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An ICT's integration Model in the Educational Context and the Greek STEM education (1984-2006)

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Abstract

Through studying the "discourse" of the integration of ICT in the educational context and the Greek STEM education emerged the approaches as well as the attitudes expressed in the texts. By plotting the findings to a model this paper illustrates the overall situation in the "discourse" for the integration of ICT in education of Greece during the period 1984-2006. The views expressed in the studied "discourse" highlight the dominant perspective of the integration of ICT in the educational Greek context, which is the Technocratic Perspective. The Greek STEM education and the teaching seem to be approached in terms of its technical and methodological conditions. It is shown that "instrumentalist" views of the integration of ICT are mainly adopted by the authors and less "substantial" views. This model of integration of ICT in the educational context and the Greek STEM education could contribute to a rational discussion on the issue, which, unfortunately, was lacking up until this time.

Keywords: STEM education, ICTs Discourse, ICT's integration model

Introduction

This paper attempts to map a model that includes all the possible, expressed views on the integration of ICT in the educational context and teaching of STEM in Greece in order to develop a rational dialogue about ICT emerging education. By using Aviram & Tami's framework (2004) for analyzing theoretical and practical views towards the "merger" between ICT and Greek STEM Education on several recent representative texts dealing with ICT and Greek STEM education (1984-2006) that are published in the pages of scientific journals with wide resonance in educational circles, such as, "*Contemporary Education*", we pinpointed their "attitudes" and "approaches" to the integration of ICTs in Greek STEM education (Nikolakopoulou et al., 2017, 2018; Pierri et al., 2006). Conclusively, we distinguished the dominant views reflected in the discourse for the integration of ICT in the educational context and teaching of STEM in Greece and mapped the ICT's integration Model in STEM education during this particular period (1984-2006).

Educators, policymakers, and parents as well believe that Information and Communication Technologies (ICT) are of supreme importance for the future of education. The large-scale introduction of ICTs in education is raising multiple debates over the substance, trajectory, purpose, and implications of ICTs in this domain. As ICT becomes an integral element for educational reforms and innovations at schools, there is need for rapid, continuous discourse *"stemming from all different approaches and attitudes to the subject*" (Aviram & Tami, 2004). The Discourse comprises a culturally constructed reproduction of reality at a specific historical period which is created, maintained, put forward and promoted by the socially powerful, who use the available means of communication for this purpose (Foucault, 1972).Foucault perceived discourse on a particular issue, such as the discourse on ICTs, as a magnetic field concentrating *"the totality of all effective statements (whether spoken or written)" which is expressed following a particular set of rules "in their dispersion as events"* (Foucault, 1972). In

this case, faculty members from the Greek universities participating to the Pedagogical Recontextualizing Field (PRF), teachers, who can act either autonomously or through their trade union organizations, scientific journals, publishing houses and the press that occupies itself with educational issues (Bernstein, 2000), play a decisive role in the shaping of "attitudes", "approaches" and actions of the teachers concerning the integration of ICTs in the Greek STEM education. Following the rules of publication for scientific articles in the pages of scientific journals through which their "attitudes" and "approaches", related to the integration of ICTs in STEM Greek education, traced, (Nikolakopoulou et al., 2017,2018) we may finally map an ICT's Integration Model to Greek STEM education at the period (1984-2006). A Model is *"a scientific activity, the aim of which is to make a particular part or feature of the world easier to understand, define, quantify, visualize, or simulate by referencing it to existing and usually commonly accepted knowledge".*[1]A great number of researchers focus on the emergence of models for the integration of ICT in education and the changes it brings. Underwood & Dillon (2004) designed a "*maturity model*" to capture the complexity of any learning environment in which technological innovations are to be introduced. According to its creators, this model includes the following five dimensions: (a) technological dimension, (b) curriculum dimension, (c) workforce dimension, (d) leadership and management dimensions, and the (e) communication and connection maturity dimensions. For each one of them, a descriptive form of maturity was created with reference to its main characteristics and levels of maturity Wellington (2005) argues that the debates raised by ICT fall into three categories: (a) vocational, (b) pedagogical and the (c) societal. These debates are likely to be perennial and recurring, whatever the advancement in the technology itself. Eshet-Alkalai (2004) stresses that the existing discourse has been practice-oriented, and so he reviews an integrative framework for digital literacy as a starting point for the much-needed theorization. By considering two basic strategies - a Conservative one which relies on the assumption of the current discourse about "*digital skills indeed nothing but skills*" and a Skeptical one based on doubts concerning this assumption, leads to two different skeptical hypotheses. The 1st stresses that "***the skill-oriented discourse*** *can be reduced to the older discourses on learning styles and multiple intelligences and the 2nd attempts to reduce it to the much more fundamental discourse on the clash between the modern book-based and the postmodern digital cultures" or the* ***"clash of civilizations"***.Ravanis (2006), attempting to codify the general orientations of the relevant literature, distinguishes three different approaches to the relationship between education and ICT, which sometimes may coexist: (a) the *Technocratic-Ahistorical approach*, which moves in the context of ahistorical enthusiasm, adopting the view that any policy choices and announced changes necessarily lead to progress, (b) the *Rational-Reformist approach* refers to the rational use of ICT in educational systems and (c) the *Critical-Rational approach*, which attempts a critical reading of the development of ICTs, with social, political, economic and cultural dimensions. Aviram & Tami (2004) consider that these views on the application of ICTs in education can represent the following three Paradigms: (a) the *Technocratic paradigm* characterizes those who reject any discussion of school change and whose views characterize Administrative, Curricular, or Didactic approaches combined with a Conservative attitude, (b) the *Reformist paradigm* characterizes those who perceive ICT as a tool that will help promote the "right" teaching and (c) the *Holistic paradigm* characterizes those who appear to be categorized in terms of the effects that ICT has on the socio-cultural situation, i.e. those who adopt Cultural-Ideological approaches in combination with Conservative, Radical or even Extreme Radical attitudes. The present research aims at the investigation of the authors' views which stem from the combination of the approaches and attitudes they adopt "*in research and theoretical texts, which come from the PRF and the Greek university scientific press between 1984-2006*" Nikolakopoulou et al., 2018).

Methodology

In this research we will attempt to map all possible, expressed views on the integration of ICT in the educational context and the Greek STEM education and figure a model in order to answer the following research question: What are the varied and different points of view that arise from mapping all possible approaches and attitudes of the ICT discourse in the educational context and the Greek STEM education? What are the dominant authors' views reflected in this discourse? This research focuses on texts published in the pages of the journal *"Contemporary Education*" between 1984 (onset of the integration of ICT in theGreek education) and 2006 (a period during which a wide relevant European Union Community Support Framework program was implemented in Greece). The scientific Journal publishes articles whose authors belong to the PRF as well, presenting a variety of "*attitudes*" in terms of the extent and magnitude of the changes that ICT integration will bring and *"approaches"* regarding the objectives of ICT integration (Nikolakopoulou et al, 2017, 2018). The qualitative and quantitative Content Analysis was performed, and the "theme" used as a unit of analysis for data recording and the 'article' used as context unit, because the approaches of the articles' authors on ICTs in STEM education were sought across the whole article (Kripendorff, 2004). The articles were analyzed with the digital software N-vivo 8. The units of analysis were classified according to one of the following three categories of analysis, which emerge from Aviram & Tami's (2004) theoretical schema revealing the authors' perspectives to ICTs in Greek STEM education (1984-2006).

Findings and Results

The texts' analysis of the educational articles of *Contemporary Education* highlighted all approaches and attitudes adopted by the authors of the studied texts for ICTs integration in the educational framework and Greek STEM education (1984-2006).

The combination of these two parameters (approaches - attitudes) led to the formation of a matrix of mapping all expressed views on ICTs integration in the educational framework and Greek STEM education in the period 1984-2006 (thermal figure 1). The horizontal axis of the resulting matrix is the axis of the "approaches" adopted by the authors regarding the goals or/and the nature of the computerization of

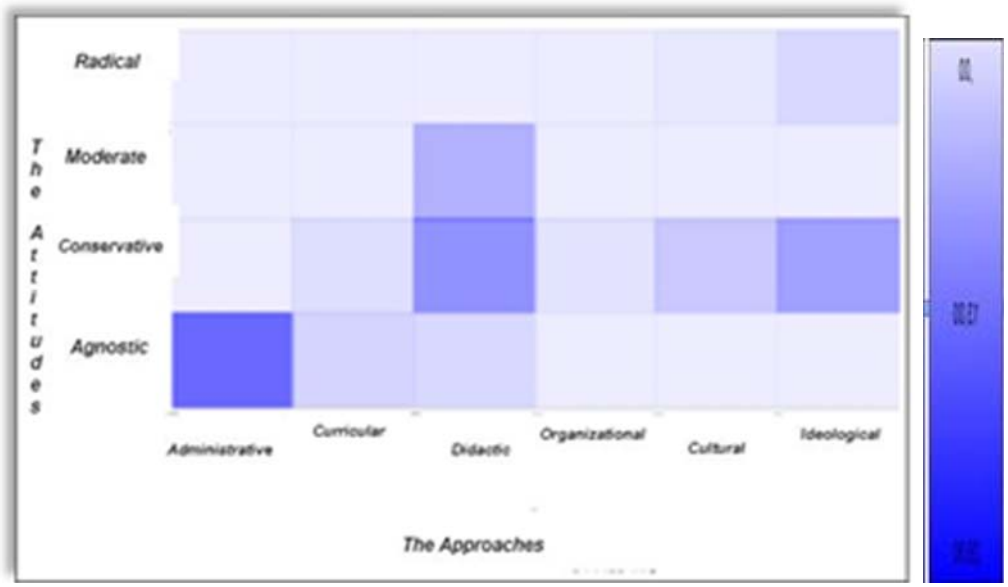

Figure 1: The Matrix of representation of all possible aspects of ICTs integration in the educational context and Greek STEM education (1984-2006)

education, while its vertical axis includes the authors' "attitudes" regarding the extent of the changes that will prevail in education framework and STEM teaching with the integration of ICT. In the above illustrated matrix, the individual values contained are color-coded. The legend placed to the right of the matrix provides information about the color-coding system used, representing the values obtained for each displayed view (combination) in hierarchy. These views, grouped together, reflect ***three clusters of views about the integration of ICTs in the educational context and the Greek STEM teaching***: (1) the "*Technocratic*"Perspectivfulle, (2) the "*Reformist*" Perspective and (3) the *"Holistic"* Perspective of ICTs integration.

Discussion

The "Technocratic" perspective of ICT integration in education

The "*TechnocraticPerspective*" (57.80%) of the integration of ICT in the educational context and the teaching of STEM Greek education is the *dominant one* (Figure 2). Dominant features of these views are the perception of ICT, as "neutral" tools in the service of a "linear" learning process, the importance of which depends on those who use them to achieve their goals.

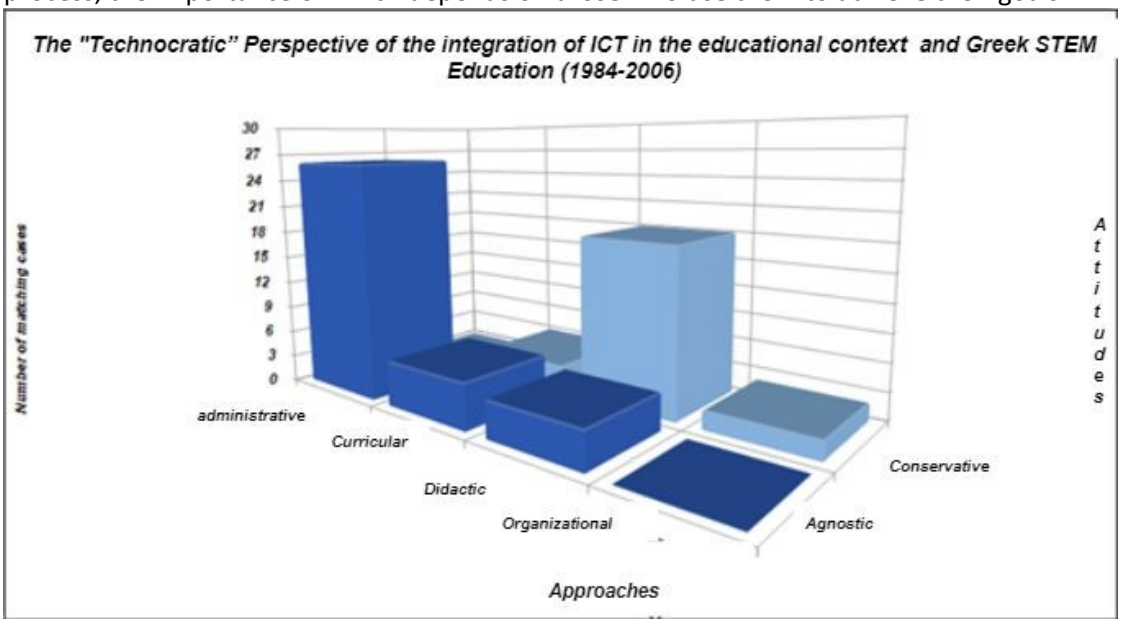

Figure 2: The "Technocratic" views of the ICTs integration in Greek STEM Education

The proponents of this perspective adopt a priori a technological determinism, since they conclude that technology is a "determining force" which the education system should "manage" to adopt, as early as possible, given it is identified with progress, the development and improvement of the educational and learning process. The communication framework within the learning process remains a framework of asymmetric relationships and the teacher maintains the guiding role. Similar findings lead to Aviram & Tami (2004) who include these views in the Technocrat Paradigm. So, the *Administrative-Agnostic* and secondly the *Didactic-Conservative* views which emerge with a strong trend within this discourse (Figure 2), are probably an effect of the convergence of the Greek educational policy towards the European policy or even the international one. It seems that the modern globalization and the postmodernism in which we live, encourage the Greek modern reality towards the adoption of "instrumental", "technocratic" views. It is said that "*Instrumental*" theory (also known as a neutralist approach) is *"probably the most commonly held belief and is one which views technology as a 'tool' without any inherent value"* (Macleod, 2005), but *"their value lies in how they are used"* and supports a one-size-fits-all policy of universal employment of ICTs (Ebersole, 1995). The analysis also shows that authors have an *optimistic rhetoric* about the

ICTs ability to improve education and this is in line with others who note that *"this is expressed in a well-recognised 'general ICT impact' discoursethat seems to be the most prevalent discourse in the vast majority of research*" (Koro, 2012). Many researchers of course question this overly optimistic discourse, due to the fact that it could potentially be guided by economic rather than by educational reasons (Robertson, 2003). It seems, that nowadays schools play a crucial role in achieving the dual orientation of the educational system, one targeting the economically disadvantaged people with emphasis on advanced technological skills and one targeting the economically disadvantaged people with emphasis on the *"drill and skill*" (Vrasidas, et.al, 2009). The "Economies" and the "Knowledge Societies" guided by the logic of investing in knowledge and in our case in the ICTs Education, led to the adoption of a "*Technocratic Perspective"* regarding the integration of ICT in education. Apple claims that it simply provided resources for change, "reform" and policy adoption "that link the educational system even more closely to the market needs" (Apple, 2001). Tyler (2001) "*warns against utopianism, pointing to management interests in 'exploiting the interdisciplinary and fluid structures of hypertext…the abolition of academic specialisms and disciplines through managerial or system imperatives rather than for intellectual and pedagogical integration'*

The "Reformist" perspective of ICT integration in the educational framework and the teaching of STEM

Observing the views for the integration of ICT in the studied period in the empirical material we find that, shortly after the middle of the 90's (1997 and onwards) a "*Reformist perspective"* begins to be formulated. It is moving in the direction of changing and overturning the existing perception of the didactic integration of ICTs as an additional tool in the service of the educational and learning process. Part of the study's authors (14.50%) promote ICT as a means of reforming the teaching and learning process, as a "tool" to facilitate the implementation of the "right" teaching. This group adopt (Figure 3) mostly *Didactic-Moderate views* and less *Organizational-Conservativeviews* which - according to Aviram & Tami (2004) - characterize those who are oriented to *"more flexible teaching/learning…organizational changes in school, consisting of more flexible attitudes to time, place, authority, roles and curriculum. It characterizes the* ***more consistent and radical*** *among the adherents to the didactic approach*". These views begin to emerge in the late 1990s and remain - without much intensity - in the debate on the integration of ICT in the educational context and the Greek STEM teaching until the end of the study period (1997-2006).

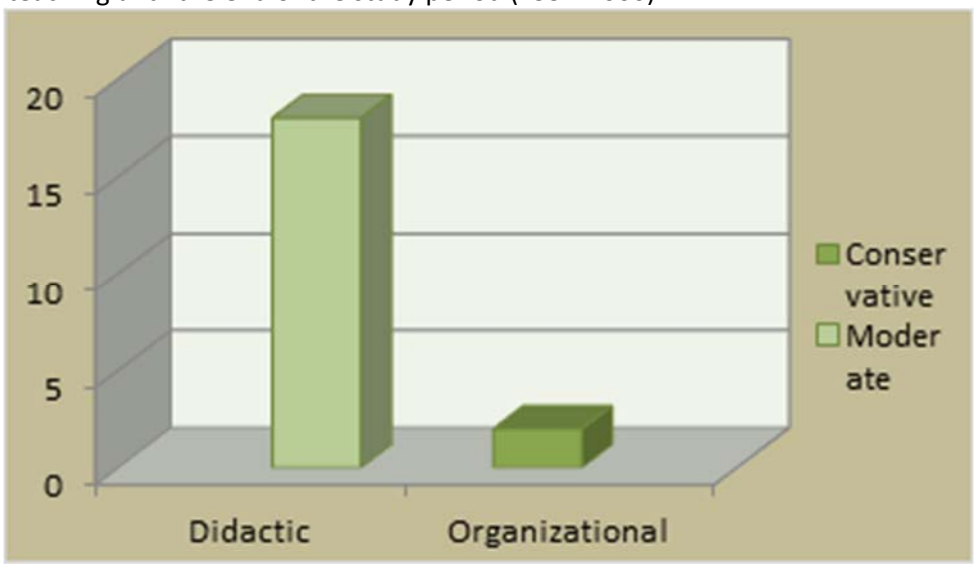

Figure 3: The "Reformist" views of the ICTs integration in Greek STEM Education

Authors who are part of the *Reformist Perspective* highlight the defining role of ICT in education and learning and embrace the notion that ICT is not "neutral", but it is also a "crucial technology" which changes the teaching and learning process. They also claim a lot of changes on both the teaching methodology and the learning process itself. They point out changes towards the formation of an alternative learning environment, in which an active and exploratory "hypertext" learning process takes place. So, the student's autonomous/self-regulated learning skills and lifelong learning skills are developed. Changes of the interactive learning relationships towards more "symmetrical", democratic relationships while also the teacher's role to a "mediator" are desired factors. They also accept the "determinist" character of ICT, as they seem to believe that if technology exists, schools should perform something *interesting, attractive,* and educationally important with it, as also stated by Aviram & Tami (2004). They propose the integration of ICT in education since they *can promote the desired (constructive) didactic*. Similar findings lead to Aviram & Tami (2004) who place similar views in the *Reformist Paradigm*.

The "Holistic" perspective of ICT integration in the educational framework and the STEM Education

Apple (2008) notes that we only pay attention to the *"main narrative*" that always considers computers as *"good"* however this is not true. A significant part of the authors' articles (27.80%) is included in the *Holistic Perspective* of the integration of ICT in the educational context and the Greek STEM education (1984-2006) (Figure 4). The adherents of this perspective present clearly and unequivocally a number of claims about the socio-cultural situation and the effects of ICT on it. They are authors who adopt *Cultural* as well as *Ideological approaches* combined with *Conservative or Radical attitudes*. They also submit specific proposals for the educational system and they *do not avoid discussing possible rival theories and views* while on the contrary they *deconstruct them by highlighting non-"privileged", but very important views*. The *Holistic Perspective* is determined by the position that ICT is a key force in culture.

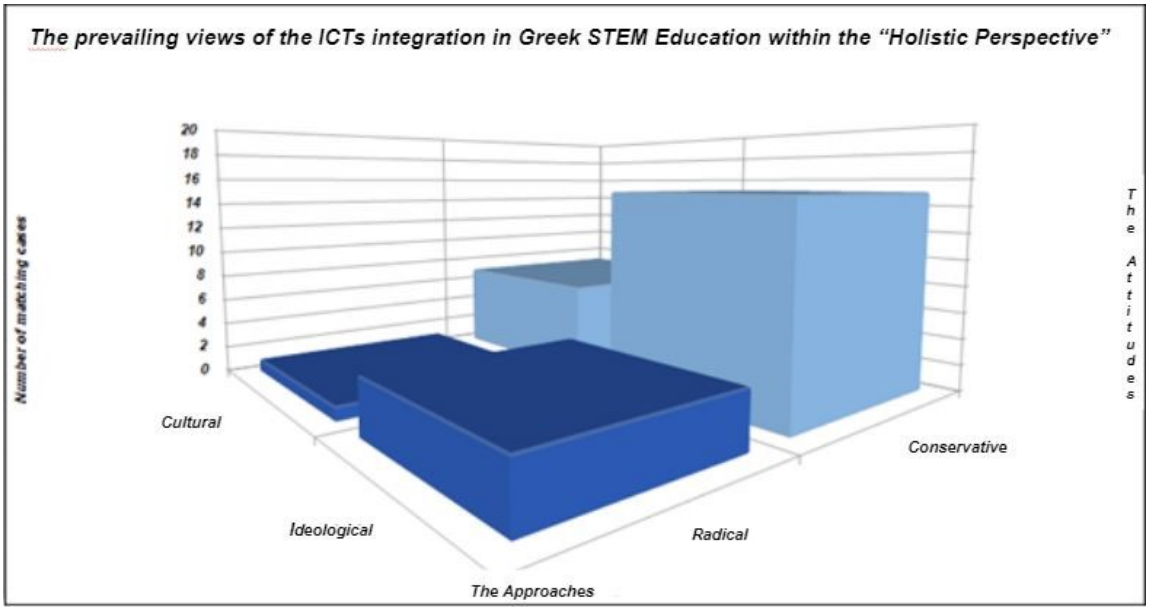

Figure 4: The "Holistic" views of the ICTs integration in Greek STEM Education

They believe that ICT is not a "neutral technology", but a "crucial technology" which, as Pasula (2003) notes, *"changes our lives"* in modern societies - where a rapid technological development and an explosion of knowledge happens - while also a lot of changes in social

and moral perceptions. They are also "*non determinist*" technologies. In this context, the tendency of *"mediation"* and possible replacement of the teacher is also discussed, since is related to the new factors and methods of disseminating information, transmitting knowledge, and shaping reality. As the authors point out, and very aptly highlighted by Verhulst (2005) we are only on the verge of *understanding what the social impact of the new mediation forces could be*. Aviram & Tami (2004) include similar views in the *Holistic Paradigm*.

The model for integration of ICT in the educational context and the teaching of the Positive Sciences in Greece (1984-2006)

The following figure (5) presents the model of ICTs integration in the educational context and the Greek STEM education (1984-2006). This figure briefly and comprehensively *shows all the authors views* analyzed in the study of the "discourse" for the integration of ICT and the Greek education, as they are grouped in the three clusters perspectives, which are described in detail above. Each "*view*" is represented schematically with a circle and its area proportionally reflects the power of its presence in the studied "discourse", while each "*perspective*" is schematically represented with a polygon (pentagon: *Reformist Perspective*, hexagon: *Technocratic Perspective*, octagon: *Holistic Perspective*) whose area represents the sum of the areas' of the individual views contained in each perspective and therefore proportionally represents the power of the presence of each perspective over all three. The dual equivalence flat arrow indicates the simultaneous coexistence (1984-2006) of the two perspectives, i.e., the technocratic and holistic perspective, whilst the other two three-dimensional arrows highlight the later beginning of the formulation of the *Reformist Perspective* (1997-2005).

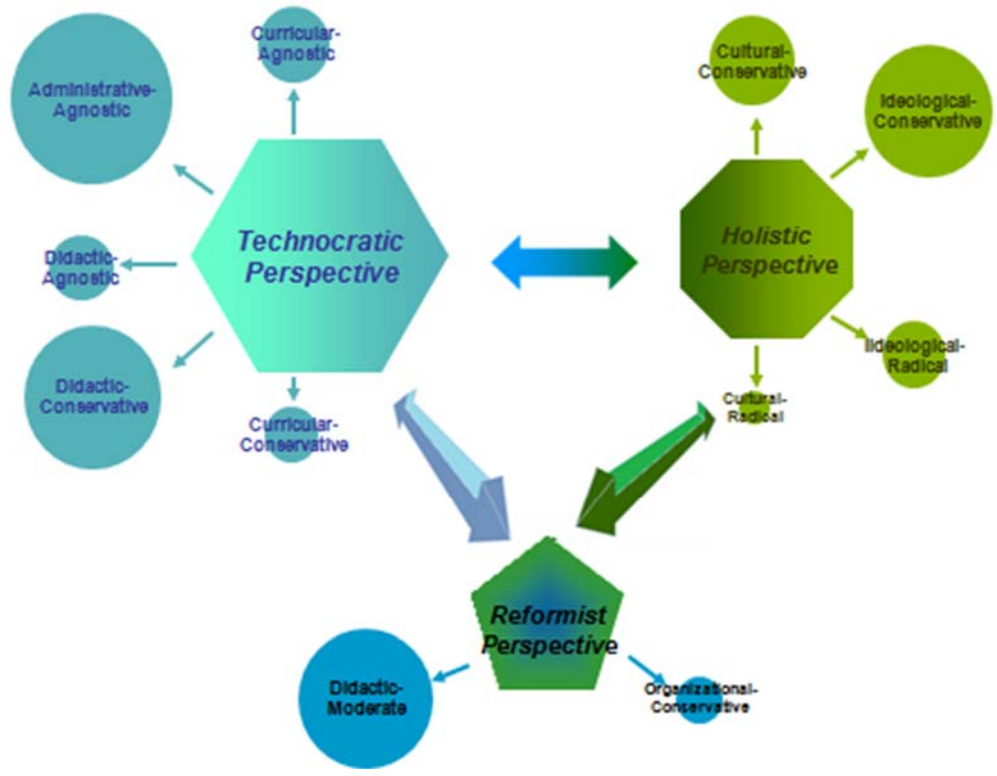

Figure 5: The model for the ICTs Integration in the educational context and the Greek STEM Education (1984-2006)

In this "discourse" formulated in Greece in the studied period, the *Technocratic perspective* emerges as a *dominant perspective* of ICTs integration in the educational context and the

STEM education. The use of computers in this context is introduced as a "*fragmented and controlled adoption of ICT in schools",* possibly as a *"safe" institutional response to keep their subversive potential under control to transform or even replace conventional schools*" (Papert, 1999 as cited in Williams, 2005). According to its inherent, no change in the existing educational structure is desirable. Many other authors point out the dominance of techno-centric approaches to the ICT use in education (Ravanis, 2006; Macleod, 2005). Stamatis (2005) discusses the emphasis on developing pupils' relevant new skills that are related and oriented towards useful and utilitarian knowledge and the educational policy choices of recent years towards educational contents that correspond to the ideology of the *economic man* and the acquisition of corresponding *technocratic knowledge* (2005). So, the *reformist views* come as an answer to this "social and economic necessity". As Apple notes (1993), teaching and society have been influenced by the ideology of pragmatism and the school can only follow the wider goals of society. Moreover, Castells, in the context of the two types of work he considers existing in the modern information economy - the "*general*" and the *"self-programmed"* - points to the need for a corresponding *"self-programmed workers"* as well as the *"perspective of multiple simultaneous positions work",* and multiple careers in a lifetime is almost inevitable" (1997).

Conclusion

The research results present that the "Discourse" for the integration of ICT in the educational context and in Greek STEM education (1984-2006) is in its vast majority a technocratic (Technocratic Perspective) and much less critical and skeptical discourse (Holistic Perspective). The authors adopt *"instrumental"* views of a *didactic reform* and a transition to an *"autonomous and self-regulating"* learning for acquiring the skills of *"continuing training"* and "*lifelong learning*", necessary for the future worker in the "knowledge society". It is a *Conservative Discourse* in almost all its manifestations and perspectives (Technocratic, Holistic), with a tendency to *remain in the existing educational schemes* inherent in their latent structural function. It suggests the *change of the educational communication framework*, the hierarchical relations and the transition from the asymmetric interactive teacher-student relations and the leading role of the teacher (Technocratic Perspective) to symmetrical communication relations and a mediating role of the teacher (Reformist). In addition, a "*substantial*" discourse and *deconstructive views are rarely expressed* about the mediation of the educational relationship and the "*replacement of the physical bodies of the educational act*" (teachers) (Holistic Perspective) (Stamatis, 2005), as well as a tendency for creating perspective identities (according to the Bernstein's typology) in teachers and students. We finally propose this ICTs integration model as an opportunity for (a) the facilitation of a desired dialogue and encouragement of the current discussion about ICT emerge Greek Education, (b) the acquisition of "awareness" of the overall picture, of the point we had currently achieved and (c) the perspectives that emerge and the possible choices that are being made.

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