UDC 004:37
Survey Paper

Use of Informatics Textbooks in School Classroom

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Abstract

Textbooks are an integral part of school classroom teaching. Their use has been researched for the past few decades with a focus on a wide variety of aspects. This paper is focused on the published literature relative to textbooks with a special focus on the pedagogical use of textbooks within school classroom of informatics. Sixty two papers of various topics related to textbooks have been analyzed. The focus was placed on a) identifying the most influential papers related to textbooks where we identified nine key papers; b) prevailing topics in research papers related to informatics' textbooks where analysis showed that most papers related to textbooks and informatics are focused on textbook content; c) identifying which topics have been researched in other fields related to use of textbooks but have not been so far included in surveys related to informatics subject, where we identified five main categories of topics researched in other fields.

Keywords: Informatics, textbook, textbook use, teacher, school classroom, citation network analysis, school

1. Introduction

Textbooks are an integral part of both traditional and contemporary classrooms. In general a textbook is a manual of instruction in any branch of study. According to the Croatian Ministry of Science, Education and Sports' "Textbook standard"[1], the textbook is defined as a tool which closely follows a curriculum and is adapted to the student's cognitive abilities and prior knowledge. It is therefore a vital element in the daily work in schools from both the students' and teachers' perspectives and is a source of facts which are presented clearly for students. They may be used as stand-alone tool and primary source of information or as supporting material for school assignments.

A number of research papers have been published in scientific databases relating to the different textbook topics. They are focused upon: (a) different educational

levels, ranging from primary to tertiary; (b) different school/university subjects, with a somewhat dominant research bias in mathematics, English language and medicine (mostly handbooks); (c) a variety of topics within a subject (d) the textbook as a tool: its content, design and visual elements, its positive and negative aspects, etc. Due to their extensive variety, textbooks are a widely researched topic. According to Numanoglu [2] "textbooks are the most commonly used tools", and are therefore one of the most important sources of valid information in the process of education.

This paper is focused upon published research papers which are related to the use of textbooks in informatics school classroom (face to face). We also analyzed dozens of papers related to textbook topics from different subjects to identify relevant topics yet to be researched in informatics classrooms. After selection of papers based on methodology described in the next chapter we conducted citation network analysis to identify core papers and their connections to other identified papers.

Informatics is an important and integral part of contemporary education and its textbooks are a challenge for the authors, particularly in view of the fast pace of change in the field. Additionally, informatics is often viewed as a supporting tool or service for other school subjects. Informatics textbooks are not widely researched as is the case for mathematics or English language. According to Woollard [3] informatics as a school subject is a young discipline, consequently there are few papers focusing on informatics textbooks. Since informatics is both a tool and a service, opposed to a school subject, part of the research papers are focused upon their use as a tool. As a young discipline, it is challenging to determine content, design and other important elements for the textbooks, as well as teaching methods, aims and content [4]. Informatics textbooks are often using IT both as a tool and as a content. As a tool it can be based on multimedia, digital books or other e-materials whilst the content itself is focused upon informatics as a school subject which can be further narrowed according to educational level and for specific topics.

2. Research questions, methodology, research limitations and results

At the beginning of this section main research questions are listed. Further in this section, the methodology as to how the research was undertaken is described. We also describe some research limitations and results.

The main research questions we are trying to answer in this paper are:

A) Which are the most influential papers covering research on use of textbook in school classroom?
B) What are prevailing topics covered in research papers about informatics' textbooks?
C) Which topics related to textbook use have been researched in other fields but have not been included in surveys of the informatics researchers?

Therefore, we are not interested in format and media of textbooks delivery but our main aim is to learn from the pedagogical practices identified in research papers.

For the research we used papers published from 1985 to 2013 in the following scientific databases: (a) ERIC, (b) IEEE, (c) ScienceDirect, (d) Springer, (e) WILEY,

(f) Google Scholar, (g) Hrcak. Searching was conducted using a combination of keywords which were separated into four categories:

1. computer science, ICT, informatics, Information communications technology, information technology, IT
2. classroom, pupils, school, students
3. course book, handbook, material, textbook
4. use, motivation, preparation, learning, teaching, retention.

It was challenging to define keywords related to the informatics field (1st category), since there is no single globally accepted definition of the term used in informatics papers. The focus of the research was not confined to a single country but was a review of the available published literature. The various terms referring to informatics in different countries were taken into consideration. For example, in the USA, a commonly used term is "computer science" whilst in most European countries the term used is "informatics".

A second constraint relates to the limited results in the field of informatics textbooks used in a school classroom. We broadened the search by including papers related to different school subjects, relative to the use of textbooks. When focusing on school/university textbooks, the word “textbook” itself is the most common used in papers, appearing in thirty eight out of sixty two selected titles. Some authors divert from that phrase by using keywords such as: “handbook”, “text book” or just “material(s)”. There is a recent trend towards digital textbooks and digital learning materials although the focus of this paper is primarily on traditional textbooks. For that reason, handbooks, as well as CD/DVD’s and other digital materials were not taken into consideration since they are beyond the scope of this paper.

Following the database query, a citation network analysis was conducted using Gephi tool [5]. The aim was to create a graph which would connect the 62 selected papers with their references. Initially, it was necessary to extract all references from the papers, normalize the data and separate its information into their respective categories, these include: author, title, year of publishing, etc. This did present a few challenges. There is no single standard method of listing references so this process could not be automated. It was necessary to undertake this work manually in order to ensure accuracy. There is software available to automatically extract references with a certain degree of accuracy but each paper must originate from a single database. In this case, there were six databases so specialized programs such as HistCite, which works with the Web of Science, could not be utilized. Alternatively, programs such as cb2Bib, text2bib, FreeCite and Wizfolio were tried but all had an unacceptably low accuracy rate and required further customization. Many programs and papers are focused upon social network analysis, while some specifically focus on citation network analysis, as in Calero-Medina and Noyos [6] which concentrates on bibliometric mapping and citation network analysis to further analyze the process of knowledge transfer in scientific papers. When listing references, some authors’ state full paper titles, others shorten the title. Some authors translate reference titles into English yet others retain the title in its original language. The final element of

significance is that some references contain special characters and country specific letters while others reduce the character set to the English alphabet. Such cases add to the complexity of the comparison and reduce the accuracy of the results.

Reference	Year	Citation count in database					Country		Paper topic		Educational level
		ACM	EBSCO	Scholar	Scopus	WoS	Authors	Paper	Textbook	Subject	
[14] Krammer	‘85	-	-	12	0	-	NL	NL	Yes	MAT	II.
[15] Barnes	‘89	-	-	2	0	-	USA	USA	Yes	-	-
[16] Shymansky et al.	‘91	-	-	69	-	-	USA	USA, PR, VG	Yes	SCI	I.
[17] Gottfried & Kyle	‘92	-	0	36	-	17	USA	USA	Yes	BIO	II.
[18] Hiebert & Wearne	‘93	-	-	264	-	75	USA	USA	Yes	MAT	II.
[19] Tulip & Cook	‘93	-	-	4	0	-	USA	USA	Yes	SCI	II.
[20] Driscoll et al.	‘94	-	0	35	10	13	USA	USA	Yes	SCI	II.
[21] Hutchinson & Torres	‘94	-	0	162	24	-	UK	-	Yes	ENG	-
[22] McNeal	‘95	-	-	20	6	-	USA	USA	Yes	MAT	I.
[23] Mills et al.	‘95	1	-	9	0	-	USA	USA	Ebook	-	II.
[24] DiGisi & Willett	‘95	-	-	44	-	12	USA	USA	Yes	BIO	II.
[25] Brown & Najork	‘96	18	-	72	9	-	USA	-	Ebook	-	-
[26] Ball & Cohen	‘96	-	0	708	-	174	USA	USA	Yes	-	-
[27] Griffith et al.	‘97	-	-	12	8	-	USA	-	No	-	-
[7] Dicheva et al.	‘97	-	-	9	-	-	BG	BG	Yes	INF	II.
[28] De Posada	‘99	-	0	27	7	7	ES	ES	Yes	SCI	II.
[29] Kostur & Aronovich	‘01	-	-	6	1	-	USA	USA	Ebook	ECON	III.
[30] Gurbiel et al.	‘01	-	-	0	-	-	PL	PL	Yes	INF	I.
[31] Haggarty & Pepin	‘02	-	13	97	27	-	UK	UK, FR, DE	Yes	MAT	II.
[32] Johnson et al.	‘02	1	-	12	-	-	NZ	-	Ebook	-	III.

[33] McConnell & Burhans	‘02	-	-	7	1	0	USA	-	Yes	INF	III.
[34] Baas	‘02	-	-	0	0	-	NL	-	Ebook	-	-
[35] Sutherland	‘04	3	0	51	17	-	UK	-	No	INF	-
[8] Brinda	‘04	1	-	10	-	-	DE	DE	Yes	INF	II.
[36] Lithner	‘04	-	-	45	8	-	SE	-	Yes	MAT	II.
[12] Freiermuth et al.	‘05	-	-	4	3	-	CH	-	Yes	INF	II.
[37] McCarthy	‘05	-	-	52	22	20	USA	USA	Yes	SCI	II.
[38]Törnroos	‘05	-	-	28	5	-	FI	-	Yes	MAT	I.
[39] Lin & Wu	‘05	-	0	4	1	0	TW	TW	Yes	INF	II.
[40] Unni	‘05	-	-	13	-	-	USA	USA	Yes	BUS	III.
[41] Panko	‘06	0	-	0	0	-	USA	USA	Yes	INF	III.
[42] Djurovic	‘06	-	-	3	-	-	RS	RS	Yes	HIST	I., II.
[43] Chuang et al.	‘06	0	-	11	5	-	TW	-	Ebook	-	-
[44] Wang & Shih	‘06	-	-	3	0	-	TW	-	Ebook	-	-
[45] Yager et al.	‘06	-	0	13	-	-	USA	USA	Yes	SCI	II.
[46] Pattanasri et al.	‘07	0	-	0	0	-	JP	USA	Yes	INF	III.
[18] Hill et al.	‘07	-	-	3	0	-	USA	-	Ebook	INF	-
[47] Lai et al.	‘07	-	-	6	1	-	TW	TW	Ebook	INF	-
[13] Gurbiel et al.	‘08	0	-	5	0	2	PL	PL	Yes	INF	I., II.
[48] Kalas & Winezer	‘08	2	-	4	2	-	SK	SK	Yes	INF	II.
[49] Stylianides & Stylianides	‘08	-	-	8	3	-	USA, UK	USA	Yes	MAT	I.
[50] Sun	‘08	-	0	43	15	10	TW	TW	No	SCI	I.
[51] Song et al.	‘09	-	-	0	0	-	KP	KP	Ebook	-	-
[9] Anderson & McMaster	‘09	0	-	0	0	-	USA	USA	Yes	INF	III.
[2] Numanoglu & Bayir	‘09	-	-	1	0	-	TR	TR	Yes	INF	I.
[52] Reininger	‘09	-	0	1	1	0	USA	-	Ebook	-	II.
[53] Hadjerrouit	‘09	-	-	1	1	-	NO	-	No	INF	II.
[10] Spiliotopoulou-	‘09	0	-	4	0	-	GR	GR	Yes	INF	II.

Papantoniou et al.											
[54] Azizifar et al.	‘10	-	-	3	3	-	IR	IR	Yes	ENG	II.
[11] Hung & Feng	‘10	-	-	0	0	-	TW	TW	Yes	INF	I.
[55] Özgeldi & Esen	‘10	-	-	1	0	-	TR	TR	Yes	MAT	I.
[56] Kırkgöz	‘10	-	-	2	2	-	TR	TR	Yes	ENG	I.
[57] McNaught et al.	‘10	-	0	7	-	-	USA	-	Yes	MAT	II.
[58] Woody et al.	‘10	1	0	38	15	-	USA	USA	Yes	-	III.
[59] Ghaderi	‘10	-	-	0	0	-	IR	IR, USA	Yes	SCI	I.
[60] Amiryousefi & Ketabi	‘11	-	-	2	0	-	IR	IR	Yes	ENG	III.
[61] Amiryousefi & Zarei	‘11	-	-	0	0	-	IR	IR	Yes	ENG	III.
[62] Miller	‘11	-	0	3	0	-	USA	-	Yes	ENG	III.
[63] Uyulgan et al.	‘11	-	-	0	0	-	TR	TR	Yes	CHEM	II.
[64] Lee et al.	‘11	0	-	0	0	-	UK	-	Ebook	-	I., II.
[65] Borić & Škugor	‘11	-	-	-	-	-	HR	HR	Yes	BIO	I.
[66] Sun et al.	‘12	-	0	1	-	-	USA	USA	Ebook	-	III.

Table 1 – Selected literature overview

Table 1 shows the results obtained from the above mentioned six databases, ordered by year of publishing. The following are five columns containing information about the citation count in the five databases mentioned in the previous paragraph. Following, is a list showing the authors’ home country and country upon which the paper is centered. The next column “Paper topic - textbook” shows if the paper topic is about textbooks and, in this case, the two types of textbooks are distinguished as either classical textbooks (marked “yes”) or e-books/multimedia, or any other kind of modern, on-line or just digitally prepared textbooks, (marked “Ebook”). The following column “Paper topic - Subject” lists the school or faculty subject upon which the paper is focused. The final column indicates educational levels. Respectively, they are marked “I.” for primary, “II.” for secondary and “III.” for tertiary educational levels. In all columns, information not available or explicitly stated in the paper is marked thus “-“.

Of the sixty two papers, thirteen accord to various topics related to textbooks in the field of informatics. Those thirteen papers are grayed out. In this selection, the oldest paper relating to textbooks in the field of informatics is from Dicheva, Nikolov and Sendova, entitled: “School informatics in Logo style: a textbook facing the new

challenges of the Bulgarian informatics curriculum". From this paper, a developing trend can be seen in subsequent papers, dealing with various topics related to informatics and textbooks. Approximately one third of the mentioned thirteen papers are focused upon specific topics within the field of informatics, such as LOGO [7], object oriented modeling [8], databases [9], internet [10], security [11], etc.

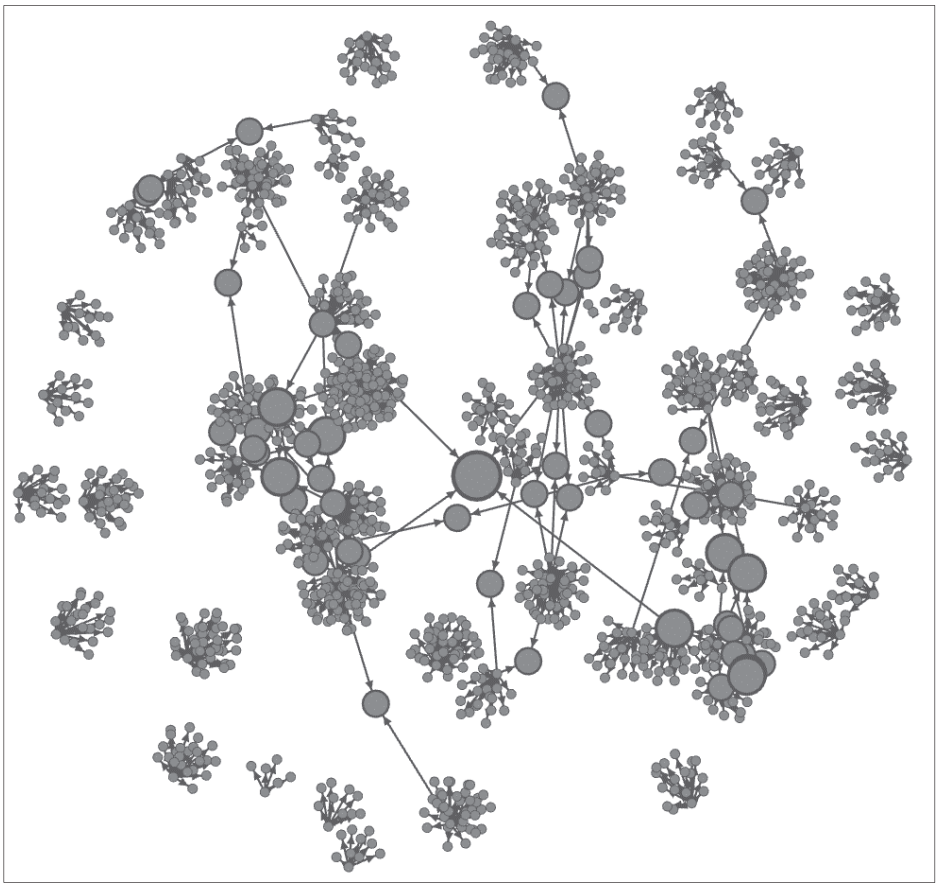
Another third are focused upon the analysis and comparison of textbooks within a certain country, these include papers analyzing: secondary school textbooks [12], informatics in the Polish education system [13] and the internet in Greek school textbooks [10], etc.

When looking at the citation count, the highest cited paper among the selected sixty two is Ball and Cohen [26] "Reform by the Book: What Is Or Might Be The Role of Curriculum Materials in Teacher Learning and Instructional Reform?" published in 1996. The paper is cited 174 times in Web of Science and 708 times in Google Scholar. The paper is aimed at curriculum materials with a focus on American textbooks, teachers and students. Their findings emphasize the importance of the connection and collaboration between curriculum items and the teachers. Curriculum creators often fail to adequately coordinate and discuss such matters with teachers who will use it in practice. The paper is not highly cited in our selected sample and is not found in top ten according to the citation network analysis but based to the overall number of citation we can conclude that the paper has been influential in general curriculum research.

1.1. Citation network analysis

Every reference from the selected sixty-two papers was extracted in order to conduct a citation network analysis with regard to the limitations and problems described in the previous chapter. This resulted in 1,432 unique references (nodes) and 1,442 unique links (edges) having a connection with those references. Among the 1,432 references, 34 titles were identified containing the word "material", 241 contained "textbook", 5 "handbook", 311 "book" and 336 "text" as part of their title. The results of the citation network analysis can be seen in graph 1, 2 and 3. Larger dots represent papers with a higher count of papers citing them. Papers with the highest citation count identified by citation network analysis are:

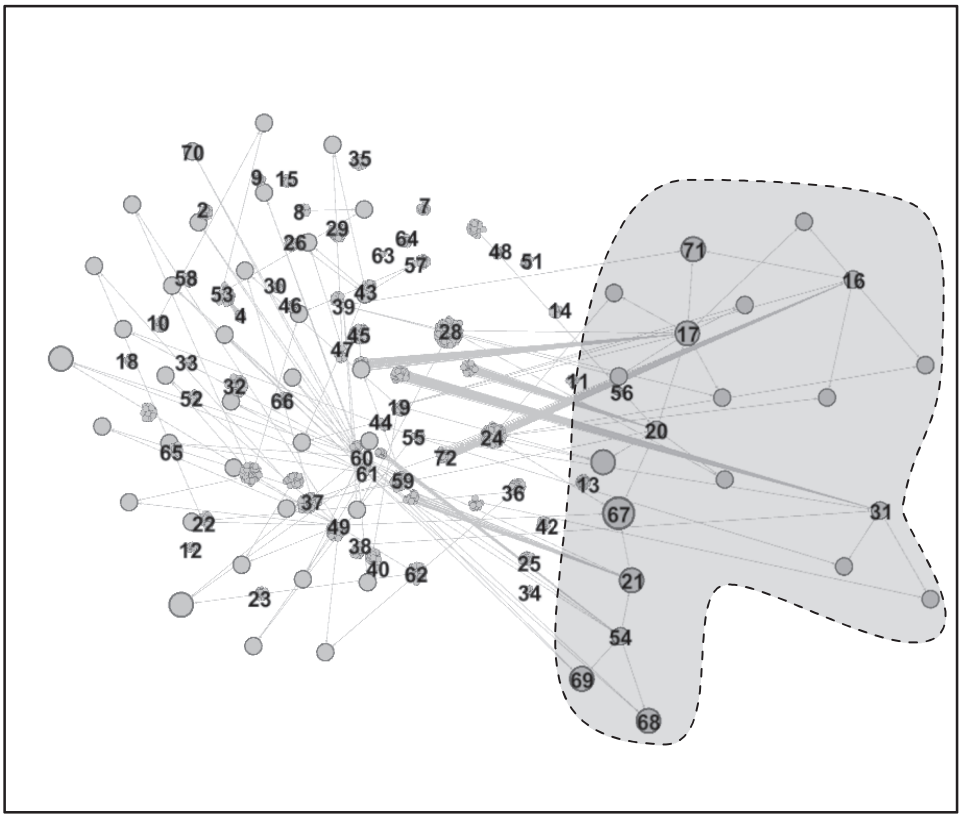
1. (4 citations) "Is teaching really by the book?" [67]
2. (3 citations) "The textbook as agent of change" [21]
3. (3 citations) "Materials Evaluation and Design for Language Teaching" [68]
4. (3 citations) "EFL courses for adults" [69]
5. (3 citations) "What do we want EAP teaching matherials for?" [70]
6. (3 citations) "English for academic purposes" [62]
7. (3 citations) "Case Studies in Science Education" [71]
8. (3 citations) "Textbook Use and the Biology Education Desired State" [17]
9. (3 citations) "Secondary science teachers' attitudes toward and beliefs about science reading and science textbooks" [72]



Graph 1 – Citation network analysis – initially formed clusters

For better viewing, Graph 1 does not show the labels for edges or nodes. It was created using the "ForceAtlas 2" layout which organized the papers into clusters. The clusters are formed around common sources including the originating paper(s). Lines in the graph represent connections between the papers with arrows highlighting the direction of the connection. In Graph 1, formed clusters are identified. It can be seen that some clusters are not connected with others, indicating that, in our sample, they do not reference any paper mentioned in the other sources. Conversely, there are some clearly visible connections between clusters. Such connections are of interest because they indicate which are the key papers in our sample selection and they will be analyzed later in this subsection.

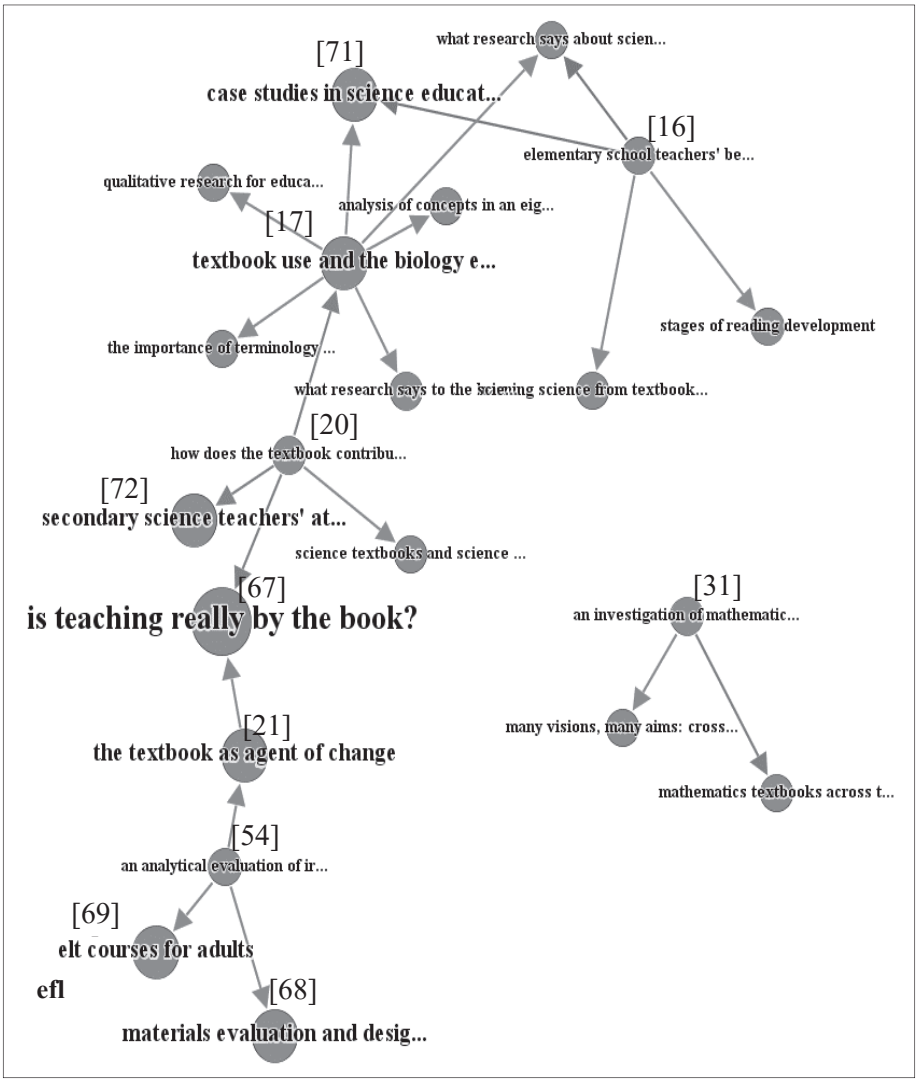
After identifying the clusters and their connections, extracting key papers became the focus. In Graph 2, papers having at least two papers citing them were extracted whilst leaving the connections to the originating clusters. Since the reduction in number of nodes it was possible to add additional information to the graph. Each of the 62 papers listed in the Table 1 which are in line with previously mentioned criteria



Graph 2 – Citation network analysis – an extraction
from clusters based on the citation count (reduction of end nodes)

are marked with their reference number. A focus was made on the connections between the key papers having a citation count of two or more. Those papers are marked with a gray area in Graph 2. One paper [67] was identified as possessing four papers citing it, eight papers have three citations pointing to them and forty seven papers have two.

For easier viewing, Graph 3 has a maximum label size limit of 30 characters. Additionally, each graph title is in lowercase because text normalization was previously applied. Graph 3 represents extracted key papers from the original cluster network. Here "ForceAtlas" was used as an option in Gephi to increase repulsion strength and to increase distance between papers for better viewing purposes. Also, this graph has labels for those key papers which are connected. Papers which are not connected to others in compliance with the above mentioned criteria of minimum citation count have been removed. From the above mentioned number of papers meeting the criteria, in Graph 3 there is: one paper [67] with four papers citing it, six (out of eight) papers with three citations and fourteen (out of forty-seven) with two citations.



Graph 3 – Citation network analysis – extracted core connections marked on Graph 2 with gray area, based on the citation count

Following paragraphs answer the first research question A) Which are the most influential papers covering research on use of textbook in school classroom? Among the top nine cited papers in the sample, papers 1., 2., 3., 4., 7., 8. and 9. can be seen in Graph 3, as well as their connections to other sources. Also, from these nine papers, three of them can be found in the selected sixty two sources. Those are:

1. "The textbook as agent of change" from 1994 [21]
2. "ESL reading textbooks vs. university textbooks: Are we giving our students the input they may need?" from 2011 [62]
3. "Textbook Use and the Biology Education Desired State" from 1992 [17]

When comparing those three papers with the citation count listed in Table 1, it can be seen that two have a respective citation count. “Textbook Use and the Biology Education Desired State” [17] is cited in 17 sources in Web of Science and 36 in Google Scholar, while “The textbook as an agent of change” [21] has 24 citations in Scopus and 162 in Google Scholar. It is note-worthy that both papers are not focused upon topics within the field of informatics. It is interesting that “English for academic purposes” [62] has only 3 citations in Google Scholar, and all 3 are presented in Graph 1 and Graph 2, but the paper is not connected to any other papers with a high citation count (as presented in Graph 3) and, for that reason, has been omitted. As it can be seen there are very few influential papers identified as common references in our sample that indicates low cross-fertilization of ideas in the area of research related to the textbooks.

3. Textbooks in informatics classes

In this chapter, the focus moves on to scientific work done in the field of informatics as it relates to textbooks to give us opportunity to answer the second research question. B) What are prevailing topics covered in research papers about informatics’ textbooks? Here we have identified thirteen papers which are focused on school textbooks.

Among papers dealing with textbooks in the field of informatics, “Creating and testing textbooks for secondary schools, "Programming in LOGO” [12] has the highest citation. The paper is focused upon textbooks used in secondary schools and has an emphasis on programming in LOGO. The conclusions support the idea that textbooks, in order to provide better explanations and clarification of each specific topic, should not be limited by length. Secondly, the language used should be aligned with the students’ comprehension level as much as possible.

The paper entitled “Informatics as a contribution to the modern constructivist education” [48] is focused upon informatics textbooks used in lower secondary schools and in their creative use by students and teachers. They use different teaching methods and tools including mind maps, illustrative examples, deliberate false information, summaries, etc. With such a textbook organization, they identify a boost in students’ motivation as well as informatics being used as a vehicle for changing the topics at hand.

“Informatics and ICT in the Polish education system” [13] deals with educational reform in Poland and its influence on informatics as a subject in schools. The reform dates from 1999 and is aimed towards the integration of informatics in all school subjects in both primary and secondary education. They find the reforms have been successful with only a few remaining issues to be settled. As informatics grows in importance, it is necessary to further analyze the methods used in teaching it. According to the authors, further research should be focused on accelerating the integration process of informatics into other school subjects. Ultimately, since Poland has established and published standards for the education of teachers, these need to be implemented at universities.

Dicheva, Nikov and Sendova [7] researched LOGO programming, as well as the above mentioned Freiermuth, Hromkovič, and Steffen [12]. Dicheva, Nikov and Sendova are focused upon secondary school textbooks for informatics in Bulgaria. Their emphasis is on bridging the gap between the two viewpoints of the user and of the programmer. The findings are based on constructivist theory which describes education as a constructive process, the approach is close to that of the LOGO community. They emphasize a modular structure of the presented textbook and three dimensions which require further research of content, software and authorship.

McConnell and Burhans [33] focus on programming textbooks as integral part of computer science. They analyze how programming has been taught over the past 28 years. Their paper presents a set of concepts evaluated in each textbook. These range from page count, algorithm design, arithmetic expressions, program structure, file types and other topics. Findings indicate a paradigm shift towards object-oriented programming which was evident from the researched textbooks. Further findings indicate that a number of topics covered by basic textbooks was increasing, resulting in students being less prepared for advanced classes.

Brinda [8] analyzes textbooks in the field of object-oriented modeling in secondary schools in Germany. The paper also identifies a paradigm change from procedural programming to object-oriented programming. Further, they created a didactic system which provides "exercise classes", "knowledge networks" and "exploration modules" aimed at helping teachers create specific exercise elements for students. The author ultimately emphasizes the importance of learning from examples and errors, cognitive problems, improved connections between teachers and student-teachers and the improved effectiveness of exercises in object-oriented programming. Future plans are to further analyze this domain and finally construct "pedagogical patterns" for informatics.

Lin and Wu [39] researched informatics secondary school textbooks in Taiwan. Mostly, the authors focus on textbook content and topic coverage. They identified a dominance of Intel architecture and the Microsoft Windows operating system. Further, they identified 13 common problems in researched textbooks which they categorized in four subsections: content selection, content presentation, provision of support materials and treatment of programming-related content. They conclude that textbooks contain too many application examples and excessive technical details whilst containing insufficient theoretical knowledge.

The paper entitled "Designing a Pedagogy for an IT Security Course and Textbook" [41] describes how the author created a course in IT security along with a corresponding textbook. The author lists students' prerequisites in knowledge and skills. One option in course design would be to construct it around a popular certification program in the researched domain. Such an approach has its disadvantages since specific certificates may or may not be specialized for specific platforms, this would apply limits to the students' regard of the technology certificate in which the student has less interest. The author also identifies a list of topics included in the textbook where there exists a requirement for further development within its content regarding IT security.

Pattanasri, Jatowt and Tanaka [46] used textbook ontologies to compile a table of contents from classical textbooks for use in e-learning materials. According to the authors, fundamental learning materials are still presented in the form of lecture notes which are often based on summarized textbook elements. The main aim is to help students construct queries which would enable satisfying search results with regard to information overload and accuracy. Future research is focused upon a generalization of their approach since the table of contents is rather limited and does not include all possible queries in which a user might be interested.

Anderson and McMaster [9] compare word frequencies in database textbooks to the students' mental frameworks in database design. The paper is based on the gestalt scale used to "measure frameworks in Mathematics, Database, Software Engineering…". We could add that the paper is related to gestalt pedagogy since they are focused upon students' mental framework which allows them to organize the content into a unified unit. Their findings note the positive correlation between students' and textbooks' findings in word frequency of key terms. Future work is focused upon the inclusion of a larger student sample as well as a comparison of the results from students who attended additional database courses.

Numanoglu and Bayir [2] evaluated the Turkish Republic of Northern Cyprus primary school textbooks in informatics according to the principles of visual design. According to the authors, "the textbooks are the most frequently referred tools." Research is focused upon the evaluation of textbooks according to five dimensions of visual design principles related to the design of text, visual elements, pages, covers and external properties directed to production. Among the 48 items of visual design principles, an average of 17 elements were identified as having been successfully implemented in the researched textbooks. According to the authors, future research should be aimed at broadening the textbook research according to the principles of visual design and should include textbooks from different subjects.

Spiliotopoulou-Papantoniou et al. [10] researched the visual representations of the internet in Greek secondary school textbooks. Further, they focused upon an analysis of the characteristics of internet visual representations and students' readings of specific Internet representations. Greek secondary school teaching... "is dominated by a textbook-oriented approach…". The authors emphasize the importance of visualization elements in textbooks, especially when dealing with modern and abstract topics such as the internet which help students to comprehend the topic at hand. Results indicate that half of the visualizations are accurate while the other half is vague, even problematic. According to the authors, similar aspects can be found in the field of mathematics (Bell & Janvier, 1981) describing "pictorial distractions". Research supports the "phenomenographic approach to learning, where a learner experiences a phenomenon (a learning object visually represented in our case) and gains knowledge about it through an ongoing exploration of the phenomenon as described by others." [10]. Future research is aimed toward further analysis of internet representations, responses from students related to the representations and teachers' use of the representations.

Hung and Feng [11] analyzed primary school textbooks in informatics in Taiwan with a focus on computer virus related topics. More than half of the 23 primary school

textbooks in use in Taiwan did not cover topics relating to computer viruses. Although teachers find the topic to be highly relevant to students, according to paper findings, 8 textbooks had 1-8% of their content dedicated to the topic of computer viruses, while 14 had the topic covered by 1% or less. In today's world of ICT and everyday security breaches, those are alarming findings.

Let us summarize answers on the second research question (B). Thirteen different papers have been presented here, each focused upon textbooks in the field of informatics. As stated in our introduction, the topics vary widely from programming in LOGO and other programming languages to security and database topics. There are papers focused on relevant national topics such as implementation of informatics subject in national educational system [13] or representation of certain topics in the curriculum [10]. Some papers are more focused upon textbook analysis and its contents, while others focus on textbook construction and design whilst keeping in mind the principles of visual design. We conclude that most of the reviewed papers are focused upon the professional informatics topics including specific programming languages, databases and security elements. In the following chapter, the researched topics in other fields related to use of textbooks are pursued. This overview seeks to highlight those topics which have been researched in other fields but have not been included in the surveys of the informatics researchers. One reason for such a situation is related to the fact that informatics is a relatively new field as compared to, for example, mathematics, medicine or language sciences.

1.2. Textbooks in other subjects

In order to answer third research paper and due to the smaller number of papers available for this research which are referring to the field of informatics and school classroom setting, the search was broadened to textbook related topics in other school subjects. Other topics were identified which were researched in other subjects, but still were not covered in the field of informatics. Only those papers selected in our sample were considered.

Törnroos [38] researched the correlation between the opportunity to learn and student achievement levels using mathematics textbooks. In the paper, the author concludes that textbooks "work very well as measures of opportunity to learn". The difference between this and previous studies is in the textbook's central role in the Törnroos study for defining students' opportunities to learn. Research showed a relatively high positive correlation between the opportunity to learn and students' achievements. Further research is aimed at defining connections between opportunities to learn and actual learning. For informatics it would be interesting to research the opportunities to learn with the topics covered in textbooks and subject curricula.

Amiryousefi and Zarei [61] analyzed multiple intelligences and motivation in textbooks for English for academic purposes (EAP). The study showed that most of the students included in the sample were instrumentally motivated and developed bases of multiple intelligences. Most of the students were not satisfied with EAP textbooks. The authors identified the reasons for this to include design, exercise types

and content issues. Similar research was conducted by Kırkgöza [56]. This author focused upon multiple intelligences representations in English language teaching (ELT) textbooks.

Shymansky, Yore and Good [16] researched primary school science teachers' beliefs about textbooks and other text materials and their uses. They point out that textbooks tend to influence a teacher's method of planning classes although this is to be expected since most school textbooks do follow a subject curriculum. These authors indicate that most teachers were unwilling to reduce the coverage of the topics presented in the textbooks allowing them to possibly increase the depth of exploration within certain topics. One of their study findings indicates that teachers recognize that textbooks cannot hold all the information necessary for covering a specific topic.

Other authors have researched a variety of topics related to textbooks, e.g: Krammer [14] who focused on the use of different textbooks in the classroom, Unni [40] researched textbook value based on students' perceived value and retention, McNeal [22] analyzed a student shift from an experimental class to a textbook centered class. Woody, Daniel and Baker [58] analyzed students' preferences between e-books and classical paper textbooks. Amiryousefi and Ketabi [60] researched pro- and anti-textbook arguments. Their results support textbook use and their findings show that textbooks are necessary and useful in the classroom. Yager and Yager [45] analyzed the difference between student achievement when using a science-technology-society (STS) approach and a classical textbook centered approach. Their findings show that both groups achieved similar results but students who used the STS approach had a deeper understanding of science topics and could apply the knowledge better than those who used a textbook centered approach.

The following five papers focus on different aspects of textbook use in classrooms. Driscoll et al. [20] researched textbook contribution to learning in secondary school science classes with a particular emphasis on how students and teachers use textbooks during the class. Results showed that teachers usually used textbooks as a source of instruction and to teach vocabulary and instructions. Students rarely used textbooks and they did so only when explicitly instructed to do so. Most of the information they received was presented directly by the teacher. For homework assignments, they usually used textbooks for reading. There would appear to be a difference between reading and learning. Consequently, there appears to be scant evidence to support assigning a textbook reading task for homework since textbooks significantly vary from those books which are used to raise students reading skills. The authors conclude that textbooks should be one of many resources available to students in their search for information related to the topic at hand. Textbooks should actively support the process of knowledge construction. Nevertheless, textbooks should be used as a source of information and should also direct attention to other relevant elements, e.g. sites, databases and books. Future research is aimed toward teaching goals and how they can be facilitated as well as helping teachers in their use of textbooks.

Many papers are focused upon specific subject topics within a researched field although far fewer are concerned with those topics applicable on a broader scale which overpasses the professional domain of a single subject. Another paper dealing with

similar topic of textbook usage is from Tulip and Cook [19] who researched the differences between students' and teachers' perspectives about the use of secondary school science textbooks. The survey also showed similar results to Driscoll et al. [20]. Tulip and Cook found that teachers mostly rely on textbooks particularly as a teaching guide. Further results show significant differences between the views of students and teachers on textbook usage. While students tend to agree that teachers often use textbooks to perform reading activities, teachers do not share this view and state they seldom use textbooks for reading assignments. Also, regarding "students use the textbook as a source of examination questions far more frequently than teachers." The authors raise an intriguing question: "could it be that there is a difference between what teachers (or students) do in the classroom and what they report they do?" When analyzing selected papers, there was a discernable discrepancy between the teachers' approach to theory and in their behavior in the classroom. This could indicate that teachers are either unfamiliar with the various theories or they lack the skills to apply them effectively. According to Tulip and Cook, although teachers rely on the use of textbooks, they do not state such a view in the survey. Conversely, students find using textbooks to be of great importance when learning science.

A third paper about the topic of textbook use is from Gottfried and Kyle [17]. They were researching textbook use in secondary school biology classes but from a different approach. These authors compared textbook-centered classrooms with those who use multiple references in class. According to their results, 95% of textbook-centered classrooms aligned with the specified state criteria in biology classes. Those using multiple references result in a 50% alignment with desired state in biology classes. Results also indicate that textbook centered classes have a dominant lecture approach to teaching compared to those classrooms using multiple references. The authors find that, irrespective if a classroom is centered on textbooks or on multiple references, the teachers tend to be passive and uncritical whilst using an authoritative approach. Gottfried and Kyle agree that poor teacher education is probably the prime cause for the teacher shortcomings in the classroom. DiGisi and Willett [24] also researched secondary school biology textbooks and the teachers' opinions of their use. Their findings are similar to those of Gottfried and Kyle in terms of how teachers utilize textbooks. According DiGisi and Willett, teachers mostly use textbooks to reinforce lessons and provide students with information. They tend to use textbooks to encourage students' individual activities. It is noted that some teachers use textbooks for developing students' reading skills, particularly in lower secondary classes. Teachers agree that textbook use is not explicitly defined and, in consequence, are sometimes unsure how best to use them.

In this chapter, four papers are discussed which relate to different aspects of textbook use in classrooms. Two papers researched biology whilst the other two researched science textbooks. Common elements can be summarized as raising teacher skills related to textbook use in classrooms plus a variety of activities they may assign to students which includes using textbooks. Most teachers rely on textbooks and use them often although, at times, they lack sufficient insight on how to use them well.

Hutchinson and Torres [21] also researched textbook use with a particular focus on the effect of change. They present past findings which state that only a limited magnitude of change is possible at a given time. The authors emphasize a clear role for textbooks as agents for change. Since teachers need clear and well-structured materials, as seen in the papers mentioned in the previous section, textbooks are an effective tool to introduce change. The growing importance of textbook use reflects the increasing challenge to meet classroom needs and, additionally, the needs from activities outside of the classroom including for stand-alone student study activity at home. The authors indicate that despite textbooks possessing a fixed format, they are an effective starting point for further development for both teachers and students. According to the authors, future research should focus on textbook use in the classroom with emphasis on teachers' use of teaching materials.

This chapter was focused on answer to the third research question C) Which topics related to textbook use have been researched in other fields but have not been included in surveys of the informatics researchers? While papers related to informatics subject are mostly focused on textbook content there are several topics found in research papers related to other subjects which are primarily focused on pedagogical use of textbooks in classroom. Those topics can be summed in five main categories: 1) methods of teaching – how do teachers use a textbook, 2) methods of learning – how students use a textbook, 3) motivation elements – how a textbook is used to motivate students for learning, 4) performance/achievement – how well do students learn from textbooks, 5) how good is textbook as a tool for teaching/learning. Additional categories can be identified in other papers related to textbook topics which are not primarily focused on pedagogical use of textbooks in school classroom, such as 6) how textbooks contribute to national curriculum and 7) methodological formatting of textbooks.

4. Conclusion

Textbooks are one of the integral elements in classroom teaching. They also play a role in some online courses. According to Hutchinson and Torres [21], textbooks are structured materials which help teachers in their planning of the teaching process and assist students in learning new knowledge. Sixty-two papers related to textbooks used in school classroom or blended learning settings have been presented here in tandem with their citation counts in five scientific databases.

In this paper we provided answers for three research questions. A) Despite the relatively small sample, with sixty two originating papers with 1,432 unique references, the citation network analysis identified the connections among them. Based upon the citation count and connections, a list of key papers for the field were proposed. We identified most influential papers covering research on use of textbook in school classroom by conducting citation network analysis. The analysis showed connections among twenty one papers. We identified nine core papers with emphasis on most cited in our sample “Is teaching really by the book?” [67] published in 1998.

Further we analyzed B) what are prevailing topics covered in research papers about informatics' textbooks? Since informatics is a relatively new subject introduced in schools, particularly compared to mathematics and languages, 13 papers were found to be related to both textbooks and to informatics. Within the selection, a variety of professional informatics topics have been assessed, these include databases and LOGO programming, viruses and security elements. None of the papers were focused upon pedagogical use of textbooks.

Lastly we provided answers to the third research question related to C) topics which have been researched in other fields but have not been included in surveys of the informatics researchers. Here we identified a broader variety of topics. Those were focused on multiple intelligences, design principles, opportunity to learn, students' and teachers' opinions, etc. Five papers were identified as being focused upon various aspects of textbook use: Driscoll et al. [20], Tulip and Cook [19], Gottfried and Kyle [17] , DiGisi and Willett [24] and Hutchinson and Torres [21]. Most of the papers emphasized the importance of textbooks for teachers both as a planning aid and for use whilst conducting classes, as well as for students whether learning in school or at home. Very few papers explicitly specify a theoretical background for their research, those that do include Dicheva, Nikov and Sendova [7], which is based on constructivist theory, plus the work from Anderson and McMaster [9] which relates to gestalt pedagogy. From those papers we identified five main categories which are related to pedagogical use of textbooks in school classroom. We also broadened the list of categories to elements which are primarily not focused on pedagogical use of textbooks.

When analyzing future research questions, most authors focus explicitly upon deeper analyses of their current topic. A small number of papers focus on broadening the field of research or connecting with other topics and/or research questions. This is particularly true for papers relating to both textbooks and informatics. These tend to focus only on professional elements as future research questions while neglecting common textbook questions such as their effective use.

Therefore, authors' future research will focus on the paradigm shift in pedagogy as it relates to textbooks. The basis for the shift is seen in the five presented papers where the emphasis is on the various pedagogical aspects of textbook use. Contemporary pedagogical approaches place students at the center of the teaching process and emphasize their active role during classes as well as in the learning process. When analyzing literature, Gottfried and Kyle [17], McNeal [22] and Yager and Yager [45] dealt with different aspects of the textbook-centered approach in classrooms. Based upon the above mentioned set of papers, there is a special need to focus research on teachers' and students' use of textbooks in a classical informatics classroom environment while taking into consideration students' active participation in class, their achievement and their satisfaction. Further research could be focused as well on the creativity of students in their learning activities with textbooks. Similar questions have been marked 20 years ago by several authors including Driscoll et al. [20], DiGisi and Willett [24] as well as Hutchinson and Torres [21] but have not been answered so far.

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