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Evaluation on the use of e-learning tools (ICT Tools) to support teaching and learning in aquaculture and aquatic sciences education
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Abstract:	The study aimed to capture a snapshot of the status of educational means used in teaching and learning in the area of aquaculture, fisheries and aquatic resources management at European level, with specific consideration on the use of Information and Communication Technologies and e-learning tools. To achieve this goal, an online survey was compiled and made available to teachers and students across Europe. In total, teachers from 31 institutions and students from 40 institutions participated in this survey. This paper presents the findings, considers trends and poses further questions for sector stakeholders to help in the development of future programmes and support. In summary it can be concluded that few teachers have a comprehensive knowledge of the wide range of ICT tools available and can make use of e-learning tools with complete confidence. There is therefore a real and urgent need to "train the trainers" to use ICT in their teaching environments. From the students' end, there is a strong desire to learn more about the application of e-learning tools and to use them in their learning process.

Evaluation on the use of e-learning tools (ICT Tools) to support teaching and learning in aquaculture and aquatic sciences education

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ABSTRACT

The study aimed to capture a snapshot of the status of educational means used in teaching and learning in the area of aquaculture, fisheries and aquatic resources management at European level, with specific consideration on the use of Information and Communication Technologies and e-learning tools.

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KEY WORDS

ICT, e-learning, teaching, education, Web 2.0, aquaculture, aquatic sciences, b-learning

ABBREVIATIONS

ICT- Information and Communication Technologies

LMS - Learning Management Systems

PDA - Personal Digital Assistant

PDF – Portable Document Format

Web - World Wide Web

INTRODUCTION

In recent decades, the widespread use of computers, tablet computers, mobile phones and other mobile devices paired with the evolution of Web 2.0 has opened new avenues for the application of digital e-learning tools which are expected to change both the teaching and learning experiences.

Kirkwood and Price (2014) showed that while technology has increasing influence throughout higher education, there is still much to be learned about its effective educational contribution.

The present study was conducted in order to acquire detailed information about the present status of the use of e-learning and ICT amongst the two main groups involved in the learning process (teachers and students). Specifically, the use of a selection of digital tools was analysed: Microsoft PowerPoint, email, word processing, LMS, blogs, online forums, audio & video podcasts, wikis, multimedia sharing platforms, voice-over-IP systems, games/simulations, electronic portfolio and social media. In addition, the emerging use of smartphones (or mobile handheld devices) in the educational area was assessed.

Since some of the above-mentioned tools are widely used and readers of this study are probably already acquainted with them, word processing, online forums and e-mail are not further explained. The rest are briefly described in the following paragraphs.

Microsoft PowerPoint is the quasi-standard for digital slide presentations. It can be considered as an evolution of overhead transparencies. Major advantages of PowerPoint compared to transparencies are the flexibility of the preparation process, the options to introduce graphs and multimedia elements and the options to re-use existing slides (Bartsch and Colbern 2003).

LMS are software applications for the administration, documentation, tracking, reporting and delivery of e-learning education courses or training programmes. Digital LMS were mainly created to manage learning content in a central location. Teachers and students can up-and download learning resources and can use collaborative tools. The most common LMS at present are Moodle and Blackboard.

A **blog** (a truncation of the expression web log) is a discussion or informational site published on the World Wide Web and consisting of discrete entries ("posts") typically displayed in reverse chronological order (the most recent post appears first). In education, a blog can be used to publish articles for discussion, including links to other sites of interest, and others can leave responses. The TACCLE project (2009) considers that blogs can be used as a two-way tool to allow interaction between the writer and the reader because they incorporate features that allow readers to comment or offer feedback on what the blogger has written. There are many free applications available (e.g. WordPress, Blogger), which can be used to create a blog.

A **podcast** is a digital medium consisting of an episodic series of audio, video, PDF, ePub, etc. files that end users can subscribe to through web syndication or using special software known as a podcatcher (e.g. iTunes, Feedbook). A podcast can be played online or alternatively downloaded to a computer or a mobile device for on-demand offline playback. The word "podcast" derives from "POD" (play on demand) and "broadcast". The success of the iPod$^{©}$ device popularised the term podcast, as audio podcasts are often listened to on portable media players. One well-known open access application to produce audio podcasts is *Audacity*.

A **wiki** is usually a web application which allows people to add, modify or delete content in collaboration with others. While a wiki is a type of content management system, it differs from a blog or most other similar systems in that the content is created without any defined owner or leader, and wikis have little implicit structure, allowing structure to emerge according to the needs of the users. The TACCLE project (2009) describes the features of a Wiki as follows; "knowledge is transitory and not static; there is always some new piece of information to add, some old piece to delete or revise and so on."

Mobile handheld devices are handheld devices that can store, process and access data, such as smartphones, conventional mobile phones, tablet computers or personal digital assistants (PDAs).

Multimedia sharing platforms are online applications that allow authors of multimedia materials to share them with other users. They usually offer several levels of accessibility, i.e. materials can be made available to the general public or they can be restricted to smaller audiences. Numerous applications are available on the web to **share digital products** such as photos, videos, sound clips and slide presentations, either with the wider public or with closed user groups where access is provided upon invitation. These applications can e.g. be used by teachers to share learning resources with students or for exchange of learning materials among the student community. Some of the best known platforms are video portals - *YouTube*, photo sharing portals - *Flickr* and slide presentation sharing portals - *Slideshare*.

Voice over Internet Protocol (VoIP) is a methodology and a group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet. One of the most extensively used applications is *Skype*.

Online games and simulations attempt to reproduce "real life" situations and can thus be used for training, analysis, or prediction purposes. For instance, in aquaculture, simulations can be used to illustrate the design and management of a fish production facility (Ernst *et al.*, 2000). An example is the POND simulation tool (www.longline.co.uk/site/products/aquaculture/pond).

An **electronic portfolio** (also known as an eportfolio, e-portfolio, digital portfolio or online portfolio) is a collection of electronic evidence of the user's abilities and a platform for self-expression. Online versions can be dynamically updated over time and some e-portfolio applications offer varying degrees of audience access, so the same portfolio might be used for multiple purposes. A popular e-portfolio application is *Mahara*.

A **social networking service** is a platform to build social networks or social relations among people who, for example, share interests, activities, backgrounds or real-life connections. A social network service consists of a representation of each user (often a profile), his/her social links and a variety of additional services. Online social networking sites are web-based services that allow individuals to create a public profile and link up with other users to share contents and comment on common-interest subjects within the system. The most popular online social media at present are *Facebook*, *Twitter*, *LinkedIn* and *Google+*.

This study was conducted by members of workpackage 5 (J Bostock, J Dhont, C Dove, J Heikkinen, M Moulton, J Pirhonen, G Santos, S Seixas, B Ueberschaer) during phase II of the AQUA-TNET 2 network project (2008-2011) and parts of the results are in reported in Jacobs et al. (2011). The aim of AQUA-TNET's workpackage 5 was to promote the use of innovative teaching tools (digital tools and ICT in general) in aquaculture and aquatic sciences. The specific aim of this study was to evaluate the current use of a selection of e-learning tools and ICT among the members of the AQUA-TNET community.

METHODOLOGY

A survey consisting of two questionnaires (one targeting teachers and the other students from the AQUA-TNET community) was launched in 2010.

Two different online questionnaires were created using the web-based tool *Limesurvey* and later hosted online in the AQUA-TNET portal (www.aquatnet.com) from January to March 2010.

The questionnaires were divided into three sections: Section 1 was designed to collect personal information, such as gender, age, academic level of the teaching staff and, in the case of students, the level of their academic studies. Section 2 was designed to assess respondents' confidence in using ICT. Section 3 was the most significant; teachers and students were asked to describe their current use of e-learning tools and ICT in general. Teachers were also asked which assessment methods they used (ICT-based methods or conventional classroom methods).

The questionnaires were pre-tested with a sub-sample of AQUA-TNET members prior to the full-scale implementation of the survey.

RESULTS AND DISCUSSION

Respondents' profiles

Teachers

134 respondents participated in the teacher survey. 73 full responses were received from 31 different European institutions.

The average age of teachers was 47 years, ranging from 27 to 64.

60% of respondents were male and 40 % female.

Respondents were mainly researchers with some teaching commitments (Figure 1).

(Figure 1)

Most were involved in both teaching and research. The teaching-research ratio varied for individuals depending on their own preferences, institutional policies and the time required to apply for research funding, write project reports, scientific papers, etc.

The item "*Academic level*" was intended to gather information about the academic level of the courses taught by the respondents. However, most respondents understood that their own level of education was requested. Thus, the results were not usable. Nevertheless, from the responses it could be concluded that all levels of teaching (B.Sc., M.Sc., Ph.D., vocational, etc.) were represented among the respondents.

Table 1 summarizes the results of question 3 "*How much time do you spend on teaching*?".

(Table 1)

Students

There were 411 student respondents to the survey from over 40 European institutions. 217 returned full responses and 194 answered some of the questions. This is the reason why the number of respondents for each question may vary.

The average age of the responding students was 27 years, ranging from 18 to 61. 54% were males and 46% females.

The educational level of responding students is depicted in Figure 2. The majority of them were enrolled in full-time M.Sc. degree courses.

(Figure 2)

Students on lifelong learning courses (LLL) were more or less split evenly between those on part-time and those on full-time courses. This result was expected because many of these students are professionals who take up their LLL courses to upgrade their skills.

Use of computers and digital tools

It was hardly unexpected that teachers' answers to the question "*How often do you use the following computer/internet applications to support your teaching*?" showed that PowerPoint (presentations) was rated as the most popular digital tool in teaching; other commonly used tools were word processors and e-mail clients (Table. 2). PowerPoint can be considered as an evolution from overhead transparencies, with options to introduce multimedia elements. Nevertheless, PowerPoint is still used mostly in old-school type of teaching, where teachers

deliver lectures as monologues. Isseks (2011) states that this approach does "little to promote creative thinking—or any thinking at all".

LMS are now widely implemented and Universities are amongst their main users. Thus, experience of their use in higher education is increasing, including the associated forums and blog tools.

A study conducted at the University of Applied Sciences of Upper Austria concluded that a type of blog, called microblogging (less than 140 characters) has great potential for the future by expanding teaching and learning beyond the classroom (Ebner *et al.* 2010)

Podcasts are rather lower-ranked tools (Table 2) but Zanten *et al.* (2012) argued that the application of podcasting for educational purposes is growing fast in universities. Podcasting is also a great way of allowing students to share their work and experiences over the Internet (TACCLE, 2009).

(Table 2)

LMS have been recently introduced to support blended-learning (b-learning), a mix of traditional face-to-face learning in the classroom with e-learning. Answers to the question "*How often do you use blended learning?*" are shown in Figure 3. The results demonstrate an average score of 3.14 (based on a ranking scale between 1 (never) and 5 (frequently)).

(Figure 3)

40% of teachers make regular use of b-learning and 47% use it sometimes or occasionally. The results suggest, nevertheless, that blended learning is gaining in popularity.

In the student questionnaire, one of the first questions was aimed at evaluating the general skills of students in using digital hardware (mainly personal computers). The results show that over 75% of the students used them confidently or very confidently (Figure 4).

(Figure 4)

The next question in the student questionnaire aimed to acquire information about the digital tools and applications used by students at home, at school/University or on mobile devices. Table 3 shows that the widest variety of tools was accessed from home using a personal computer, while little use was made of mobile devices.

(Table 3)

Currently used teaching methods

In order to assess teachers' motivation, a question in the teacher survey requested respondents to rank the main reasons for using ICT in teaching. Results are shown in Table 4.

(Table 4)

This ranking shows that the teachers participating in this survey held traditional academic values in terms of wishing to stimulate students' thirst for knowledge and help them to develop capacities and skills in academic methods. The process of assessment and accreditation was not seen as the primary purpose of education by most respondents.

The next question requested information regarding the preferred teaching style and which and how often digital methods were used. Table 5 combines results from both the teacher and the student survey to compare their perceptions of how much use is made of different teaching methods.

(Table 5)

The overall rankings by teachers and students were relatively consistent and show newer on-line tools such as chats, forums and wikis as being least used.

Based on their overall teaching experience, teachers were asked to score the importance of a selection of learning activities in the students' learning process. Teacher perceptions of the importance (value) of different types of teaching methods were consistent with the answers provided for the previous question. Face-to-face learning, and particularly practical (usually lab) based learning were considered to be the most important. Private study was also amongst the highest ranked, most likely because it is pivotal in the process of acquiring knowledge and study skills. Contact with industry was also considered to be quite important, both via the Internet and face-to-face.

Given the teachers' overall assessment of these activities it was important to compare the perceptions of the students. Their scores for the same teaching/learning activities are shown in Table 6.

(Table 6)

Teachers were further asked about the training they had received in the use of computer/internet-based (learning) tools. 43 responses were received which indicated that over 50% of responding teachers had received some training, mostly relating to the LMS used by their institution and the associated principles of e-learning. There was little evidence of teachers being prepared for future increases in the use of video and audio content. For comparison, a study carried out by Zelick (2013) in the United States looked into faculty members' perception of Web 2.0 technologies on teaching and learning in higher education compared to traditional classroom teaching methods. The results demonstrated that only 36.7% agreed that using Web 2.0 technologies improved the quality of teaching, whereas 45.8% agreed that using Web 2.0 technologies enhances student's experiences.

Regarding students' opinions about the current use of computer/internet-based teaching in their courses, the majority of respondents felt that the use of ICT was either more or less right or below recommendable levels (Figure 5). However, nearly 27% felt they were either over-used or wrongly used. Problems in this area were not specifically identified, but subsequent discussions with smaller groups of students suggested that poor use of PowerPoint or the use of online materials as a substitute rather than as a supplement to face-to-face teaching might be examples of this.

(Figure 5)

Students considered that ICT is being used reasonably well to support administration, knowledge construction and associated learning, and rather less well to raise student confidence or stimulate social interaction (Table 7).

(Table 7)

The Zelick (2013) study demonstrated that the majority of the participants agreed that teaching courses using Web 2.0 technologies provides more flexibility than the traditional face-to-face method, with almost half agreeing that they are self-motivated and 34.5% strongly agreeing that they are self-motivated.

Assessment methods used

When teachers were asked which assessment methods they used, their answers showed that assessment is still substantially based on traditional exams and written assignments (Table 8), although student presentations to the class are also widely used and assessed. Little use is made of online assessment methods, peer assessment etc.

(Table 8)

Trends, activity and interest in developing and implementing innovative approaches

When teachers were asked if their teaching methods had changed over the past three years, 70% answered yes, but when asked if the tools had changed over the past three years, only 35% answered yes. The answers show that teaching methods are changing, although the rate of adoption of new tools is somewhat slower.

The teacher survey included two questions specifically designed to:

- assess the recent evolution of teachers' use of a selection of teaching methods

- forecast how teachers' use of these methods will continue to evolve in the near future.

The results can be seen in Table 9.

(Table 9)

The greatest change in the last three years appeared to be in the use of more private study, which is perhaps linked with the increase in available materials via the Internet. Increased interaction with industry and more lab work is also notable. The key decrease is in traditional face-to-face lectures.

Looking forward, teachers expected more contact with industry both face-to-face and via online interactions. The increased use of real-time video streaming of lectures is also envisaged, as well as more use of labs and private study. Interestingly, the use of more face-to-face learning (e.g. lectures and tutorials) was expected to increase by some, as well as the use of newer tools such as forums, chats and wikis.

According to the answers to the question "*Based on your overall teaching experience, what is the importance of the following activities for the students' learning process?*" the use of wikis was ranked below average. However, teachers' answers to recorded recent evolution and envisaged short-term evolution of teaching methods suggest a significant increase in the use of wikis. As a result, they ranked at higher-than-average levels.

A case study about the use of wikis in university (Hernández et al. 2014) in an e-learning environment proved that students consider that wikis are easy to use. Nevertheless, some difficulties were encountered when wikis were used to reflect different points of view on a particular issue. On the whole, the case study concluded that it is beneficial to use wikis in higher education.

Results suggest that blogs are used less than average compare with other tools. Although, a study by Chang and Chang (2014) revealed that this tool allows students to learn from their peers and teachers to follow the development of student skills over time.

Several questions were included in the questionnaires to gather information that would help understand the mechanisms that drive changes in teaching methods. The results are summarised in Table 10.

(Table 10)

The answers to this question suggest that changes in teaching methods are very much driven by the interests and motivations of individual teachers and the example set by peer groups rather than by external pressure from students or institutional policies.

Similarly, questions specifically designed to understand the constraints involved in the evolution of teaching methods were included in the questionnaires. The results are summarised in Table 11.

(Table 11)

Overall, teachers were neutral or slightly in agreement with most of the statements suggested to them. These were phrased as positives towards the introduction of new tools and methods. The main negative response was to the statement that teachers are being stimulated by their superiors.

Regarding teachers' interests in learning about new teaching tools, the following is a list of ICT-based tools that they would be eager to learn more about (in order of preference):

1. Learning management systems

2. Games/simulations

3. Forum

4. Sharing multimedia

5. PowerPoint

6. Wiki

7. Podcast

8. Word

9. Blog

10. Social network sites

11. Voice over IP

12. E-mail.

Interestingly, LMS gathered the most interest. This is in complete contradiction with the results obtained by Schoonenboom (2014), who ran a similar survey at Vrije University in Amsterdam. Her results showed a low interest in LMS and she justified this by arguing that teachers question the usefulness and user-friendliness of LMS.

Teachers generally expressed interest in learning about new tools if they were given the time to do so. When asked how they would like to learn about new teaching tools, teachers ranked the following delivery methods as the most popular:

- Workshops - 70%

- Web-based 68%

- Helpdesk 65%.

A majority of teachers (45%) were willing to spend at least one day learning more about ICT-based teaching tools and a further 28% were prepared to invest at least half a day.

A study into an efficient training of university faculty on ICT carried out by the University of the Basque Country also demonstrated the need to train teachers in the use of ICT in the learning environment (Lareki *et al.* 2010).

A question in the student questionnaire was specifically designed to assess if they had received any training on the use of the computer/internet-based tools available at their institutions. 67% answered yes and 32.8% answered no. This suggests that if not already done, training in the use of such tools should be included in their courses. There is also room for some improvement as the average score amongst students who had received some training was 3.24; which means that they considered the quality of the training they had received was average.

Regarding institutions' capacity to deliver courses using computer-based tools, students mostly scored it as average or above (Figure 6).

(Figure 6)

Figure 7 reflects students' opinions about the ability of their teachers to deliver courses using computer-based tools.

(Figure 7)

Overall the students gave a relatively balanced view on the adequacy of training and provision of ICT.

Table 12 shows how students ranked the teaching methods they found most effective in terms of the acquisition of knowledge, learning skills, developing an understanding of the subject and raising self-confidence.

(Table 12)

According to students' answers, the most effective methods are labs (practical work) and face-to-face teaching, followed by engagement with industry online. Wikis appear to be considered a more useful tool than discussion forums and chats for most learning objectives.

CONCLUSIONS

Results suggest that teachers tend to use the tools that they are already familiar with and they are generally satisfied with traditional teaching methods. Teacher training is thus needed concerning the potential of new teaching tools and methods and the benefits they provide to the learning experience.

Teachers broadly believe in the evolution of teaching methods, but at the same time they seem hesitant to start using new teaching tools.

However, there is evidence that only a few teachers have the necessary comprehensive knowledge of the wide range of available ICT to make use of e-learning tools with complete confidence. While ICT have an increasing influence throughout our entire life, there is apparently a real and urgent need to "train the trainers" to use ICT in their teaching environment.

Students showed confidence in their ICT skills and that they are familiar with the different applications which can be given to computer-based tools depending on the context (learning vs. leisure).

Results show that no significant use is being made of mobile tools in the learning environment. Mobile devices seem to be used to access the internet, but virtually no use is being made of them as a platform for learning or learning management.

Students generally held their study institutions in high regard. Institutions were considered well equipped in terms of ICT, and teachers were thought to possess the necessary ICT literacy to support the implementation of new teaching methods in higher education.

University teaching is evolving slowly with prominent use of PowerPoint presentations in lectures and increased use of LMS and e-mail to distribute materials to students and enhance communications.

Some universities have experimented with innovative technologies and teaching approaches in higher education. However, implementation in the area of aquaculture teaching and learning appears to be relatively limited.

Students regularly use ICT for social interactions and not so much for formal learning. Besides, the fact that they are regular users of ICT cannot lead to the conclusion that they are better able to use new technologies than teachers.

Opportunities for enhancing learning and improving efficiency through new tools are still under-appreciated.

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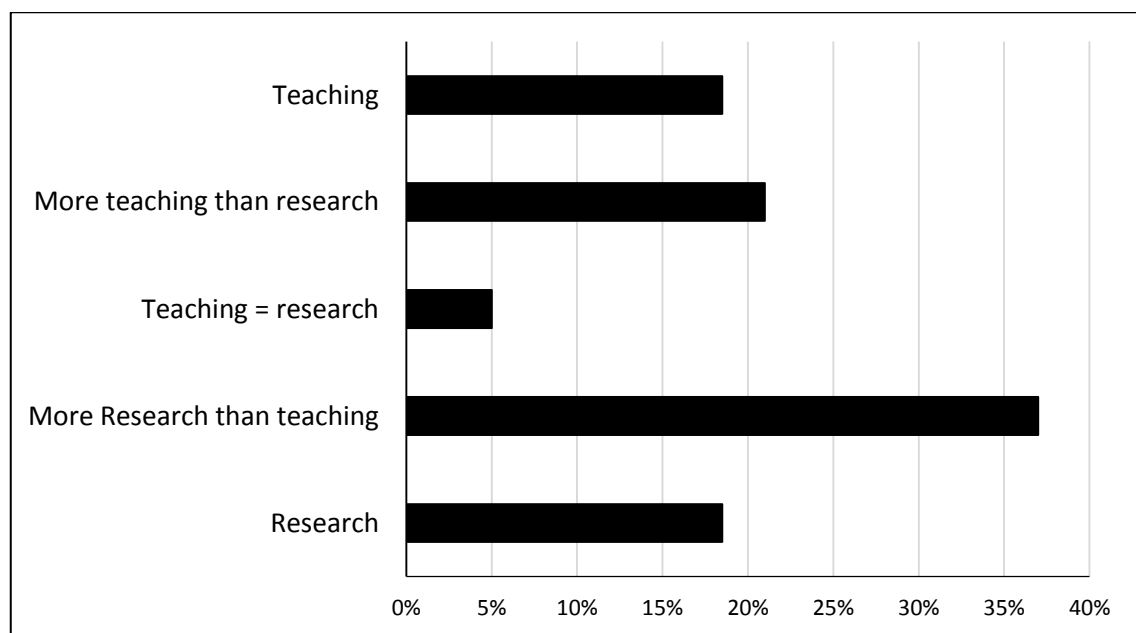Figure 1 - Primary commitments of participating teaching.

Figure 2 – Answers to questions "*What type of study programme are you involved in*" and "*Is your study programme full time or part-time?*"
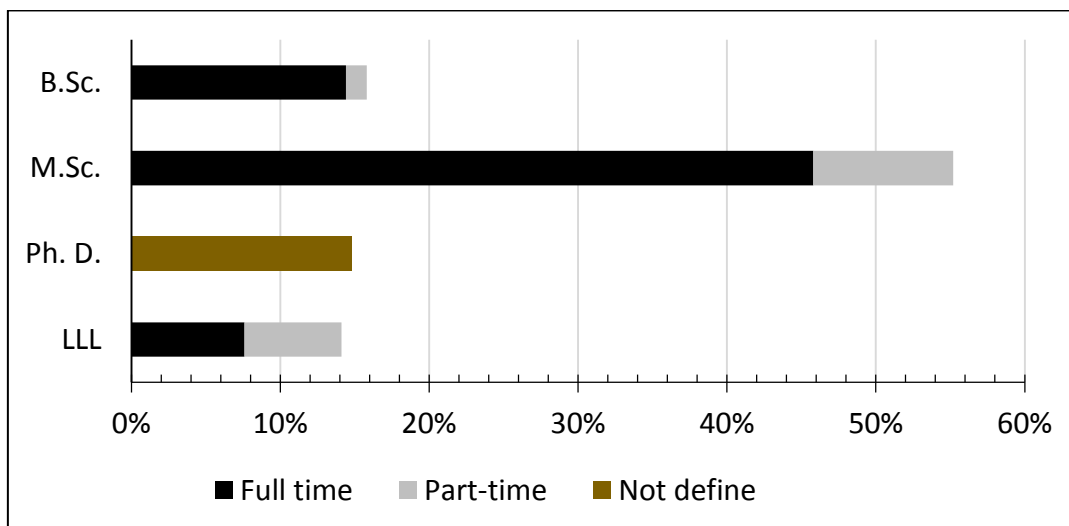
Figure 3 - Answers to the question "*How often do you use blended learning?*"
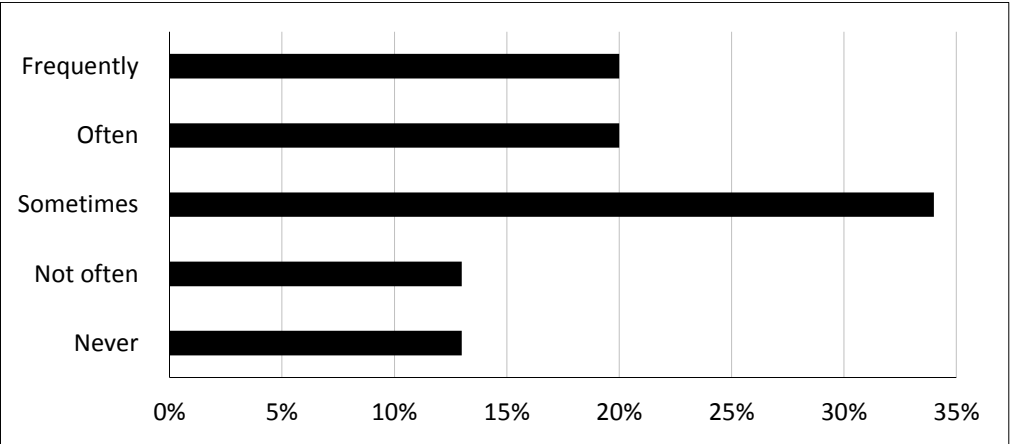
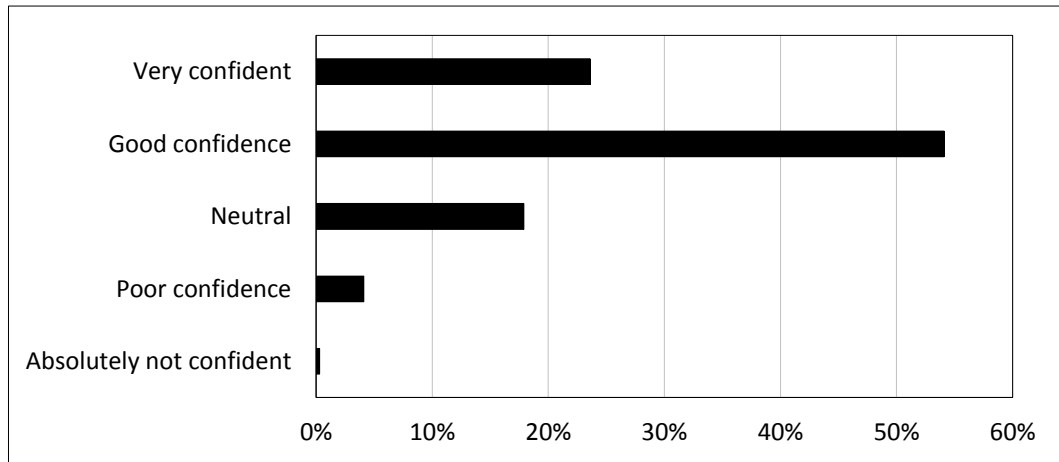Figure 4 - Answers to the question: *How would you rate your confidence in your computer skills?*

Figure 5 - Answers to the question "*What are your views about the current use of computer/internet-based teaching on your courses?*"
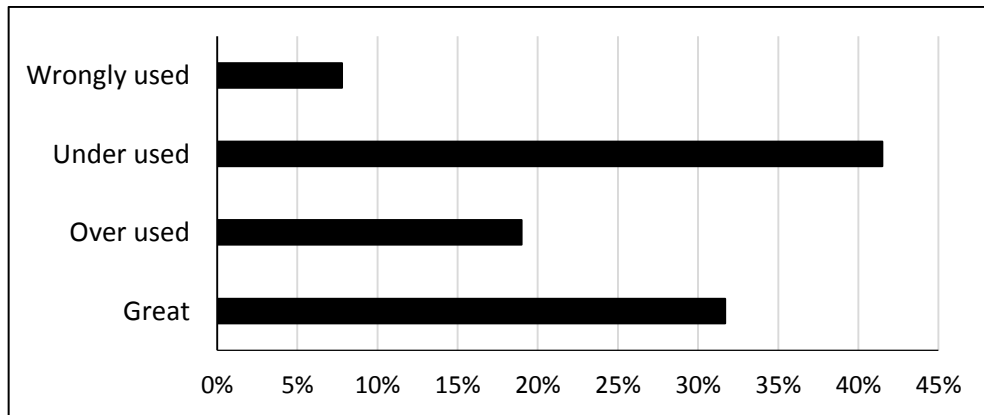
Figure 6 – Answer to the question "*Is the institution well prepared to deliver courses using computer-based tools?*"
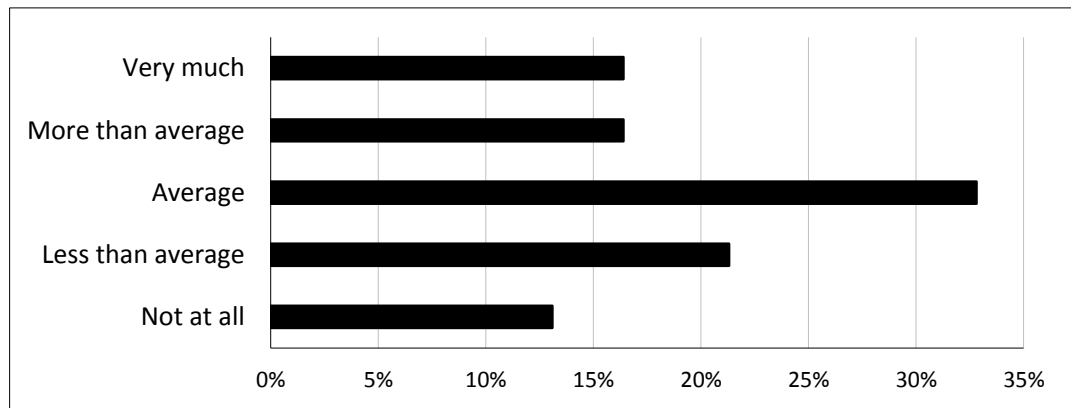
Figure 7 – Answer to the question "*Are the teachers well prepared to deliver courses using computer-based tools?*"
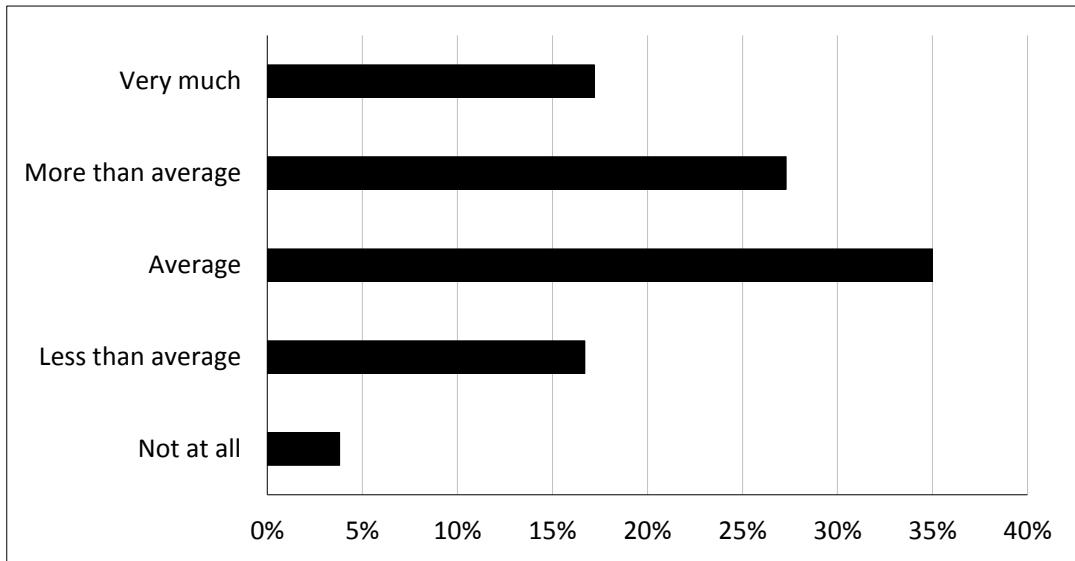
table

Table 1 - Time spent by teachers on teaching activities.

Occasional (less than 30 hours – 5 ECTS)	22,2%
At least one full course (30 to 120 hours – 5 to 20 ECTS)	38,3%
More than 3 courses (>120 hours – > 20 ECTS)	39,5%

Table 2 – Ranked answers to the question "*How often do you use the following computer/internet applications to support your teaching?*"

Ranking based on usage higher than average	Ranking based on usage lower than average
PowerPoint	Listening to a podcast
E-mail	Using a wiki
Word	Mobile handheld devices
Learning Management System	Sharing multimedia
Blogs	Voice over IP
Using a forum	Games/simulations
	Electronic portfolio
	Social network sites

Table 3. Answers to the question "*Which computer/internet programmes do you use on a regular basis to support your learning? (at home, at your college/university, and do you access it by mobile?)*". Darker shaded cells indicate low usage of these tools.

At Home	At School	By mobile devices
E-mail	E-mail	E-mail
Word	Word	Word
Powerpoint	Powerpoint	Powerpoint
Wiki	Wiki	SNS
SNS	SNS	Listening to podcast
Voice over IP	Forum	Sharing multimedia
Listening to podcast	LMS	Wiki
Sharing multimedia	Reading a blog	Voice over IP
Forum	Voice over IP	Forum
Reading a blog	Listening to podcast	Blogs
Games/simulations	Sharing multimedia	Electronic portfolio
LMS	Electronic portfolio	Games/simulations
Electronic portfolio	Games/simulations	LMS

Table 4 –Teachers' answers to the question "*The aim of my teaching is to…*

Options and score:

1. *Strongly disagree; 2. Disagree; 3. Neutral, 4. Agree; 5. Strongly agree*"

Items	Score (mean)
Stimulate students' thirst for knowledge	4,68
Coach students in their learning	4,68
Help students develop problem-solving skills	4,64
Transfer my knowledge to the students	4,18
Prepare students for work in industry or wider society	4,15
Instruct students on what they should know	4,14
Train students to be good researchers	3,77
Produce graduates who will change the world	3,39
To enable students to pass exams and gain qualifications	3,35

Table 5 – Answers to the question "*Score based on your overall teaching activities, how often are the following teaching methods used, according to teachers and students. Options and score:*

1. *No use; 2. Rare use; 3. Less than average use; 4. More than average use; 5. Frequent use"*

Activity	Teachers Score - mean	Students Score-mean
Face-to-face learning	4,49	3,94
Labs	4,26	3,59
Private study	3,24	3,48
Online real-time lectures	2,15	2,11
Chats	1,89	2,05
Forum	1,74	2,21
Wiki	1,79	2,25
Contact industry online	3,34	2,67
Contact industry real-life	2,29	2,41

Table 6 - Scores for the question: *"Based on your overall teaching experience, what is the importance of the following activities for the students' learning process?"*

Options and score:

1. *Not important; 2. Less than average; 3. Average; 4. More than average; 5. Very important*

Activity	Score (mean)
Labs	4,68
Face-to-face learning	4,18
Contact with industry online	3,97
Private study	3,52
Contact with industry real-life	3,25
Online real-time lectures	2,82
Wiki	2,51
Forum	2,32
Chat	2,17

Table 7. Answers to the question "*How well is the computer/internet being*

used?

Options and score:

1. Not used; 2 - Low use; 3 - Neutral use; 4 - High use; 5 - Full use"

Item	Score
To support administration	3,46
To support knowledge construction	3,38
To support skills development	3,14
To help understanding the course	3,19
To raise confidence	2,90
To stimulate social interaction	2,99

Table 8. Score results of the answers to the question: "*Which of the following assessment methods do you use?*

Options and score:

1. *No use; 2 - Rare use; 3 - Less than average use; 4. More than average use; 5 - Frequent use*"

Method	Score (mean)
Classroom tests, exams and essays	4,59
Classroom presentation assessed by teacher	4,06
Portfolio (handed in on paper)	2,87
Peer assessment in classroom	2,67
Online portfolio	2,19
Self-assessment in classroom	2,01
Online tests (assessed by teacher)	1,80
Online tests (assessed by student)	1,75
Online products made by students	1,70
Peer assessment online	1,56
Self-assessment online	1,55

Table 9. Recorded and foreseen evolution of the use of a selection of teaching methods over the last three years and in the next five years.

Options and scores:

1. *Less use; 2. Slightly less use; 3. No change; 4. Slightly more use; 5. More use*

Method	Score (mean) Last 3 years	Score (mean) Next 5 years
Private study	4,21	3,70
Contact with industry real-life	3,79	4,08
Labs	3,56	3,67
Online real-time lectures	3,56	3,73
Contact with industry online	3,49	4,00
Wiki	3,44	3,11
Forum	3,31	3,36
Chat	3,09	3,30
Face-to-face learning	2,83	3,25

Table 10. Answers to the question "*How do changes in teaching methods generally take place?*

Options and score:

1. Never; 2. Not often; 3. Sometimes; 4. Often; 5. Frequently"

Items	Score (mean)
Own initiative	4,25
Good example from other colleagues being taken over	3,42
Student initiative	2,86
Collaborative effort of faculty	2,83
After teacher workshops/training	2,80
Superimposed by administration	2,18

Table 11. Answers to the questions about constraints to the introduction of new teaching methods and tools.

Options and score:

1. *Strongly disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. Strongly agree*

Items	Score (mean)
Appropriate infrastructure is present	3,72
Stimulated by superiors	2,89
Perceived need by students	3,75
I believe I have the skills to use new teaching tools	3,72
The use of computer/internet based teaching is appropriate in my courses	3,73
Introduction of new teaching tools will change my role as teacher	3,41

Table 12. Teaching methods ranked for each of the key learning objectives. Cells with darker shading indicate lower than average scores (Students were asked to rank each method from 1 (not effective) to 10 (highly effective)).

Knowledge	Learning skills	Developing understanding of subject	Raising your self-confidence
Face-to-face learning	Labs	Labs	Labs
Labs	Face-to-face learning	Face-to-face learning	Face to face learning
Private study	Contact industry online	Contact industry online	Contact industry online
Contact industry OL	Private study	Private study	Private study
Wiki	Contact industry real-life	Contact industry real-life	Contact industry real-life
Contact industry RL	Wiki	Wiki	Wiki
Online real-time lectures	Online real-time lectures	Online real-timelectures	Online real-time lectures
Forum	Forum	Forum	Forum
Chat	Chat	Chat	Chat