DSXC: TOOLKIT TO SUPPORT DESIGN EDUCATION PROCESSES FOR SUSTAINABILITY

Adolfo Vargas Espitia
Bucaramanga, Colombia, University of Research and Development - UDI. avargas2@udi.edu.co, Christian Daniel *Álvarez Quintero,*
Bogotá, Colombia, assistant of the Research group - University of Research and Development - UDI danialvarezq@gmail.com
Willmar Ricardo Rugeles Joya
Bogotá, Colombia, Pontificia Universidad Javeriana. rugeles-w@javeriana.edu.co, Nataly Guataquira Sarmiento, Torino, Italia, Open Source and Circular Economy Days Torino. guataquira.nat@gmail.com

ABSTRACT

The education for sustainability in design should be approached from the knowledge of global methods but taking into account the contextualization of the tools and not the simple translation and use of methods developed outside Colombia, using tools that connect with students and new ways of learning and facilitating the teacher the dissemination of knowledge in a structured and concrete way. The (DSxC) aims to develop this support, always focusing on the context and facilitate the student to understand and apply sustainable strategies to the development of their projects in classroom.

Key Words: Sustainable design, design methodology, academic tool

INTRODUCTION

The current academic paradigm as a mediator of the relationship between sustainability, design -theory and praxis- and designer presents great difficulties. Approaches between sustainability and design date from the 70s (Andrade Vicente, Frazão, & Moreira da Silva, 2012, Madge, 1997) has been transformed from the hand of the social conjunctures; The Rio Summit of 1992 and its proposal for the reorientation of education towards sustainable development marks the entrance of the academy as a mediator in this relationship. To date, Education for Sustainable Industrial Design presents multiple difficulties excelling the distancing between the generation of academic knowledge and its application in professional praxis. In the case of Educational Sustainable Industrial Design (in Latin America, this distancing is the product of: 1. There is little specialized training of professionals in Sustainable Design which translates into an inappropriate transfer of knowledge, 2. The theory surrounding Sustainable Design has been imported, which to generated barriers of the context for its implementation, 3. The Education for Sustainable Industrial Design thought only as isolated courses in the curriculum-does not allow to know and use by students the broad spectrum of principles, methodologies and methods offered by the Sustainable Design (Geli de Ciurana & Leal Filho , 2006; Sterling & Thomas, 2006). According to the previous assessments, the research question is formulated: What characteristics should have a pedagogical tool that supports the processes of education in sustainability contemplated under the academic context of industrial design?; This problem question is the starting point for the design of the research project whose main objective is then: Design an academic tool that supports pedagogical processes in sustainable design. Consequently, the hypothesis is presented: Through the use of a pedagogical tool -linking the general concepts of Sustainable Design, tools, methods and principles of different existing methodologies- as support for an academic design exercise it is possible to improve the teaching process in classroom for Educational Sustainable Industrial Design.

METHODOLOGICAL FRAMEWORK

The process to reach the DSxC has been systematically developed in the following steps: research, structure approach -architecture of the tool-, design of the information and interface and finally the presentation of the results for validation and feedback.

RESEARCH: This process has been carried out to understand the content and the form. On the content, the pedagogical models applicable to the Education for Sustainable Industrial Design (Aguayo, Estela, Lama, & Soltero, 2011, Bovea & Pérez-Belis , 2012, Ceschin & Gaziulusoy , 2016, Navarro, Rizo, Ceca, & Ruiz, are tracked and analyzed. 2005, Pigosso , McAloone , & Rozenfeld , 2015) prior , prioritizing those that allow a flexibility approach, construction and dialogue between the teacher (Marlene & Rodríguez, 2007) ₫ the student and the case study.

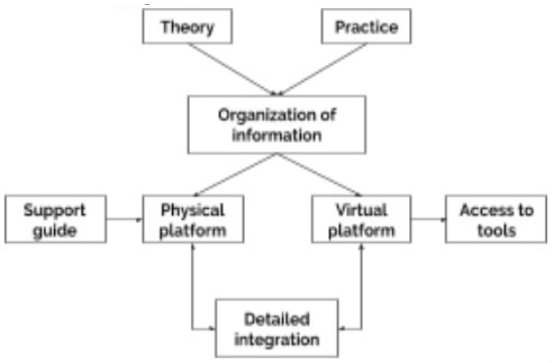
DESIGN: Based on the research, it begins with the conceptual and criteria approach of the DSxC, then the information architecture is designed and finalized with the materialization of the tool taking advantage of design principles. The results of the research are based on the creation of the structure of -DSxC- managing to integrate theory and practice as a guide.

PRESENTATION: The tool is exposed to be used in different academic contexts in Educational Sustainable Industrial Design processes looking for a feedback as part of a process of continuous improvement.

RESULTS THE DSX COLOMBIA: ANATOMY OF AN ACADEMIC TOOL.

STRUCTURE AND FUNCTION OF THE TOOL

The general structure of -DSxC- is divided in two parts, that is, the theoretical vision and practice of the Sustainable Design is integrated through two platforms -Enterprise and Virtual - which provides support to the teacher as a guide and accompaniment to the process of design, in order to generate knowledge and improve Educational Sustainable Industrial Design training. Under this order of ideas, the guide is composed of: key questions for the formulation of the challenge and/or problem, step-by-step guide for the theoretical analysis that facilitates the es-



tablishment of the requirements of a service product system, checklists for the evaluation of results of objectives and

tips to reduce complexity in the application.

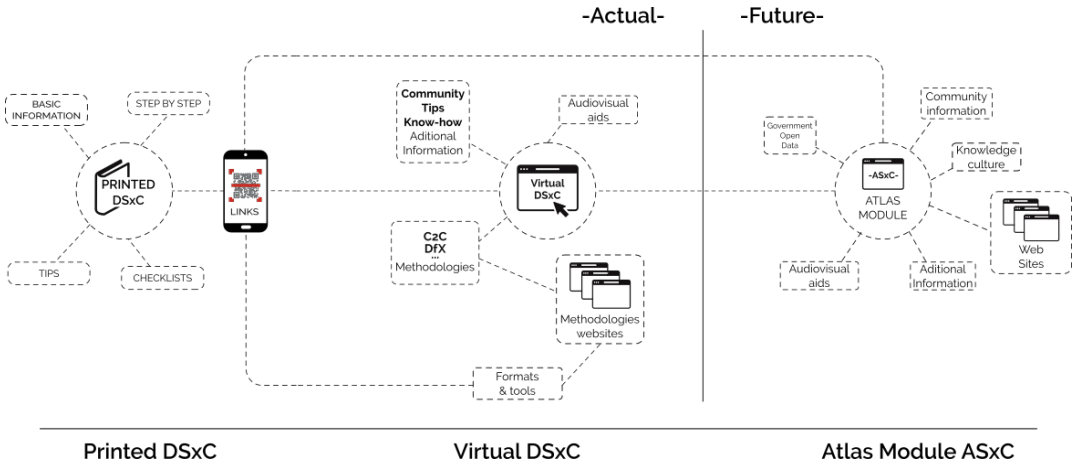
[Figure 1] General structure of -DSxC-

ANATOMY OF THE FUNCTION. DSxC acts as a tool composed of four phases: investigate, conceptualize, detail and deliver; that within each one opens a range of possibilities so that the student or professor according to a series of recommendations established by the booklet can generate his own methodological algorithm. These possibilities are the decomposition and characterization of 10 methodological approaches and principles around Design for sustainability considering those that address systemically the problems (Design of Product Service Systems for Sustainability and Distributed Economy -SPSSDE-, Systemic Design, Biomimicry, Cradle to Cradle -C2C-, Circular Design, The Natural Step - Backcasting , Human Centered Design -HCD-, Life Cycle Assesment -LCA-, Design for X -DFX- and Permaculture). The printed DSxC, shows the theoretical structure of the tool under a pedagogical approach that allows to understand the generation of methodological algorithms and acts as a step-by-step application guide for the application process, making recommendations through the research project , proposing general visions and checklists.

[Figure 2] Printed DSxC and Virtual DSxC design .

The Virtual DSxC -www.dsxc.ga- that it deepens the information of the booklet and the previously categorized methodologies to take to the generation of the methodological algorithm according to the suggestions made by the physical guide; complemented by Colombian Atlas for Sustainability, which presents information in open data mant Colombian territory making a gate understanding the context depending on the tool and algorithm generated.

The Colombian Atlas for Sustainability - ASxC - It is a future phase of the research whose aim is to incorporate a database of the Colombian context as a tool that complements the DSxC and exercises as a fundamental module of the methodological algorithm through the use of data from real contexts that enables the optimal development of the project. The atlas collects the information from the open data generated by the Colombian government, provides timely information to the designer and practical integration in the academy with solid foundations, as Leal (2016)



says: “that has shown a preference in developing programs that are culturally sensitive to the contexts in which they operate, instead of being satisfied with the importation of ‘prepared solutions’ from other countries/regions.”

[Figure 3]. Status and structure of the project

The DSxC proposes to connect through three platforms (printed, virtual and the atlas) to maintain a broad and detailed perspective of the project that provides and makes efficient the SPSS development process, as well as facilitating the understanding and education in the Sustainable Design to students and teachers. That is why DSxC seeks to generate feedback that allows improving the application of this toolkit, due to its cyclical, systemic approach and the U-Process that according to Hassan, Z. (2006) is based on the belief that there are multiple ways of dealing with highly complex problems, some of them more successful.

CONCLUSIONS

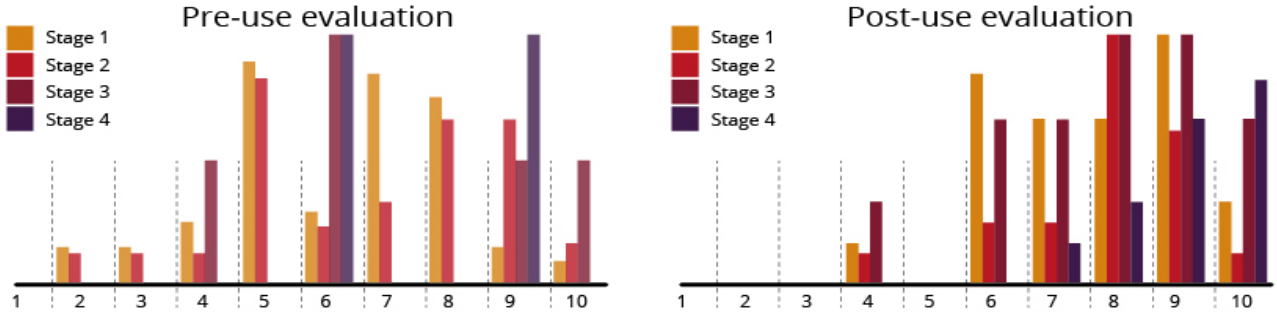
I. The activity has been carried out in 2 groups (57 students) of the University of Research and Development of Bucaramanga and 6 groups (180 students) of the Pontificia Universidad Javeriana of Bogotá (Figure 4), which at the

beginning and end of each of the stages have been able to evaluate the state of knowledge and usefulness of the tools around three thematic axes: usability, usefulness, and content.

[Figure 4]. Development of classroom activities

To date, there are numerous proposals for the Sustainable Design that have been developed, among them you can identify clear differences in approach that respond to the very nature of the intention with which they have been conceived. If we cross this premise with the current situation of the Educational Sustainable Industrial Design seen as a chair within the curricula of the industrial design program in addition to the lack of teacher training, it is essential to consider a tool that contemplates: 1. The accompaniment to teacher and not only the training of students, 2. Guide in the selection of the Sustainable Design approach according to the characteristics of the project, 3. Support the process of recognition of the contextual features of the project and 4. An important contribution from the design of the information that would allow a better acceptance by the interested parties of the process.

Regarding usefulness, between the first and last stages of the exercise the students expressed improvement in their learning and knowledge of the concepts related to sustainability applied to design (mostly valued in 5 out of 10 (25.4%) before starting stage 1 and in 9 out of 10 (27.3%) after finishing this stage. In the last stage the students evaluated their knowledge previously divided into 6 and 9 out of 10 (50% each value) and later into 10 out of 10 (41.7%) Figure 4.



[Figure 5]. Comparison charts BEFORE AND AFTER

In the first and last stage, the total number of students affirmed that the tools have been useful to facilitate the planning activity, but these values have not been maintained in all stages, indicating some type of difficulty in the usefulness (usefulness of the tool in stage 2: 95%, stage 3: 90%). Finally, in terms of content, the importance of the components of the document has been ranked as follows: in stage 1, Description 10: 27%, tools 8: 27%, tips 5: 31%, how 8: 22%, examples 8: 36%. In the final stage, Description 10: 33%, tools 10: 33%, tips 9: 33%, as 10: 42%, examples 9: 41%

DEBATES

USABILITY: Regarding the usefulness and according to the results, there is a favourable perception on the part of the students in all the phases; however, the students in the interviews carried out have expressed some difficulties in the way in which the contents are exposed both in the platform and in the shared pdf document, but we consider that this is due to several aspects: the first one, they do not read the contents but they seek to go directly to select the tools that guide them step by step, not to make an adequate selection according to their difficulties. Second: the platform and the book are not very clear which is the most appropriate tool to develop each theme (social, product, service). Third: the time for the exercise often does not allow us to delve into a topic, so many students do not seek more information outside the classroom or provided by the teacher. Fourth: the designer is not used to reading during the development process of the project, but more to executing it. With respect to the printed guide, when it is designed in polychrome, it presents disadvantages when printed in black ink; some graphics are incomprehensible and some elements lose the intentionality given by the color and the backgrounds of photographs lose contrast with the letters in the coverage pages; on the other hand, the digital platform has proved to be very useful as a support

for the process but not without presenting usability disadvantages in terms of navigability, particularly to find additional information to that presented in the printed content; this situation is presented given that the additional information is not directly linked to the phases of the process; this situation is presented given that the additional information is not directly linked to the phases of the process. Similarly, the students state that the process is orderly, but when they arrive at the tools they consider that there is no clarity as to their contribution to the project. The difference between the tools is very noticeable and it is not clear which is better or more adequate than another. Not even by themes, a small description of each of their functions can be made.

UTILITY: In some moments of experimentation, attention has been overloaded on operational processes such as the use of tools and their formats, a situation that has led to the neglect of the reflective processes inherent to sustainability for design; this process of excessive "formatization" the SD process is typical of the scientification of design inherited from German schools in the second half of the twentieth century (Krippendorff, 2008); although it brings to the design project procedural rigour and standardization in deliverables, if it is not well worked on by the teacher, fundamental aspects of educational processes in SD can be neglected. Phase 2 called MACRO is the one that has presented the greatest complexity for students, given that in the cases studied there were few precedents of academic processes in which these issues had been addressed. This is why it is essential to improve the support material in this phase by including audiovisual help in the web platform. In this way to maximize the usefulness.

CONTENTS: There is evidence of a contribution of the tool in terms of process information, evidenced in the results (see figure 4) there is an increase in understanding of the exercise and its contribution to sustainability, as well as the fact that sustainable analyses must be done from the outset but their relevance can be better explained by themes, the most problematic are economic and social. On the other hand, a very important point is that it allows the teacher to help in organizing the process and does not seek to replace it but to strengthen and argue their work at each stage. The tool, having a strong theoretical component that in many cases is completely new for students, requires a learning quota that is difficult to achieve in the academic time of the case studies, causing the practical part to assume a leading role during phases 3 and 4 of the process, and the theory is left in a second plane and left to the disposition of each student to expand their knowledge individually; a situation that in most cases does not succeed. The tool must be adjusted according to the results and be used again in new academic contexts with a view to being officially presented for use.

BIBLIOGRAPHY

1. Aguayo, F., Estela, P. M., Lama, J. R., & Soltero, V. M. (2011). Ecodiseño: ingeniería sostenible de la cuna a la cuna (C2C). RC Libros.
2. Andrade Vicente, J., Frazão, R., & Moreira da Silva, F. (2012). *The Evolution of Design with Concerns on Sustainability.* Revista Convergencia. Retrieved from http://convergencias.esart.ipcb.pt/artigo/124
3. Bovea, M., & Pérez-Belis, V. (2012). A taxonomy of ecodesign tools for integrating environmental requirements into the product design process. *Journal of Cleaner Production*, 20(1), 61–71.
4. Ceschin, F., & Gaziulusoy, I. (2016). Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies,* 47, 118–163. https://doi.org/10.1016/j.destud.2016.09.002
5. Crul, M. R. M., Diehl, J. C., & Delft University of Technology, P. B. (2007). Diseño para la sostenibilidad: Un enfoque práctico para economías en vías de desarrollo. Retrieved from http://www.d4s-de.org/d4sspanishlow.pdf
6. Geli de Ciurana, A. M., & Leal Filho, W. (2006). Education for sustainability in university studies. *International Journal of Sustainability in Higher Education,* 7(1), 81–93. https://doi.org/10.1108/14676370610639263
7. IDEO.org. (2008). The Fieldguide to Human Centered Design, 83.
8. IDEO.org. (2015). Design Kit. Retrieved May 18, 2018, from http://www.designkit.org/methods
9. Krippendorff, K. (2008). Designing in Ulm and off Ulm.
10. LeNS International. (2016). Retrieved May 18, 2018, from http://www.lens-international.org/
11. Madge, P. (1997). Ecological Design: A New Critique. Design Issues, 13(2), 44–54. https://doi.org/10.2307/1511730
12. Marlene, I., & Rodríguez, D. (2007). Herramientas para la producción de materiales didácticos para las modalidades de enseñanza semipresencial y a distancia. Acimed, 16(2). https://doi.org/ISSN 1024-9435
13. Navarro, T. G., Rizo, S. C., Ceca, M. J. B., & Ruiz, D. C. (2005). Ecodesign function and form–classification of ecodesign tools according to their functional aspects. In DS 35: Proceedings ICED 05, the 15th International Conference on Engineering Design, Melbourne, Australia, 15.-18.08. 2005.
14. Pigosso, D. C. A., McAloone, T. C., & Rozenfeld, H. (2015). Characterization of the State-of-the-art and Identification of Main Trends for Ecodesign Tools and Methods: Classifying Three Decades of Research and Implementation. Journal of the Indian Institute of Science, 95(4), 405–427.
15. Riverdale + IDEO. (2011). Design Thinking for Educators. Evolution, 1(April), 94. https://doi.org/10.1007/978-3-642-13757-0
16. Starkey, K. (2016). Follow the Rabbit: A Field Guide to Systemic Design. Managing.
17. Sterling, S., & Thomas, I. (2006). Education for sustainability: the role of capabilities in guiding university curricula. *International Journal of Innovation and Sustainable Development,* 1(4/2006), 349–370. https://doi.org/10.1142/S2010324713400092