Chapter 4
Opportunities for Participation, Productivity, and Personalization Through GeoGebra Mathematics Apps

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ABSTRACT

The development of mobile devices as well as the technical possibilities going along with this progress are extensive. Especially since the last few years, the widespread availability of mobile technologies offers new opportunities to improve learning and teaching both in- and outside of classrooms. Bring Your Own Device (BYOD) models can help to support the shift towards more student-centered learning environments with their unique benefits for learning. This chapter takes a closer look at GeoGebra, a set of apps for learning and teaching mathematics and science, and how they can support teaching, learning, and assessing in relation to the aspects of participation, personalization, and productivity of BYOD.

INTRODUCTION

The dynamic mathematics software tool set GeoGebra (Hohenwarter et al., 2016) is used by millions of students and teachers worldwide for learning and teaching mathematics and science. For the development of the GeoGebra math apps, an international team of researchers and open source software developers are working together in order to continually improve the functionality and usability of this software. Since a few years, the interactive mathematics learning tool GeoGebra is also available as apps for the

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major tablet and smartphone platforms. Concerning the use of GeoGebra in BYOD classrooms, it is essential to support all the different kinds of mobile devices as well as their different operating systems.

In addition to the mathematical applications GeoGebra also provides an online materials platform where users can publicly share and collect interactive online materials or browse through already more than 700k shared open educational resources. For the use in school GeoGebra has also released a special-purpose learning management system called GeoGebra Groups (Hohenwarter, 2016). Using GeoGebra Groups allows easy sharing of privately authored as well as publicly available GeoGebra materials. Currently the system supports basic elements like text, videos, questions, interactive GeoGebra tasks, public commenting, and private feedback all usable across different platforms including smartphones.

Today our society is changing due to the increased dissemination of mobile devices and their impact on how people are connected and related to each other (K-12 Blueprint, 2014; Sharples, Taylor, & Vavoula, 2010). In addition to the changes of the mobile devices in everyday life also the use of these technologies in education entails a change of design and organization for teaching and learning (Alberta Education, 2012). The integration of technology such as (pocket, graphing) calculators or computers with special software programs in education is nothing new (Burrill, 2011; Pimm & Johnston-Wilder, 2005). Already in the 1970s the first hand-held, arithmetic calculator was established in the UK (Pimm & Johnston-Wilder, 2005). Although these devices were even restricted for the use in class at its inception, their potential was soon recognized and calculators were adopted for teaching and learning purposes (Pimm & Johnston-Wilder, 2005). Moreover, it was already proposed many years ago that technology enhanced learning and teaching environments are essential for high-quality mathematics education (Burrill, 2011; Pimm & Johnston-Wilder, 2005; NCTM, 2008). Especially the new approach of dynamic interactive software activities was seen as great potential for teaching and learning, because it could engage students in exploring, reflecting, and observing mathematical concepts (Burrill, 2011). Today teaching environments are expected to take our mobile device-centered lifestyle into account, to enable collaborative learning, and to offer opportunities for digital learning (Bachmair, 2013; Kerres, Heinen, & Stratmann, 2012). Many authors (Alberta Education, 2012; K-12 Blueprint, 2014; Rogers, 2015) recommend a Bring Your Own Device (BYOD) model as a successful strategy for supporting learning and teaching in the 21st century. As the main part of this chapter, the open source mathematical learning apps of GeoGebra are considered as example tools for a BYOD model and how they can support learning and teaching with personally owned devices related to the aspects of participation, personalization, and productivity (Alberta Education, 2012).

Technological Impact on Human Life

Due to the recent technological progress, computers were becoming suitable for mobile usage because they were lighter, easier to handle, and also adapted to the aesthetic ideas of users. A major step for the evolution of computers was the breakthrough with smartphones, that can be defined as mobile computers (Wildt & Meister, 2012). Important features that characterize a smartphone are a touch-sensitive screen, a camera, GPS positioning, access to the Internet, a variety of sensors, and of course the possibility to write messages and to make phone calls. Because of the combination of a touch-sensitive screen, text- and speech-input, such as a variety of sensors, or a camera, there is wide range for interaction and input. Thus, a smartphone can be seen as a small miniaturized mobile version of a computer which supports the same technological possibilities (in some cases with weaker performance capacity). In addition to the enhanced hardware of the smartphone, there is also the possibility to enhance the software with so-