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Digital Transformation of Education and Learning through Information Technology in Educational Management

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Abstract. 2021 is a year of anniversaries in the IFIP family. IFIP TC3 WG3.7 is 25 years old. Celebrating anniversaries is a good opportunity to reflect on how far we have come, and what the future holds. The incorporation of digital technology in education reflects an evolution of light and shadow, with many challenges for the future. Information technology has not only been present in the field of education as a teaching-learning tool, but has also played an important role in educational management. This paper analyses the contribution of IFIP TC3 WG3.7 to the development of the field of Information Technology in Educational Management. It contextualises its origins within the framework of the evolution of digital technology and analyses the most recent situation. The challenge for the future is to reflect on the possible contribution of contemporary educational management trends to help create a balance that facilitates the implementation of digital technologies in education while meeting the social objectives that give meaning to the educational system.

Keywords: Information technology, educational management, WG3.7

1 Introduction

In 2021, the Working Group 3.4 (WG3.4) of the Technical Committee 3 (TC3) of the International Federation for Information Processing (IFIP) celebrates its 50th anniversary. During its years of existence, WG3.4 has successfully contributed to the creation of knowledge in the field of Professional, Higher and Vocational Education in ICT. Numerous publications attest to this, as well as a remarkable number of international conferences and events in which researchers and practitioners from all over the world have contributed. Interestingly, one of the most relevant results of WG3.4 was the birth of a new Working Group within TC3. In 1994, WG3.4 organised a conference in Jerusalem with the theme Information Technology in Educational Management (ITEM). The conference aroused a great deal of interest in the scientific community and during the conference there was a high level of agreement on the importance and timeliness of the chosen topic. This interest led to the creation, after its approval by IFIP in 1996, of the Working Group 3.7 (WG3.7) focused on the discipline of Information Technology

for Educational Management. The year 2021 is therefore also an important anniversary for WG3.7, namely its 25th anniversary.

The Open Conference on Computers in Education 2021 (OCCE2021 DTEL) is a good opportunity to celebrate such an important date for WG3.4, the host of the conference, and for WG3.7, both of which are linked by close ties. The conference is also a good opportunity to reflect on the contribution that WG3.7 has made to the Digital Transformation of Education and Learning over the past 25 years. Schools, high schools and universities prepare students for the world of the future, and this requires the management of educational centres for the upcoming years. The digital transformation of education and learning has necessarily been linked to a process of digital educational management, which has also had to adapt to new technologies. From the beginning of the existence of WG3.7, it was established as a premise that the focus of the research would be on the impact of information technology for educational management on the teaching-learning process. However, after 25 years, questions can be raised as to whether the use of digital technology (DT) in educational management is the same as the use of DT in business management. There are many parallels between the two types of management, although perhaps the biggest difference lies in the tempus or time lag between the implementation of new management techniques in business and education.

This paper reviews the topics of research interest in information technology in educational management in the past and present, as well as considers foreseeable future trends. Parallel to the review, the contribution of WG3.7 in this arena is described - the Annex 1 summarises the conferences organised by WG3.7 and the books published in these 25 years. Finally, a conclusion is offered on the potential role WG3.7 can play in new scenarios.

2 Information Technology for Educational Management: Origins

Educational management is a broad field that, as its name denotes, encompasses two converging disciplinary areas. The appropriate management and administration of educational institutions has been a matter of concern since the creation of the modern educational system all around the world. Independently of the profit or non-profit nature of schools, universities and other educational centres, the need to efficiently invest in certain resources with the purpose of providing an effective socio-economic education to citizens, has grown a body to manage and administrate the educational process. Educational management includes managing the internal work of educational institutions (budget, personnel, infrastructures, strategies, goals) as well as their external work (external stakeholders' demands and needs, goals coherence within a broader educational setting, policies). Another dimension to be managed in the educational arena has to do with teaching and learning aspects of the education process, i.e. the promotion of best educational practices by part of teachers and trainers to achieve the educational goals. These goals are set by the policies and strategies stated externally and internally

to educational centres. The educational picture widens as societies increase their complexity.

In the educational setting, technology, to a greater or lesser extent, has always be present (buildings, papyrus, abacus, pencils, slide rules). With the development of computer technology and its popularisation because of the continuously decreasing costs and improved performance, digital technology has become an additional actor in the educational arena, accompanying the work of teachers and educational administrators and managers. Although no universal definition for information technology for educational management has been provided, the term may include the combination of computing and communication hardware and software adapted to support the administration and management of internal and external work of educational institutions. The beginnings of the use of information technology for educational management date back to the 1970s [1]. At that time, some teachers created the first amateur school administration programs for their own schools or colleges, and also in some university departments. At the end of that decade, software providers entered this market by producing software adapted to more professional standards. Some developed countries had school software applications in place in a large number of schools by the end of the 1970s. These applications were primarily for administrative purposes. In the 1980s, with the commercialisation of personal computers, there was a period of expansion in school computing. At this stage, office and administrative computer applications were used with the characteristic that they were not integrated with each other. The lack of integration limited the possibilities for management support, as managers needed to identify relationships between data. During the initiation and expansion stages, the main objective of software development was to improve the efficiency of school office activities. The next stage, the integration stage, can be characterised by information management and the integration of computer modules with administrative and teaching functions. In those years, educational authorities in technologically advanced countries became aware of the importance of information technology in the field of educational management, and invested large sums of money in the improvement of school computer systems [2, 3].

Parallel to the development of information technology for educational management, academic interest in this field was growing. In 1994, the first International Conference on Information Technology in Educational Management was held in Jerusalem, where the creation of WG3.7 was conceived. Subsequently, in 1995, at the World Conference on Computers in Education held in Birmingham, a considerable number of papers were presented on this topic. A professional group of 20 experts from ten different countries worked during the conference to produce a report addressing the development, research and implementation issues central to the continued growth of information technology for educational management. The report also proposed research methods and strategies needed to generate the desired knowledge and understanding.

In the last decade of the 20th century and the first decade of the 21st century, the use of information technology for educational management grew enormously in industrialised countries. Also, since the beginnings of the 21st century, developing countries began to utilise the potential of these systems, with very high levels of use in countries such as Botswana and Uganda [4].

Typical data processing functions in schools during the early stages of the uptake of educational management information systems included [1]:

1. Updating of the computer database with affiliation information of students, educators and support staff.
2. Retrieval of information and production of documents to obtain information on the situation of the school.
3. Support to the decisions of the educational managers based on the available information.
4. Internal communication within the educational community and external communication to stakeholders of the educational system.
5. Student monitoring systems by assessing students' progress over the long term. This function was considered as one of the most important, as it enables the management of data on student progress. Technology facilitates the production of student progress reports, which can be used by both teachers and school management.

Special mention should be made of the research carried out on information technology for educational management in the sphere of the activities organised by WG3.7. The most popular topics over their first ten years were Assimilation and integration of DT into educational management, followed by Assessment of DT support to educational management, DT applications in educational management, and National, regional and local experience in the use of DT for educational management. All together these topics represented 76.2% of all papers (117) included in the publications by WG3.7 during their first ten years of existence. The most recurrent topic was the Assessment of DT support to educational management, which was repeatedly dealt with because of the importance of analysing the results obtained after implementing new strategies, policies, techniques or tools [5]. Annex 2 describes the research topics covered primarily by WG3.7 members during the initial period of activities. Further information about research methodologies and main contributions that were put forward during this stage can be found on [5].

3 Information Technology for Educational Management: Maturity

Whilst progress is clearly marked during the origins of the field, some common elements requiring development remained. In particular, the following issues were common concern during the transition stage to maturity [6]:

1. Use of the management information systems (MIS) limited to administrative tasks.
2. Lack of MIS availability to all teaching staff.
3. Unsuitable training and support.
4. Inappropriate software interface.
5. Usability and functionality limitations.
6. Inadequate reporting and decision support facilities.
7. Lack of user-centric implementations.
8. Minimal interoperability with other systems.

A review of the literature related to the field of information technology for educational management shows that the main driving force is information technology. The vast majority of publications are related to the description of new software applications or the results obtained after applying a particular information technology in an educational context. The number of publications related to the incorporation of new management theories in the educational arena is very small compared to those dealing with educational technology. Also, many publications referring to recent trends in the field of management that have been put into practice in the educational management area have, as their background, the use of some form of information technology as a supporting tool. Information technology has been growing steadily both in terms of computing power and its incorporation into people's daily lives. The spectacular development of the Internet and the rise of social networks has also had a decisive influence on educational management. On the other hand, one of the greatest advances in information technology has been the integration of information among previously isolated systems.

The opportunities provided by information technology in recent years should not obscure the risks inherent in the massive incorporation of digital technology in education. Teachers' use of technology can be uneven. Some instructors design effective and creative learning opportunities for their students that precipitate deep thinking and reflective engagement in the development of conceptual knowledge. However, some use digital technologies as shortcuts to learning, without focusing on intended outcomes. For example, some educators do not deliberately teach effective online search and verification strategies, nor are they even aware that they should, nor do they know how to incorporate such practices into classroom work. Some teachers, especially at secondary level, struggle to see beyond the content of their subjects, looking only for content-oriented digital solutions, rather than how they might enhance students' own abilities to problem solving, critique and create knowledge with expert guidance [7].

Moreover, many technology companies have turned their attention to education, given that, because of its volume, it can be a lucrative business. Large firms with an interest in education constitute what have come to be known as big Edtechs or Lordtechs. Most of the software applications currently used as learning and educational tools are practically the same all over the world. The influence and ability of big Edtechs to reach all geographical areas has made this possible [8]. All of the above is an element of concern for those responsible for educational management, who must

ensure that information technology does not become a mere commercial instrument that prevents the real objectives of the education system from being achieved. However, it is worth highlighting the information technologies that have played a leading role in recent years, given that they have influenced and, foreseeably, will continue to influence the educational process and, therefore, are and will be the object of attention from the perspective of educational management. Weller [9] identifies the most influential educational technologies developed in the last twenty years, with their lights and shadows: E-Learning, Learning Objects, Open Educational Resources, Blogs, Learning Management Systems, Video, Web 2.0, Second Life and Virtual Worlds, E-Portfolios, Twitter and Social Media, Personal Learning Environments, MOOCs, Learning Analytics, Digital Badges and Artificial intelligence. From the mentioned technologies, Learning Analytics and Artificial Intelligence are having an increasing weight in the educational management arena and, very likely, they will constitute critical tools supporting for decision making in this field [10–12].

In this period of maturity, research on information technology for educational management has followed the path of technological development. In the sphere of the conferences organised by WG3.7, the most popular topics over their second ten years of existence have been Assimilation and integration of DT into educational management, DT applications in educational management, and DT applications for teaching. Although the latter is not directly related to the scope of the WG 3.7, this theme gradually has gained importance [13]. Annex 3 describes the research topics covered primarily by WG3.7 members during the maturity period. Further information about research methodologies and main contributions can be found on [13].

4 Information Technology for Educational Management: Future Trends

The rapid development of technology and the constant innovation and application of computer and information technology make information technology change the future lifestyle of human beings and induce comprehensive changes in human learning. The promotion of information technology education policy will enable education to present a new appearance of learning [14].

Drawing on current technological developments and existing applications in digital education, such as mobile apps, learning management solutions and anti-plagiarism software, Popenici and Kerr [15] raise the critical question of who will set the educational agenda in the future, i.e. corporate companies or educational institutions. Large digital and technology-driven companies such as Netflix, Samsung, Google, Microsoft and Facebook, also referred to as Lordtechs, are seeking to develop new data-driven learning programs that enable new teaching tools in public institutions through the optics of these business-driven companies [16]. For example, the Netflix group developed

the DreamBoxLearning program for mathematics in the US market, which enables personalised learning based on Artificial Intelligence (AI) technologies with an adaptive intelligent learning system. That these Lordtechs are investing heavily in the development of AI-based teaching and learning solutions inevitably raises the question of whether educational institutions are prepared to implement such data-driven technology in their teaching and learning programmes [17].

This leads one to consider the importance of the challenge facing educational institutions if they are not to become mere instruments of the decisions taken at Lordtechs' headquarters. One possible answer lies in the importance of strengthening the knowledge and skills of future educational managers through a structured training process. In this respect, it could be pointed in two research directions [18]:

1. To analyse the level of training of modern managers in accordance with the requests of the society on DT competences of managers in the educational system.
2. To analyse the problems of selection and application of professionally oriented information technologies in the educational process to meet the needs of educational stakeholders (students, educators, society).

Moreover, the importance of national responses to these challenges should be anticipated. Schools and higher education systems are continuously confronted with the growing challenges of preparing students to successfully participate in the digital age. In many countries, this is leading to multiple efforts and changes in national policies regarding the integration of DT into education systems [19]. Educators, researchers and policy makers believe that the full potential of educational technology will ultimately only be realised when educational policymakers, administrators and teachers effectively integrate and authentically incorporate technological improvements along with data science concepts into their practice and curriculum [20].

It can be expected that alongside the commercial interests of the Lordtechs, national policies align as frameworks for establishing the objectives and limits to the indiscriminate implementation of new technologies in education. The agents that can serve as a means to align both legitimate kind of interests may ultimately be the educational managers, because of their proximity to the reality of students' and educators' demands to consume the latest available technology, but also as guardians of the social interest of national education systems. It is on this latter aspect that the research activity of WG3.7 may focus part of its future activities.

5 Conclusions

Information technology for educational management offers solutions for a wide range of activities at different levels of education - primary, secondary, higher education and adult learning. The broad spectrum of needs to be covered by providers of technology solutions for educational management means that there is no single product that can

cover all needs. Moreover, it could be considered that the search for such a single product is a naive and unachievable goal. However, it is necessary to assume that the need to develop multiple products to meet the different demands of the educational management field implies that these have a low level of data integration with each other, at least in their initial stages of development.

Looking back, it can be concluded that in the field of information technology for educational management the technological part of the sentence has been the most prominent. Most of the innovations in this field have been technology-driven. Sometimes they have been accompanied by strong educational frameworks, but sometimes they have only been technologies in search of an application. It is also true that, from an educational management perspective, the social impact of promoting or implementing a technology beyond its uses as an educational tool has often not been addressed. The widespread adoption of technologies such as social networks, MOOCs, learning analytics and AI have social implications that educational authorities have often been unable to appreciate. It is therefore necessary to learn from the past and anticipate the future by studying the social and educational implications of emerging technologies. A good example in this regard is the initiative carried out by IFIP's TC3, under the name of Zanzibar Declaration, which involves a large number of actors in the educational arena to reflect and expose their concerns and recommendations to identify the social and educational implications of technologies such as Big Data, Machine Learning, Autonomous Systems and Artificial Intelligence, among others. Therefore, the challenge facing the discipline of information technology for educational management, and for WG3.7, is to better balance digital technology with conceptual frameworks, both managerial and educational pedagogies, and social movements.

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Annex 1 Conferences and publications led by WG3.7

Venue	Year	Book title	Editor
Jerusalem (Israel)	1994	Information Technology in Educational Management	Chapman & Hall
Hong-Kong (China)	1996	Information Technology in Educational Management for the Schools of the Future	Chapman & Hall
Maine (USA)	1998	The Integration of Information for Educational Management	Felicity Press
Auckland (New Zealand)	2000	Pathways to Institutional Improvement with Information Technology in Educational Management	Kluwer
Helsinki (Finland)	2002	Management of Education in the Information Age: The Role of IT	Kluwer
Gran Canaria (Spain)	2004	Information Technology and Educational Management in the Knowledge Society	Springer
Hamamatsu (Japan)	2006	Knowledge Management for Educational Innovation	Springer
Darwin (Australia)	2008	Evolution of Information Technology in Educational Management]	Springer
Kasane (Botswana)	2010	Information Technology and Managing Quality Education	Springer
Bremen (Germany)	2012	Next Generation of Information Technology in Educational Management	Springer
Guimaraes (Portugal)	2016	Stakeholders and Information Technology in Education	Springer

Annex 2 Number of papers classified by research subject published by WG3.7 (1994-2004)

Topic	Number Percentage (%)
Strategies to integrate IT into educational management	9 7.7
Assimilation and integration of IT into educational management	27 23
ITEM state of the art. The discipline's present situation and trends	3 2.7
Assessment of IT support to educational management	20 17.1
National, regional and local experience in the use of IT for educational management	18 15.4
IT applications in educational management	20 17.1
Mathematic tools employed to make models for educational management	6 5.1
IT applications for teaching	8 6.8
Teacher and manager training in the use of IT for educational management	6 5.1
TOTAL	117 100

Annex 3 Number of papers classified by research subject published by WG3.7 (2006-2014)

Topic	Number Percentage (%)
Strategies to integrate IT into educational management	7 7.3
Assimilation and integration of IT into educational management	26 27.1
ITEM state of the art. The discipline's present situation and trends	3 3.1
Assessment of IT support for educational management	9 9.4
National, regional and local experience in the use of IT for educational management	5 5.2 20
IT applications in educational management	20.8
Mathematical tools employed to create models for educational management	4 4.2 16
IT applications for teaching	16.7
Teacher and manager training in the use of IT for educational management	6 6.3
TOTAL	96 100