

Promoting a Meaningful Learning Experience with a Born-Digital Interactive e-book and a Digital Teaching Platform

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Abstract—The goal of this research was to evaluate the effects of learning mathematics with a born-digital interactive e-book and Digital Teaching Platform (DTP) on various aspects of a meaningful learning experience. DTP is a real-time learning system designed for one-to-one 21st century environment. To that effect, the learning experience and perceptions of a class of sixth grade students and their teacher were evaluated. Research was conducted using a qualitative-constructivist approach. Twenty two (22) students, who study at one school, were observed and interviewed. These students learn mathematics with an advanced e-book, on the Digital Teaching Platform of "Time to Know". Analysis of the observations and the interviews led to the identification of three themes relating to aspects of learning with a born-digital interactive e-book: (1) Independent learning with collaboration, (2) Aspects of the technological environment and their implications and (3) The role of the teacher. Findings show that learning mathematics with a born-digital interactive e-book is characterized by a sense of relevance, learner involvement, a sense of value for the learner, independent learning with collaboration and a positive learning experience. It seems that learning with an e-book promotes a meaningful learning experience. The teacher perceives her role as the designer and the manager of the learning process. Most of the students think that it is easier to teach with an e-book and say that the teacher is no longer the only source of knowledge.

Index Terms—e-book, digital teaching platform, learning mathematics

I. INTRODUCTION

Studies show that in a classroom operating in a digital learning environment, there is the expectation of finding other types of learning, different from the traditional type of frontal teaching, in which the teacher is the omniscient authority and the central person leading the learning process [1]. In a digital learning environment, unlike in traditional learning, the student can be placed at the center of the learning process, while the teacher only guides him/her. This creates several types of interactions and encounters: Interactions between students and technological tools, interactions between teacher and learners, and interactions between learners [2].

Learning in an on-line environment, however, does not necessarily guarantee meaningful learning. Meaningful learning is defined by the Israeli Ministry of Education as learning that enables an emotional, social and cognitive learning experience, connected to three main aspects that exist simultaneously: Value to the learner and to society; involvement of the learner and the teacher, and relevance to the learner's world [3]-[5].

The above definition raises the question: How to promote meaningful learning in a digital learning environment? Since 2012, the Israeli Ministry of Education has been implementing a national E-Learning program that tries, among other things, to promote advanced teaching and learning in classrooms and to adapt them to the 21st century. One of the main means of realizing this goal is the use of digital e-books. However, the variety of e-books in the schools is wide, ranging from a printed book scanned to the computer (level I), to a digital book rich in interactions and accompanied by a learning management system (Level III). Regarding the above, it is important to investigate the effectiveness of digital e-books in promoting meaningful learning.

This was the rationale of this qualitative-constructivist study that took place in an elementary school in northern Israel. It focused on the impact that learning with an advanced digital e-book (Level III) had on various aspects of meaningful learning. The study examined the learning experience of sixth graders and their mathematics teacher. The study included observations and interviews with the students and the teacher.

II. MEANINGFUL LEARNING

The educational system is now required to adapt itself to the zeitgeist and to be relevant and meaningful for students. As mentioned above "Meaningful Learning" is based on three components simultaneously: Value to the learner and society, learner and teacher involvement and relevance to the learner [6]:

- Relevance: Experience in tasks related to the learner's changing and renewing world and life experiences.
- Value for the learner and society: The learner feels that the content of the study grants him meaning and importance on a personal level and on a

general level, that is, the content studied is of value to him/her and to society.

- **Involvement:** The learner is active in the learning process, develops a deep understanding of the subject; learns out of interest, curiosity and motivation. S/he takes initiative to carry out the tasks and to learn more about the learned material, namely: Structuring of knowledge.

III. DIGITAL E-BOOKS

In a General Manager's circular, 2012, published as part of the national plan for "Adapting the Educational System to the 21st Century", the Israeli Ministry of Education distinguished between three types of digital e-books, with the major long-term goal of switching to third-level digital books. The three types are:

Textbook in its basic on-line version, Level I: A digital textbook (such as PDF, EPUB) that can be downloaded to a computer. In this mode, the book is available for reading on any computerized environment and any operating system (e.g. Windows, IOS, MacOS or Android).

Digital Textbook, Level II: A textbook in digital format that meets the conditions of a textbook in the basic on-line version (Level I) with the following additions:

Links to additional relevant study material.

References to on-line activities relevant to the study material, such as: Widget, activity, questionnaire, test or game. References to relevant videos.

Digital textbook, Level III: A book that meets the requirements of a textbook in Level II and also contains modular and interactive digital content that is an integral part of the book, as well as support for Learning Management System (LMS). This system enables the teacher to create learning tasks for students, receive ongoing reports on the progress of students' work, check student work on-line, and conduct personal, on-line communication with each student [6].

The Time to Know environment is based on third-level digital books (Level III) in core subjects. The environment also includes an innovative Digital Teaching Platform, with built-in tools for teaching management, learning and evaluation inside and outside the classroom. Third-level digital books also enable teachers to introduce additional pedagogical content, if the teacher cares to do so. The combination of Level III digital e-book and Digital Teaching Platform enables differential learning: Each student receives tailor-made tasks adjusted to his/her learning style. The teacher has the ability to monitor the entire class or a single student, which makes it possible to produce reports that reflect both the teaching and the learning [7].

IV. METHODOLOGY

A. Research Method

The research method chosen is qualitative-constructivist. The constructivist approach considers reality as multi-faceted and dependent on its context and

on the interpretation given to it by the people who experience it [8], [9]. The qualitative-constructivist method views the world as complex and dynamic; containing many layers of meaning and concepts. The study leaves room for subjective interpretation by participants [10], [11]. It deals with a holistic understanding of phenomena through an examination of processes and meanings [12]. The qualitative-constructivist approach claims that people organize their perceptions of the world and manage them through the stories they tell [13]. The present study is based on constructivist theory strategy, anchored in the field. This method encourages the use of systematic and flexible guidelines to extract theoretical insights from the narratives of study participants [8], [9], [14].

B. Research Population and Research Question

The study participants were twenty two (22) sixth graders and their teacher of mathematics, in an elementary school in the north of the country.

The main research questions that were examined were: How do the students and the teacher perceive the learning experience of mathematics with third level e-book? What expressions of meaningful learning of mathematics appear in the perceptions of the students and the teacher who learn and teach with third level e-book?

C. Research Process

Findings were collected from three main channels:

1. The researcher's observations in three different classes, without intervention. At the end of each lesson, several short, closed interviews were held about the lesson; a total of ten (10) interviews.

2. In-depth, semi-structured interviews were conducted with twenty two (22) students. Each student was interviewed separately and privately, in a classroom. The interviews were all recorded and transcribed for analysis.

3. During the final stage of data collection, a semi-structured in-depth interview was conducted with the teacher. Like the students, the interview was also conducted at the school, and was also recorded and transcribed.

D. Data Analysis

The findings of the study were analyzed according to principles of the field-anchored approach that uses students' answers to the semi-structured interviews and the teacher's response to the in-depth interview [8], [9], [14]. Data collected from the three observations in the classrooms was also included. Data was fed into the computer and codified into major categories. This method of analysis identifies themes and structures meanings captured in the transcripts of the interviews, in an attempt to form a theoretical model that can explain the students' and the teacher's perception of learning in the environment of a third-level e-book. Texts were divided into categories according to the following stages of analysis:

In the preliminary phase of analysis, all transcripts of the interviews were carefully read several times, as were all the notes from the three classroom observations, in

order to become familiar with the data and to experience each interview as a whole before dividing them into meaningful units during analysis [15]. In the first stage, "open coding" was conducted, which included a careful reading of the interviews, identifying ideas significant for participants [16]. As the study interviewed students aged 11-12, it was very important to adhere to the subjects' terms of reference, which Glaser & Strauss [14] have called "in vivo codes." Comparative analysis identified ideas with common denominators, using the same conceptualization. These constituted the initial categories of research and the primary foundations for theory construction. At this stage all categories were of equal importance.

During the second stage of analysis, "axial coding" was performed. Links were now made between the categories and associated sub-categories. At this stage, the relations between concepts and sub-concepts were defined, in order to discover how the categories relate to one another [17], [18]. Names given to concepts at this stage are either in the participants' language or on an abstract level. Analysis ended after relationships were established between all categories.

Selective coding was done in the third stage is. At the selective coding stage, the relationships between the concepts were recognized by the researcher in preparation for creating a theoretical model, anchored in the data [17]. At this stage, the existing categories were sampled and thickened into all their dimensions and characteristics, in order to ascertain that they do indeed represent the phenomenon in its entirety [12]. The main themes of the study were formulated through these stages.

V. FINDINGS

An analysis of the interviews and observations revealed three main themes regarding the study of mathematics in the environment of a third level digital e-book (Level III):

- Independent learning and joint learning
- Characteristics and implications of a technological environment
- Role and duties of the teacher

A. Independent Learning and Joint Learning

All students noted the high level of concentration they experienced when learning independently on-line. They liked the option of receiving immediate personal feedback ("It's like I'm my own teacher").

They also appreciated the diversity of the on-line environment, as compared to frontal learning. In addition, they felt that learning had been tailored to them personally.

The findings also show that learning in pairs increases motivation and achievement. Alongside negative emotions that sometimes emerge (such as shame), it is evident that most students enjoy working in pairs and creating a partnership (As the teacher said: "I call it one plus one = greater than two"). Of all the above, the high level of students' involvement in learning with a third level digital e-book was clearly evident.

B. Characteristics and Implications of a Technological Environment

Findings show that the students felt a natural connection with the computer; they describe the on-line learning experience with a sense of pleasure, which helps to motivate learning. For most children, the rapid pace of on-line learning is perceived as positive and meaningful for their learning. Most children mentioned the headphones (audio support) as something that increases concentration. The visual dimension of the integrated interactions of the on-line learning was also mentioned as contributing to the learning experience and to the enjoyment of students in classes. Findings show that all students prefer the use of computers over writing in a notebook, which makes they claim makes learning easier. Findings also revealed that teaching in a technological environment sometimes involves coping with technical difficulties. The students reported occasional computer malfunctions followed by frustration. All of the above shows that on-line learning environment with a third level digital book was perceived as relevant and valuable to the learner.

C. Role and Duties of the Teacher

Findings indicate that the teacher has many interactions with her students during the lessons and encourages the internalization of the material and its understanding. In the on-line learning environment, the teacher acts in an intermediary role; certain interventions are required during students' independent learning on the computer. In addition, most of the children have noticed that the teacher's job is easier when teaching on-line than it is in other classes. Students said that they were aware of the teacher's constant monitoring, and thus of her ability to control the learned materials, navigate, and mediate. Regarding the issue of computer authority versus teacher authority, it would appear that in the students' perception, the teacher is no longer the sole source of knowledge.

VI. DISCUSSION

This study sought to examine how students and their teacher perceived learning mathematics in the environment with a third level digital book, and what expressions of meaningful learning appeared in their perceptions.

Findings show that students who studied mathematics with a third level digital book reported major aspects of meaningful learning: Learner involvement, learner value, linguistic response, independent learning, collaborative learning, relevance, and a positive learning experience.

The findings show that a learning environment based on a third-level digital book is the natural environment for students who are considered "digital natives". However, there are also some difficulties unique to learning in an advanced technological environment for example, when there is an outdated infrastructure or when there are disruptions in the software. Therefore, to prevent frustration, regular maintenance must be available at the school.

Regarding the role and duties of the teacher in the environment of a third level digital book it is evident that the teacher plays a significant and important role in teaching. She experienced her role as designer and director of content and learning in general. Although the program is structured and defined within clear boundaries, the teacher experienced degrees of freedom in editing the pedagogic content. The teacher feels that she had an important interpersonal relationship with the students - the ability to influence what they are learning.

Students considered the teacher a significant figure. They appreciated her role, her presence in the classroom and their relationship with her. Despite the fact that the teacher is not perceived as the sole source of knowledge, some students perceive the teacher's role as supportive or "helpful when necessary."

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