, v. 21, n. 1, p. 83-90, 2008.

KOLODNER, J. L. et al. Learning by design from theory to practice. **Presented at the International Conference** of the Learning Sciences, Georgia Tech University, Atlanta GA, 1998.

KRESS, G. R.; VAN LEEUWEN, T. **Multimodal Discourse**: The Modes and Media, 2002.

LAYTON, D. **Technology's challenge to science education**. Buckingham, UK: Open University Press, 1993.

LEE, H. K.; BREITENBERG. M. Education in the new millennium: The case for design based learning. **International Journal of Art & Design Education**, v. 29, p. 54-60, 2010.

MASON, I. **On scores for yes / no forecast**. Preprints of papers delivered at the ninth conference on weather forecasting and analysis, 28 June – 1 July 1982. Seathe Washington, USA. American Meteorological Society, 1982.

NICKERSON, R. S. The teaching of thinking and problem solving. In STERNBERG, R. J. (Ed.), **Thinking and problem solving**. San Diego, CA: Academic Press, 1994. p. 409-449.

PÖLLÄNEN, S. Beyond craft and art: A pedagogical model for craft as self-expression'. **International**

Journal of Education through Art, v. 7, n. 2, p. 111-125, 2011.

ROTH, W. M. Learning Science through Technological Design. **Journal of Research in Science Teaching**, v. 38, n. 7, p. 768-790, 2001.

SANTAELLA, L. **Comunicação e pesquisa**: projetos para mestrado e doutorado. São Paulo: Hacker Editores, 2001.

SPERB, D. Q. **Letramento criativo**: métódica para o desenvolvimento da consciência de design no Ensino Médio. Porto Algre, 2016. 201f. Tese de Doutorado. Programa de Pós-Graduação em Engenharia de Produção. Universidade Federal do Rio Grande do Sul, 2016.

SYRJÄLÄINEN, E.; SEITAMAA-HAKKARAINEN, P. The Quality of Design in 9th Grade Pupils' Design-and-Make. Assignments in Craft Education. **Design and Technology Education**, v. 19, n. 2, p. 30-39, 2014.

WICKLEIN, R. C. Curriculum focus for technology education. Georgia. **Journal of Technology Education**, 1997.

WOOD, D. **Como as crianças pensam e aprendem.** São Paulo: Martins Fontes, 1996.

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