LOGO

Applying a mapping tool to define digital product strategy towards positive user experience

Aplicação de ferramenta de mapeamento para definição da estratégia de produtos digitais com foco na experiência do usuário

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ABSTRACT

Software commonly addresses different social, organizational, and user needs. In this context, a systemic view of such demands is necessary to define a product's positioning strategy and functionalities. Considering this problem, this article presents a canvas mapping tool that allows for the alignment of needs, action goals, and interactive conditions at individual, organizational, and social levels. Filling out the mapping tool provides an overview of the value proposals to be offered at each level and serves as a starting point for the design process and the treatment of multiple user experiences. Its application was evaluated among undergraduate design students and demonstrated good results in supporting an understanding of the problem domain.

KEYWORDS

Interaction Design, User Experience. Activity theory.

RESUMO

Produtos de software comumente atendem a necessidades sociais, organizacionais e de diferentes usuários. Neste âmbito, é necessária uma visão sistêmica dessas demandas para definir a estratégia de posicionamento do produto e suas funcionalidades. Considerando esta problemática, este artigo apresenta uma ferramenta de mapeamento do tipo canvas que permite alinhar necessidades, metas de ação e condições interativas em nível individual, organizacional e social. Seu preenchimento oferece uma visão global das propostas de valor a serem oferecidas em cada um dos níveis e serve de ponto de partida para o processo de design e para o tratamento da experiência do usuário. Sua aplicação foi avaliada com alunos de graduação em design e demonstrou bom resultado no apoio à compreensão do domínio do problema.

PALAVRAS-CHAVE

Design de interação. Experiência do usuário. Teoria da atividade.

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1 Introduction

Recent advances in computer technology motivate transformations in the way services are provided and in the organization of work. Across several sectors, traditional processes are being redesigned with software support and as a result, new relationships between people, organizations, technologies, and information are being created. As examples, one considers iFood and Rappi in the delivery business, Uber and 99 in the transport sector, and Nubank in the financial segment. In all these examples, organizations structure their activities around a system using software capable of making their internal processes more efficient, reducing costs, offering scalability, as well as promoting a positive experience for all those who are served.

For example, in using the 99 app, individual demands from passengers and drivers, as well as organizational demands from taxi cooperatives and social mobility demands are all met. In the case of iFood, there are demands from consumers who place orders, from the professionals who carry out the deliveries, as well as from the restaurant staff who control sales, produce, and package the food. In this sense, beyond the focus on the final consumer experience, it is necessary to understand the entire value chain and identify the complete set of demands to design systems like these. By relying on many stakeholders to operate, such systems must offer positive experiences for all of them, or their use will invariably decline. In this way, a systemic vision is necessary in order to define the software product's positioning strategy as well as the functionalities that will be offered to the different stakeholders involved.

Aiming to facilitate the design of software that deals with a complex value chain, this article presents a canvas mapping tool that aligns needs, action goals, and interactive conditions at individual, organizational, and social levels. Filling out the mapping tool provides an overview of the value proposals to be offered at each level and serves as a starting point for the design process and the treatment of multiple user experiences. The application of the tool was evaluated among undergraduate design students and demonstrated good results in supporting an understanding of the problem domain.

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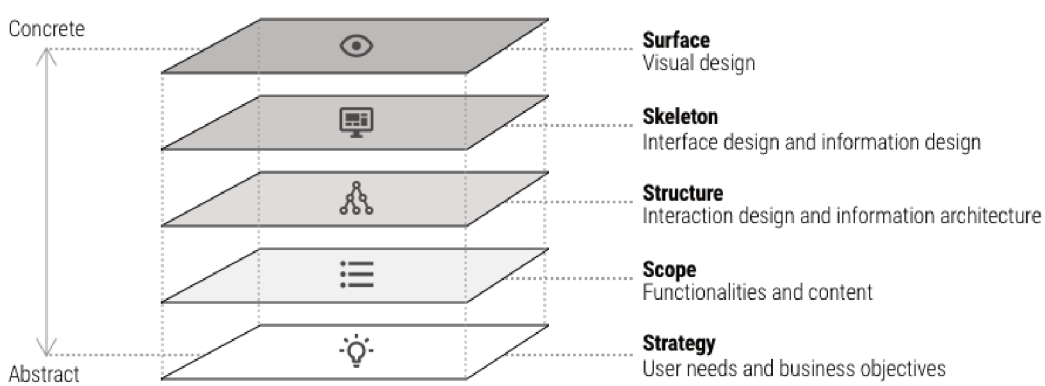
2 Theoretical foundation

This section provides an overview of the design process chosen for this study which focuses on promoting positive user experiences. It also briefly presents activity theory and affordance theory, which are applied in this article as a basis for the construction of the mapping tool.

2.1. Design for experience

According to Garrett (2011), the different aspects that impact the user experience (UX) must receive attention during a product's design. With this in mind, the author developed a model that describes five abstraction plans in which project decisions are made, as shown in Figure 1. Each of these plans addresses different aspects that are essential to ensure UX. The first plan is called strategy. In it, user needs and business objectives that to be met by the product are defined. The second plan is called scope. In it, the functionalities and contents necessary to meet said strategy are selected. The third plan is called structure. It focuses on defining the information architecture and interaction flows used for performing tasks. The fourth plan is called the skeleton. In it, interface and navigation are defined. Finally, the interface components receive graphic treatment in the fifth plan, called surface.

Figure 1 - Elements of the user experience



Source: adapted from Garrett (2011).

This model presents design as a construction process, whose foundations are laid in the strategic plan. As highlighted by the author, it is essential to understand what needs the product must meet, since

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decisions on how to treat UX in remaining plans are derived from such understanding. In the specific case of a software product, its essential purpose is to support an activity performed by one or more users that aim to satisfy certain needs. Thus, it becomes necessary to map the activity; the different user groups involved; and the related individual, organizational, and social needs. This mapping leads to a more complete comprehension of the complex nexus of demands, giving rise to a strategic vision that allows for product positioning. Once accomplished, it is possible to move on to the scope plan, in which functionalities will be provided.

2.2. Activity theory, affordances and user experience

This study addresses activity mapping to be supported by software based on activity theory. Specifically, the **structure of activity** (LEONT'EV, 1978) is used for its mapping. This structure, shown in Figure 2, is a hierarchical model composed of three levels of abstraction that correspond to the affective, rational, and sensory-motor dimensions of human activity.

The highest level of abstraction focuses on the **activity** as a whole and deals with its purpose, which is the satisfaction of needs. These needs give rise to the activity itself and act as energizing motives (why one does something). According to Leont'ev (1981), motives serve the function of helping the individual to evaluate different circumstances and their respective potential actions, endowing them with meaning and affection. The second level is composed of **actions**, which are the processes that allow the activity to be carried out. Actions are planned based on the identification of a general goal capable of satisfying needs (what to do). For example, to satisfy the need for rest, an individual may choose to travel to a beach area (their goal). To achieve this goal, the individual plans the coordinated actions of buying airfare, renting a car, and booking a hotel. Finally, at the third level, each action can be broken down into one or more **operations**, which establish the concrete steps for the physical execution of said action (how to do it). Operations are not planned by the individual but carried out according to the conditions given by context, which includes the software used. For example, when purchasing said airfare, the individual will indicate departure and return dates according to the components of the site or application interface. This may include typing in a text box or selecting from a calendar. These conditions are detected and handled by the sensory-motor system (LEONT'EV, 1981).

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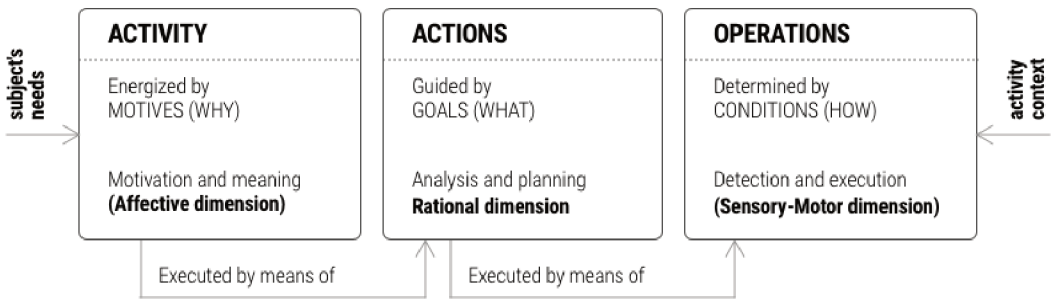
Figure 2: Structure of activity



Source: elaborated by the authors.

An understanding of this activity structure is important for a UX approach because of the multidimensional nature of human experience. According to standard 9241-11 (ISO, 2018), UX includes "all emotions, beliefs, preferences, perceptions, physical and psychological responses of users, behaviors and achievements that occur before, during, and after use". In other words, it involves the affective, rational, and sensory-motor dimensions of human activity.

The way a product can support this structure can be understood according to affordance theory. According to Mettler & Wulf (2019), affordances are action potentials that arise from the relationship between a product and an individual in a certain context. These potentials enable and restrict what the user can do by means of the product (HUTCHBY, 2001). In this sense, they are preconditions for the activity (VAN OSCH; MENDELSON, 2011). Since experiences occur through activity, they are also preconditions for the user experience.

According to Bærentsen & Trettvik (2002), there is a category of affordances associated with each level of the activity structure. Thus, a holistic UX approach involves ensuring that the product provides potentials to support the activity's affective, rational, and sensory-motor dimensions. In this sense, the affordances lens helps to identify and describe what a product should offer at each level, establishing requirements to be met. For Galvão & Sato (2005), it is essential to combine user studies with affordance thinking in order to generate the functional architecture of the product in question.

Under such a view, the relational character of the concept of affordances offers a great contribution. For its creator, Gibson (1979), affordances are not product properties. They arise from the relationship between the characteristics of users and the characteristics of the product and context. In this sense, using affordances to define product strategy

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means mapping these relationships to identify what the product has to fulfill at each level of the activity structure for each user group. This is the essence of the tool described in this article.

3. Methodology

To develop the proposed mapping tool, a theoretical model was first elaborated that describes the potentials that a product must offer within each dimension of the activity, as well as the elements that interrelate to form such potentials. Subsequently, these elements were organized in the format of a canvas that allows the alignment of motivations, actions, and conditions of those involved in the activity.

The basis for the theoretical model was a systematic review of studies describing categories of affordances. These categories were used to identify the relationships that underlie the formation of affordances in the different dimensions of activity. The protocol for the review was created based on the methodology of Kitchenham & Charters (2007). The defined search strategy[1] was applied in SCOPUS, ACM Digital Library, and Web of Science databases.

The tool was evaluated based on its use by undergraduate design students. The criterion for participant inclusion was that they were enrolled in the subjects of Ergonomics, Usability, or Interface Design. The participants employed the tool to generate a research script for a software project. After doing so, they completed an evaluation questionnaire. Finally, the questionnaires were collected anonymously.

4. Results

4.1. Theoretical model

Based on the studies identified in relevant literature, a model was synthesized with the categories of affordances that a product must offer

1 Two different searches were used to identify studies that describe categories of affordances. The first aimed to identify classification schemes of affordances based on activity theory. The string contained the keywords ("activity theory") AND ("affordances" or "affordance"). The second aimed at identifying classification schemes not based on activity theory. The search string used was ("affordances" OR "affordance") AND ("model" OR "framework" OR "approach" OR "classification" OR "typology" OR "categories" OR "types" OR "levels" OR "classes" OR "taxonomy") AND ("human computer interaction" or "product design"). Articles from both journals and conferences were included, with no limitation on the publication period.

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to enhance the user's activity and experience:

• **Experience opportunities:** associated with the activity level, they represent the potential that the use of the product has towards satisfying the needs that give rise to the activity (BÆRENTSEN; TRETTVIK, 2002). They reflect the adequacy of the product to the purpose of the activity (TURNER; TURNER, 2002). The perception of this potential motivates individuals to use the product (TANG; ZHANG, 2018; WEISER et al., 2015; ZHANG, 2008). The realization of this potential generates gratification in users (SHARRITT, 2010). In other words, they have positive experiences, as the experience becomes linked to the pleasure of having their needs met (PUCILLO; CASCINI, 2014);

• **Task-performing opportunities:** associated with the actions level, they represent the potential that the product's functions have to allow for accomplishing the task and achieving the goal (JONIETZ; TIMPF, 2013; SHARRITT, 2010). They are linked to being able to successfully complete something through using the product (GRANGE; BENBASAT, 2011; TURNER; TURNER, 2002);

• **Manipulation opportunities:** associated with the operations level, they represent the potential the product's interface has in being handled according to its conditions of use (POLS, 2012). They allow the user to physically enact the product (CIAVOLA; GERSHENSON, 2016; KAPTELININ; NARDI, 2012) and to activate its functions (GRANGE; BENBASAT, 2011).

Regarding the formation of affordances, Kaptelinin & Nardi (2012) highlight that they arise from the relationship between the user, the product, and the environment. The work of Rozycki et al. (2012) broadens this view and describes that the environment must be considered both in its physical dimension with its material characteristics as in its abstract dimension with its socio-cultural characteristics. It also proposes that the human element should be considered in both its individual and group dimensions. The approach to individual and group dimensions is corroborated by Vyas et al. (2017), who propose three levels: the individual, the organizational, and the socio-cultural. In this study, these relationships were combined with the hierarchy of affordances, as shown in Figure 3. This model explicitly demonstrates that product characteristics must be complementary to individual, organizational, and environmental factors across the three dimensions of activity. If complementarity is achieved, the product will be able to provide holistic support to UX.

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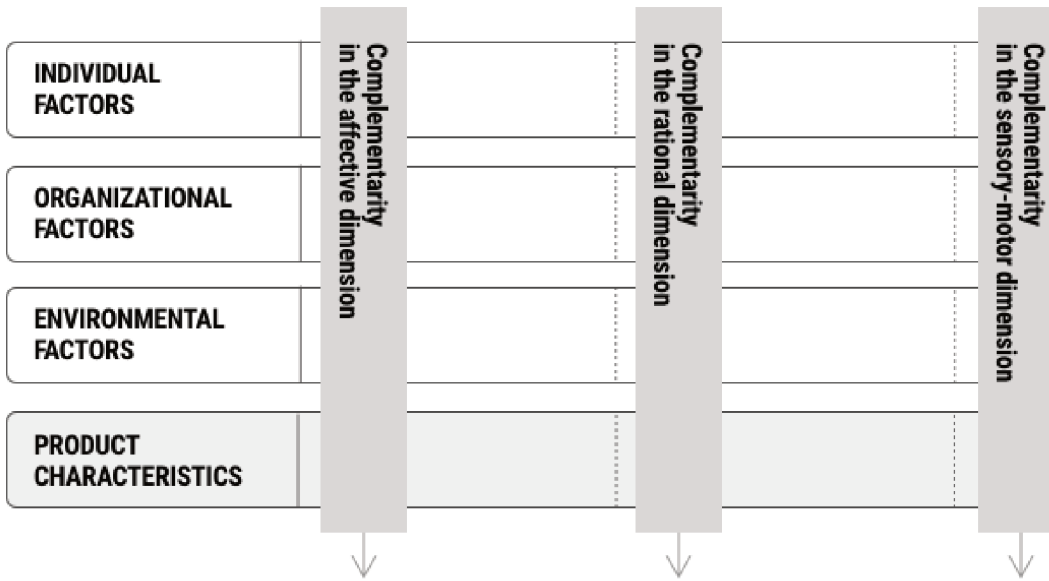
Figure 3: Complementarity for affordances



Source: elaborated by the authors.

In **experience affordances**, the central point of complementarity concerns the relationship between benefiting from using the product and satisfying needs (VYAS; CHISALITA; VAN DER VEER, 2006). This alignment may occur at various levels, as the actions of an individual may be directed towards satisfying his or her individual needs as well as those of a third party, organization, or social needs. In **task-performing affordances**, the central point of complementarity concerns the relationship between functionality and support for user goals (POLS, 2012). In addition, individual goals can support organizational goals as well as social goals. Thus, these relationships must be understood in order to define a product's functionality. In **manipulation affordances**, the central point of complementarity concerns the relationship between product interface, user conditions, and environmental conditions that influence product use. These conditions include physical user and environmental issues (ROZYCKI; KELLER; CYBULSKI, 2012). In the case of digital systems, there is particular interest in conditions of a technological nature, such as devices that users apply to the task, other systems with which the product communicates, and the organization's or environment's network infrastructure. All these elements are summarized in Figure 4.

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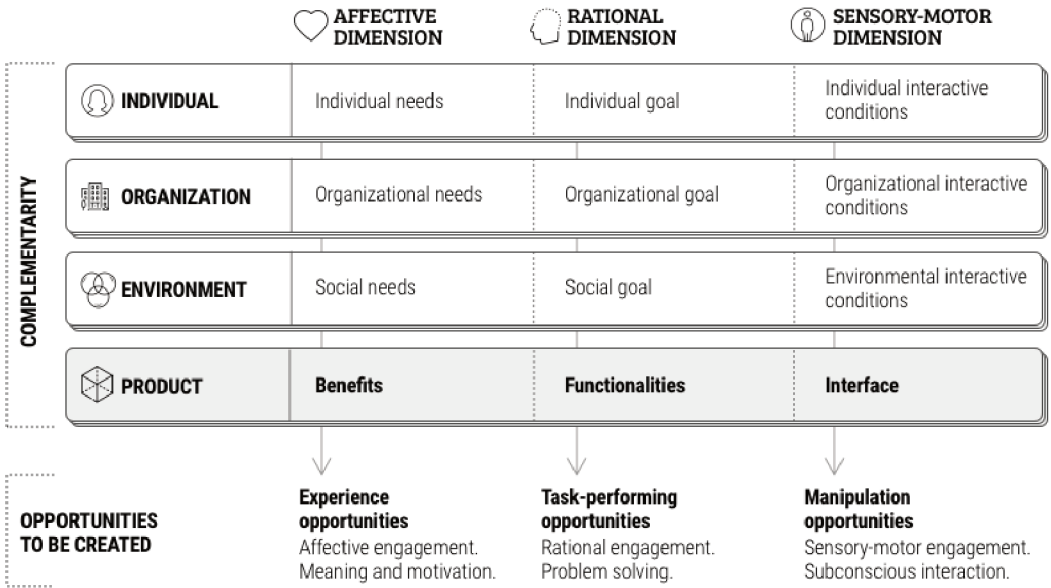
Figure 4: Theoretical model



Sourceelaborated by the authors.

4.2. The mapping tool

The canvas was elaborated based on the theoretical model, as shown in Figure 5. It has a matrix format, in which columns two, three, and four represent the affective, rational, and sensory-motor dimensions of activity. Each line allows for the description of a different source of demand that can be met by the system in these three dimensions. The first column of the canvas serves to identify the sources of demand handled in the project in question.

Three types of sources can be listed: individual, organizational and environmental. The individual sources deal with the different user groups involved. Each user group represents a set of actors who play a role within an activity. For example, in the 99 app, there are users in the role of passenger and others in the role of driver. Each role brings its own demands to the product and must be represented as a canvas line. If any of the user groups were related to a type of organization, it should also be included as a canvas line, as there may be organizational demands that need to be met. For example, in the 99 app, a line can be included for taxi cooperatives, which are organizations to which the drivers are connected. Finally, a line can be included to map environmental demands, which include both social and physical aspects that influence the activity.

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Figure 5 - Proposed Canvas

UX-QUALI 01 - ACTIVITY OVERVIEW

	AFFECTIVE DIMENSION	RATIONAL DIMENSION	SENSORY-MOTOR DIMENSION
Sources of demand Individual (user roles), organizational or environmental.	**Needs (motivation)** **Why.** Something that the individual, the organization, or society desires. Its lack motivates the activity. **(noun)**	**Action goal** **What.** Describes what will be done (through the software) to satisfy the needs. **(verb)**	**Conditions of interaction** **How.** Resources available to achieve the action goal. **(noun)**

Source: elaborated by the authors.

After listing all the sources of demand that must be covered by the product, it is necessary to analyze each of them. Analysis involves the identification of motivating needs, action goals, and interactive conditions related to each source. Needs are in the affective dimension and represent something that the individual, the organization, or society desires. Therefore, they serve as motivation for the activity. They are related to vitality, well-being, and growth (ZHANG, 2008) and include aspects such as autonomy, self-image, competence, success, leadership, influence, security, and connection to others (TANG; ZHANG, 2018). They are be-goals (PUCILLO; CASCINI, 2014) and can be sought at individual, organizational, or social levels. The action goals are in the rational dimension and describe what will be done to satisfy such needs. That is, they are do-goals (PUCILLO; CASCINI, 2014). In individual terms, the action goal describes what the product will enable each user to do by means of its functionality. At the organizational or social level, the goal describes what will be done collectively. That is, it is the result of the actions of groups of individuals in organizational and social terms. Finally, conditions are linked to the sensory-motor dimension and describe the resources available to achieve the action goal, for example the types of devices users will have at their disposal to use the app. In

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the organizational or social scope, the conditions involve environmental resources or collective activity integration resources.

The proposed mapping aims to stimulate an overview of the structure of the activity. Its execution allows motivations, actions, and conditions of the users involved in a determined activity to align, taking organizational and environmental demands into account as well. For example, in a taxi app such as 99, the needs of passengers (e.g. efficient, safe, and cost-effective transport), drivers (e.g. good income), the taxi cooperative (e.g. profitability), and society (e.g. improved urban mobility) must be met. To achieve this, the system should support the action goals of passengers (e.g. quickly finding a good driver at a fair price), drivers (e.g. accepting as many races as possible), the taxi cooperative (e.g. earning and retaining customers) and society (e.g. reducing the number of cars in circulation by stimulating shared transport). Finally, interaction with the system should be compatible with the interactive conditions of passengers (e.g. smartphone use) and drivers (e.g. smartphone use while driving).

In summary, the canvas guides the organization of knowledge about the domain of the problem, including identifying the information that the designer has at the beginning of data collection, identifying unknown information, as well as generating hypotheses for these items. Thus, it serves as a starting point to develop a roadmap for field research. Once the information filled in has been validated, the canvas offers an overview that describes value proposals at individual, organizational, and social levels. According to Osterwalder et al. (2014), a value proposition should promote a "fit" that includes relevant tasks to be performed, relieves acute pain, and creates important gains.

It is important to point out that the canvas has the flexibility to represent different configurations of demands, as represented in Figure 6. It is possible to map simple situations in which the system covers a single type of user whose activity aims to meet their individual needs (IN), as illustrated in 6A. An example would be a user who records information in a notification application for his or her personal organization. On the other hand, it is also possible to map service delivery scenarios, as illustrated in 6B and 6C. In both cases, there is one user in the role of customer who hires a service through the application to meet their individual needs (e.g., passenger) and another user who supplies the service. This supplier user has their individual needs indirectly met by attending to the consumer's needs. For example, the driver meets his income needs by transporting the passenger and receiving payment. The

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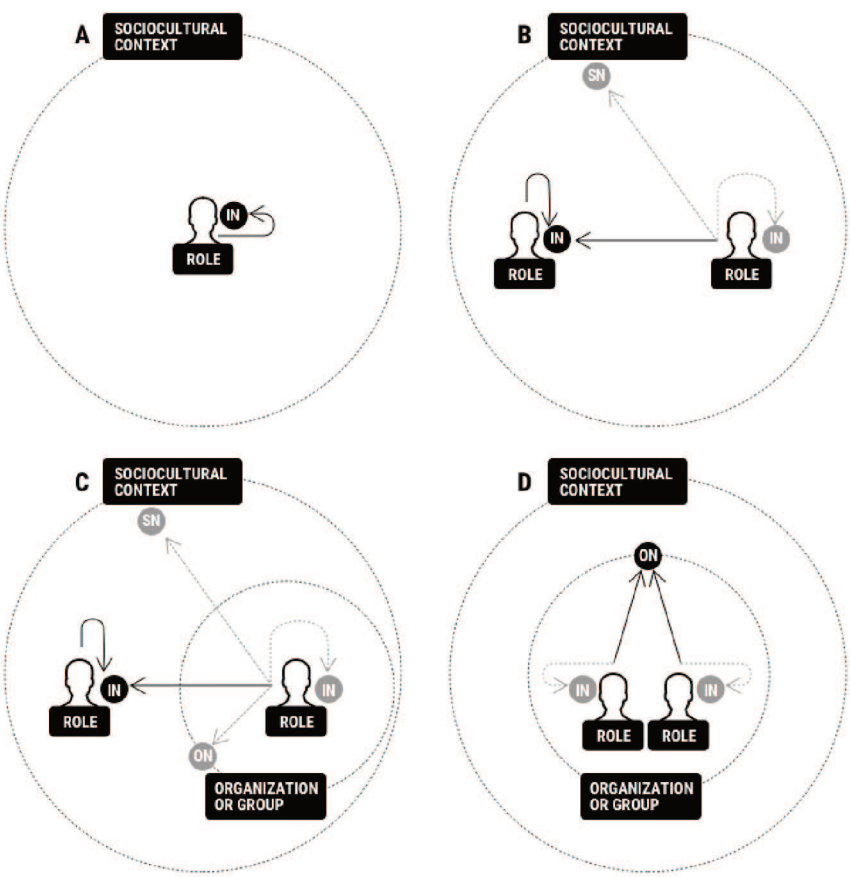
difference between scenarios 6B and 6C is whether or not an organization is present. Thus, the traditional taxi service involving cooperatives could be fit into scenario 6C. In the case of services that have a collective impact, the actions of individuals can also meet social needs (SN). For example, in the case of Uber, it contributes to the improved urban mobility. Finally, it is also possible to describe scenarios such as 6D, in which two employees of an organization interact through the system to meet the needs of that organization (ON). The individual needs of the employees are indirectly met as a consequence of meeting organizational needs.

Figure 6: Examples of demand configurations that can be mapped



Source. elaborated by the authors.

5. Tool evaluation

Forty-five undergraduate design students between their fourth and seventh semesters participated in the evaluation. They organized themselves in pairs or trios and each team mapped a system with at

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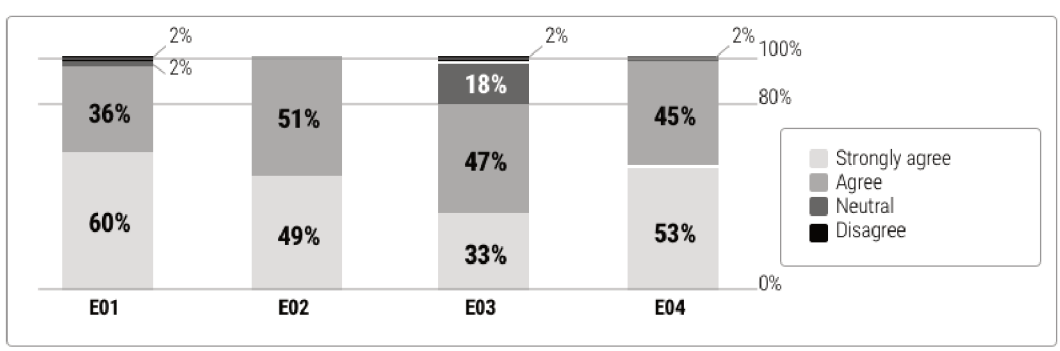
least two types of users inserted in organizational and social contexts.

After applying the tool, students received a questionnaire with statements about using the tool and answered it individually. Each statement was accompanied by an item on a five-level likert scale which included the options 'strongly disagree', 'disagree', 'neutral', 'agree', and 'strongly agree'. The statements were: (E01) the concepts of needs, goals, and conditions helped to reflect on future users' activity and to explore how each will be then supported by the application software; (E02) the tool helped to reflect on relationships among future users, contributing to a macro view of the project and its scope; (E03) the use of the tool is easy, simple, and clear; (E04) the support material developed facilitates understanding and applying the tool.

The numerical results show a positive perception of the tool, as can be seen in Figure 7. For all statements, at least 80% of the participants chose the options 'agree' or 'strongly agree'. No participants chose the option 'strongly disagree'. This result meets the criteria of Putnam et al. (1995), which defines that approval on an item on a five-level likert scale is achieved when eighty percent of participants vote for the two highest levels for that item.

Figure 7: Tool evaluation



Source: elaborated by the authors.

The strong agreement with statement E01 reveals the tool's potential to contribute to the understanding of the problem domain based on the concepts of needs, goals, and conditions. In addition, strong agreement with the E02 statement demonstrates the tool's systemic potential to relate users, organizations, and the environment. Lower approval in item E03 is related to the difficulty that some students found in generating hypotheses of needs. Unlike action goals, which are objective, motivating needs have a subjective character and often can only be understood through research. Thus, reaching the synthesis of needs, goals, and

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conditions is not a simplistic task. On the other hand, considering that 88% of students had never designed applications or had only participated in academic projects, an 80% agreement regarding the ease of application of the tool reveals its didactic potential.

6. Final considerations

This article presented a canvas-like tool to support the initial stage of the software project, in which the demands that the product will meet are defined. To do so, the tool allows mapping the motivating needs, action goals, and interactive conditions of the different stakeholders at their social, organizational, and individual levels. In this sense, it addresses not only the experience of the final consumer, but the entire chain of demands related to the activity supported by the software.

This systemic view is the main differential offered by this mapping tool. Its value can be corroborated by Standard 9241-11 (ISO, 2018), which highlights the importance of identifying all user groups and relevant stakeholders and conducting research to obtain a complete understanding of needs. Additionally, it is important to highlight that the canvas guides the organization of knowledge about the domain of the problem, including the identification of unknown information about those involved as well as the generation of hypotheses that can be validated through research.

Finally, the positive results obtained in evaluating the tool with undergraduate students demonstrated both its good applicability in structuring knowledge about the product strategy as well as its didactic potential. Due to this, the tool can also be used to support the UX teaching process. Finally, for future work, the development of other design tools capable of supporting the functional specification and quality evaluation of software products is suggested.

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