Pedagogical beliefs and attitudes of computer science teachers in Greece

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Abstract. Pedagogical beliefs and attitudes significantly determine the professional skills and practice of teachers. Many professional development programs for teachers aim to the elaboration of the pedagogical knowledge in order to improve teaching quality. This paper presents the study of pedagogical beliefs of computer science teachers in Greece. The research data reveal that computer science teachers usually hold mixed traditional and constructivist theories which are generally irrelevant to either demographic factors or their pedagogical training. In some cases statistically significant correlations to the educational level or the total teaching service are detected. The results of the study set out suggestions concerning the design of pedagogical training programs.

Keywords: Teachers' pedagogical beliefs; professional development; computer science education

Introduction

Over the last few decades researchers interested in the pedagogical training of teachers, focus on the relationship between the knowledge of teachers and their practices in classroom. More specifically, their interest has shifted from the relationship between the observable behaviour of teachers and their students' achievements to the study of teachers' pedagogical beliefs and attitudes and to the planning and decision–making procedures they apply (Fang, 1996). The term "Beliefs" is being used here to denote the cognitive structures which help teachers interpret their experiences and specify their teaching practices (Nespor, 1987; Pajares, 1992). Subject teachers' beliefs are formed by several factors such as the culture of their subjects' discipline, the quality of their experiences in the classroom as students and the opportunities for reflection upon it (Fang, 1996). The "Attitude" concept concerns the general appreciation or the feeling of favourable or unfavourable disposition of a person towards another person or an object. According to the Theory of Reasoned Action (Ajzen & Fischbein, 1980), beliefs and attitudes determine human behaviour and consequently, teachers' practices, to a significant extent (Kagan, 1992). The exploration of teachers' beliefs and attitudes about pedagogical approaches can therefore inform the process of designing the teachers' training and support.

Lim, & Chan (2007) claim that the study of teachers' pedagogical beliefs is critical to education since research studies have shown that teachers with traditional pedagogical beliefs are more likely to employ didactic instructional practices in their professional course (Niederhauser, Salem, & Fields, 1999). For this reason, Applefield et al. (2001) propose the involvement of pre-service teachers in processes that enable them to examine and change their traditional pedagogical beliefs with the aim of encouraging them to adopt constructivist instructional approaches when they become teachers. The problem concerns also any attempt to integrate ICT in education because the real exploitation of ICT requires constructivist learning approaches. According to Jimoyannis and Komis (2007) who examined primary school teachers' concerns and beliefs about the role of ICT in education

and the integration of ICT into classroom practice in Greece, teachers are aware of and sceptical about ICT pedagogical perspectives and the difficulties they will face in classroom practice (e.g. to organize and manage students' learning activities based on ICT). Furthermore, there are cases of large group of teachers lacking any kind of pre-service pedagogical training. This is also the case with, a large proportion of Computer Science (CS/ICT) teachers in Greece where, due to the shortage of available qualified teachers in the 1990s, when CS/ICT courses were first introduced in the Greek educational system and for many years onward, the main requirement for recruitment was the CS degree. In the present paper we are investigating the pedagogical beliefs of Computer Science teachers in Greece. Coming from diverse backgrounds –both in terms of major degree and pedagogical training– Greek Computer Science teachers, constitute a specific target population for our research.

The Information and Communication Technology/Computer Science (ICT/CS) curriculum was first introduced in Greece in 1992 (for the Gymnasium stage, grades 7-9). It was then reformed in 1998 (for the Lyceum stage, grades 10-12) (Hellenic Pedagogical Institute, 2003) and is currently under major revision towards the direction of integrating ICT/CS in kindergarten and primary school curricula. The new ICT/CS curriculum is consistent with the international standards of ACM and ISTE and aims to bridge the ICT and CS directions by both integrating learning goals to other subject matters curricula and providing a separate course for the development of ICT competence (Lavy & Or-Bach, 2011) and CS concepts (Barr & Stephenson, 2011). The successful implementation of any curriculum requires well prepared teachers. The majority of Greek ICT/CS teachers are well qualified in terms of content knowledge since they study the subject for 4 or 5 years at university level. However, only a small percentage of them have attended educational courses. As a result, several professional development programs in Greece have been implemented to develop ICT/CS teachers' pedagogical knowledge. To what extend have these efforts influenced the pedagogical beliefs and attitudes of Greek ICT/CS teachers and what are the pedagogical beliefs of the rest of the teachers? The examination of this question is the main issue of this research.

Theoretical framework

The theoretical approach is based on the work of Becker (2000), who designed instruments for examining the relationship between teachers' pedagogical beliefs and their use of ICT for teaching and learning. Becker's analysis of the distinction between the traditional and the constructivist approach is based on four dimensions: curriculum, teaching approach, students' work and assessment. The comparison presented here aims at a better understanding of the results of the research. According to Becker, the traditional teacher–centred practice is characterized by the emphasis on the transfer of knowledge and skills from teachers to students. This approach proclaims a theory of learning whereby understanding emerges from a carefully planned immediate teaching within a narrowly - defined cognitive field or skill set and from guided practice. In contrast the constructivist consideration claims that, understanding is neither transferred, nor a result from mere skill practice. Efficient constructivist teaching includes the creation of suitable learning environments by the teacher. Within those, students make personal efforts for the development of their own understanding and are given the opportunities to learn when and how to do it, with the mediation of fellow students in the framework of collaborative and communicative activities with personal meaning for each one of them. Table 1 summarizes

the comparison between the traditional and the constructivist pedagogical approaches, regarding the four dimensions.

Moreover the assessment of elementary knowledge and skills can be achieved quite reliably through both teacher-made tests and external large scale examinations (e.g., OECD PISA test). "Knowledge transfer" pedagogy and the tests which certify its success are mainly oriented towards a narrow scope of academic abilities which emphasize isolated mental processes (Perkins, 1998). On the contrary, with the constructivist model students should develop abilities of deep understanding of a subject and realize the relationships between different ideas and concepts in order to be able to know both when and how to apply their knowledge in specific cases and to communicate their meanings to others.

Consequently, the consolidation of constructivist pedagogy is usually what the teachers' pedagogical training targets to. As has already been mentioned, the conventional organisation of the educational system (predetermined syllabus, limited time, extended material to be covered, and demand of memorization especially for standardized examinations) is not compatible with the student–centred pedagogical approach and, therefore, a degree of divergence is expected between the teachers' beliefs and practice. This incompatibility increases the interest of investigating the ICT teachers' pedagogical beliefs and approaches and their interrelation with factors such as sex, years of experience, educational level, and existing pedagogical training. The research results will be important for the assessment of the needs and for the designing of methods for teachers' initial training, professional development and support.

Table 1. Comparison between traditional and constructivist pedagogy

Traditional	Constructivist
Curriculum	
Predefined, for both teachers and students, program of distinct skills and mainly factual knowledge	Selection of topics, concepts and skills after negotiation with the students starting from their interests.
Teaching approach	
Direct teaching with presentation and explanation of the skills and knowledge to students	Minimum direct teaching, organisation of explorative learning environment. The teacher as facilitator, supporter and catalyst.
Students' work	
Written exercises frequently assigned to the students aiming at the students' memorization of knowledge and precise application of skills later on.	Projects, complex projects of designing – construction of artefacts. Variety of activities: e.g. researching, inquiring, communicative, and collaborative.
Assessment	
Through written tests which urge students to recognize suggestions relevant to knowledge and apply algorithms or skills to produce correct answers.	Holistic, complex evaluation e.g. portfolio, presentations and reflection. Self-assessment, appreciation, peer assessment, agreed participative formulation of assessment criteria.

For the investigation of teachers' pedagogical beliefs and attitudes, questions described in Becker's work were used (Becker, 2000). The results per set of questions are presented in the following paragraphs.

The research

Aim

The aim of the research is the investigation of the pedagogical philosophy (pedagogical beliefs and attitudes) of the CS/ICT teachers in Greece. More specifically the research explores teachers' preference between the traditional knowledge-transmission oriented teaching and the constructivist consistent teaching. Beyond the description and interpretation of the pedagogical philosophies of the teachers who participated in the research the paper gives an overview on the situation of the general population of CS/ICT teachers in Greece.

Methodology, research questions and hypotheses

The method we have chosen to apply in the present work is a small scale questionnaire survey. Survey is a descriptive research method which is concerned with the "what is" or "what exist" about points of view, attitudes that are held, trends that are developing etc. For the data collection a modified version of the national survey of teachers' use of computer technologies and their pedagogies, known as the TLC survey (Becker, 2000) has been used. The survey contains several closed questions that reveal information about the teachers' views in the dimensions of *curriculum, teaching approach, students' work-assignments and assessment*. In order to be able to both, describe the pedagogical views of the sample by presenting the answers in frequency tables and also detect possible correlations/relationships of teachers' answers to demographic variables such as age, gender, educational level, professional development and, basic degree, modifications of the TLC questions have been used. The most important questions are presented in the article. The results from the TLC questions are used to approach the research questions which are:

RQ1. What are the main qualitative characteristics of the pedagogical beliefs of the Greek CS/ICT teachers? More specifically: a) Do teachers prefer the traditional teaching or the constructivist one? b) How are the teachers' pedagogical beliefs and attitudes about the curriculum, the teaching approach, students' work and assessment described from their answers to the TLC questions?

RQ2. Are there any statistically significant correlations between the teachers' answers to the TLC questions and the demographic variables? How are the eventual correlations interpreted by the researchers?

Because of the lack of formal pedagogical preparation for CS/ICT teachers in Greece we expect to find personal educational theories made up of mixed elements of traditional and constructivist theories. It is even possible for these personal theories to contain contradictory components. As far as the research question RQ2 is concerned it is possible to formulate several hypotheses including: "The pedagogical training of teachers correlate to their pedagogical beliefs" or "The years of experience relates to the teachers' philosophy". The correlation examination results for selected pairs of variables and their interpretations are described in the following subsections. Both the significant and non-significant relationships among the teachers' answers and their demographic variables are also highlighted-mentioned.

Participants and procedure

The participants in this research study were 100 ICT/CS teachers, who responded to a call for participation through e-mail sent by ICT/CS school advisors. ICT school advisors in Greece are highly qualified public school teachers. Their main duty is the didactical and pedagogical guidance of teachers. The procedure included the answer to anonymous online questionnaire which was filled in electronically and through the internet, between October 10th and November 10th 2009. In order to be able to identify the sample and explore possible relationships various demographic elements were collected, such as: sex, year of birth, year of appointment, years of experience (Table 2), basic degree (Table 3), graduation year, post graduate studies (Table 4), pedagogical training (Table 5), educational level (Table 6), number of students at the school and per class.

Table 2. Distribution of teaching experience

Teaching experience (years)	N	Percentage %
< 5	31	31
5 – 10	38	38
10 – 15	16	16
15+	15	15
Total	100	100

Table 3. Distribution of basic degree

Basic degree	N	Percentage %
Tertiary non computer science (CS)	8	8
Tertiary CS – 3 Years	28	28
Tertiary CS – 4 Years	46	46
Tertiary CS Eng – 5 Years	18	18
Total	100	100

Table 4. Distribution of further studies

Title	N	Percentage %
No any further studies	7	7
Pedagogical degree of vocational education teachers	16	16
Education degree	1	1
Master in education	6	6
PhD in education	1	1
In service training	41	41
Master not in education	26	26
PhD not in education	2	2
Total	100	100

Table 5. Distribution of post-graduate studies

Pedagogical training	N	Percentage %
No training	45	45
ICT teachers' in service training	33	33
Formal pedagogical studies (Doctorate, Master or Degree in Education)	22	22
Total	100	100

Table 6. Distribution in educational levels*

Level	N	Percentage %
Primary	1	0.88
Junior high	44	38.60
General senior high	36	31.58
Vocational Lyceum (3 years)	32	28.07
Vocational school (2 years)	1	0.88
Total	114	100.00

* 14 teachers teach in more than one level

From the demographic data and although it has not been possible to check it formally, the sample seems to have come out fairly representative of the general Greek population of ICT teachers. From Table 4 we observe that a large subset (~41%) of teachers has attended the pedagogical in service training, organized by the Greek ministry of education between 2007 and 2009. Another important percentage (~16%) has been pedagogically trained in the Greek School of Pedagogical and Technological Education (the ASPETE school trains postgraduate students from several different disciplines in order to get teaching license mainly in vocational education). A smaller number (~7%) has conducted post graduate studies in education. It is obvious that the investigation of interrelation between the pedagogical training of teachers and their pedagogical beliefs and attitudes has special interest. The investigation of the interrelation has been done between the variable whose distribution appears in Table 5 and the various questions which detect the teachers' attitudes and beliefs. The calculation of the data shown on Table 5, were based on the assumption that cases of educators who had received both the formal and the in-service professional development training, would count for the category of teachers with formal training. As will be pointed out in the following section the teachers' answers do not reveal significant correlation to their pedagogical training. Therefore a number of questions arise concerning the effectiveness of the various pedagogical training programs. The only significant relations presented refer to the teachers' teaching experience (Table 2) and the educational level (Table 6) which they serve. This supports the hypothesis that the professional experience, the educational system framework and the specific organizational conditions in which teachers function every day, constitute important factors in the formation of their personal professional theories. Especially if these conditions are incompatible with the desirable pedagogical theories, the latter are weakened and appear inapplicable. The relation to the rest of the factors like sex, basic degree, and size of school and of class do not appear to be significant.

Analysis of research data

QU1. The next paragraphs refer to descriptions from the observation of the classes of two teachers, Ms Vrontou and Mr Makris

Ms Vrontou was leading her class in an animated way, asking questions that the students could answer quickly; based on the reading they had done the day before. After this review, Ms. Hill taught the class new material, again using simple questions to keep students attentive and listening to what she said.	Mr Makris' class was also having a discussion, but many of the questions came from the students themselves. Though Mr. Makris could clarify students' questions and suggest where the students could find relevant information, he couldn't really answer most of the questions himself.

Answer each of the following questions checking the column which best answers the question for you:

Q1. Which type of class discussion are you more comfortable with in your class?

Q2. Which type of discussion do you think most students prefer?

Q3. From which type of class discussion do you think students gain more in terms of knowledge?

Q4. From which type of class discussion do you think students gain more in terms of useful skills?

The possible answers (columns): 1. Definitely Ms Vrontou's, 2. Possibly Ms Vrontou's, 3. I cannot decide, 4. Possibly Mr Makris', 5. Definitely Mr Makris'

The teachers' answers are summarized in Figure 1.

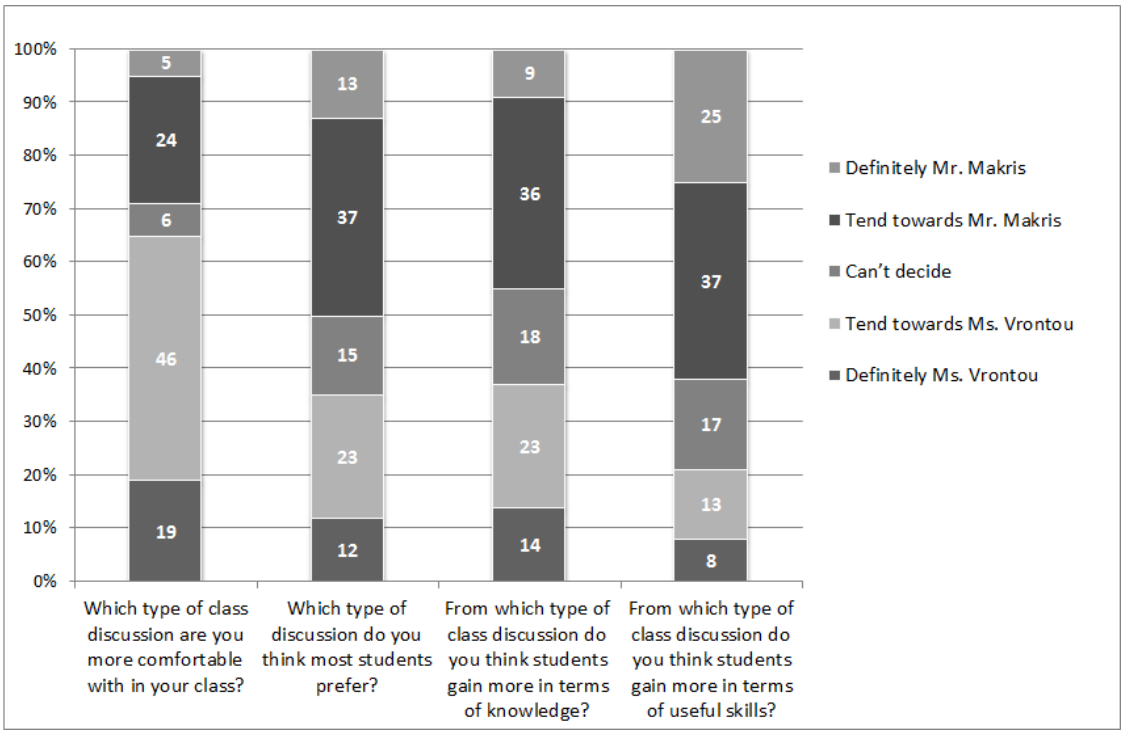

Figure 1. Teachers' answers to QU1

Interpretations for the answers to every separate question:

Q1. Which type of class discussion are you more comfortable with in your class?

This question investigates the teachers' attitude towards the two approaches. As opposed to the rest of the questions the majority of teachers (>60%) state that they feel more comfortable with Ms Vrontou's class. This means that teachers, regardless of their beliefs regarding the educational value of the constructivist approach, are not familiar and comfortable with applying it. There is, thus, a divergence between teachers' beliefs and everyday practice. It is reasonable that teachers who completed their academic studies in a traditional teacher–centred environment should easily reproduce it, adopting methods and practices of their own traditional teachers. This is rather expected if we also take into account the general Greek educational system framework (e.g. assessment, and organisation), which, despite the opposite urges of the official curriculum standards (Hellenic Pedagogical Institute, 2003), favours traditional pedagogy. The teachers' answers do not seem to have any significant (according to X^2 test) relation with sex, age, years of experience, size of class, basic degree, year of graduation, pedagogical training or educational level.

Q2. Which type of discussion do you think most students prefer?

The question investigates the teachers' beliefs concerning the pedagogy preferred by students. Here the picture is reversed, most teachers (~50%) state that students seem to prefer the constructivist approach. The percentage of floating teachers increases significantly, a fact that may show uncertainty and puzzlement regarding whether they are really aware of their students' wishes. These allows us to suppose that teachers do not often wonder about or detect their students' wishes - perhaps because they do not take them into account when planning their courses - which affirms the strong roots of the behaviouristic approach.

The teachers' answer seems to significantly relate with junior high school level (grades 7-9) parameter (X^2=10.19, *df*=4, *p*=0.037). Junior high school teachers in particular seem to believe, more frequently than teachers of other levels, that students definitely prefer Ms Vrontou's style. They may attribute this to the students' age, the nature of the contents of the subject, the students' experiences-expectations from primary school and from other subjects, the struggle to teach all material of the subject within the tight time schedule, imposed by the one-hour-per- week course/class. This correlation strengthens the view that the systemic framework (e.g. legal - organizational system, atmosphere of school and class, local conditions, older colleagues' views, psychological and sociological factors) affects the applicability of constructivist pedagogical approaches, practically allowing the domination of teachers-centered methods.

Q3. From which type of class discussion do you think students gain more in terms of knowledge?

Concerning the learning value of each style, 45% of teachers state that the constructivist style is preferable for learning, while the floating percentage rises to 18%, the highest among all the questions. The teachers' theoretical knowledge of the effectiveness of the constructivist approach is probably confirmed at this point. However, this knowledge, as already stated above, is not reflected in their teaching practice. The teachers' answers do not present any significant correlation with any of the demographical variables of the sample, except the years of experience. In particular, teachers with previous service of 5-10 years appear more hesitant than expected: 13 out of 18 floating votes belong to the group with 5-10 years of experience, this difference being statistically significant (X^2=21.575, *df*=12, *p*=0.043). In the

following paragraph we try to interpret this fact, which also results from the answers to question Q4.

Q4. From which type of class discussion do you think students gain more in terms of useful skills?

62% of teachers state that with the constructivist approach students develop useful skills. A large percentage remains hesitant (like in question Q3), while in this quota 12 out of the 17 floating votes come from teachers with previous service of 5-10 years. The differentiation with the years of experience is statistically significant like in Q3 (in Q1 it is 3/6 and in Q2 it is 8/15).

Table 7 summarizes the frequencies of the floating votes to questions Q1-Q4 with the years of previous service. Data in Table 7 strengthen the argument that ICT/CS teachers probably enter service with various pedagogical approaches in mind. After some years of experience they develop relevant questioning, while later on they tend to solidify beliefs again, at least as far as the learning effectiveness of specific pedagogical approaches is concerned. This conclusion poses questions about the effectiveness of the pre-service pedagogical training. The pre-service training seems to be inadequate, either because the trainees come with already solidified views (Pajares, 1992), or because they are being taught about constructivism through teacher-centered, traditional methods (Wideen et al., 1998).

In an attempt to detect groups with consistent preference to one or the other pedagogical approach, k-means analysis was applied to the questions Q1-Q4. We therefore detect three groups.

Group 1. With 17 members. The central member of the group is teacher T020, whose answers to (Q1, Q2, Q3, Q4) are respectively (1, 2, 1, 1). These are the teachers who are identified as having traditional beliefs and attitudes.

Group 2. With 49 members. The central member of the group is teacher T003, whose answers to (Q1, Q2, Q3, Q4) are respectively (2, 3, 3, 3). They hesitate in Q2-Q3, they are more comfortable with the traditional approach (Q1).

Group 3. With 34 members. The central member of the group is teacher T013, whose answers to (Q1, Q2, Q3, Q4) are respectively (4, 4, 4, 5). The teachers of this group consistently express constructivist beliefs.

From the grouping analysis Group 2 turned out to be the most numerous one, an observation that leads to the result that most teachers have a variety of confused views.

Table 7. Distribution of teachers' floating votes

Previous service (years)	Q1	Q2	Q3	Q4
<5	1	3	3	3
5-10	3	8	13	12
10-15	1	2	0	1
15+	1	2	2	1

Table 8. Distribution of answers to question QU2

Statement	I strongly disagree	I moderately disagree	I slightly disagree	I slightly agree	I moderately agree	I strongly agree
Q1. Teachers know a lot more than students; they shouldn't let students muddle around when they can just explain the answers directly	35	35	12	9	6	3
Q2. A quiet classroom is generally needed for effective learning	7	18	16	20	26	13
Q7. Students will take more initiative to learn when they feel free to move around the room during class.	8	20	10	17	31	14
Q3. Students are not ready for "meaningful" learning until they have acquired basic reading and math skills	33	21	13	15	11	7
Q10. How much students learn depends on how much background knowledge they have, that is why teaching facts is so necessary.	5	10	13	26	21	25
Q4. It is better when the teacher not the students decides what activities are to be done.	15	14	24	27	15	5
Q8. Students should help establish criteria on which their work will be assessed.	5	6	9	21	37	22
Q5. Student projects often result in students learning all sorts of wrong "knowledge"	29	25	30	10	3	3
Q9. Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly	0	14	14	15	38	19
Q6. Homework is a good setting for having students answer questions posed in their textbooks.	18	21	12	22	19	8

QU2. State to what extent you agree with the following statements

The teachers' answers appear in Table 8 in order to estimate their beliefs on the four axes of the pedagogical consideration appreciated. The general impression is that the teachers present mixed pedagogical theories, having strong personal characteristics, not lacking contradictions. The formulation of the questions allows us not to interpret the contradictions from the selection of various teaching methods, e.g. in questions Q2 and Q7 they seem to support both a quiet class and the students' freedom of movement in the class. A similar contradiction appears in Q3 and Q10 about the value of the factual knowledge in education. Moreover, with regard to the kind of learning activities, some teachers seem to support both projects (Q5) as well as structured and closed activities (Q9), some accept students' participation in the formation of assessment criteria (Q8) while teachers appear almost divided in half in the question about who should determine learning activities (Q4) and the role of homework (Q6). Finally, an impressive percentage of teachers realize that providing

direct answers is not useful (Q1). The frequencies of the participants' answers are equal to the percentages because the participants are 100 teachers.

Junior high school teachers seem to disagree more than others on the role of homework (Q6), considering that dealing with the questions of the book is not suitable for homework (X^2=11.67, *df*=5, *p*=0.04). This may have to do with the fact that both the new ICT textbook for junior high school and the Hellenic Pedagogical Institute (official advisor of Greek ministry of education) guide teachers towards focusing on class work rather than homework assignments. There is also a relationship between quietness in class (Q2) and senior high school. This finding may be due -if we refer to the nationally examined subjects- the inconsistency between covering extended content and the constructivist approach.

QU3. Pairs of opposite statements

In this question teachers had to choose one statement for each of the pairs declaring their agreement and to what extent (Table 9). Z1 refers to attitude, the rest to beliefs.

The teachers' answers are summarized in Table 10, and appear mostly constructivist except pair Z3, which concerns the width with regard to the depth of covering the cognitive objects. The answers do not present significant correlations with any of the demographic variables. The grouping analysis did not give significant results, which means there is a great dissimilarity of views.

Table 9. Pairs of opposite statements of question QU3

Z1	"I mainly see my role as a facilitator. I try to provide opportunities and resources for my students to discover or construct concepts for themselves."	"That's all nice, but students really won't learn the subject unless you go over the material in a structured way. It's my job to explain, to show students how to do the work, and to assign specific practice."
Z2	"The most important part of instruction is the content of the curriculum. That content is the community's judgment about what children need to be able to know and do."	"The most important part of instruction is that it encourages "sense-making" or thinking among students. Content is secondary."
Z3	"It is useful for students to become familiar with many different ideas and skills even if their understanding, for now, is limited. Later, in college, perhaps, they will learn these things in more detail."	"It is better for students to master a few complex ideas and skills well, and to learn what deep understanding is all about, even if the breadth of their knowledge is limited until they are older."
Z4	"It is critical for students to become interested in doing academic work; interest and effort are more important than the particular subject-matter they are working on."	"While student motivation is certainly useful, it should not drive what students study. It is more important that students learn the history, science, math and language skills in their textbooks."
Z5	"It is a good idea to have all sorts of activities going on in the classroom. Some students might produce a scene from a play they read. Others might create a miniature version of the set. It's hard to get the logistics right, but the successes are so much more important than the failures."	"It's more practical to give the whole class the same assignment, one that has clear directions, and one that can be done in short intervals that match students' attention spans and the daily class schedule."

Table 10. Distribution of answers to question Q3

Pair of opposite statements	Strongly constructivist view	Constructivist view	Traditional view	Strongly traditional view
Z1	15	41	37	7
Z2	38	49	11	2
Z3	17	24	36	23
Z4	35	46	16	3
Z5	30	38	24	8

Table 11. Distribution of answers to question QU4

Kind of assessment	Not at all useful	Slightly useful	Moderately useful	Very useful	Indispensable
Short-answer and multiple-choice tests	6	18	27	35	14
Written tests	3	20	39	26	12
Open problems (without a unique solution)	3	9	19	54	15
Individual and team projects	1	3	11	44	41
Formal standardized tests	10	32	36	18	4
Presentations/Performances from students	0	5	5	57	33

QU4. In your opinion, how useful is each of the following kinds of assessment under the criterion of how much it helps students learn

The kinds of assessment and the teachers' answers appear in Table 11. The learning value of student-centered methods (projects and presentations) is recognized. At the same time, quite a few recognize usefulness in tests and written examinations. It would be interesting to investigate the assessing methods used and their frequency. The answers reveal mixed pedagogical views and do not present significant statistic correlation with any of the demographic variables.

Conclusions

According to researchers, teachers' pedagogical beliefs determine to a great extent their professional practices. From the presented research it seems that ICT/CS teachers in Greece, in particular, have personal pedagogical theories which -to a high extent- consist of a mixture of traditional and constructivist principles. For example, the same teacher is possible to state that her/his role is "mainly as a facilitator who tries to provide opportunities and resources for students to discover or construct concepts for themselves" and –at the same time- to prefer "short-answer and multiple-choice tests". Survey data show that it is easier for teachers to adopt the traditional approach instead of the constructivist one. As far as curriculum-content is concerned, they also seem to have traditional beliefs. Concerning students' work they reveal generally constructivist views although the research

does not give information about what teachers actually do in practice. In addition teachers have mixed beliefs, concerning methods of assessment where the value of presentations, of open problems and of projects is recognised along with written tests and multiple-choice tests.

Teachers' answers do not usually depend on factors such as age, basic degree, and sex, but what is most impressive is that they do not depend on their pedagogical training either. Some views (Q1) seem to have a statistically significant association with educational level and teachers' years of experience. Most of floating vote teachers had 5-10 years of previous service, an observation supporting the hypothesis that teachers enter the service with a personal pedagogical theory which they start to reconsider and doubt after some years of experience and which eventually solidifies again. In other words, teachers' pedagogical beliefs and attitudes change along with the years of service. Teachers seem to have strong beliefs at the beginning of their career (either traditional or constructivist ones) which weaken after some years of experience (cannot decide which of the two sets of beliefs in about a quarter of cases), formulate again new personal solid theories (in the traditional, a constructivist, or a mixed spirit). Although, in some cases, statistically significant relations to the educational level of service or to the years of teaching experience are detected, teachers' beliefs and attitudes seem to be generally unrelated to their prior studies in education and/or participation in professional development programs. This observation combined with the lack of correlation of teachers' beliefs with their possible pre-service training, strengthens the view that sufficient teachers' training requires: a) a practical as well as a theoretical form and b) the creation of continuous supportive structures in the form of professional communities of learning and professional practice, where teachers working in teams, will exchange and reflect on their experiences, will experiment with teaching methods, with the ultimate goal of generate ever-evolving, efficient teachers. Finally, the study reveals systemic and administrative factors (e.g. school culture, assessment laws considering the number and types of tests, time administration in schools) that shape teachers beliefs, making modern pedagogy appear impractical (e.g. preferring short teacher-centred discussions because of short class sessions per week), especially for ICT/CS, and undermining any teaching reform effort and curriculum principles implementation. The findings are quite unique in comparison to other similar researches. For example Lim, & Chan, also applied a modified version of Beckers' TLC questionnaire to 19 pre-service teachers and found that the majority (12/19 = 63.15%) of the teachers preferred constructivist instructional style. This is in contrast with the case of Greek CS/ICT teachers where only 34% make up the constructivist group as this follows from the QU1. The data show that there is much room for improvement in the pedagogical philosophy of the Greek in service CS/ICT Teachers.

The present research presents methodological limitations among which we highlight the non-randomized sampling method, the verification of its representation and the nature of the questionnaires, the data of which had also better be combined to qualitative elements (e.g., of observation) to support their credibility (Ma et al., 2008). A further constraint of this study is that the transfer of its results to the cases of other countries is not easy and straightforward since the recruiting procedures for CS/ICT teachers may vary substantially across countries. Despite this fact it makes sense to hypothesise that this situation could be repeated in countries which will choose to employ CS scientists as CS Teachers without and systematic pre-service pedagogical preparation. Regardless of its limitation, the authors feel that the present study is consistent with the experiences of the educational community and could be of interest to those involved in teachers' pedagogical training.

In the future this work can be continued with: a) the investigation of teachers' practice and its consistency with their beliefs and b) the investigation of the training-supportive practices which would combine practice communities with models of theoretical and practical training like "the pedagogical workshop" (Brandsford et al., 1999).

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To cite this article: Fesakis G., & Karakiza, T. (2011). Pedagogical beliefs and attitudes of computer science teachers in Greece. *Themes in Science and Technology Education*, 4(2), 75-88.

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