

**Edmund Lorencowicz, Milan
Koszel, Sławomir Kocira, Jacek
Uziak**

Student Use of Mobile Devices in University Classes

Edukacja - Technika - Informatyka nr 2(16), 206-219

2016

Artykuł został opracowany do udostępnienia w internecie przez Muzeum Historii Polski w ramach prac podejmowanych na rzecz zapewnienia otwartego, powszechnego i trwałego dostępu do polskiego dorobku naukowego i kulturalnego. Artykuł jest umieszczony w kolekcji cyfrowej bazhum.muzhp.pl, gromadzącej zawartość polskich czasopism humanistycznych i społecznych.

Tekst jest udostępniony do wykorzystania w ramach
dozwolonego użytku.



**EDMUND LORENCOWICZ¹, MILAN KOSZEL²,
SŁAWOMIR KOCIRA³, JACEK UZIAK⁴**

Student Use of Mobile Devices in University Classes

¹ Profesor doktor habilitowany inżynier, Uniwersytet Przyrodniczy w Lublinie, Wydział Inżynierii Produkcji, Katedra Eksploatacji Maszyn i Zarządzania Procesami Produkcyjnymi, Polska

² Doktor inżynier, Uniwersytet Przyrodniczy w Lublinie, Wydział Inżynierii Produkcji, Katedra Eksploatacji Maszyn i Zarządzania Procesami Produkcyjnymi, Polska

³ Doktor habilitowany inżynier, Uniwersytet Przyrodniczy w Lublinie, Wydział Inżynierii Produkcji, Katedra Eksploatacji Maszyn i Zarządzania Procesami Produkcyjnymi, Polska

⁴ Doktor, Department of Mechanical Engineering, University of Botswana, Gaborone, Botswana

Abstract

Computer technologies are widely used by students of any level of education. In the broad range of computer hardware mobile devices deserve special attention. They offer a number of benefits to students including the possibility of making editable notes, searching for information on line, communicating quickly and effectively or accessing multimedia materials. Due to the size of those devices the students can easily use them during classes. The study reported was done on a relatively large group of students (503) from students of the Faculty of Production Engineering of the University of Life Sciences in Lublin, Poland. Its main goal was to establish students' use of mobile devices in the educational processes, and in particular during formal classes (lectures, tutorials and lab experiments). The key finding was that above 90% of students used mobile devices during classes. The most popular mobile device was a notebook (used by 80% of students), followed by a smartphone (71%) and tablet (17%). The most popular activity was making calculations related to attended courses.

Key words: educational technology, Mobile devices, University teaching.

Introduction

The method and speed of processing information is crucial in today's global society. Continuously improving information technology makes it easier to communicate but also create challenges related to its ever increasing capabilities. It is especially applicable to mobile devices, which allow to access and process information from any place and at any time [Staś 2012].

Computers, and especially internet, changed our society and nowadays it is difficult to imagine almost any activity without their ever presence. The invention of the computer and common access to internet not only transformed human lives but became the driving force for industrial development and globalization.

Computer technology invaded also the job market. Under fierce competition the computer skills became a necessity as the potential employers demand knowledge of computer techniques and specialised software. Computer skills come as an extra ‘bonus’ on top of ‘normal’ technical know-how based on education in a particular discipline and knowledge of foreign languages. The above creates new situation for educational institutions, especially institutions of higher education.

Traditionally, the emphasis in university programs has been on the development of discipline specific knowledge and skills (disciplinary or vocational skills). However, increasing importance has been recently placed on the development of generic skills. It is now a common practice for undergraduate curricula to be finely balanced between disciplinary knowledge and the more universal generic skills. Such demands emerge from stakeholders in higher education and, in particular, from the two most interested groups: employers, who wish for the best prepared workers, and students, who wish for the best employment [Walczak et al. 2013]. The debatable question is whether computer skills are indeed generic. They can be considered generic [Dickerson, Green 2004], in the part related to general information technology skills and knowledge, and specialized, discipline related when it comes to dedicated software and applications.

Computer technologies are widely used by students of any level of education [Lorencowicz et al. 2013; Yau, Cheng 2012]. Independent of their place of residence, the current generation students are familiar with computer technologies from the beginning of their education and have high acceptance of such technologies [Uziak 2009; Lorencowicz et al. 2013]. Study indicate that students can be considered as ‘early adopters’ and ‘early majority’ i.e., a group which is the quickest to accept new solutions and innovations [Robinson 2009; Joo et al. 2014].

Computer equipment, including mobile devices, as well as internet, is ever present in students’ lives. It helps in everyday life and also in the learning process. The range of computer hardware is constantly expanding and at the moment includes laptops, notebooks, netbooks, tablets, smartphones, eBook readers. The current generation of students is familiar and comfortably work in the digital environment in order to communicate and to collect and analyse data [Oblinger 2004]. Mobile devices are increasingly used by students and can be considered as basic educational tools [Traxler 2010]. Authors even use the term ‘mobile learning’ or ‘m-learning’ to emphasize the already embedded use of such devices in the teaching and learning processes [Motiwalla2007; Ally 2009; Kinash et al. 2012]. Hence, the monitoring and analysis of the use of mobile devices by students becomes essential.

Mobile devices offer a number of benefits to students [Koszel et al. 2015]. That includes the possibility of making editable notes quickly and effectively

[Annan-Coultas 2012; Murray 2011], the possibility of searching information on-line [Weaver, Nilson 2005], use of multimedia material during classes [Hall & Elliot 2003]. The additional advantage is the possibility of sharing documents/notes created electronically. Such documents can provide the potential possibility of studying 'anytime and anywhere' [Gulek, Demirtas 2005]. Young [2009] indicates that mobile devices can also be used for immediate responses to discussion boards and social networking services.

Despite all the advantages the mobile devices can also create problems such related to loosing concentration during classes and diminishing classroom discussion [Maxwell 2007; Murray 2011]. Similar problems are reported by Yamamoto [2008] who, in addition, indicates that use of mobile devices in classrooms may lead to overdependence on technology, when students rely more on digital sources that actual reading and understanding of course material. In addition devices may influence and disturb fellow students blocking the view of the board, projector screen and the professor. The fellow students can also be distracted by the hue of screens, noise coming from the devices [Maxwell 2007]. Furthermore, students glued to the screens of their devices show evidence of losing touch with reality [McCreary 2009; Roberts, Rees 2014]. All the indicated reasons led some of the universities to ban the use of mobile devices in classrooms [Luther 2012; Foster 2008].

The technological revolution changed the job market. New emerging technologies and new organizational systems require well educated graduates who will develop to multidimensional and all-around employees capable to consider the working environment holistically and to work in a group. It is related to the need in continuous improvement of human communication and searching and verification of various type of information [Feiner 2012]. New technologies, on the other hand, create new educational opportunities, making the teaching and learning process more attractive and tailored made for individual student. It is also noticeable that nowadays one can gain a lot of more knowledge simply staying at home in from of the computer. One can argue that the education of the future will be characterized by interactivity, pragmatism and quick adaptation to the new situations and contexts [Szpunar 2006]. It is in fact internet, with its opportunity of immediate contact via e-mail, discussion boards, web fora, chats and social networking, simplified and abridged communication between people [Pereira, 2012]. Modern technologies change also the educational approach and gain finer importance in university pedagogy [Ramos, Coppola 2009].

The objective of this paper is the assessment of students' use of mobile devices in their learning process. The investigation covered the type of the device used and the frequency and type of use, i.e. what the students use them for. The investigations of the use of computers in the learning process have been undergoing since 2009 [Lorencowicz, Kocira 2009; Lorencowicz et al. 2015].

Material and Methodology

The data used in this paper was collected in academic year 2014/2015 from students of the Faculty of Production Engineering of the University of Life Sciences in Lublin, Poland. The students registered for the following programmes: Safety Engineering, Chemical and Process Engineering, Geodesy and Cartography, Agricultural and Forestry Engineering, Transport, and Management and Production Engineering. The majority of students were from the undergraduate programmes (Year 1 to Year 4) – 88.3% although there were also 11.7% students from postgraduate programmes (master's level).

A diagnostic survey was used to collect data, with survey as the technique. Diagnostic survey is one of the most popular methods in social studies research. The method allows collecting information about functional and structural features and also the dynamics of social processes, opinions and views of a specific group of people. It applies many techniques, including survey, interview or analysing the documents. The method implies and determines the selection of the appropriate research technique [Szczepanowska, Fiedler 2010]. A questionnaire was employed as a tool in the current survey.

The survey covered 503 undergraduate and masters' full time students. Structures of the sample as a function of the academic programme and the level of study are presented in Figs 1 and 2. A paper questionnaire was administrated among the students at the end of a few lectures. The response rate achieved was 100%.

In terms of the programme of study, the largest group represented students of Management and Production Engineering (33.6%), followed by Agricultural and Forestry Engineering (27.8%) and Geodesy and Cartography (21.5%). In terms of the level of study, the majority of students were in their first or second year of undergraduate study (a total of 69.2%).

The comparison between students' ownership of desktop computers and notebooks and also access to internet at their place of residence between years 2009 and 2015 are presented in Fig. 3. The data indicates that the number of students owning a desktop computer dropped almost three times (from 60.3% to 22.9%). At the same time the ownership of a notebook has doubled as the percentage increased from 39.1% in 2009 to 79.9% in 2015. Some of the students have both types of computers, with 17.3% of desktop owners declaring also possession of a notebook. Almost all of the respondents to the survey declare that they access to internet in their place of residence (97.4% in 2015). In 2009 such access was declared by 86% of students. The increase in numbers, both in the ownership of the hardware and access to internet, is obviously related to the general spread of digital technologies, decrease of purchase prices on individual products and general development of internet services.

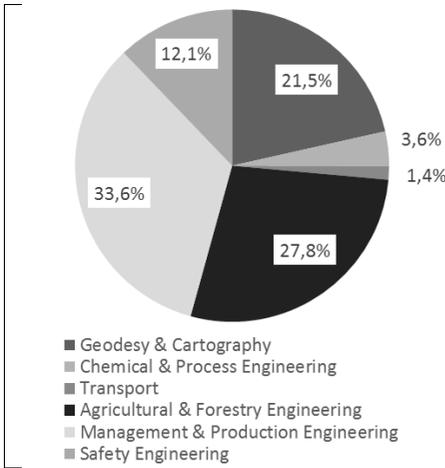


Fig. 1. Distribution of students according to the programme of study

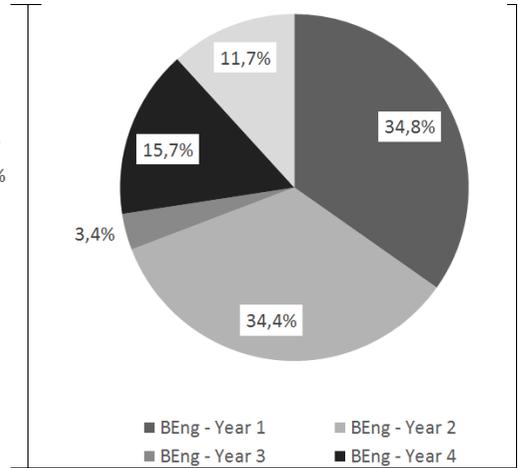


Fig. 2. Distribution of students according to the level of study

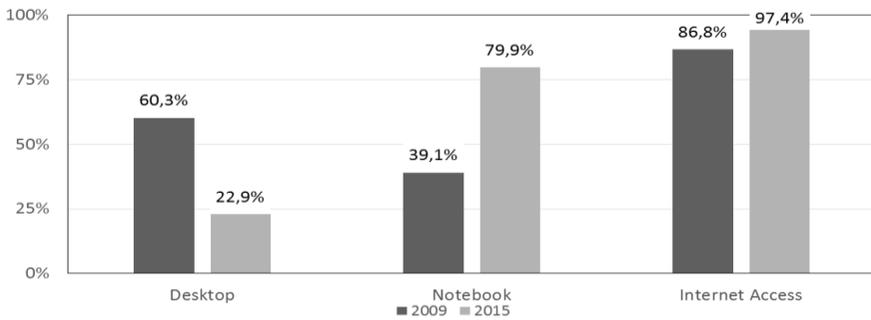


Fig. 3. Ownership of notebooks and access to internet by students in years 2009 and 2015

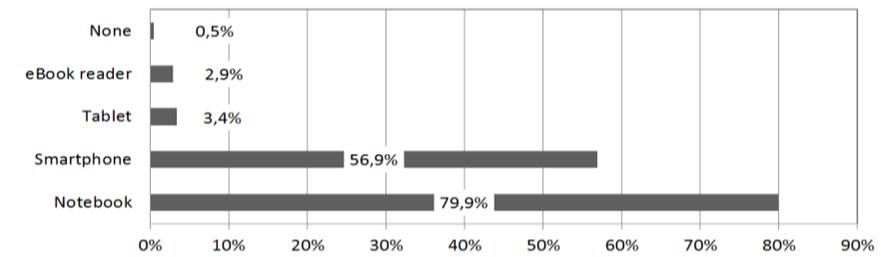


Fig. 4. Shows ownership of mobile devices declared by the students

The data proves that practically every student has at least one mobile device; only 0.2% indicated lack of any mobile device. A notebook is the most popular hardware with 80% of students having one; it is followed by a smartphone, owed

by 57%. The possession of both a notebook and a smartphone was declared by 45% of students. Tablet is not very popular as only slightly more than 3% of students acknowledge owning one. eBook reader is even less popular not reaching 3%, with none of 503 students declaring the possession of an eBook reader only. Approximately 15% of the respondents indicated the possession of multiple mobile devices with only 4 students declaring ownership of all four devices and approximately 10% ownership of notebook, tablet and smartphone.

Results

Usage of mobile devices

Overall, 91.1% of students declared using mobile devices during classes. The usage of mobile devices is presented in Fig. 5, whereas Fig. 6 presents the frequency of use; term ‘classes’ covers both lectures and tutorials in different courses.

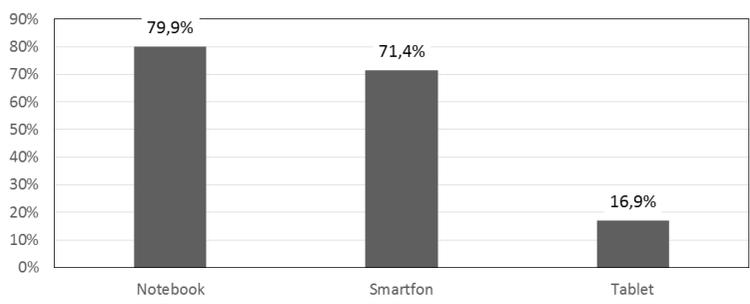


Fig. 5. Usage of mobile devices in classes (multiple choices were allowed)

Almost 80% of the respondents used notebooks in the learning process; also relatively high percentage used smartphones (71.4%) with fewer students using tablets (16.9%). Interestingly, whereas almost 17% students acknowledged using tablets in learning only 3.4% declared owing one.

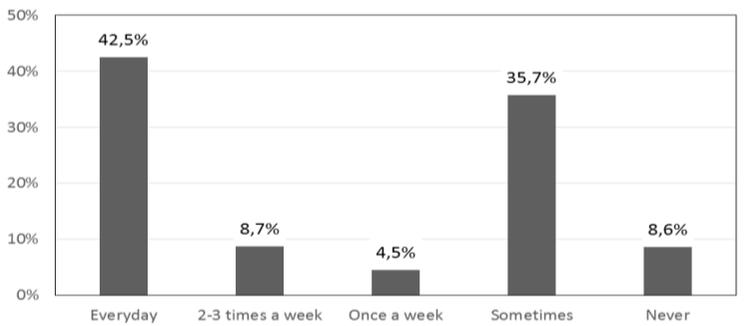


Fig. 6. Frequency of usage of mobile devices in classes

Students indicated that they did use eBooks during classes which is most likely due to its limited capability as they are almost solely dedicated to reading the text in the electronic format. The highest percentage of use by notebooks is easily understandable as they are very comfortable to use and available of software.

Mobile devices were quite frequently used during classes; 42.5% of the students reported using them every day, 35.7% said that they used them sometimes and only 8.6% declared never using such devices (Fig. 6). Only 6% of the students used mobile devices in both lectures and tutorials; the rest used them only either during lecturers or only during tutorials.

Student activities using a notebook

As shown in Fig. 7 the most common use of notebooks during classes were calculations (62.2%). It has to be noted that the term classes covers not only lecturers but also tutorials and practicals and lab experiments. Searching information related to classes (class research) was utilized by 36.8% students, whereas exchanging information on the studied topics (class communication) – 24.7%. Much less frequently a notebook was used for making notes (14.5%) and only 5% declared making audio recordings. Although little usage of notebooks for audio and video recording is not surprising but the low percentage of not even 15% of students using it for making notes indeed comes as a surprise. Video recording was also relatively popular reaching almost 15%.

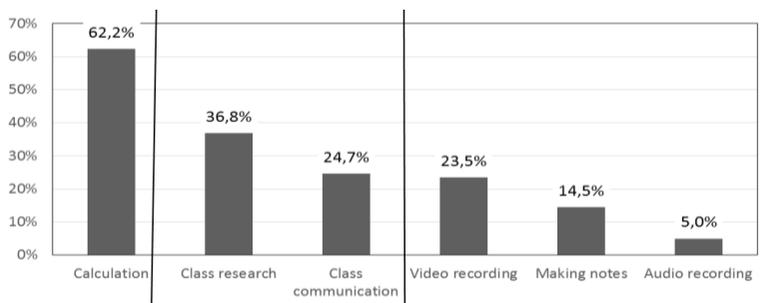


Fig. 7. Types of activities on notebooks during classes

Student activities using a smartphone

Smartphone was declared as the second most popular mobile device by students. It was mostly used for calculations (58.5%) but also for class related research (34.4%) and class related communication (24.7%). Once again, similarly to notebooks, making notes (14.5%) and especially audio recording (4.2%) were not popular. Video recording was more popular than for notebooks reaching 23.3%.

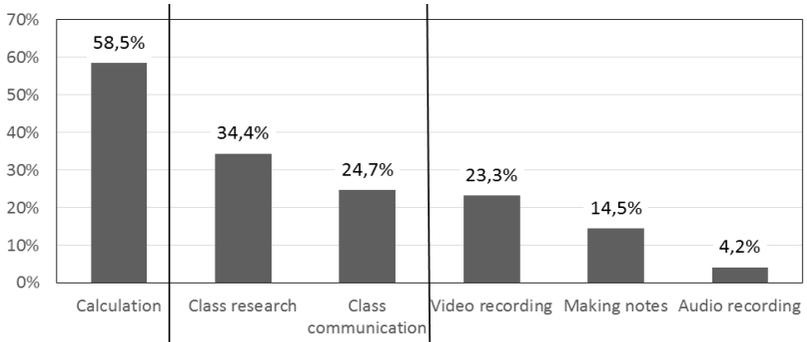


Fig. 8. Types of activities on smartphones during classes

Student activities using a tablet

Tablets were not as popular in class use as notebooks or smartphones as only 16.9% of students declared using them. The low tablets usage may be related to the fact that smartphones have similar functions and sizes as some of the smartphones. Fig. 9 shows type of activities performed by used in classes using tablets.

As in other devices, the most popular type of activity was performing calculations (58.5%), followed by class research (34.4%) and class communication (24.7%), and video recording (23.3%). Again, notes taking was not as popular as expected (14.5%) with only 4.2% of students using the device for audio recording.

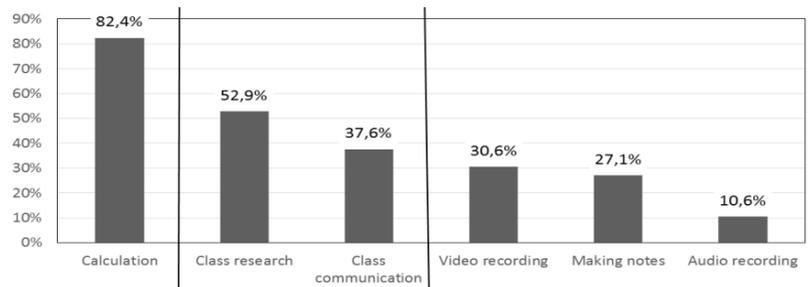


Fig. 9. Types of activities on tablets during classes

Usage of mobile devices for activities not related to educational activities

Mobile devices were also used during lectures and tutorials for activities not related to classes. The activities covered research (27.6%) and communication (22.1%) not related to educational pursuits. Disturbingly almost 21% of students admitted to use mobile devices for cheating during classes (Fig. 10).

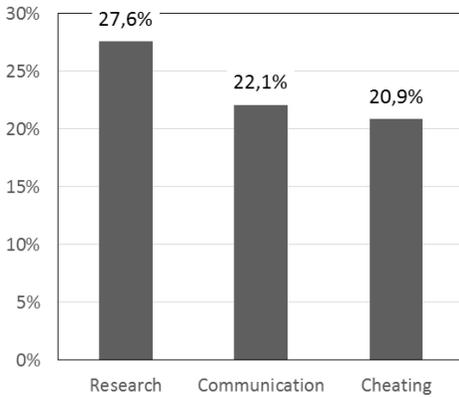


Fig. 10. Activities during classes not related to education

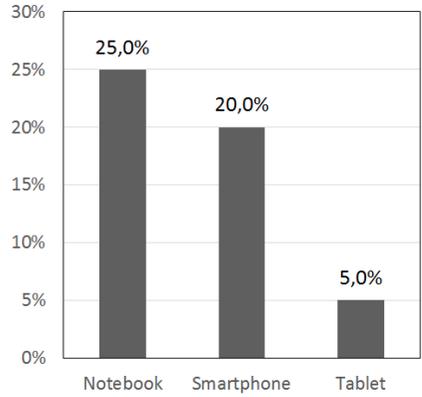


Fig. 11. Usage of mobile devices in classes for activities not related to education

Discussion

The aim of the investigations was to establish students' use of mobile devices in the educational processes, and in particular during formal classes (lectures, tutorials and lab experiments). From the survey it is clear that practically all students use mobile devices during classes (91%), although the usage varies. Only 9% of students state that they never use mobile devices during classes. The result of overall use of mobile devices is much higher than 66.2% reported by Roberts and Rees at Bond University, Australia in 2014. It is closer to 89% found at Abilene Christian University in 2011 [Abilene Christian University 2011].

Most of the students use them on every day basis (43%). Mobile devices are mainly used as tools for searching information related to courses. The most popular devices used during classes are notebooks (ca 80%) and smartphones (above 70%). The percentages are again much higher than those reported by Roberts and Rees at Bond University, Australia in 2014 (30% and 33%, respectively). The numbers are not only higher but also show the prevalence of notebooks over smartphones.

Unlike results reported by other researchers the most popular usage of mobile devices was for calculations. It can be attributed to the fact that the questions in the survey covered not only lectures but also tutorials and lab experiments. Also, the study was done for the population of students registered only for engineering programmes. The study confirmed however the popularity of using the mobile devices for searching information and communication related to courses and not related to educational activities. That follows the argument by Weaver and Nelson [2005] and Hall and Elliot [2003] that the main advantage of mobile devices is their ability to search information on-line in the educational process.

The low use of mobile devices, and especially notebooks, for audio recording and particularly for making notes has come as a genuine surprise. The expectation was that, similarly to other studies, notebooks would be most frequently used for taking notes [Roberts, Rees 2014]. However irrespective of the type of the device the note taking was always the second least popular activity reaching 27% only for tablets and being as low as 14.5% for both notebooks and smartphones.

Class research and class communication was, after calculations, the most popular activity on all mobile devices listed in the questionnaire. The class research took the following percentages of users: 36.8% – for notebooks, 34.4% – for smartphones and 52.9% – for tablets. Whereas for the class communication the percentages were: 24.7% – for notebooks, 24.7% – for smartphones, 37.6% – for tablets.

Video recording was apparently for all devices more popular than traditional note making. Based on the discussions with students the video recording was used as type of creation of records for different classes. That type of activity was most popular for tablets (30.6%) and being almost the same for notebooks and smartphones (both ca 23%).

Audio recording was the least popular activity on all devices, reaching 10% only on tablets and staying as low as 5% for both notebooks and smartphones. Once again, from the discussions with students, it was used for record making.

Considering that both video and audio recording were modern type of creating the class records the picture of class notes is indeed slightly different. Fig. 12 shows combined class notes making for different devices, where the traditional notes making (although in the digital form) were combined in video and audio recording. The results obtained show probably more realistic image of recording information during classes.

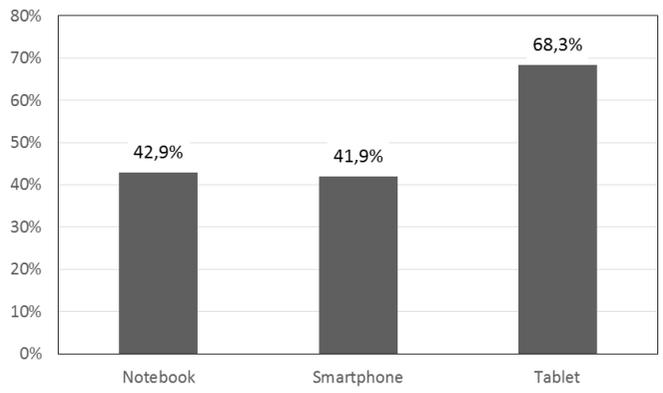


Fig. 12. Use of mobile devices for preparing class records

Computers, including mobile devices, are largely considered as very useful tools helping students in their education [Traxler 2010]. However, there are also undesirable although may be rather obvious applications of such devices. One of the most unfortunate uses is cheating; that applies mainly to smartphones but not only. In the study 21% of students responding to the survey admitted using mobile devices for academically dishonest actions. Although the results is not novel [Campbell 2006; Nyamawe, Mtonyole 2014], it is undeniably a very serious problem which may even increase with the development of mobile devices. Special attention to further investigate and find some remedies for that concern is highly recommended.

Conclusions

The study confirmed high usage of mobile devices for searching information and communication in the educational process. It also proved continues growth in the ownership of computers by students and their access to internet. That supports statements by Oblinger [2004] that the current student generation are highly digital literate and are used to work in the digital environment as a result of growing up in an IT and media-rich environment. The similar conclusions were drawn by Lorencowicz et al. [2014].

Mobile devices are very popular and are ever-present in students' lives. Students eagerly use mobile devices in their learning for research and communication. The devices also help them to organise and plan courses, access to knowledge and contact with their peers. Similarly, Chao and Cheng [2009] showed that mobile phones are effective supportive tools to augment paper-based learning and could support students' planning and management of learning strategies or activities. They also argue that the portability of mobile phones may provide the flexibility in planning ahead for suitable learning strategies or activities and may enhance students' assessment for management of students' learning goals.

The data collected during the investigation reveal an alarming problem of using mobile devices in cheating. Although mainly used for research, communication or pleasure students quite often use smartphones to cheat through using their improving features. A separate study to investigate the issue and to recommend several solutions is needed on that particular aspect of mobile devices usage by students.

The data shows once again that each country may have different results depending on its historical and cultural context [Mac Callum, Jeffrey 2013]. Moreover, it is also necessary to continuously analyse the situation in order to adapt educational processes to changing environment. Investigations done by the authors as well as reported in the literature [Martin et al. 2011] prove that it is difficult to predict the direction of technological advancements. For instance

study done in 2009 [Lorencowicz, Kocira 2009] did not even include mobile devices in the survey as such devices were hardly available and not popular. Since then the popularity and accessibility, due to technological development, social changes related to students' usage and mainly due to drop in price, increased tremendously and mobile devices were included in the surveys. As such changes are inevitable further research in the applications and effectiveness of mobile devices in educational processes.

Literature

- Abilene Christian University (2011), *2010–11 Mobile Learning Report*, http://www.acu.edu/technology/mobilelearning/documents/ACU_M-_2010-11.pdf (20.04.2014).
- Ally M. (red.) (2009), *Mobile Learning: Transforming the Delivery of Education and Training*, Edmonton, Canada.
- Annan-Coultas D. (2012), *Laptops as Instructional Tools: Student Perceptions*, „TechTrends” no. 56(5).
- Campbell S. (2006), *Perceptions of Mobile Phones in College Classrooms: Ringing, Cheating, and Classroom Policies*, „Communication Education” no. 55(3).
- Chao P., Chen G.D. (2009), *Augmenting Paper-Based Learning with Mobile Phones*, „Interacting with Computers” no. 21(3), DOI: 10.1016/j.intcom.2009.01.001
- Dickerson A., Green F. (2004), *The Growth and Valuation of Computing and Other Generic Skills*, „Oxford Economic Papers” no. 56.
- Feiner J. (2012), *Metodyczne aspekty wykorzystania technologii informacyjnej w procesie kształcenia studentów AGH*, <http://winnitbg.bg.agh.edu.pl/skrypty/0037/cz4-r39.pdf>. (22.03.2015).
- Foster A. (2008), *Law Professors Rule Laptops out of Order in Class*, „The Chronicle of Higher Education” no. 54.
- Gulek J.C., Demirtas H. (2005), *Learning with Technology: The Impact of Laptop Use on Student Achievement*, „Journal of Technology, Learning, and Assessment” no. 3(2).
- Hall M., Elliott K. (2003), *Diffusion of Technology into the Teaching Process: Strategies to Encourage Faculty Members to Embrace the Laptop Environment*, „Journal of Education for Business” no. 78(6).
- Joo Y.J., Lim K.Y., Lim E. (2014), *Investigating the Structural Relationship Among Perceived Innovation Attributes, Intention to Use and Actual Use of Mobile Learning in an Online University in South Korea*, „Australasian Journal of Educational Technology” no. 30(4).
- Kinash S., Brand J., Mathew T. (2012), *Challenging Mobile Learning Discourse through Research: Student Perceptions of Blackboard Mobile Learn and iPads*, „Australasian Journal of Educational Technology” no. 28(4).
- Koszel M., Kocira S., Lorencowicz E. (2015), *Zmiany w technikach komunikacji internetowej studentów*, „Edukacja – Technika – Informatyka” nr 4(14).
- Lorencowicz E., Bejgrowicz A., Kocira S., Lorencowicz H. (2013), *Use of Information Technology by Selected Polish and Portuguese Students*, „Polish Association for Knowledge Management. Series: Studies & Proceedings” no. 67.

- Lorencowicz E., Kocira S. (2009), *Wykorzystanie komputerów i Internetu przez studentów studiów o profilu rolniczym*, „Inżynieria Rolnicza” nr 9(118).
- Lorencowicz E., Kocira S., Uziak J., Tarasińska J. (2014), *Application of ICT by Students at Selected Universities in Poland*, „TOJET: The Turkish Online Journal of Educational Technology” no. 13(4).
- Lorencowicz E., Koszel M., Kocira S., Uziak J. (2015), *Changes in ICT Use by Polish Students from Life Sciences University*, „Procedia – Social and Behavioral Sciences” no. 176.
- Luther J. (2012), *Laptop Bans in Class Receive Mixed Reaction*, <http://www.dukechronicle.com/article/laptop-bans-classes-receive-mixed-reaction> (27.03.2015).
- Mac Callum K., Jeffrey L. (2013), *The Influence of Students' ICT Skills and Their Adoption of Mobile Learning*, „Australasian Journal of Educational Technology” no. 29(3).
- Martin S., Diaz G., Sancristobal E., Gil R., Castro M., Peire J. (2011), *New Technology Trends in Education: Seven Years of Forecasts and Convergence*, „Computers & Education” no. 57(3 1893–1906), DOI: 10.1016/j.compedu.2011.04.003.
- Maxwell N. (2007), *From Facebook to Folsom Prison Blues: How Banning Laptops in the Classroom Made Me a Better Law School Teacher*, „Richmond Journal of Law & Technology” no. XIV(2).
- McCreary J.R. (2009), *The Laptop-Free zone*, „Valparaiso University Law Review” no. 43.
- Motiwalla L.F. (2007), *Mobile Learning: A Framework and Evaluation*, „Computers & Education” no. 49(3).
- Murray K.E. (2011), *Let Them Use Laptops: Debunking the Assumptions Underlying the Debate Over Laptops in the Classroom*, „Oklahoma City University Law Review” no. 36.
- Nyamawe A.S., Mtonyole N. (2014), *The Use of Mobile Phones in University Exams Cheating: Proposed Solution*, „International Journal of Engineering Trends and Technology” no. 7(1).
- Oblinger D. (2004), *The Next Generation of Educational Engagement*, „Journal of Interactive Media in Education” no. 8.
- Pereira B. (2012), *O uso das tecnologias da informação e comunicação na prática pedagógica da escola*, <http://www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/1381-8.pdf> (14.03.2015).
- Ramos M., Coppola N.C. (2009), *Uso do computador e da internet como ferramentas pedagógicas*, <http://www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/2551-8.pdf> (14.07.2012).
- Roberts N., Rees M. (2014), *Student Use of Mobile Devices in University Lectures*, „Australasian Journal of Educational Technology” no. 30(4).
- Robinson L. (2009), *A Summary of Diffusion of Innovations*, http://www.enablingchange.com.au/Summary_Diffusion_Theory.pdf (1.06.2015).
- Schepman A., Rodway P., Beattie C., Lambert J. (2012), *An Observational Study of Undergraduate Students' Adoption of (Mobile) Note-Taking Software*, „Computers in Human Behavior” no. 28.
- Stas T. (2012), *Możliwości wykorzystania kodów dwuwymiarowych w dostępie do informacji za pomocą urządzeń mobilnych [w:] Odpowiedź pokolenia Y na zmianę wzorców komunikacyjnych*, http://www.ue.katowice.pl/uploads/media/9_T.Stas_Mozliwosci_wykorzystania_kodow_dwuwymiarowych.pdf (19.03.2015).
- Szczepanowska E., Fiedler M. (2010), *Internet jako medium o doniosłym wpływie na zdrowie człowieka u progu dorosłości [w:] Dziedzictwo kulturowe: historyczne podróżowanie i współ-*

czesne aspekty turystyki, Szczecin, http://www.wydawnictwo.wsb.pl/sites/www.wydawnictwo.wsb.pl/files/czasopisma-tresc/SP_4_calosc.pdf (5.04.2016).

- Szpunar M. (2006), *Internet a nowoczesna edukacja – czy istnieje jakaś alternatywa?*, „SCENO. Zeszyty Naukowe” nr 2, http://www.magdalenaszpunar.com/_publikacje/2006/internet_a_nowoczesna_educacja.pdf. (14.03.2015).
- Traxler J. (2010), *Students and Mobile Devices*, „ALT-J, Research in Learning Technology” no. 18(2).
- Uziak J. (2009), *Acceptance of Blackboard Technology by Mechanical Engineering Students at the University of Botswana*, „International Journal of Engineering Education” no. 25(1).
- Walczak M., Uziak J., Oladiran M.T., Baeza C.C. & Paez P.T. (2013). Industry Expectations of Mechanical Engineering Graduates. A Case Study in Chile. *International Journal of Engineering Education*, 29 (1), 181–192.
- Weaver B.E., Nilson L.B. (2005), *Laptops in Class: What Are They Good for? What Can You Do with Them?*, „New Directions for Teaching and Learning” no. 101.
- Yamamoto K. (2008), *Banning Laptops in the Classroom: Is it Worth the Hassles?*, „Journal of Legal Education” no. 57.
- Yau H.K., Cheng A.L.F. (2012), *Students' Age Difference of Confidence in Using Technology for Learning in Higher Education*, „TOJET: The Turkish Online Journal of Educational Technology” no. 11(3).
- Young J. (2009), *Teaching in Twitter: Not for the Faint of Heart*, „The Chronicle of Higher Education”, <http://www.chroniclereaders.com/article/Teaching-With-Twitter-Not-for/49230/> (2.06.2015).