Problem Solving through a Participatory Design and Education Perspective

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Abstract

Through a bibliographic investigation and a survey about projects that use Participatory Design, we intend to comprehend the place of Design in teachers' performance and others involved in teaching, focusing on the knowledge construction by the student. How do teachers help students in their own construction and perception of the world, in a formation towards problem-solving? Where is Design's place in this scenario? We explore the intercrossing of Design-Education based on: Coyne (2004) and his studies about wicked problems and different approaches related the persons involved; Maturana & Varela (1998) about the individual meaning construction through problem-solving and the perception that every explanation it's a lived experience reformulation; Couto (1997) and her studies about Design being a field of technological vocation and interdisciplinary nature. Through this study and project examples, we demonstrate that Participatory Design can collaborate in teachers' performance, favoring the development of methods and techniques for problem solving.

Keywords: Education, Problem Solving, Complexity

1. Introduction

This article is the outcome of two separate qualitative and interpretative surveys held within the Post Graduate program in Design of the Pontifícia Universidade Católica of Rio de Janeiro – PUC-Rio/Brasil. One of them broaches the subject of cognition and the development of knowledge in a child and the other deals with how the Basic Education teacher acts in the classroom, related to one of the characteristics of a training in Design that is highlighted in the Public Policies for the Basic Education in Brazil: the resolution of problems.
On the basis of these two biases we intend to introduce the result of bibliographical and documental research about the knowledge construction process in the student and the National Curricular Parameters for the Basic Education, to think about the governmental objectives in a dialogue with the educational realities in face of the power of the student in the modern world.

We understand the need to contextualize the situation in order to propose Design as a field that has its place in the formation of future teachers, overall, because of the expertise for developing projects that are based on Design in partnership with a focus on problem resolution.

2. Problem Solving through Participatory Design and Education Perspective

2.1. Knowledge construction processes

In the 50's, predominantly in Europe and in America and in the 70's in Brazil, the specific context of our research, due to the contact researchers in Human Sciences had with the studies of Jean Piaget (1974; 1975) which brought a cognitive interactive perspective to the practical aspects of teaching and a systemic approach about the way children think as they construct knowledge. Concepts emerged on the scene that to this day is found to be theoretical contributions in the most diversified fields of Human Science. The cognitivism, constructivism and social constructivism were explored by educators who defended learning proposals based on the idea of non-linearity in the acquisition of knowledge and the valuation of the different ways and rhythms followed by each child in order to acquire this.

Within this movement of theoretical reformulation in the cognition area, in addition to Piaget, Lev Vygotsky (1984, 2000) should also be mentioned. They demonstrated that the construction of knowledge happens precisely during the interaction between man and his environment, but each one also developed his theory based on different paradigms about the principles of interactionism, which are referred to as Constructive Interactionism of Piaget and Social Interactionism of Vygotsky.

Piaget emphasized exactly what had not been taken into account by the behaviorist vision: the act of knowing, related to how the human being learns about the world. Primarily he investigated the cognitive processes underlying the elaboration of knowledge. In his perspective, the construction of knowledge happens within the constant exchange between the organism and the environment and this process acts as an action scheme. His theory is formulated around the different stages of cognitive sensorial dexterity stages pre-operatory, actual operatory and formal operatory, which are the stages that go right from birth until reaching adulthood. According to Piaget, each child develops a new way of operating within each stage.

Even though Vygotsky is in agreement with the interactionist approach heralded by Piaget he severely criticized the researcher's perspective by concluding that Piaget did not consider, in his theory, the social historical dimension within the child's cognitional process. His criticism was mainly about the Piagetian notion of self-centeredness within the child's process of learning a language because, for Vygotsky, in spite of what Piaget had formulated, the idea of the only reality in the first phase of infancy being the "me" and the consequent non differentiation of "me" / "environment" is a mistake since this outlook leads the child within the first phase of infancy to being "non-socialized".

Vygotsky effectually points out that the cognitive skills and the ways each individual structures their thought processes are not primarily influenced by congenital factors, such as those demonstrated in the Piaget studies. He therefore introduces the relevancy of the cultural and historical social dimension in the cognitive processes. For the author, development is driven by the language and this, in its turn, is the learning process itself that generates and promotes the development of upper mental structures.

At the beginning of the 21st century, Humberto Maturana (Maturana & Varela, 1998) (Maturana, 2001) who was still addressing the elements within the dimension of the process of constructing knowledge extended his studies. He brought to the research about the construction processes of knowledge the construction of a language that starts in relationships and therefore has an emotional dimension. According to the author an observer has an operational capacity comprising of knowledge; this makes him able to formulate questions about observations of experiences and therefore explain them. He introduces to this discussion the perspective of an observer as a result of his life experiences. In his conception, if the individual changes his questions, he automatically changes the path of his experience and consequently his explanations, developed in accordance with his criteria of acceptability.

In Maturana's viewpoint the construction of meaning does not only happen when you have the solution to the problem, but also when the individual has the capability to raise questions. In other words, according to Maturana, from the moment the individual accepts the question that proceeds from the observer and also as from what he has observed, he discovers that reality is an explanatory proposition, that is to say, he presumes to be impossible "to make reference to entities that are independent from me (the individual) in order to construct my (self) explaining." (Maturana, 2001). Some of his studies propose explaining the construction of knowledge (the author refers to cognition) as something done specifically as a way of living (culture).

Also, Kastrup (2000), at the beginning of the 21st century corroborates Maturana's perspective by introducing the idea of inventive cognition. The author proposes that cognition extends beyond the process used for solving problems, but is defined as the invention of oneself and the world. She understands that all learning starts with the invention of problems, that is, with the questions of the observer according to his observing. From this point of view, to make this process of constructing knowledge happen**,** the author proposes Art as a place of action, within a perspective from whence we understand that learning is questioned. On the whole, Kastrup believes that the innovation consists in experimenting, sharing problems, seeing and being able to solve them based on actual experiences they have lived through.

From the concepts for construction with an emphasis on construction in the social environment, the relevance of emotion and affection in harnessing actions and learning discussions in the perspective of the present article and the relational process between teacher and student, mediated by common teaching practices, with the respective methodologies and strategies, is the greatest challenge for Education.

We take into consideration here that all and every public policy related to Education will be fully achieved in the following educational actions to be taken. Actions that involve, places filled by directors, coordinators, teachers and psychologists. And finally, actions that involve mediators of process education and the students in their interactions with the chosen practices. Here we defend, above all, that the process of constructing knowledge happens as an outcome of the way a human being lives his life and is based on a relationship with others, which is also immersed in the language. It is of vital importance to have guidelines in a discussion about teaching-learning and the role of institutions as relational spaces.

2.2. The contemporary educational reality – a Brazilian outlook

Within the National Curricular Parameters (PCNs) (Brasil, 1998) for Basic Education – developed within the scope of Brazilian government Public Policies by the multidisciplinary teams that involve researchers from different Brazilian universities – it is anticipated that students should be prepared to deal with the complexities of the world. They should become citizens who are able to experience the different situations imposed by daily living and it is hoped that this will happen in the educational facility. In spite of the seriousness of the work that involves the development of the PCNs in their distinctive segments (early childhood, primary years – 1st to 5th, middle school – 6th to 9th years and high school) and of the theoretical and methodological support that provides the necessary credibility for formulation by multidisciplinary teams, what we observe is that even after 16 years since the first national PCN the objectives have not yet been fulfilled.

Even though, intended to guide schools to understand their surroundings and also to act in situations imposed on the students through the complexities of life and through the development of skills and abilities, it remains a distant student reality, when we consider the last results of PISA (International Student Assessment Program) for example. The PCNs warn that there is a lack of professional training of teachers who even these days are ill prepared to develop teaching techniques that will enable them to participate in the training of a student/citizens.

There seems to be a consensus that teaching practices and the development of strategies are the result of the sum of graduation/time against dedication/aptitude. Instead of having teachers developing teaching practices and implementing new projects in sync with the demands of modern society, what we observe are classroom teachers who act as technicians/specialists. Thus we have skilled professionals who maintain a status quo in detriment of trained professionals for the revision of models, criticism and propagation of new practices through the bias of social redimensioning (Giroux & Simon, 1997).

Today teachers are focused mainly on fulfilling goals and achieving results. There is a lack of time and preparation for the development of approaches that are part of the process for the construction of knowledge of students, which we have already observed in this article. To achieve this will demand teaching practices that build on the social environment, take into consideration the relevancy of emotion and affection in harnessing their actions and are based on the concept of learning issues. Reality has shown that the knowledge developed and the content covered tend to be standardized instead of criticized, in conjunction with teaching focused on the elucidation of "how to do" and not on the understanding of the problems related to each specific situation.

The assessment models (systems in place to control and measure), adopted by the government, even today disregard the context of where the school operates and also the differences and individual needs of the students. In reality there is also space for their own assessments and procedures, specific to each class/school, however, all schools are obliged to participate in the evaluation methods determined by the government. With this type of model the competition amongst schools and teachers increases, since good results mean investments (prizes).

Ball (2002) emphasizes that according to this structure what is observed is that there is a change of focus in the performance of teachers in the classroom because the students then cease to be the center of attention and become the means by which desired ratings can be reached. As a means of survival, in proportion to the shortfall in training/time dedicated/aptitude and even in fulfilling quotas for the government evaluation system, teachers focuses their attention on the teaching of specific knowledge, reproducible in different classes, while the solving of problems and the crossover between the different subjects, end up being only secondary.

In a completely negative vision of the total picture, Young (2011) emphasizes that the curriculum becomes a totally different way of "being accountable instead of being a guide for the teachers".

As a solution to the established destructive dynamics, Young (2011) proposes that teachers should consider the fragmentation of disciplines as a means of supplying trustworthy knowledge to students within a specific context, however, always linking knowledge, through the curriculum, using the students' own experiences, with the way they process the construction of knowledge and also, with the other subjects taught in the school environment.

In light of this situation, how can teachers meet the demands of the PCNs and evaluation systems and also cast a reflexive look upon their students that takes into consideration an effective process of the construction of knowledge which is built from emotion and affection, that harnesses actions based on learning issues due to their harsh reality in their social environment? How does Design fit into this context?

3. The collaboration of Design

In the different meanings about "what is Design", we can identify an aptitude for problem solving. The designer, according to his training, gains knowledge from a variety of areas such as philosophy, history, communication, technology, anthropology, etc. because it is an interdisciplinary vocational field.
A student of Design is taught and expected to develop skills and abilities to deal with a complex world and society in order to identify and solve problems, through the consciousness that each individual or group, has specific characteristics and needs. Using these skills and abilities as a starting point the future professional becomes able to configure objects for use, information systems, services and activities that develop meaning for people who can then fulfill their desires and their needs (Bomfim, 1994; Frascara, 2001).
Tabak & Farbiarz (2012) point out that it is characteristic of their field to try and "move from a present stage to another desired stage (goal, objective), without any obvious means of proceeding so that this change can happen". Simon (1984) had already foreseen this vision when he affirmed that Design is classified as an "artificial science" since it regards what is created by man and not natural. He advocates that Design is a "course of action aiming to transform existing situations into others that are more preferable".

Miller (2004) contributes to this conceptualization by introducing this "course of action" as a process and more than this, by defining Design as a thought process that is able to create an entity or a solution to a perceived demand. His vision brings Design closer to methodology, planning, strategy and technique. Already the International Council of Societies of Industrial Design - ICSID, highlights Design "as a creative activity where the objective is to establish the multifaceted qualities of objects, processes, services and their systems within their life cycles." (ICSID, 2014).

The summation of these concepts leads us to the affirmation that the professional in this field of work has, taking into consideration the skills and abilities taught in his training, the capacity to act as an interdisciplinary mediator/manager with a focus on creative resolutions to problems, from the development of project methodologies that will transform what already exists into something meaningful.

For this article we chose the methodology of Participatory Design, which was used in two subjects with students from the first and second periods of the graduate course on Design at PUC-Rio. This will serve as an illustration for the answer and as a proposal for interaction between Design and Basic Education with regards to a contribution of Design for the construction of relational practices of teacher learning that aim to train a citizen who will be able to resolve problems in a complex world (Figure 1).

In their respective subjects the students are instructed to carry out projects in the communities outside of the university. At the moment 140-160 projects are being developed in each subject, and approximately 60% of these projects result in objects/materials/resources, systems, services and practices of teaching/learning for Basic Education, including a Partnership of Technical Cooperation with the Municipal Board of Education in which students are invited to carry out projects in Municipal schools in the State of Rio de Janeiro/Brazil.
In the Post-graduation course of Design at PUC-Rio, concentration area Design and Society, there is also space for university-school work together with a view to developing skills for problem-based education. In the field of languages, for example, the development of educational materials focusing on grammatical structure of sentences was the focus of one of the studies, as Figure 2, where grammatical molecules were developed to facilitate the production of texts by the students.

Even in the fields of languages and humanities, another example is the development of dolls (Figures 3 and 4) with recycled materials to improve oral communication and raise ecological awareness.
An agreement was established between the São Tomé and Príncipe government, mediated by UNICEF, for three semesters (not consecutive). The focus was on the basic education in that country.

In this project the students were invited to think about projects directed towards classroom interaction, in other words, related to teaching subjects, development of materials and helping teachers in their practice (Figures 5 and 6).

The undergraduate courses in Design, as well as the proposal of the Graduate Program, are intended to take into account the students/researchers real demands and needs.

As it is understood as their being partners of the project, enrolled in situational contexts for which they receive design projects. It is not a question of projecting something for an unexpected situation, but of understanding that the object/system/process/activity, which is set, is derived from the social environment, emotion and affection therein harnessing actions and based on learning issues. Consequently aiming to lead the Design student to understand that products derived from the activity generated by the project should be understood to be meaningful to those people were projected for and thus fulfilling their desires and needs.

The methodology as a way to problematization following steps of development: (1) visit to possible contexts of project development; (2) mapping out of opportunities f r the project in the contexts that were visited; (3) definition of the theme and project concept alongside the users (understood to be the project partner); (4) establishment of the project parameters and the objective of the project alongside the partner; (5) generation of alternatives with experiments; (6) definition of the adopted party alongside the partner; (7) construction and refinement of the prototype with experiments; (8) final experiments. One of the references in this article is Vitor Papanek (1974) in his emphasis on the need to design for the genuine needs of man, which is only possible with the participation in their environment. Also dialogue with Milton Santos (2002) in the perspective that space is constituted as a set of object systems and stock systems that act simultaneously.

In the Participatory Social Design there is the awareness that each situational context requires a specific method, as emphasized by Santos (2002), on one hand, object systems affect the way you give the shares and on the other hand, the stock system takes the creation of new objects or is over pre-existing objects. Therefore, the space becomes better, dynamic and change. By this bias, it requires constant and unique ability to read and differentiated front action in every situation.

It's the responsibility of the Training Design (education), the development of the skill of constitution and an attitude that emphasizes the interaction between designer and its target public, towards showing the real demands of the users, the meaning of their actions and respecting their values. Therefore, it's awareness in the Participatory Social Design that "the designer's task will be done through the setting of poetic forms of coming-to-be. And for this to happen it's necessary more than knowledge in specific areas of knowing. It's necessary the familiarity and the comprehension of the cultural web, the locus that the persona identifies itself in its place in the world." Bomfim, In: Couto, Farbiarz, & Novaes (2014).

From this perspective, education in design and from the bias of the Participatory Social Design, prepares students to work together with you in your real designed environment, because only form there it can develop solutions to the demands perceived, taking into account the experiences and perceptions within the world of those involved. In the words of Farbiarz & Ripper (2011) "to design in partnership is to realize that the methods are developed from a new reading of the shares, a new reading of the interactions that could have been mentally, but have shown new possibilities the concrete level. " This definition approaches the vision Coyne had about the "wicked problems". A problem at this level would be more complex and would require a contextualized approach, taking into consideration where the problem is, who has caused it and whom he interacts with.

We highlight that methodology is essential for the training of designers prepared to develop projects with a focus on problem resolution in a complex world, and also important for the partnership between Design and Education. By this bias, this article defends the need to including within the teachers training courses for Basic Education the subject of Design, linked to the methodology from Participatory Design for the joint development of projects that uphold teaching practices (including their objects/materials/resources for teaching, services and activities) on the problematization.

Redefine the teachers training is not enough for an effective implementation of the PCNs for the Basic Education in Brazil. It is believed is also known that worthy work conditions, not attached to a training focused on the understanding of the process of the construction of knowledge happen in the social environment, is significant in the emotion and affection and in the harnessing of the actions and is based on the learning issues that invalidate the relational perspective that is foundational for constituting significant learning.

The experiences and perceptions of the world by the student and also the teacher have gained ground through the methodology of the Participative Design; they become the foundation for the educational objectives proposed in the PCNs and are in agreement with the proposal from Schön (2000) of "reflection in action" in the school.

4. Concluding remarks: Design & Education: a partnership for optimization of teachers actions

In this article, it was assumed that the teacher, in accordance with his professional training to teach in the classroom and due to the political context of in which he is situated, is lacking training that will prepare him for action focused on learning issues. Moreover, it is known that in the daily routine of the Basic Education in Brazil, despite the objectives laid out by the PCNs continue to submit educational projects with a predetermined curriculum, based on content to be complied with in detriment of skills and abilities to be developed in accordance with the students process for the construction of knowledge. It is possible to perceive the difficulty in training the teacher to develop teaching/learning practices according to their complexity.

It was understood that the student has needs, characteristics and specific individual perceptions regarding the content applied and about life, which generates a mismatch between their demands and teaching that favors the overall aspect in detriment of the specifics. Giroux & Simon (1997), in illustrating this issue declares that this is a "(…) misleading impression that all students can learn from the same materials, teaching techniques within the classroom and evaluation methods".

In between the teacher's formal education and the student's demands, it is correct to say that in order to attain the proposed objectives from the PCNs it will be necessary to review the relationship between the teacher's repertoire and the daily classroom activities. Even though, up until this present moment, the fragmentation within the subjects is treated as inevitable and also the focus is still on evaluations, Morin (2003) is warning, "education should favor the natural propensity of the mind to place and resolve problems and concomitantly stimulating the full employment of general intelligence".

It was proposed that there could be collaboration between Design and Education, through the presentation of the methodology Participatory Design as a possibility of optimization between the teacher's postgraduate training and the actual practices within the classroom.

In this article, we would emphasize that the Design professional bases his actions on practices applied within different areas of knowledge, in their different existing expertise, in order to develop their products/solutions. We defend that including the subject of Design in the teacher training program for Basic Education helps in the comprehension of a problem and becomes a way of generating good teaching practices, objects/ materials/resources, systems and services in order to optimize the teacher's actual training. Taking into consideration that this insertion in the Basic Education can be a two way street, because apart from optimizing the teachers actions, it will resignify the importance of the field of Design in society, evidencing that the knowledge and Design methodologies are characterized by a social knowledge that seeks to understand the peculiarities, the real needs of the individuals and the means of reaching them.

In summary, emphasizing the interdisciplinary vocation of the field of Design through the Participatory Design methodology here we defend in this article that Design can optimize the teaching-learning practices in collaboration with Education, in a joint action between designers-teachers and students within the classroom context. With this, it is believed that there will be a sound foundation for the transferred from one teaching model based on knowledge transmission to another model with an emphasis on problem resolution and the development of skills and abilities.

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Figure 1: Projects developed in Rio de Janeiro Schools in the discipline Basic Design Concept and Context where graduate students use the methodology Design in partnership with teachers and students to develop teaching resources for different subjects / teaching practices. (Baptista , Fernanda Nazareth)

Figure 2: Project developed at Symposium for Schools Continuing Education teachers in Rio de Janeiro focused on Portuguese discipline. (Oliveira, Eduardo Andrade)

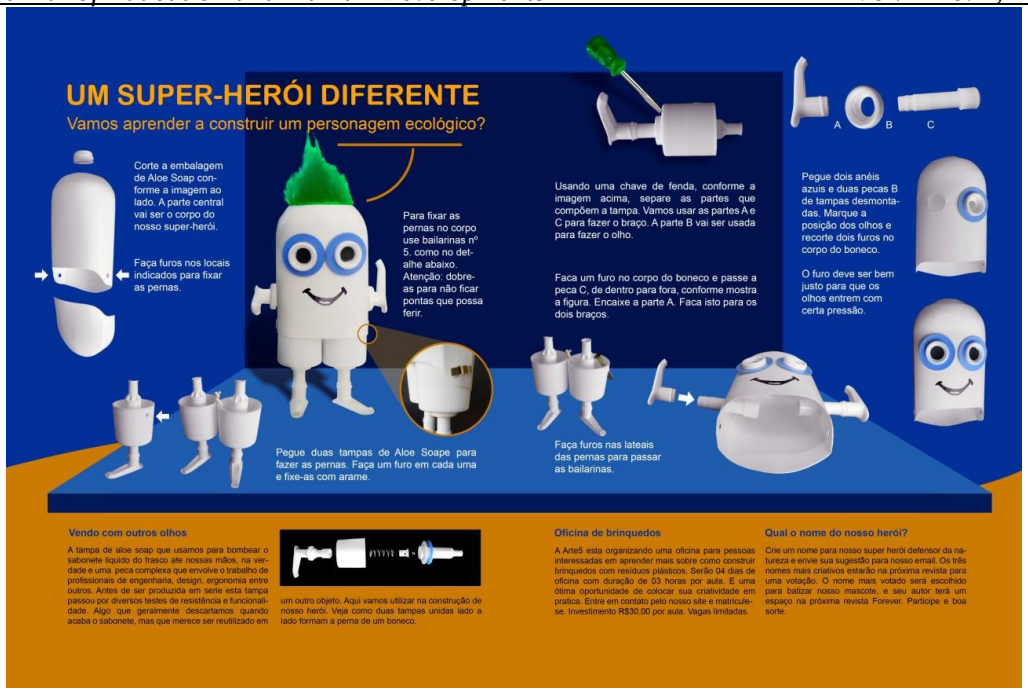

Figure 3: Project developed for Continuing Education Schools teachers in Rio de Janeiro focused on ecological awareness. Source: (Oliveira, Eduardo Andrade, Magazine Forever 2011, 150-151)

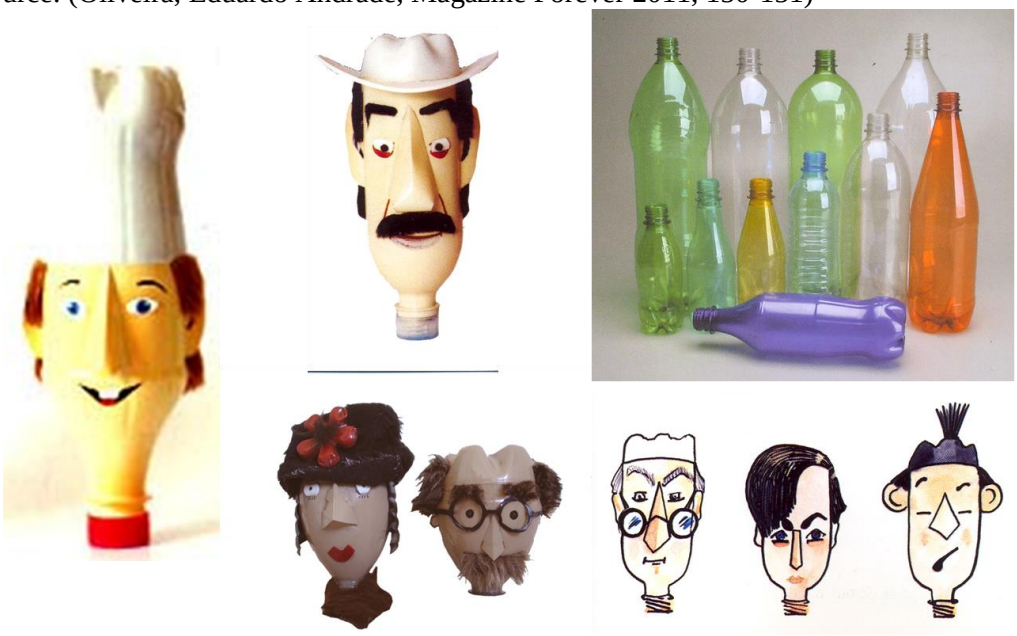

Figure 4: Project developed for Continuing Education Schools teachers in Rio de Janeiro focused on ecological awareness. Source: (Oliveira, Eduardo Andrade, Magazine Forever 2011, 150-151)

Figure 5: Project Exhibition developed for the Department of Education of Sao Tome and Principe Source: (Portas, Roberta 2012).

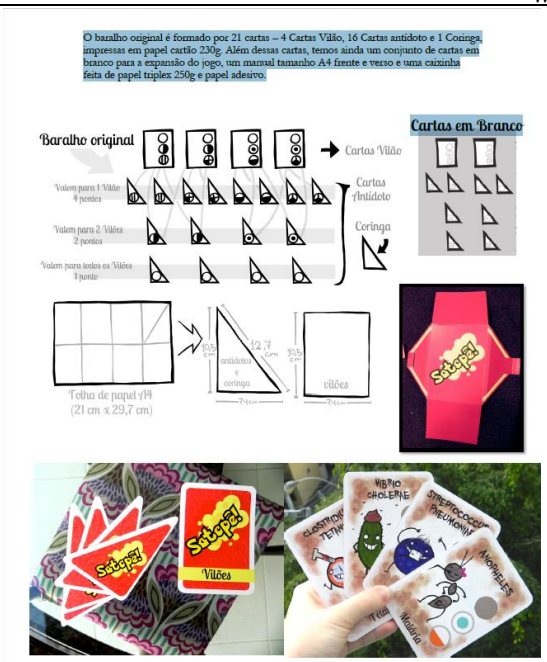

Figure 6: Project developed for use by teachers and students from kindergarten to Sao Tome and Principe with a focus on awareness of the health problems. Source: (Portas, Roberta Selected Projects 2012).