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PRIMARY SCHOOL TEACHER'S PRACTICES AND STUDENT'S MENTAL REPRESENTATIONS: THE LEARNING OBJECTS OPTION

Evgenia-Motya Sotirova[i]
MSc in Education,
Russia

Abstract:
This research focuses on the study of the integration of physical science Learning Objects by primary school teachers. In this paper, we present the results of an empirical study to identify the views of teachers on the quality and adaptation of Learning Objects to mental representations of children to the physical world. The research was carried out using a questionnaire that consisted of 6 questions. The results show that the Learning Objects used are relevant for the elaboration of representations of primary children and that the teachers' training in this subject is not enough.

Keywords: learning objects, primary school, didactics, representations, science education

1. Introduction

The digital world opens up many opportunities for youth to develop the capacity for action, skills and knowledge construction and a prospect to overcome disaffection with scientific studies (Boilevin & Ravanis, 2007; Daniels, 2002; Flecknoe, 2002; Mooij, 2007). But digital world is here, it has invaded our lives, it's a fact. So, we can't just say we're for it or against it. We start from the premise that the effects of digital technology on education must be measured. The idea is then to test the tools on performance with a concern for obtaining scientific data. To do this, we are going to manipulate tools in the school field, populations will be "treated", in a controlled and non-invasive way.

How teachers integrate teaching and communication technologies for education (ICTE) and how students appropriate knowledge through ICTE are two major themes of contemporary research in didactics and education in general (Bellegarde, Boyaval & Alvarez, 2019; Norgy, 2019; Ntalakoura & Ravanis, 2014; Yashwantrao, Bholoa, Watts, & Nadal, 2018). The research presented in this article is part of a larger study that addresses the problem of teaching processes and learning of physical sciences in education (Bahar, 1999; Kocakülah, 2006; Ravanis, 1994, 2005). The study therefore focuses on the use of Learning Objects (LO) for the physical sciences in the classroom where curricula around

[i] Correspondence: email evmosoti@gmail.com

the world advocate the implementation of ICT-based teaching (Dodani, 2002; Quinn & Hobbs, 2000; UNESCO, 2002). It is also an opportunity to question teachers on how LO are involved in their science teaching activity.

But what's a LO? "*A learning object is:*

A. *A chunk of content structured to support learning through the possible inclusion of educational objectives, content, resources, activities and assessment.*
B. *Content designed to ensure reuse within different instructional settings.*
C. *Content that can be stored within different digital learning management systems (LMS) or used in many different delivery modes (Norman & Porter, 2007)*".

In the scientific literature we find LO as multimedia objects (Norton, 1996), knowledge objects (Merrill, 1998), reusable information objects (Barritt & Alderman, 2004), digital learning, teaching or educational objects (Friesen, 2001; Gibbons, Nelson, & Richards, 2000; Muzio, Heins, & Mundell, 2002), digital learning resources (Van Assche & Vuorikari, 2006). The essential characteristics of educational digital LO are accessibility, reusability, interoperability, adaptability to different software.

Different Science Education approaches considers the situations of knowledge appropriation simultaneously with the knowledge at stake in these situations (Dedes & Ravanis, 2009; Delclaux & Saltiel, 2013; Fragkiadaki & Ravanis, 2015, 2016; Johsua & Dupin, 1993; Sotirova, 2017). Examining ICTE and more specifically the use of LO in education, implies taking into account what is taught just as the way of teaching is inseparable from the instruments used in the classroom activity. Thus, we can consider LO in relation on the one hand to the knowledge at stake in the teaching situation and on the other hand to the way of teaching.

The research concerns the initiation of physical sciences in primary school through the use of ICT and more specifically through the use of appropriate LO. It is therefore possible to question the specific nature of this teaching in terms of LO. LO are therefore inseparable from the four-dimensional teaching system that links the teacher, the knowledge involved, the means used and the student.

Representative thinking in childhood is a form of intelligence that has been explored. Within the framework of Didactics of Physical and Biological Sciences and also in the field of Pre-school Education all over the world, research oriented towards the study of spontaneous and/or erroneous representations of pupils frequently shows that children use reasoning to approach reality but generally they do not correspond to the concepts used in Science. In recent years research in Didactics has been based on the hypothesis that children in a given situation mobilize individual explanatory reasoning and tend to approach the physical world and also to understand the concepts and phenomena of science. These reasonings, called "*mental representations*" or "*alternative ideas*" or "*misconceptions*" in the literature, are very often obstacles to the appropriation of scientific concepts (Grigorovitch & Nertivich, 2017; Hoang, 2020; Kaliampos, 2015; Ravanis, 2017; Tin, 2018).

Taking into consideration the mental representations observed by research can point out to the world of research and the world of education the existing difficulties of

pupils and allow the elaboration of teaching activities likely to favor the passage from spontaneous representations to new logical explanatory constructions that can be reconciled with scientific concepts. But what are the teaching devices that are used especially in primary education so that these naïve and spontaneous representations can be envisaged? An analysis of the relevant bibliography shows that over the last twenty years a series of efforts have been made to reconstruct representations of students in the physical and biological sciences. In relation to the means used in school work, two frameworks for the deployment of teaching activities can be distinguished: (a) The first, in which the emphasis is placed on interactions between teachers and young pupils with the aim of transforming student's mental representations (Kambouri-Danos, Ravanis, Jameau, & Boilevin, 2019; Liu & Tang, 2004; Rodriguez & Castro, 2016). (b) The second framework includes activities using new technologies (Arun, 2019; Castro, 2019; Monroy-Hernández & Resnick, 2008; Sasaki, 2019).

This descriptive research is interested in the use of Learning Objects by primary school teachers in introductory activities in the physical and biological sciences, from the point of view of didactic intent and the challenges of overcoming difficulties related to mental representations.

2. Method

An online questionnaire was completed anonymously by 249 volunteer primary school teachers. This is a tool created and used for kindergarten teachers by Grigorovitch (2016). The teachers in our sample had previously received didactic intervention on ICTE, including LO in Science Education, and also reported using LO during teaching activities. Part of the questionnaire, six items (in the Appendix) out of 14, collected teachers' responses to our research question.

3. Results

The analysis of the replies to the questionnaire reveals some interesting points which should be moderated, given the declarative aspect of the questionnaire. Indeed, what teachers say does not necessarily reflect their actual practice. However, one can distinguish variations in the answers that certify different visions of investigation. Thus, some teachers associate these LO more with an instrument for aligning scientific activities with new knowledge learning objectives than with an innovative numerical means.

From the first question it can be seen that the majority of teachers use other teachers' personal websites as resources to choose from for digital LO (Table 1). Almost two out of five of them also use academic sites as traditional references and about one out of five teachers search in specialized repositories. In the category "other(s)", a few teachers refer to special software and educational games.

Table 1 : Answers to question 1

Response Category	Frequencies	Percentages %
Academic websites	99	40
Personal sites of teachers	188	76
Repositories	55	22
Other(s)	41	16

The second question refers to the devices used by teachers (Table 2). Almost 9 out of 10 use a computer to work with LO in physical and biological sciences. Only 20% have laptops in their classrooms available for students. Three out of four teachers refer to more traditional technical means such as slideshows. Here the responses "Other(s)" can be classified into two types of responses:

a) those that explicitly refer to digital OAs such as CD ROMs, DVDs, various software, YouTube and
b) those that do not explicitly refer to OAs, without excluding them, but to various types of media such as personal documents, newspapers, videos, photos, books.

Table 2 : Answers to question 2

Response Category	Frequencies	Percentages %
Laptop computers used by students	49	20
Computer for the teacher	191	77
Videoprojector, Slideshow	189	76
Other(s)	155	62

In the third question, we can see that teachers make extensive use of Learning Objects to work with students on the development of their mental representations (Table 3). Beyond a classic approach of computers for presenting pictures etc., 92% of teachers do activities to develop students' representations and lead them to a conceptual change. Also, only one out of ten is familiar with the use of LO as a means of research, i.e. to identify and categorize representations. In the "Others" response, several teachers deplore the weakness of their students in using LO effectively so that they can turn the discussion with the children towards the representations and the difficulties they cause. For the first category of responses, it should be pointed out that a picture or figure does not explicitly refer to the LO but is becoming more and more easily accessible through the Internet.

Table 3 : Answers to question 3

Response Category	Frequencies	Percentages %
Presentation of images, figures, software etc.	144	58
Research on children's representations	22	9
Representation Change Activities	227	92
Other(s)	98	39

With regard to the quality of LO, it should be noted that teachers point out that different types of resources coexist, characterized more by their variety than by their concentration

on the purpose of developing student's representations (Table 4). What seems remarkable is that almost the same teachers (8 out of 10) simultaneously report two categories of LO: relevant and adaptable objects. This coexistence of different FOs highlights the variety of educational FOs that can be found on the Internet and underlines the need for specialized training of teachers so that they are able to select the appropriate ones. Furthermore, the majority of respondents in the "other" category refer mainly to this need for training.

Table 4: Answers to question 4

Response Category	**Frequencies**	**Percentages %**
LO are relevant for this purpose	225	90
These are not created for this purpose, but we can adapt them	242	97
LO are not well created	33	13
Other(s)	137	55

The issue of alignment of LO leads to an unexpected finding (Table 5). The majority of teachers (83%) choose the category "Other(s)" and they generally explain that LO are not constructed for the education and change of children's representations. Rather, they are commercial products that require pedagogical and didactic elaboration by teachers. This result is very interesting in relation to national education decision-makers, as it highlights a considerable pedagogical need for digital resources for pre-schools.

Table 5: Answers to question 5

Response Category	**Frequencies**	**Percentages %**
Alignment with learning objectives	32	13
Alignment with learner characteristics	41	16
Alignment with available technical means	78	52
Other(s)	207	83

In response to the sixth question, a large majority of teachers (4/5) agreed on one aspect: the poor training they received (Table 6). In the "Other(s)" category, however, they referred overwhelmingly to the large number of discussions with colleagues on this subject and the importance of a systematic relationship with universities. The importance given to the dimension of exchanges among teachers is confirmed with regard to the resources teachers use in the first question.

Table 6 : Answers to question 6

Response Category	**Frequencies**	**Percentages %**
Sufficient	17	7
Medium	32	13
Poor	199	80
Other(s)	129	52

4. Discussion

The role played by Learning Objects seems indeed important for the teaching activity of teachers from primary school to the initiation of children in physical and biological sciences. The concepts and phenomena and consequently the knowledge at stake in the situation of deployment of teaching activities in primary classes appear interesting for teachers as an object of teaching. And Learning Objects as a means of teaching seem necessary especially at a time when digital technology could give self-confidence and enable us to do things that we cannot do without it.

The concepts and phenomena and therefore the knowledge at stake in the situation of deployment of teaching activities in primary classes appear interesting for teachers as a teaching object. A very interesting question is whether OL can offer an additional opportunity for students to better approach the content of physical and biological science teaching and also whether this tool is more effective compared to other computer and digital tools (Cuban, 2001; Kay & Knaack, 2007; Marx & Harris, 2006; Software and Information Industry Association, 2002).

The majority of the answers in the six questions show that the implementation of these new prescriptions, demands the didactic capacity of teachers and also the pedagogical relevance of Learning Objects. The choice of digital media of the Learning Objects type is intimately linked to what they will do with the students, particularly from the point of view of the importance they attach to questioning in relation to their representations (Hashweh, 1986; Kada, & Ravanis, 2016; Voutsinos, 2013). They use them as instruments that enable them to adapt their teaching work to the initiation in physical and biological sciences for what it carries within it as a potential aid to learning.

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Appendix: Questionnaire for teachers

(You can choose one or more answers and add another answer)

1. What digital Learning Object (LO) resources in the physical sciences do you use?

☐ Academic websites
☐ Personal sites of teachers
☐ Repositories
☐ Other(s), specify:

2. With which device(s) do you use LO in the implementation of science activities?

☐ Laptop computers used by students
☐ Computer for the teacher
☐ Videoprojector, Slideshow
☐ Other(s), specify:

3. For what purpose do you use LO as a means?

☐ Presentation of images, figures, software etc.
☐ Research on children's representations
☐ Representation Change Activities
☐ Other(s), specify:

4. How do you find the LO for work on children's representations?

☐ LO are relevant for this purpose
☐ These are not created for this purpose, but we can adapt them
☐ LO are not well created
☐ Other(s), specify:

5. The selected AOs have alignment:

☐ Alignment with learning objectives
☐ Alignment with learner characteristics
☐ Alignment with available technical means
☐ Other(s), specify:

6. Is your training on the relationship of LO with children's representations sufficient?

☐ Sufficient
☐ Medium
☐ Poor
☐ Other(s), specify: