DESIGN OF DIDACTIC MATERIAL FOR TEACHING AND LEARNING SITUATIONS: THE CASE OF SÃO TOMÉ AND PRÍNCIPE, AFRICA

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Abstract

Much of the didactic material of São Tomé and Príncipe for teaching and learning situations for early childhood education is not guided by interdisciplinary dialogue between design and education suitable to the country's context. A proposal is presented for a system of objects that support the early childhood education curriculum, designed to be used as a guide and supporting material for preschool teachers of São Tomé and Principe and illustrates the various ways in which design can contribute to teaching-learning processes, strengthening knowledge building through the development of artefacts, environments, and education systems. This material is one of the outcomes of the project developed by the Interdisciplinary Education Design Lab (LIDE), from PUC-Rio, Brazil, using the Design in Partnership methodology for the development of curriculum content for early childhood education. The project is being developed by researchers at LIDE/PUC-Rio, the Ministry of Education, Culture and Science of the Republic of São Tomé and Príncipe, Africa, and UNICEF, and has other spheres of action, including the development of early childhood education curriculum content, ongoing teacher and assistant training courses, the recycling course offering for educators and assistants, the teaching materials project, and the redesign of physical spaces in kindergartens. This material contributes to the application of the curriculum under development.
Key words: *education design, design in partnership, early childhood education, teaching materials.*

Introduction

Within the ambit of the Interdisciplinary Education Design Lab (Laboratório Interdisciplinar Design Educação, LIDE), whose basic goal is to carry out research to enhance the knowledge acquisition process through artifacts, environments, and analog and digital systems, a research project is being developed in partnership with the Ministry of Education, Culture and Science of the Republic of São Tomé and Príncipe, Africa, and UNICEF. The project includes designing curriculum content for early childhood education, ongoing teacher and assistant training courses, the didactic materials project, and the redesign of physical spaces in kindergartens.

The development of the project, through interdisciplinary dialogue between design and education, illustrates the various ways in which design can participate in the teaching-learning processes, strengthening the construction of knowledge through the configuration of artefacts, environments, and educational systems.

To design the project, the Design in Partnership methodology was adopted, which involved seeking validation by future users for all the elements from the curriculum, ensuring the final product greater effectiveness in achieving its goals. This methodology proved effective in the educational ambit in that it engaged the different stakeholders involved in the construction of knowledge – students, teachers, specialized professionals, consultants, and sponsors – around a common goal. When the final object incorporates the ideas of all those involved, the situation in which it is used can be enriched and matured (Couto & Ribeiro, 2001).

This article presents a proposed system of supporting objects for the curriculum, which are designed to be used as a guide and supporting material for early childhood educators from São Tomé and Príncipe. This material is one of the products of the LIDE project based on the Design in Partnership methodology to develop early education curriculum content.

Education for the Integrated Development of Children

The purpose of education is to provide conditions for children to develop fully, considering their learning potential at different age groups. This work is led by actions that enable the development of physical, emotional, cognitive, ethical, aesthetic, and interpersonal skills and social inclusion, considering the specificities of the sociocultural context.

The idea of setting objectives in terms of capacities – not behaviors – is designed to increase the chance of attaining the educational goals, since skills are expressed through various behaviors. In this sense, the learning activities involved can be of different kinds, so when goals are set in these terms, teachers have a better chance of taking account of the diversity of interests presented by the children, considering their different abilities and ways of learning.

Respect for the diversity of students is part of this project. If it is to be accepted by children, the adults with whom they spend time in the institution must demonstrate in their actions and attitudes that they accept their differences and particularities, from differences of temperament, skills, and knowledge to differences in gender, ethnicity, and religious belief. It is extremely important to promote respect for this plurality, which should permeate daily relationships.

In this sense, the primary task of schools must be to work with material that is living and concrete, inseparable from social reality, not material that is abstract. It is about adopting a pedagogic proposal based on "dialogue – action – comprehension – participation", always drawing on the experience of the students.

According to Kramer (1999), children and their teachers all have the right to cultural education, since children and adults are all historical and social subjects, citizens produced in culture and creators of culture. As citizens, they have social rights, which includes the right to education.

Children have the right to respect and protection from society and the state, with a view to their full development, according to the São Tomé and Príncipe Constitution, which, in Article No. 55, states that education is a recognized right for every citizen, including their active participation in the community.

Therefore, there must be an understanding of the development needs of professional teachers in order for them to rethink their practices with a view to ensuring that all children have a childhood with access to knowledge and interaction with culture, through formal and informal spaces.

The presence of properly trained teaching professionals is important for the design of development strategies for education in São Tomé and Príncipe and it is a decisive factor for the attainment of goals for preschool education in that country.

Considering these principles of child development and the Design in Partnership methodology on which the entire project is based, it is worth also mentioning the challenges

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of designing for a different culture and gaining familiarity with it. This methodology made this work possible, based as it is on the principle that design is not socially neutral, but an activity that influences and is influenced by the balance of interests among the different social groups participating in the process. In other words, design is intrinsically an interactive and social process (Couto & Ribeiro, 2001).

Conceptual Bases that Guide the São Tomé and Príncipe Preschool Curriculum

When designing the proposed preschool curriculum, it was considered that people are social beings and are also interdisciplinary beings who develop in their successive exchanges with the external environment. This conception is opportune for the methodology adopted in this project, since the learning is structured and confirmed by the cultural code of the environment of which it is a part. The cultural environment is defined as the surroundings that build the structure of the subject and determine their actions, branding them with the features of their own time and place. People's relationship with their cultural environment is a relationship of reciprocity and, likewise, the relationship between peers is and will always be of exchanges (Mamede-Neves, 2013).

On that basis, pedagogical work makes sense only if it takes into account how the different dimensions of this being are constituted and integrated, as well as the physical structure, the rational dimension, the motivational dimension, and the social dimension, the last of which shapes the contextual and interpersonal dimension.
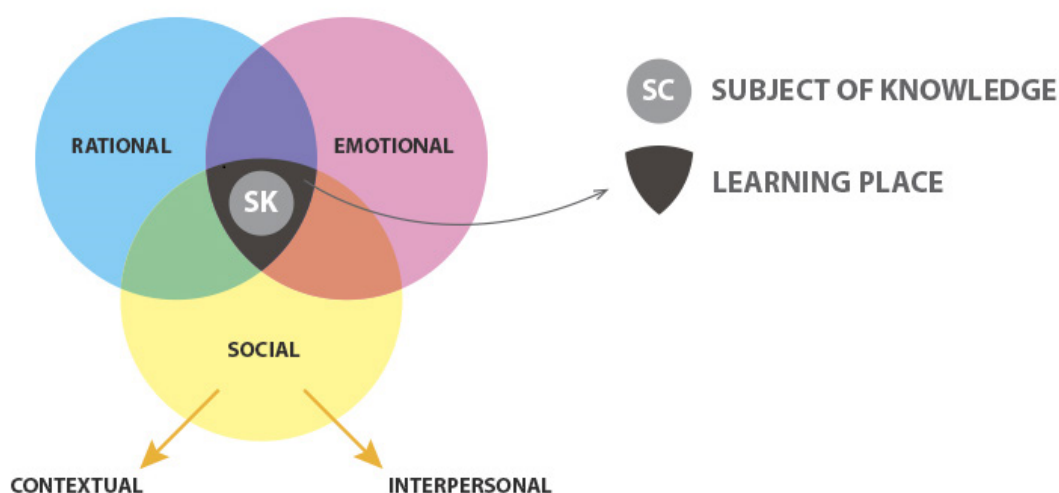

Figure 1: Subject of knowledge and place of learning.

According to Mamede-Neves (2013), learning is a concept that can be understood as a process and as a product. As a process, it refers to the organization of mental structures to levels that are built up in increasing complexity and operate in different dimensions. It is essential, therefore, that teachers understand this process in order to properly organize their teaching and how they teach and how far to go when teaching.

As a product, learning is not a single process, but is translated by changes in observable behavior, which occur in many types, according to Lewin (1965):

▪ Change in the knowledge network with progressive differentiation in its complexity.
▪ Change of interest (positive or negative motivations) that is built by the relationship between the subject and the areas that attract them or make them step back, not desire.
▪ Change of values, as a result of the identification of the child with their parents, family

members, teachers or guardians, so at first only with those who are around them and teach them the beliefs, ways of behaving, myths, and rules of their context. Later, this circle begins to open to new experiences and contact with other contexts, still within the country, or through international exchanges as they take place.

Accordingly, learning within this conceptual base is not designed only as rational, cognitive learning that needs to evolve into abstractions; it is much more.

The main point of learning as a complex concept is perception, not only of concrete objects, but going beyond these concrete objects. People perceive ideal objects, resulting from their imaginary constructs, and learning is above all the perception of relationships between people, facts, phenomena, etc. That given, human behavior is the result of how people perceive the world and how they are perceived in the world.

This substantive proposal for early childhood education was built on the conceptual foundations described above, after which came the actions required for the development of the content, teaching methodologies, design of teaching materials, and training of teachers.
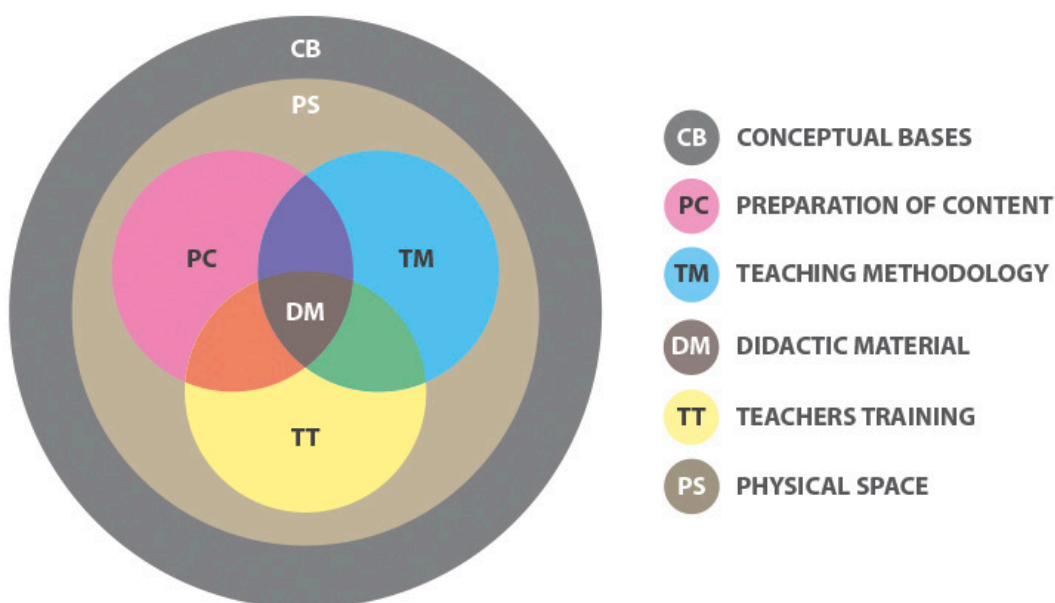

Figure 2: Overview of the political pedagogical project.

The proposed curriculum, anchored in the conceptual basis described above, draws relationships between the content and the meanings it may have for the students, the methodological developments needed for each area of knowledge in the curriculum, and living and concrete contents – i.e. ones that are inseparable from the social reality.

It is about a pedagogical proposal that is consistent with the following dynamic: ACTION <> DIALOGUE <> PARTICIPATION. It is based on the experiences of the students as well as the competence of the teacher.
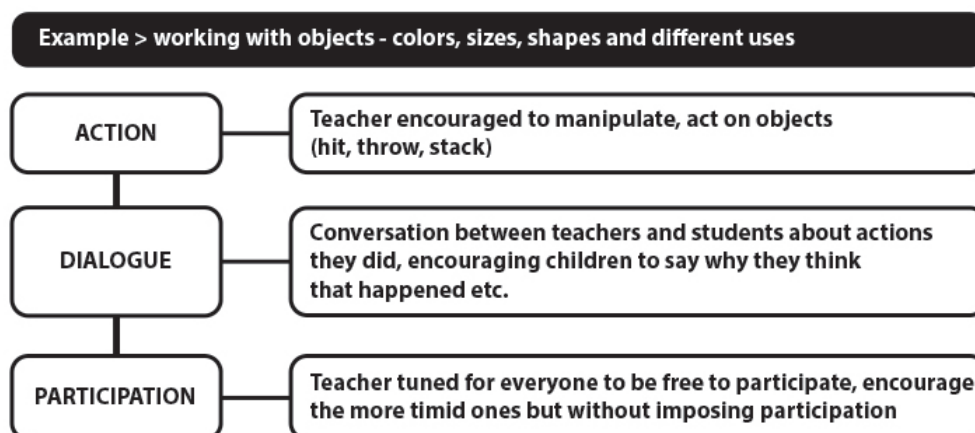
Example > working with objects - colors, sizes, shapes and different uses

ACTION — Teacher encouraged to manipulate, act on objects (hit, throw, stack)

DIALOGUE — Conversation between teachers and students about actions they did, encouraging children to say why they think that happened etc.

PARTICIPATION — Teacher tuned for everyone to be free to participate, encourage the more timid ones but without imposing participation

Figure 3: Example of interrelationship between action, dialogue and participation.

Design in Partnership draws an analogy with these interrelationships (Figure 3), in that it is a design attitude that enables the development of projects related to social realities in specific contexts, contributing to the discovery of cultural values. It requires the effective participation of individuals or social groups in the development of the projects at every stage. It favors the generation of effective solutions that are aligned with the needs and desires of all those involved and leads to the construction of objects that can be easily recognized, accepted, absorbed and signified by the group that participates in the design process.

The methodology used to design the curriculum structure is predominantly "learning through problem-solving" as proposed by Polya, a teaching strategy adopted by Mamede-Neves (2012) to be developed individually or in small groups, where there is a great emphasis on the comprehension of how children think and learn when faced with a problem, whether it is simple or complex.

It revolves around the observation of children's actions, their formulations, how they express themselves to explain how they reached certain results, why they acted this way or that, etc. This didactic way of leading teaching in preschool is essential because it leads the students to take interest in what is being proposed, to go beyond what is taught, and develop collaborative autonomy and learning, making them better prepared to use the knowledge structures as required.

Teaching materials are considered here as instrumental resources for teaching interventions. Therefore, they and the proposed dynamics are linked up with the preschool curriculum, using the work developed and established at the Interdisciplinary Education Design Lab as their methodological foundation.

Structure of the Proposed Curriculum

In line with these educational tenets, the proposed curriculum presents living and concrete contents, which are therefore inseparable from social reality, giving special emphasis to the relationships between the contents and the meanings they may have for the students. It also assimilates the methodological developments necessary for each area of knowledge, albeit always within the development levels presented by children of four or five years old.

In terms of duration, the curriculum covers eight school months with eight content units: one for each month of the academic year. Each content unit covers four five-day weeks and each day has seven modules of activity.

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Each of the eight units of the curriculum presents the core elements of the unit, a table showing the distribution of the units across the areas of knowledge – Language, Mathematics, Physical and Social Environment, Expressions – Art, and Expression – Movement. There is also a board setting forth the content for each knowledge area for the age group, according to the targeted competencies and skill sets. Lastly, there is a board of educational goals, expressed in terms of the competencies and skill sets for the age group.
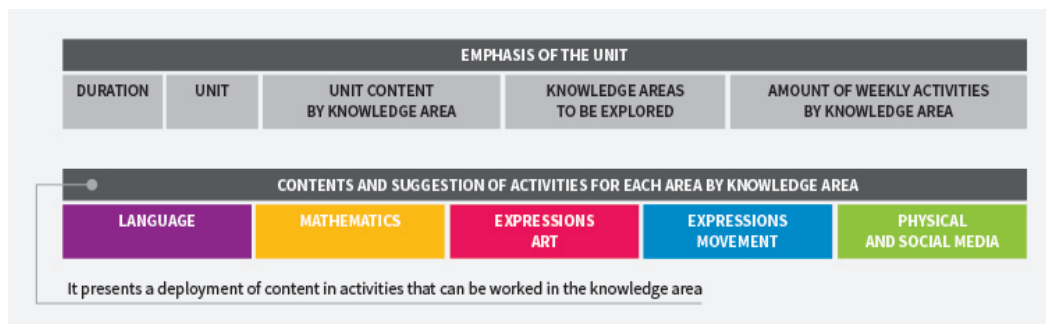
Figure 4: Structure of the content's distribution board of each unit.

For each unit, there were suggested daily activities based on the contents of the knowledge areas, taking into account the competencies and skill sets. Each day of the week consisted of seven activity modules, namely: reception activity; daily activities; snack; activity to integrate the knowledge areas (1); free activity; activity to integrate the knowledge areas (2); and external guided activity.
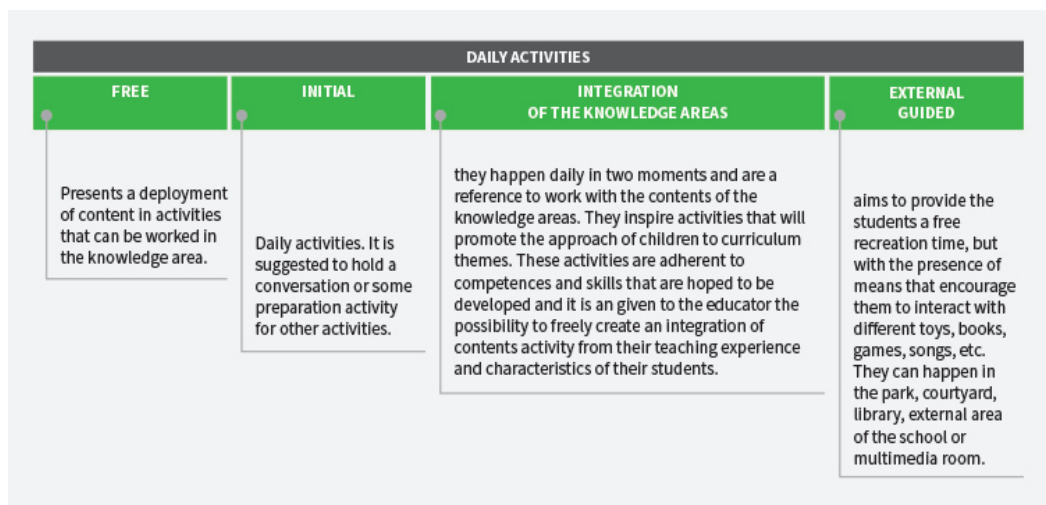

Figure 5: Nature of daily activities.

System of Objects that Support the Curriculum

One of the challenges of the proposed system was to develop educational support material for the educators that had dual functions: to present the pedagogical foundations of the curriculum and the curriculum structure with its contents.

In the analysis of the references found in the research of educational materials, it was

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noticed that most educational support materials consist of a teacher's book that contains a version of the student book with suggestions and solutions for the proposed activities.

In the initial stages, the content was organized in a printed publication with multiple pages, like most teacher's books, but when the mock-ups were prepared and the limitations of its use were observed, it became clear that having all the content bound in a single volume would not translate the spirit of the curriculum.

Accordingly, a new graphic format was designed for the supporting didactic material using an open structure that reflected the units the curriculum was divided into. As well as allowing more than one teacher to use the material at the same time, this division means that individual units can be reviewed and reprinted without affecting the others. Considering the possible shortage of printing resources, the division of the material into booklets was the solution encountered for enabling the content to be reviewed and updated on an ongoing basis.

The following guidelines were then set for the development of the publication: the graphic material should reflect the interdisciplinary approach of the curriculum; the content should be presented in a way that invites its use; the formal organization of the content should contribute to the precision of the message; and the use should contribute to autonomy of the educator.

From the studies, mock-ups, and proofs, it was decided that the material should be contained in a folder, which would hold all the printed materials for each classroom. The folder contains nine booklets and 320 cards, and a booklet with the presentation of the theoretical bases of the curriculum and the information system that articulates the themes present in each unit, and eight booklets, one for each of the eight school months. Each card represents a Knowledge Area Integration activity. Considering that there are two daily activities of this nature, this means ten cards a week, 40 cards per unit/month, and a total of 320 cards in all.

The idea of using a card format for the Knowledge Area Integration activities was so that a board of weekly activities could be set up and displayed in the classroom, allowing all the teachers and assistants involved in the classes to keep up with the week's activities. For the cards to be viewed, we created an activity board in PVC vinyl with crystal PVC pockets for the cards.

Below are some pictures that illustrate and help understand the objects in this system.
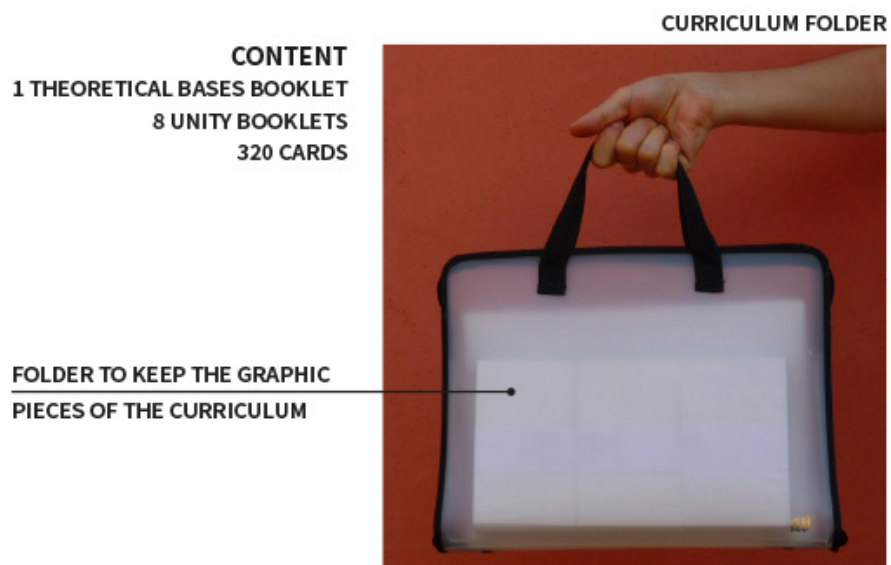

Figure 6: Curriculum folder.

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Figure 7: Set of graphic elements that make up the curriculum.
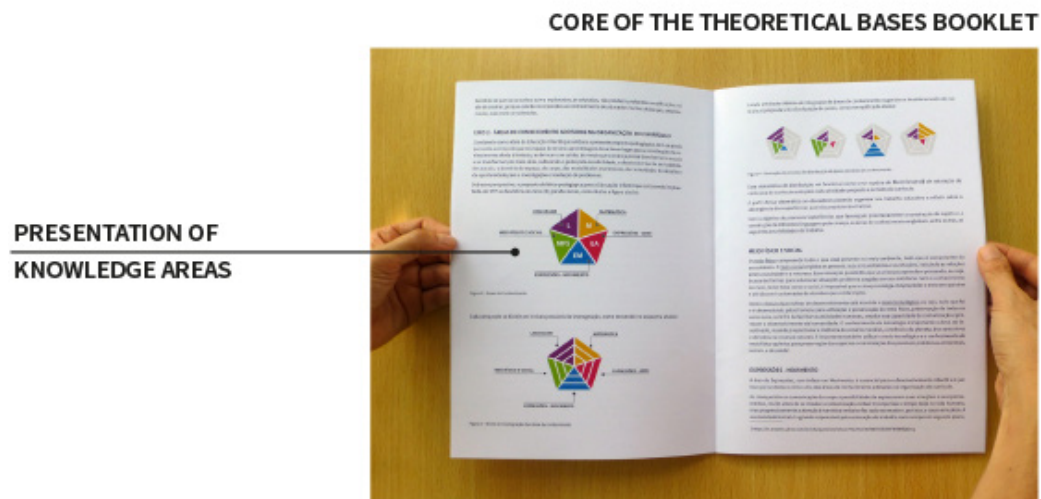
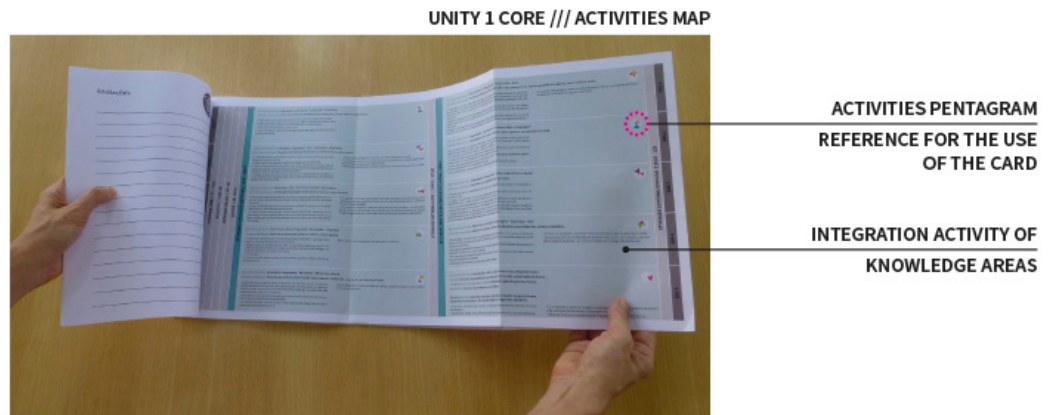**Figure 8: Core of the booklet presenting the theoretical bases and diagrams of knowledge areas.**

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UNITY 1 CORE /// ACTIVITIES MAP

ACTIVITIES PENTAGRAM
REFERENCE FOR THE USE
OF THE CARD

INTEGRATION ACTIVITY OF
KNOWLEDGE AREAS

Figure 9: Page with weekly activities for unit 1 of the curriculum for 4-year-olds.

CARDS DIVIDED BY UNITS

TEACHER CHOOSES THE
WEEK CARDS FOR THE
ACTIVITIES BOARD

Figure 10: Set of curriculum letters for 4-year-olds.

ACTIVITIES BOARS

GAPS FOR THE NAMES
OF DAILY ACTIVITIES

WHITE AND CRISTAL
PVC HOLDER

WEEK CARDS
CHOSEN FOR THE BOARD

MONTH CARDS
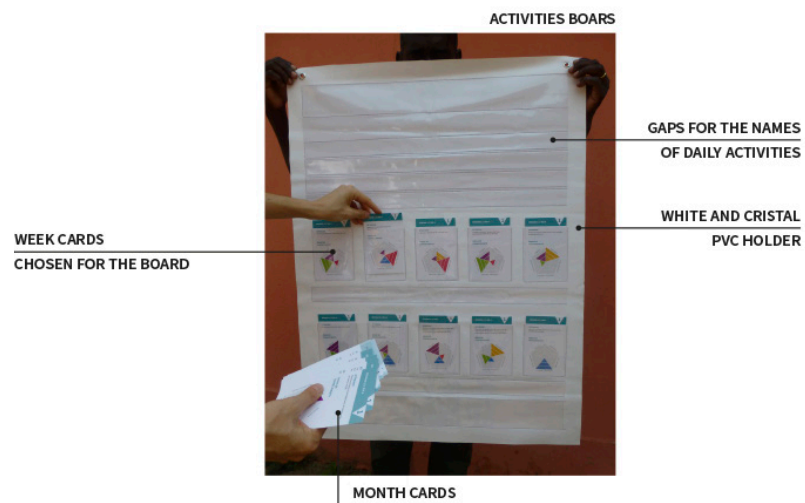
Figure 11: Activities board – card holder.

To validate this proposed structure and information system, a white model was made with all the elements that make up the folder, and a fully typesetted booklet and respective cards were printed. This material was submitted to the Ministry of Education, Culture and Science and to UNICEF at the Republic of São Tomé and Príncipe and tested with the preschool (age 4 and 5) teachers and assistants.

Diagram Illustrating the Integration of the Knowledge Areas

The proposed curriculum includes two daily activities designed to integrate the knowledge areas. Each activity combines at least three different areas.

As we worked on the organization of the material, a search was made for alternatives that could foreground the interdisciplinary nature of the content and the problem-solving approach. Accordingly, an information system was constructed that shows the possible articulations of the knowledge areas and gives an understanding of the essence of the proposed activity through a diagram.

The curriculum is based on the articulation of five knowledge areas, which are present in all the activities, although in different subjects. A pentagram was used to reinforce the idea that all the five areas have a meeting point at the centre of the pentagram. It demonstrates that the five areas are interconnected and always present.
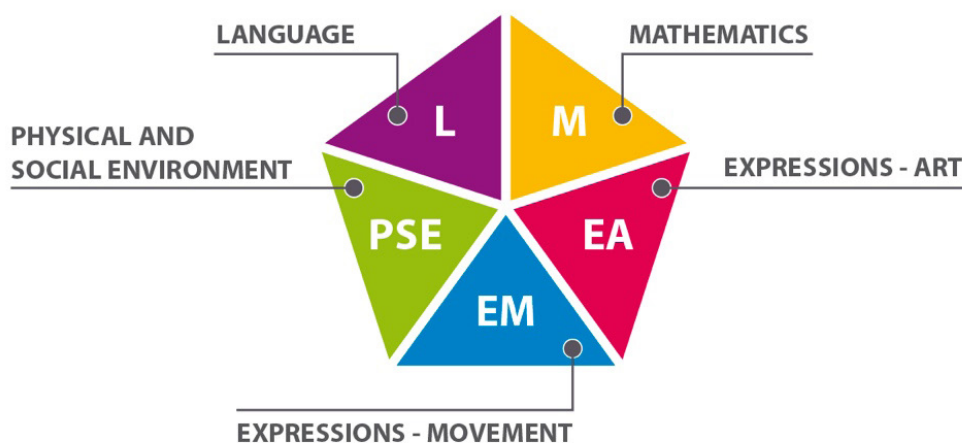

Figure 12: Pentagram divided by knowledge areas contained in the curriculum.

To reinforce the knowledge areas, a colour palette was designed of four equidistant areas of the visible spectrum filled with a single bright, saturated colour. For the fifth color, one quadrant was subdivided and the brightness was changed. The group of colours allows the three areas to be highlighted, creating visual limits.
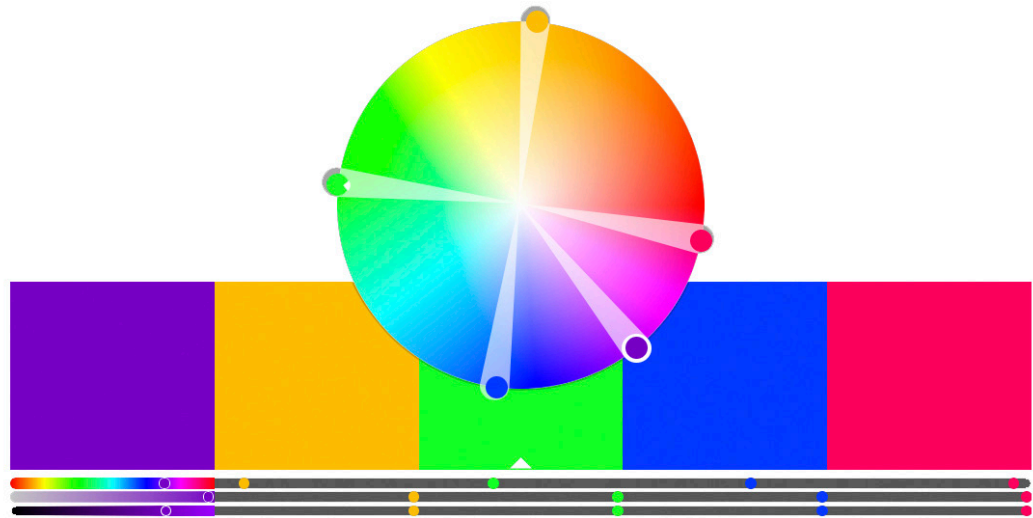
Figure 13: Color palette adopted for the pentagram: four equidistant quadrants and one subdivision between one quadrant.

From this geometric structure, each slice of the pentagram (knowledge areas) was subdivided into three levels of intensity, from the centre outwards. This enabled three areas (minimum for each activity) to be working with simultaneously, but allowing a different intensity level for each one.
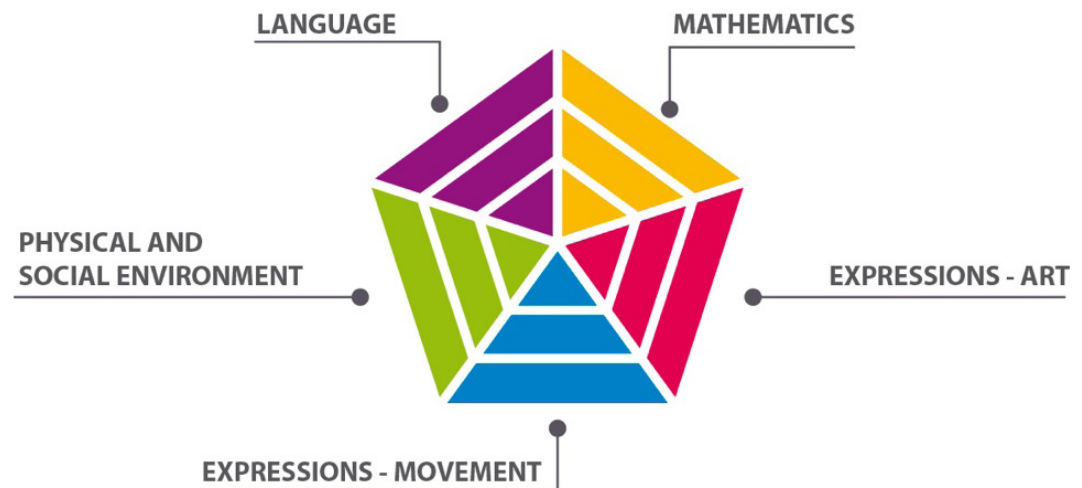

Figure 14: Pentagram divided into five knowledge areas and subdivided into three intensity levels for each area.

When the assembly of the pentagrams to illustrate the Knowledge Area Integration activities was completed, it became clear that when the areas were not visually highlighted, noise was created in the information. Even when there is no emphasis on a certain knowledge area, it is still present, so not to reinforce its geometry imparts the message that that area is not covered in the activity. This is not consistent with the educational proposal on which the curriculum is based.

To address this issue, a decision was made to leave the pentagram visible and to fill in the areas that were not being focused on with a neutral grey. This choice of color is based on the Munsell color system and meets the criterion of keeping the knowledge area present, but changing its strength to zero and its brightness to 50. To reinforce the existence of the knowledge areas, subtitles were added to the pentagram showing the name of each area.

PENTAGRAM WITHOUT REINFORCEMENT
OF THE KNOWLEDGE AREAS
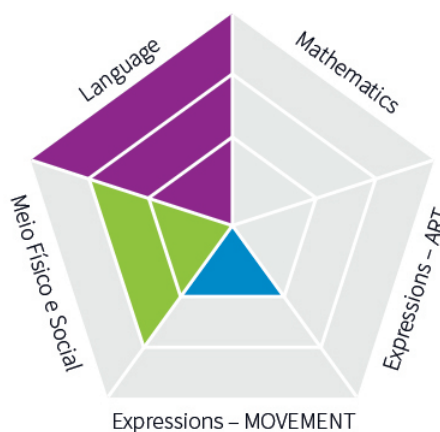
PENTAGRAM WITH REINFORCEMENT
OF THE KNOWLEDGE AREAS IN GREY

Figure 15: Pentagram without visual reinforcement of the five knowledge areas and with visual reinforcement in neutral grey.

In the curriculum, there are three models of diagrams that illustrate the ways the knowledge areas can be integrated, namely:

1. A complete model, in which three knowledge areas – one major and two complementary– are presented; the activity to be conducted; the methodology that will guide the activity; and suggestions for teaching materials. In this model the activity is complete.
2. A partial model, in which just one knowledge area is presented, while the educator chooses two other complementary areas and objectives are suggested, in harmony with the interrelated capacities and skills from the unit. By using this model, the educator begins from a suggestion, but needs to choose two other areas to dialogue and develop a new activity.
3. A free model, in which the educator can plan their own class, choosing the areas, activities and methodology. To create the pentagram of the activity, the educator fills in the colors of the knowledge areas present in the activity that is created.

In the curriculum proposal, it is suggested that the educator freely creates the initial activity from their teaching experiences and the characteristics of their students. It is suggested that the educator documents the activities devised and the methodologies employed with texts and drawings. With this step, the experience in the classroom is recorded and can be reused by the same teacher or by their colleagues. The object discussed in this paper encourages the educators, since it provides space for creating and recording activities.
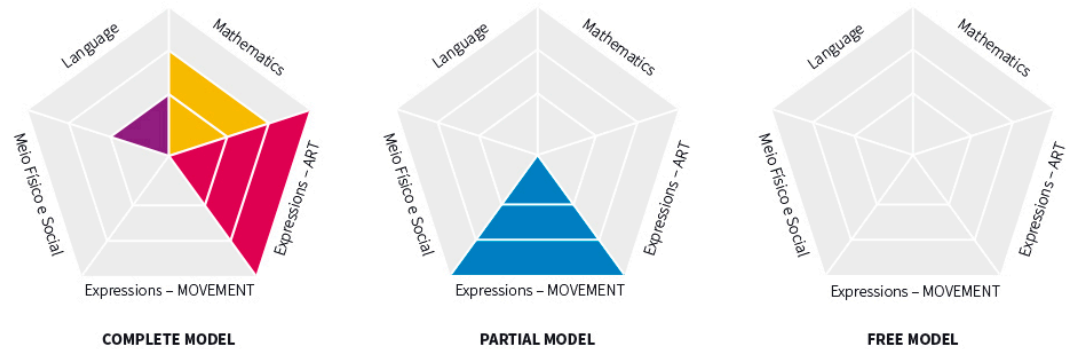
Figure 16: Types of pentagrams used in the curriculum.

This system, illustrated in each diagram, guides the activities to be performed each day and visually represents the inclusion and the weight of each knowledge area in each activity from the curriculum.

These diagrams are very valuable graphic tools, because they allow the content integration idea that should guide the preschool pedagogic work to be represented clearly and simply. In addition to this, they visually translate the possibility of engaging in effective interdisciplinary work, calling for the construction of methodologies and dynamics for the effective integration of knowledge areas.

Conclusions

The basic precondition for schools to serve social interests is that it should guarantee good teaching for everybody; in other words, the ownership of basic curriculum content that resonates in the lives of students. Understood in this sense, education is one of the ways by which the students – through the intervention of teachers and their own active participation – progress from an initially confusing and fragmented experience to an organized and unified view.

Schools should be effective in preparing students for the adult world and its contradictions, providing them with the necessary instruments for the acquisition of contents, for socializing, and for their organized and active participation in the democratization of society.

If the school's aim is to prioritize the acquisition of knowledge, especially knowledge connected to social reality, the methods must encourage the contents to be in harmony with the students' interests, allowing them to recognize how they support their efforts to understand reality.

The development of this project, through interdisciplinary dialogue between design and education, aims to present how design can participate in the training of teachers, teaching-learning processes, and the development of teaching materials, enhancing the process of knowledge acquisition through the design of educational artefacts, environments and systems. Therefore, each design solution represents the search for a balance between the interests and needs of teachers and students, as well as educational establishments.

Based on the extensive experience of the Interdisciplinary Education Design Lab in the design of projects for teaching and learning situations and from the perspective of Design in Partnership, projects can be created according to each school's curriculum or thematic projects that arouse the interest of students, to reinforce academic content while learning new skills.

The support materials to be used by early childhood educators from the Democratic Republic of São Tomé and Príncipe are the result of interdisciplinary work between design and education, benefitting not only from the formal results, the physical layout, but also the possibility of the information system becoming an important element in the development of these teachers. The ongoing use of this system will lead to autonomy in the planning of daily activities and provide integration between all the schools in the country.

This also emphasizes how design can be involved in education, drawing on interdisciplinary nature, and in this case the specific methodology of Design in Partnership. In contemporary times, the epistemology of design is tending towards social issues and is not restricted only to aesthetic concerns. It is consistent with a paradigm shift in teaching and learning, where thoughts and acts trigger needs that schools, teachers, and students must adapt to, since the emphasis of education in the current paradigm is on learning and not education, and on knowledge building and not training.

The Design in Partnership methodology enabled a curriculum model to be developed that was completely appropriate for the context of the country. This was achieved not only by the researchers involved, but also by the educators, who will become the curriculum mediators, and the countries' government, which will legitimize its implementation. The progress of children can be seen *in loco* and through the statements of some parents, who have called for the new curriculum to be implemented in their children's schools as soon as possible. In addition to providing quality education for the children of this country, the project enhanced their general culture and allowed – in equal opportunities conditions – the development of their skills and their individuality, their sense of social and moral responsibility, as established by the Declaration of the Rights of the Child approved by the United Nations.

Acknowledgements

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