Innovation and Technology Enhancing Mathematics Education

Perspectives in the Digital Era

MATHEMATICS EDUCATION IN THE DIGITAL ERA
Volume 9

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Springer

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ISSN 2211-8136 ISSN 2211-8144 (electronic)
Mathematics Education in the Digital Era
ISBN 978-3-319-61487-8 ISBN 978-3-319-61488-5 (eBook)
DOI 10.1007/978-3-319-61488-5

Library of Congress Control Number: 2017944210

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword by Ferdinando Arzarello

The issue of a fresh and creative use of technology to enhance innovation in mathematics education is a hot spot in current debates on mathematics education. Many countries invest a lot in equipping the schools with (more or less) updated devices and in organizing consequent teachers' training for a suitable use of the new tools.

The research is cautious in claiming that technology has great positive associations with educational outcomes (see, e.g. the Report of Higgins, Xiao, & Katsipataki, 2012). What is there underlined more is that:

> The range of impact identified in these studies suggests that it is not whether technology is used (or not) which makes the difference, but how well the technology is used to support teaching and learning. There is no doubt that technology engages and motivates young people. However, this benefit is only an advantage for learning if the activity is effectively aligned with what is to be learned. It is therefore the pedagogy of the application of technology in the classroom which is important: the how rather than the what. This is the crucial lesson emerging from the research. (p. 3)

Hence, it is this lesson that must be considered by researchers and practitioners: it underlines the necessity of approaching technology in the classroom from a wider standpoint, namely considering what Mishra and Koehler (2006) call the technological pedagogical content knowledge (*TPACK-perspective*).

Another issue about the type of impact that technology can have in schools emerges from PISA surveys. In one of the last PISA in Focus (n.64), it is pinpointed that

> even when most students have easy access to new media, inequalities persist in the way they use these tools. The use of online media depends on the student's own level of skills, motivation, and support from family, friends and teachers, which vary across socio-economic groups. In their free time, disadvantaged students tend to prefer chatting rather than sending e-mails. They are also much less likely to read the news or obtain practical information from the Internet, perhaps because their navigation and reading skills are often more limited than those of advantaged students. (p. 4)

In fact, PISA results show that proficiency in the ability to use ICT tools for learning is strongly related to more traditional school abilities:

> Proficiency in online reading and navigation requires students to plan and execute a search, evaluate the usefulness of information, and assess the credibility of sources on line – skills that schools can encourage students to practice and develop. […] Proficiency in online reading and navigation requires students to plan and execute a search, evaluate the usefulness of information, and assess the credibility of sources on line. […] students with good reading skills, regardless of their background, have a much easier time ending their way around–and mining the considerable assets of–the Internet.

The lesson here is that the activities with ICT should be designed according to a global standpoint of the teaching design for the classroom activities: let us call this the *global skills perspective*.

These two combined perspectives require that researchers deeply rethink the theoretical and empirical frames at the base of the educational projects for enhancing and improving mathematics teaching and learning in the classrooms. What is needed is not a cumulative programme where new devices are at stake together with the old ones focussing on possible hoped advantages for teachers' and students' activities, perhaps without any founded assumption. There is the necessity of a deeper insight, which touches the real roots of learning according the hewn findings that research puts forward not only from the pedagogical and technological innovation standpoint but also considering the new results of other disciplines, from neuro- to social sciences, which can give fresh ideas and programmes to pursue global learning and teaching designs, aligned with the two perspectives pointed out above.

In this sense, the book is very useful. From the one side, it offers some interesting suggestions for these new spaces for research and for innovation, pushing forward possible programmes of innovation linked to the last findings in technology: from the affordances allowed by touch screen devices to those that Wii-environments offer, and others. The interest of these proposals consists in the deep analysis of the intertwining between the cognitive, embodied and didactical affordances that such devices allow. From the other side, also more or less standard examples are considered and innovative uses of digital technologies are exemplified in different contexts: CAS environments, interactions between concrete and simulated artefacts, construction of mathematics concepts within institutional infrastructures, the use of a single computer in a classroom, the use of technology for students having mathematical learning difficulties or disabilities.

Overall, the chapters offer an interesting updated survey of important researches in the field, as pointed out in the retrospective Chap. "From Acorns to Oak Trees: Charting Innovation Within Technology in Mathematics Education": there, it is shown how the progress of innovations in this field has "been seeded and taken root" within the ICTMT community in the years.

In most of the book, the two perspectives—TPACK and global-skill one—are both present: therefore, the book can be read with benefits not only by researchers but also by practitioners.

Practitioners will find new ideas about an old issue that new technology today puts forward, but that is connected to older problems raised many centuries ago by a philosopher like Bacon (1620), who, at the beginning of the scientific revolution, summarized a main issue that even today teachers (and not only they) face when using artefacts, and specifically technological devices in their classrooms:

> Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand. And as the instruments of the hand either give motion or guide it, so the instruments of the mind supply either suggestions for the understanding or cautions.[1] (Book I, Aphorismus 2).

Hopefully this book can give some contribution to enter further into the fascinating interactions between hand, artefacts and mind within the social, technological and cognitive environments where we live today.

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[1]Nec manus nuda, nec intellectus sibi permissus, multum valet; instrumentis et auxiliis res perficitur; quibus opus est, non minus ad intellectum, quam ad manum. Atque ut instrumenta manus motum aut cient aut regunt; ita et instrumenta mentis intellectui aut suggerunt aut cavent.

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