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Barriers and Opportunities in Developing 'Do-it-yourself' Products for Low-income Housing

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Abstract: Direct involvement of the user in the assembling process of his/her own products or even entire house is a reality among low-income populations in developing countries. Nevertheless, there are a limited number of products that have actually been designed from a do-it-yourself (DIY) perspective, which results in several problems, such as poor user safety while the product is being assembled or inadequate results from an improvised assembling. Hence, the main goal of this paper is to analyse barriers to and opportunities for developing DIY products for low-income housing in developing countries. The research method utilises a case study of a DIY product consisting of a hybrid solution that acted as both a partition wall and a wardrobe. The identified opportunities included more systematic use of existing craft competencies among low-income families and the possibility of cost reduction through DIY concepts. Major barriers included the perception of the DIY product as inferior and the difficulty of communicating the DIY assembly process to users who quite often are illiterate.

Keywords: Do-it-yourself (DIY), Sustainable design, Low-income, Partition wall, Furniture design

INTRODUCTION

In most developing countries, a large percentage of construction activities take place in the informal sector, often through self-help or unpaid labour action (Wells, 1986). This is the case in Brazil, where the construction of low-income housing is largely realised in a 'build-it-yourself' or 'do-it-yourself' (DIY) fashion. For instance, a study carried out by Booz Allen Hamilton for the National Association of Building Materials Commercialization Agents (ANAMACO) revealed that the residents themselves managed 77% of the housing units produced, modified or expanded in Brazil. The study further noted that self-managed construction is more common among low-income populations (classes D and E); in low-income neighbourhoods, construction firms are responsible for only 1% of housing expansions and 4% of new housing constructions. This implies that the residents themselves typically carry out the procurement process and engage in building or managing the construction of their own house (ANAMACO, 2008).

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The increasing participation of households in the housing provision process can be viewed as a trend in the Brazilian context. According to the Ministério das Cidades (2004), recent changes have occurred in the Brazilian housing policy concerning the government's role in the provision of housing-related goods and services. There has been a trend toward reducing direct government intervention in the housing provision process and increasing the participation of non-public agents such as private and community-based organisations (Werna et al., 2004). Similarly, Keivani and Werna (2001) advocated the utilisation of more pluralistic (i.e., involving a multitude of actors) and comprehensive approaches to housing provision in developing countries. According to these authors, such approaches include not only traditional private market strategies, but also co-operative and community-based modes and informal modes that increase the households' involvement in the housing provision process.

Regardless of these initiatives, DIY practices in Brazil, as in other developing countries; occur without the proper design and development of components and sub-systems for DIY purposes.

This situation results in hazardous situations, especially with regard to users' safety while designing, producing, maintaining and/or recycling a product, resulting in high environmental damage and poor habitability conditions. In general, issues such as product ergonomics, information design, sustainability, modular design, safety and other key aspects are ignored in the design of construction components or products. This creates a critical situation given that the effectiveness of DIY relies on the embedded knowledge of the tools and materials themselves as well as the competence of those that undertake DIY productions.

DIY products should be designed in order to avoid or transfer potentially problematic aspects away from the user interface. An example provided by Watson and Shove (2005) illustrates this idea: painting a panel door used to require that the painter know the appropriate order in which to paint and how to apply the paint without drags or drips. Meanwhile, fast-drying non-drip water-based paint 'knows' how to go on to a door with an acceptable finish, without requiring any special skills from the painter.

Considering the recurrent 'build-it-yourself' practices in housing construction among low-income populations and the lack of adequate products for this purpose, the DIY approach can clearly contribute to improve the quality of life in these populations, especially in developing countries such as Brazil. Moreover, considering that almost 8 million families in Brazil need new homes and that 90.7% of these families belong to the poorest category of citizens (Ministério Das Cidades, 2006), DIY represents an approach with a broad potential impact since it is already an

established practice among low-income families. The existence and extensive usage of 'built-yourself' practices suggests there will be less rejection among low-income households when offering products developed according to this perspective. Santos (2002) proposed that having DIY products packed as 'kits' will make easier for the government and industry to reach an agreement regarding tax benefits for solutions aimed at low-income families.

In this context, the main goal of this paper is to identify major barriers to and opportunities for developing DIY products for low-income housing in developing countries. It presents the case study of a DIY product designed by the Sustainable Design Research Centre at Paraná Federal University (UFPR). The product in this case was a hybrid product that acts as both a partition wall and a shelf. The concept for this DIY emerged from observations of several low-income household practices in Brazil; these observations noted that a wardrobe was often used to provide visual separation between the living room and bedroom. This situation often resulted in poor living conditions from aesthetic, functional and technical (thermal and acoustic insulation) perspectives and therefore represented an opportunity for an adequate solution to be developed. This paper builds upon earlier results published by the main author at the Change the Change Conference (Santos et al., 2008).

It is important to note that this study was developed in partnership with Masisa (an oriented strand board (OSB)/medium density fibreboard (MDF) manufacturer), a corporation whose strategic goals include the development of 'socially inclusive business' projects in low-income segments of the market. The company has established a goal that 12% of total sales in 2010 will come from the "base of the pyramid" and socially inclusive businesses. In order to achieve this goal, Masisa has created partnerships with more than 300 of its retail outlets (PlacasCentro) licensed in Latin America so as to train carpenters to produce better furniture that meets the needs of the low-income population. The project also involved a furniture producer (PlacasCentro), a furniture retail company (M&M Móveis) and an NGO that provides support for craftsman cooperatives (Aliança Empreendedora).

THE DIY CONCEPT AND HISTORICAL BACKGROUND

DIY solutions are those in which users themselves can be involved in designing, producing, maintaining and even recycling a product in a safe manner and with effective improvements in the quality of life of the user. Campbell (2005) proposed the term 'craft consumer' as a more precise definition for DIY. Craft consumption explicitly entails production of a product designed and created by

the consumer him/herself, requiring the application of competencies and passion in order to creatively transform raw materials and components into a finished product (Campbell, 2005; Watson and Shove, 2005). To Watson and Shove (2005) and Mintel (2005), DIY products can function simultaneously as leisure and work, and as consumption (of materials and tools) and production (of changes to the home).

DIY can be traced back to the pre-history of mankind since it was once the only way to obtain a desired product. Edwards (2006) argued that prehistory provides an opportunity to investigate the reasons why people want to 'do-it-themselves' Edwards (2006) analysed this issue in the context of the more recent history of mankind and noted the continuities between modern DIY and the crafts pursued by women in the eighteenth and nineteenth centuries. In the eighteenth century, creative work was about self-expression through craftwork. Gebler (1997) also identified this craft motivation in his historical analysis, which indicated the arts and crafts movement of the late nineteenth century as one of the main influences on redefining the concept of DIY. At that time, aspects of DIY projects, such as ingenuity, enterprise and self-reliance, were common among female homemakers, who used their own craft and design skills.

Women's domestic arts and crafts reflected a process of design democratisation through self-expression. By the end of the nineteenth century, women were still defined by their ability to create crafts for the home. The change in women's attitudes, status and roles compared to the early to mid-twentieth century allowed a shift in the gender paradigm. However, there are many who still distinguish between soft (decorative) DIY projects and hard (structural) DIY with its gender stereotypes (Edwards, 2006). Similarly, Gebler (1997) identified a relationship between DIY projects and the presence of men in domestic activities through the early to mid-twentieth century in the United States. Gebler highlighted the role of DIY as an important device for men to play an active role in household activities from the end of the nineteenth century. Elements of personal 'handicrafts' are often mentioned alongside the concept of DIY. Edwards (2006) noted that this proximity of craft with DIY was expressly stated in an early DIY text from the 1950s: "Do-it-yourself is an expression of the ingenuity, enterprise and self reliance of the individual, and in an age of automation it is good that fundamental arts and crafts are not being lost".

Recently, Watson and Shove (2005) argued that DIY has moved from a largely unwanted responsibility to a desirable pastime for men and women, enabling a release from alienated paid work through participating in a part-

time craft activity. Modern DIY projects appear to reflect aspects of self-expression and to represent a change from alienated products into artefacts with personal associations; modern DIY also speaks to leisure pursuits, the desire to be creative and the need for economy (Edwards, 2006). Motivations for DIY can also be linked to postmodern consumption in which the consumer is also a manipulator of the symbolic resources afforded by commodities, through which DIY can be a means to realise effects that convey individuality and self-identity (Woodward, 2003). This might even include media-inspired consumption aspirations.

DIY PRACTICE AS A MEANS FOR HOUSEHOLD INVOLVEMENT IN HOUSING PROVISION

As previously mentioned, the participation and involvement of households in the construction of their own homes is a recurring practice in developing countries, as well as a major research theme. In general, research on this topic has dealt with strategies to engage users in an architectural project or in the construction process, oriented by construction experts (Abiko, 1995). In this regard, a major form of household engagement in building products or house construction is called joint or group building. According to Abiko (1995), joint building is also known as mutual help building. The joint building strategy is defined as a mutual effort driven by a community in order to build their own homes, while financially and technically supported by the government. Although the projects are simple and the construction techniques and materials employed are low-tech, the process creates a bond between users (i.e., households) and the product of their work (i.e., their homes), which induces proper use and maintenance of the homes (Abiko, 1995). DIY also has a social impact since it can give satisfaction and pride to the prospective household in a low-income house once the product is the result of his/her/their own labour (Vieira et al., 1993). Moreover, the design and development of a product according to a DIY perspective enable the anticipation of possible mistakes during construction by using poka-yoke systems (error-proof devices), increasing the likelihood of a house with adequate quality levels.

Nevertheless, joint or group building and 'build-it-yourself' can generate technical and constructive problems, resulting in buildings below the standard quality level and leading to poor living conditions. Thus, these processes require design solutions that take into account the implications of DIY throughout the product's life cycle, thus demanding a more complex product development process. The next sections present the field study developed by the authors with a focus on this issue.

RESEARCH METHOD

This research was composed of three main phases: an analysis of the requirements of low-income households concerning furniture, the design of the DIY product/process and an analysis of the resulting DIY assembly/disassembly process. Several sources of data, including semi-structured interviews (with audio recording) and direct observation (with photographic records), were used for data collection, enabling data triangulation as advocated by Yin (1994). Each source of evidence followed a protocol, which guided data collection and facilitated the analysis.

The main goal of the first phase was to identify the existing furniture in low-income houses, including its characteristics and forms of use by the household. The data were collected by direct observation and semi-structured interviews with ten households in a low-income community on the suburbs of Curitiba. The criteria for selecting interviewees aimed to include different types of household arrangements in order to identify a multiplicity of requirements. The community was selected by Curitiba Popular Housing Company (COHAB-CT), which also allowed the researchers access to the same community.

The purpose of the second phase, which was carried out by the Sustainable Design Research Centre at UFPR, was to generate ideas and design and develop a DIY product that provided an adequate solution for the partition wall/wardrobe problem previously presented. Several creativity techniques, such as 635 and brainstorming, were applied, resulting in approximately four hundred ideas. The selected idea evolved into a design, which was then developed according to major guidelines. One key guideline was to create an adequate solution for visual and acoustic separation between the two rooms from aesthetic, functional and technical perspectives. The DIY product should be in accordance with the financial conditions of low-income households, while simultaneously adopting the guidelines regarding the sustainable design of products proposed by Manzini and Vezzoli (2002). Finally, the DIY should be flexible, so that users can position it anywhere in the household, and simple, to allow for easy assembly.

The main goal of the third phase was to analyse the DIY product assembly and disassembly processes by the target client (i.e., low-income households). The main sources of evidence used were direct observation of the assembly process and semi-structured interviews. Nine low-income households were selected and grouped into four teams that were given the task of assembling and disassembling the DIY furniture. The research team requested that the team members vocally express their

feelings, doubts, difficulties, etc. throughout this process. Afterward, a semi-structured interview was conducted with each of the participants.

RESULTS

Requirements of Low-income Households

In total, the authors investigated 10 houses selected from a community composed of 40 houses. The most frequently recurring pieces of furniture in the analysed houses were beds (single, double and twin beds), wardrobes, lockers, table, shelves and sitting devices (sofas, chairs, benches). Very few of these (0.5%) were acquired in stores; almost all of them (99.5%) were second-hand, having been donated or sold by their first owners. Concerning the transportation of second-hand furniture, the interviewees explained that these items were transported fully-assembled whenever possible and that only large furniture items, such as wardrobes and shelves, were partially or totally disassembled. When disassembly was necessary, major problems were associated with the re-assembly process, including missing parts or components and lack of knowledge/skills regarding the re-assembly process. With regard to the ownership of the tools needed to assemble the furniture, only 80% of the interviewees had a toolbox with basic tools like hammers and screwdrivers. The furniture assembly and disassembly processes were viewed negatively by 90% of households, whose members defined the process as time-consuming, difficult and mentally and physically exhausting. Only one of the interviewees (10%) felt able to perform this process. Additionally, 60% of the interviewees reported difficulties in visualising the furniture in its complete or assembled form, as was illustrated by statements such as "When the furniture comes disassembled, we don't know how it goes, I don't even take a chance on assembling it!". None of the second-hand furniture came with a manual or instructions for assembly; for those products that did include these items, less than half of the households (40%) stated that they read the manual or assembly instructions for the product.

With regard to the condition of the furniture, the damages observed were classified into three categories: structural, functional and superficial or aesthetic damage. Superficial or aesthetic damages (such as stains, holes, cracks, etc.) were observed in 95% of the furniture. Functional damage (lack of a component such as a closet door) was observed in 76% of the furniture. Much of the functional and superficial damage observed was associated with the processes of assembly and disassembly, which usually occur several times during the life cycle of a piece of furniture. The household's lack of technical

knowledge when performing these processes and the lack of consideration for these processes when the furniture was designed were also identified as causes of damage. The existence of structural damage such as loose components and lack of structural elements, which can endanger user safety, was also observed in some furniture. In general, only furniture with severe structural damage that hindered any kind of use or recycling was disposed of, while furniture with aesthetic and functional damage continued to be used.

Only 20% of the interviewees were acquainted with DIY furniture and had previously bought and assembled simple DIY furniture such as centre tables or small shelves. Nevertheless, DIY furniture was viewed as inferior in terms of quality compared to traditional furniture.

Development of the DIY

The design research team adopted the 635 creativity technique. This technique consists of six people generating three ideas every 5-minutes on a sheet of paper divided into 18 parts. At 5-minute intervals, each participant must give the sheet of paper to the next participant, who can then present new ideas or build upon the ideas generated by the other participans. Placing the ideas generated in these creativity sessions into clusters resulted in about 400 ideas. These ideas involved a variety of concepts, which ranged from multi-functional shelves to inflatable furniture. The idea chosen for implementation was the Zig-Zag solution (see Figure 1), which is composed of a set of rectangular modular components that allow for a variety of layout solutions and enable both sides of the product to be used as storage furniture. The components of each module consist of a sandwich of OSB and cardboard, connected by MiniFix® connectors. These connectors have eliminated the need for any special tools when assembling the product and are widely available on the Brazilian market. The interfaces of the modules, including the furniture connections with the walls, floor and ceiling, were covered in a flexible polymer, thus allowing for appropriate acoustic insulation. The total weight of each module was designed in order to enable its assembly by only two people. The design team also conceived of a number of accessories that enhanced the Zig-Zag's functionality; these are to be produced by small businesses within the low-income communities, enabling their active involvement in the production of this product and its components. Figure 2 shows possible positions for the Zig-Zag on architectural plans designed by COHAB (Municipal Company for Popular Housing).

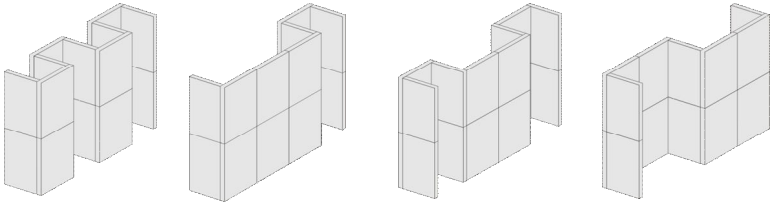

Figure 1. The Zig-Zag Concept

Source: Research.

The DIY Assembly and Disassembly Process

This phase of the research involved testing the DIY solution with nine low-income households grouped into four teams with the task of assembling and disassembling the hybrid product (partition wall+wardrobe). Concerning the participants' profiles, 70% had previous experience with assembling furniture, although it was the first time for all participants with assembling modular furniture. Prior to the assembly process, most of the participants (77%) read the assembling manual, although only a few (11.1%) understood the assembly process. The most helpful information, as identified by all the participants, was the colour pattern used for the Zig-Zag components, which was replicated in the manual.

All of the participants reported difficulties in understanding how the MiniFix® worked due to a lack of experience with these components. Nevertheless, participants did not report any difficulties in using traditional tools (screwdrivers and hammers). Most of the participants (66.7%) did not consider the number and weight of the components as obstacles when assembling the Zig-Zag furniture. As for the psychological aspects of assembling a DIY product, three participants expressed fears about assembling the product incorrectly, resulting in damage to the furniture. Two participants reported feeling afraid at the start of the assembly process, but felt comfortable afterwards. With regard to the participants' general feelings about assembling a DIY product, two participants considered it difficult, but the rest reported positive feelings.

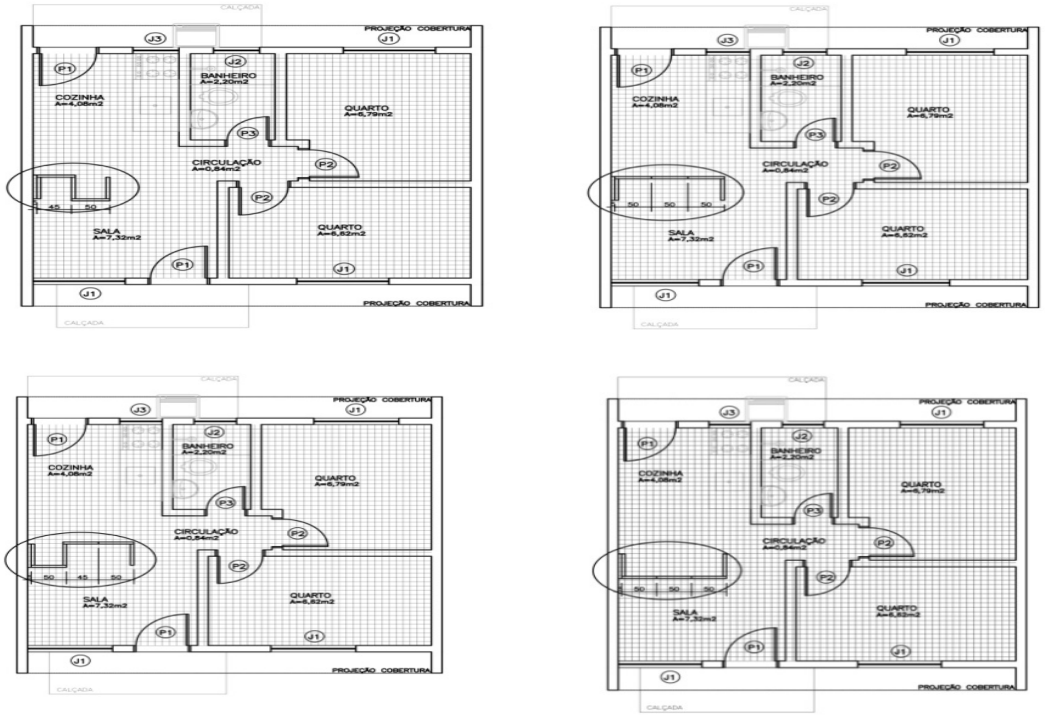

Figure 2. Positioning of the Zig-Zag Furniture in COHAB´s Typical Housing Plans
Source: Research.

ANALYSIS

This section presents the major findings of this study regarding developing DIY solutions for low-income housing. The findings are organised in three parts: the case study results (both barriers and opportunities), the lessons learned from developing a DIY product and the major conclusions.

Barrier: In general, households do not read product manuals or instructions for assembly, which hinders proper assembly of DIY products. Furthermore, most households revealed that manuals were lost during moves from one house to another. Major damage observed in furniture was associated with a lack of skill or knowledge on the part of the household when assembling and disassembling furniture.

- **Lesson:** DIY products need to integrate information concerning design solutions into the product, and this should go beyond just written information. Those developing these products should also consider the possibility of integrating mistake-proof solutions (e.g., a poka-yoke). Ideally, the form of a DIY product and its components should allow for a quick understanding of the assembly process. Repetition of the same assembly procedure within a manufacturing environment presents learning benefits that cannot be replicated in a DIY context. The short learning curve for DIY can lead to problems such as products with poor quality and an unsafe assembling process. As stated by Watson and Shove (2005), competence and confidence are developed among DIYers when boundaries are pushed back based on the active synthesis of existing experience and knowledge through practical engagement with the DIY activity. Stores should make staff available to help consumers understand DIY products and their associated processes. Information boards and free 'how-to' leaflets could also be useful tools for enabling customer learning regarding DIY.

Opportunity: Low-income families use second-hand furniture extensivey; market offers of new furniture often ignore key requirements of this population.

- **Lesson:** The DIY approach presents a competitive solution in terms of cost when compared to second-hand furniture. Furthermore, DIY products can enable income generation within the community, thus incurring wider social benefits. Moreover, considering the integration of local manufacturing competencies as well as the user´s

own competencies when designing DIY reduces the resistance of user involvement in the assembling process. One barrier to DIY discussed in the literature is the strong resistance on the part of professionals and companies, who usually consider traditional products to be more profitable. Watson and Shove (2005) argued that rather than viewing DIY as simply de-skilling, it should be understood as a 'redistribution of competences' that enables a wider range of people to take on a task, like painting a door. This barrier was not identified in this study since DIY activities are widely performed in low-income households in Brazil, although the products are rarely designed for DIY.

Barrier: Simple spare parts or technical assistance were not available within a reasonable distance, and families often have little or no money for replacement components.

- **Lesson:** DIY for low-income households should consider not only the need to use parts that are available to the community, but also the need for local manufacturers, therefore allowing for maintenance or upgrade of the DIY product in the long term. Vlosky et al., (2007) investigated the challenges of ready-to-assemble (RTA) furniture manufacturers; the issues they discovered included obtaining consistent pricing of raw materials in the marketplace, overseas competition and local competition. Despite these barriers, it is important to note that, in sectors like furniture, recent advances in production machinery have enabled more intricate cuts, which then give the designers of DIY products more freedom (Vlosky et al., 2007).

Barrier: Many families lacked a toolbox and the specific tools needed for the furniture assembly process.

- **Lesson:** DIY products for low-income household should consider solutions that do not require tools or only require very simple tools, like kitchen knives. In developed countries, there may be only a few households that do not have a toolbox with a set of basic tools such as hammers and screwdrivers, but in developing countries, this can be a barrier for DIY. Watson and Shove (2005) called attention to the fact that it is ultimately the practice of DIY that accounts for the importance of the usefulness or absence of a given tool.

Barrier: Households perceived DIY products as inferior because of the materials used; this perception then leads to a short product lifespan. The perceived poor quality of

finished DIY products was expressed in terms of both aesthetic and durability concerns.

- **Lesson:** DIY products require solutions that enable them to be perceived as durable and sophisticated in order to increase the commitment of the user to its life cycle. The poor design and assembly process identified for the conventional furniture present within the houses explains this negative perception of DIY products. In terms of aesthetics, Vlosky et al., (2007) argued that DIY furniture should add real wood surfaces and other authentic-looking finishes such as veneers, improved laminates, and coatings that enhance the quality and protect the surface against scratches in order to be more competitive with conventional furniture. For this type of product, the design of the assembly process, including the embedded information design required by DIY, should receive as much attention as the design of the product itself.

CONCLUSIONS

This article presented major barriers to and opportunities for developing DIY solutions for low-income housing. Some of the barriers that were identified are similar to those in developed countries, such as the perception that DIY produces inferior products. Other barriers are associated with the deprived conditions in developing countries, especially among the low-income population; these include lack of tools and lack of financial mean for new components. On the other hand, developing countries also have particular characteristics that create major opportunities for the successful development and acceptance of DIY products, such as the exclusion of low-income household from the traditional trade market, the low cost of DIY products, and the incorporation and transfer of labour from manufacturers to users.

The virtues of DIY can be explored with low-income households in developing countries in mind. Some of these virtues include the ethics of self-sufficiency; the desire to demonstrate personal capability; the pleasure that comes from solving practical problems; the recreational properties of physical labour; and the satisfaction of using the right tool for the job, mastering a skill or getting the job done (Watson & Shove, 2005). There is also a 'no one can do a better job than me' syndrome among DIYers as mentioned by Watson and Shove (2005); this could help enhance the adoption of DIY among low-income families.

Finally, an important motivation for promoting the development of DIY solutions in the context of a

developing country like Brazil is the possibility of closing the gap between the existing knowledge present among low-income families and the highly complex technological knowledge embedded in materials, products and tools. By embedding products with solutions that consider the involvement of the user in the assembly process and by considering existing knowledge within low-income families, DIY seems to present a feasible strategy for providing sustainable living standards for these families.

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