Shape Recognition in Early School

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Abstract

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Reference


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SHAPE RECOGNITION IN EARLY SCHOOL
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After presenting the context of the teaching of mathematics in early school in Geneva we describe a research about de conception of games for shape recognition.

CONTEXT
Since 2012, in Geneva, like in all French speaking Switzerland, primary school is compulsory from age 4 (grade –2) and finishes at age 12 (grade 6). The eight years of primary school are named 1P until 8P and are divided into two divisions: elementary (1P to 4P) and middle (5P to 8P). All primary school teachers in Geneva are trained the same way for all degrees and they are generalists. Moreover, there is a common program for all compulsory education (grades -2 to 9) for all French speaking Switzerland (Plan d’études romand2, https://www.plandetudes.ch/per). In mathematics, there are also common official textbooks and resources for teachers (for all 11 grades of compulsory education), which are elaborated by an “inter-cantonal”3 commission and are supposed to be the main (and only) source of activities and reference for teachers and students.

For the curriculum, in the elementary division, students use a physical space where «the shape is linked to the visual perception of the object»4. Then, in the middle division, they use a conceptual space where objects are associated with figure like «unchangeable and ideal»5. These figures are independent of the graphical representation. We consider that in this important gap between these two divisions, an intermediate level can be explored. Young students, from the elementary division, work on the first geometrical properties (sides, vertex, …) when they manipulate the physical shape. So for us it seems possible to work on the first properties without the conceptual and abstraction geometry. This intermediate land between physical geometrical object and the figure is our land for research. In order to distinguish the properties bound to the figure and the work about the properties on physical objects, we use characteristics. Research like Braconne-Michoux (2008); Houdement & Kuzniak (2000); Parzysz (2003) and Van Hiele (1959) show the rupture, in the geometry teaching, between primary and secondary school and finally in high school where the focus is on reasoning and deduction. Duval (2005) identify different visualization of a geometrical shape. The first one is a global visualization, all the shape, the edging, and the interior of the shape is the shape. This first visualization is called the 2D (2 dimensions) visualization. Then sides, vertex, diagonals are identified, the visualization takes into consideration the different elements of the shape. This visualization is the 1D (one dimension) with the line and 0D with the vertex.

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1 The 8 years of primary school are followed by 3 years of lower secondary school (grade 7 to 9, called 9e, 10e and 11e) which complete the 11 years of compulsory school.
2 French speaking Switzerland is called: « Suisse romande »
3 Switzerland is divided into 26 cantons, which have the responsibility for education. Thus there are 26 different educational systems in Switzerland, but there is a process of harmonization...
4 Our translation : « la forme est liée à la perception d’ordre visuel d’un objet »
5 Our translation « immuables et idéaux »
Our goal in this research is to develop some pre-geometrical activities around shape recognition using these characteristics.

PRESENTATION OF THE SHAPES COLLECTION

Our first observations show that young students need to name the different shapes they manipulate. This name can be a geometrical name or a non-geometrical name. When they don’t know a geometrical name or don’t have inspiration for a non-geometrical name for the shape, they stop all communication activities. Some exceptions show that some students try to communicate using the characteristic. So if we want to work with the characteristics, we need a collection of shapes that students won’t be able to name. Figure 1 is a selection of our collection of 75 shapes. All the different tasks are built around this collection.

To construct this collection we use some didactical variables like the number of sides, the convexity, the complexity shape with curve and lines… Each shape is cut in a rigid disk. By using a disk we don’t promote a specific orientation. With this material, we can work on the shape using the edging by the exterior or the interior of the shape.

SOME USES

Starting with this collection we construct five different tasks. We present only two examples.

The first task is named “build families” and uses between 9 and 16 different shapes (or the disk or the cut shape), depending on the teaching motivation and the student’s knowledge. All the shapes are on a table, the student (or group of student) has to group shapes together in order to construct families. The number of families can be given by the teacher, or not. When the student (or the group of students) has made families, he has to explain how, or why he has this organization. When they have to construct the families, student can use either the global visualization of the shape (2D), or the geometrical characteristic of the sides or vertex (1D or 0D).
The second game is called “the star game” and uses 2 shape cards. Figure 3 shows an example. The 2 shapes can be removed from the card, uncovering in the background of the card one star behind one of the 2 shapes (blue on the Figure 3). It is a 2 players game, and only one player can see the star, the other one has the 2 cut shapes in his hands. Only one characteristic distinguishes the 2 shapes of one card. The goal of this game is that the player who sees the star has to give oral information to the other one, and this second player uses this information to decide between the 2 shapes, which one is associated to the star. When the second player thinks that he has the right shape, the first player puts the card on the table and they try to fit together the selected shape and the star location. If they can, the selected shape is the good one, they win 1 point, if they cannot, they don’t win the point.

SOME RESULTS

We tested these two tasks in several schools in France and Switzerland. The task “build families” is very interesting for the researcher because it gives a lot of information about the student’s perception of the shape like the visualization to build the families (global or not), the use of characteristics to build the families, the use of a pertinent language for oral interactions. This task is also rewarding for the student. When he constructs the families, he has to associate shapes, but some shapes are difficult to associate only using a global visualization. When the student has to explain how he built the families, if he uses characteristics he has to communicate these characteristics. But this communication could be very difficult for young students (less than 5). The manipulation of the shapes help students to find words to communicate the characteristics they see. For example, many students construct 3 families (table 1). They name these families using: (a, d, i) “the vertex’s family”; “the big spike family” - (c, e) “they look the same”; “the small lines” - (g, h) “they are the same shapes”; “iron horse”; “smiles”; “it’s two heads with ears”, “sharp and round”. Shapes b and f seems to be more difficult.

<table>
<thead>
<tr>
<th>(family 1)(a,d,i)</th>
<th>(family 2)(c,e)</th>
<th>(family 3)(g,h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b)</td>
<td>(f)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1

Sometimes (f) is associated with (g, h) and they say “they almost going together look like” or “the round family” or “piece of round”. For other students, (f) is associated with (c, e), they say “these shapes can exist” or “the rounds 2” or “the almost round”. Sometimes (b) is associated with (a, d, i) because “they do not exist” or “the pick family” or “the mountains”. The imposed number of families has a direct impact on the student work and this is linked to the available shapes. In the example, more than 3 families do not allow a reflection about characteristics, like with 2 families. The importance of the task is the personal formulation of some characteristic (round, pick, spike), formulation found in other games.
In the second task, the reflection is focused on only one characteristic for each card. For some cards, students succeed without the use of a characteristic (first image, table 2). Most of the students use characteristics with a personal language. The most important is not the quality of the vocabulary but the efficacy. Sometimes the vocabulary is relevant but needs specification for collective communication. For example “peak” and “spike”. For some students one is used to describe angles bigger and the other one for angles smaller than the right angle. But the same word is used in the opposite meaning for some other students!

![Images of cards with characteristics](image)

**Table 2**

**CONCLUSION**

In reference to Faggiano (2012), the manipulation helps student in the use of characteristic to recognize shape. The shapes collection that we have needs to be organized in specific tasks. It seems that these tasks allow a progressive change of the visualization for geometrical shape. According to our analysis, this evolution of the visualization is accessible for the students of this age although it does not seem to be used spontaneously.

**References**


