Profiles of students who use mobile devices for the purposes of learning science and mathematics

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Summary

Introduction

There are a growing number of learning applications for mobile devices on the market but according to the research literature the effects of these are often contradictory or not generally visible (Hassler et al., 2016). Several meta-analyses have focused on the effect of using applications or the design of learning management systems (Hwang & Tsai, 2011; Wu et al., 2012), but not on the profiles of students using mobile devices for learning purposes, which is the topic of this study.

According to several authors, changes in the use of information and communication technologies (ICT) have resulted in the rise of a new generation – the so-called *Net Generation* (Hartmann, 2003) or *Digital Natives* (Prensky, 2001). This generation is described as a homogenous group with similar ICT skills. Van den Beemt, Akkerman and Simons (2010) questioned this assumption and gave an overview of the empirical studies that showed more of a variety among students ICT use. In two studies (Van den Beemt et al., 2010, 2011a) they focused on differences in the students' use of ICT in everyday life for *interchanging*, *browsing*, *performing*, and *authoring*. Their cluster analysis showed four profiles of applying ICT: *traditionalists*, *networkers*, *producers*, and *gamers*.

Related to the context of learning using ICT, the DIGCOMP framework (Ferrari, 2013) highlights five important competence areas: information, communication, content creation, safety, and problem solving. The DIGCOMP framework is also used in the Estonian national curriculum to support the development of students' digital competence. However, there are validated instruments for evaluating digital competence that are missing.

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Whilst one of the aforementioned frameworks was not yet developed in its educational context and the other yet to be empirically tested, there was still a need to conduct a survey. Our general long-term aim was to develop new interventions to support the effective use of mobile devices for learning science and mathematics, but first it was necessary to identify the profiles of students' mobile device use for learning. More specifically we focused on two research questions:

1. Which profiles of using mobile devices can be differentiated in the context of learning science and mathematics and how frequently do they occur?
2. Which profiles of using mobile devices characterise students in different grades and between girls and boys?

Methods

A cross-sectional survey was conducted in spring 2016. The sample of the study consisted of 3521 students. 2673 studied in the 6th grade and 848 in the 9th grade, 1824 were girls and 1697 boys. The questionnaire on the use of mobile devices in learning science and mathematics was designed by the authors on the basis of the DIGCOMP framework. It focused on three areas of competence: information, communication, and content creation in the contexts of classroom study and homework. Hierarchical cluster analysis using the "Ward" method was applied to find the profiles of the learners. The number of groups was decided by using a dendrogram and the differences of groups were analysed using ANOVA and χ^2 analysis. A Z-test was used to evaluate the statistical significances between comparison groups.

Results and discussion

The results of the study show that students can be divided into two groups according to their profiles of using mobile devices for learning science and mathematics – users and non-users. Users can be further divided into two groups and one of these can be divided into three sub-groups. Thus, all together it is possible to distinguish five general groups that can be later divided into 11 sub-groups. The users apply mobile devices for learning at least once every month while the non-users do it less frequently. Among the large users' group (50.1%) a small group (4.9%) of students use mobile devices daily for all activities studied in our analysis. They are named

'digital natives'. The others use mobile devices for learning usually once or twice in a week and mainly in the context of information-related and content-creation activities. The three groups identified in this sub-group are 'information students' (21.2%), 'communicating information students' (12.5%), and 'content creation students' (11.5%). The 'information students' are very active in sharing links, 'communicating information students' in using social media, and 'creation students' in developing and adapting different materials in both lessons and homework.

Further, the 'information students' can be divided into 'collaborating information students' (6.6%) and 'non-collaborating information students' (14.6%). The first group is much more active in sharing links. 'Content creation students' can be further divided into 'communicating content creation students' (7.8%) and 'non-communicating information collection oriented content creation students' (3.7%). The group of 'non-users' was divided into four sub-groups: 'non-users' (9.3%), 'beginners who use social media' (7.9%), 'beginners who use information from tasks given to them by teachers but do not collaborate with others' (22.5%), 'beginners who use information from tasks given to them by teachers and collaborate with others' (10.1%).

The second research question of the study focused on differences among grade and gender. A χ^2 analysis revealed some differences between 6th and 9th grade students and girls and boys. The 9th grade students are more often in the group of 'communicating information students' and the 6th grade students in the group of 'non-users'. The 9th grade students are also more likely to be in the group that was active in social media. The boys are more often in the groups of 'content creation students' and 'digital natives'.

The results of the study show that most of the students use mobile devices for learning mainly by collecting information. Different types of information-based groups comprised 77.9% of the sample in our study, which is much more than in the traditionalist group of Van den Beemt et al. (2010, 2011a) which included only 28% of students. In this study, a group of networkers was also defined, which included 39% of students and was characterised by sharing content. This group could be compared with 'communicating information students' and 'communicating content creation students' – all together 24% of students. The comparison of these studies showed that the 'net generation' present in everyday context is not yet distinguishable in the learning context. It is important in designing interventions to support the effective use of mobile devices for learning science and mathematics. Our recommendation is to design learning tasks that guide students in sharing information and content with their peers.

The group of producers in Van den Beemt et al. (2010, 2011a) was very small (6%) but its size was comparable to the group of 'digital natives' in our study (4.9%). Thus, it seems that most active users of mobile devices transfer their methods of using mobile devices in everyday life to the learning context as well. This group is too small to organise peer-group support in the classroom. Therefore, the role of assisting teachers should also be considered in the case of other groups, e.g. 'communicating information students', 'communicating students', and 'communicating content creation students'. Together, these groups form 26.9% of the sample which means that in every classroom teachers can organise group work where at least one experienced student belongs to all of the groups. In forming groups, it might be advisable to have both girls and boys in every group, as there is a difference in their context, more boys belong to the groups 'content creation students' and 'digital natives'. Their support could be used in assisting other students. And finally, we also recommend more tasks where students have to communicate with their peers.

In conclusion, there are several limitations in our study: the analysis is based on students' self-evaluations, the instrument for collecting data was not validated in previous studies, the findings can only be used in the context of science and mathematics, the use of mobile devices by students is linked to the teachers' activities, the size of the sample in the 6th grade and 9th grade was different and this should be kept in mind when interpreting the outcomes where students of both grades are in the same analysis. However, despite the limitations, the data of the study opens up a discussion about the use of mobile devices for learning. Furthermore, their actual use and effect on learning outcomes should be studied.

Keywords: information and communication technology, mobile learning devices, user profiles, cluster analysis