European Journal of Geography Volume 8, Number 3:30- 40, July 2017
©Association of European Geographers

HOW DOES STUDENTS MOTIVATION TO ACQUIRE NEW GEOSPATIAL SKILLS INFLUENCE THEIR CHOICES OF E-LEARNING CONTENT?

Aneta Szablowska-Midor
Jagiellonian University, Institute of Geography and Spatial Management, Kraków, Poland
www.geo.uj.edu.pl
aszablowska@gis.geo.uj.edu.pl

Natalia Kolecka
Jagiellonian University, Institute of Geography and Spatial Management, Kraków, Poland
www.geo.uj.edu.pl
nkolecka@gis.geo.uj.edu.pl

Jacek Kozak
Jagiellonian University, Institute of Geography and Spatial Management, Kraków, Poland
www.geo.uj.edu.pl
jkozak@gis.geo.uj.edu.pl

Krzysztof Ostafin
Jagiellonian University, Institute of Geography and Spatial Management, Kraków, Poland
www.geo.uj.edu.pl
kostafin@gis.geo.uj.edu.pl

Abstract

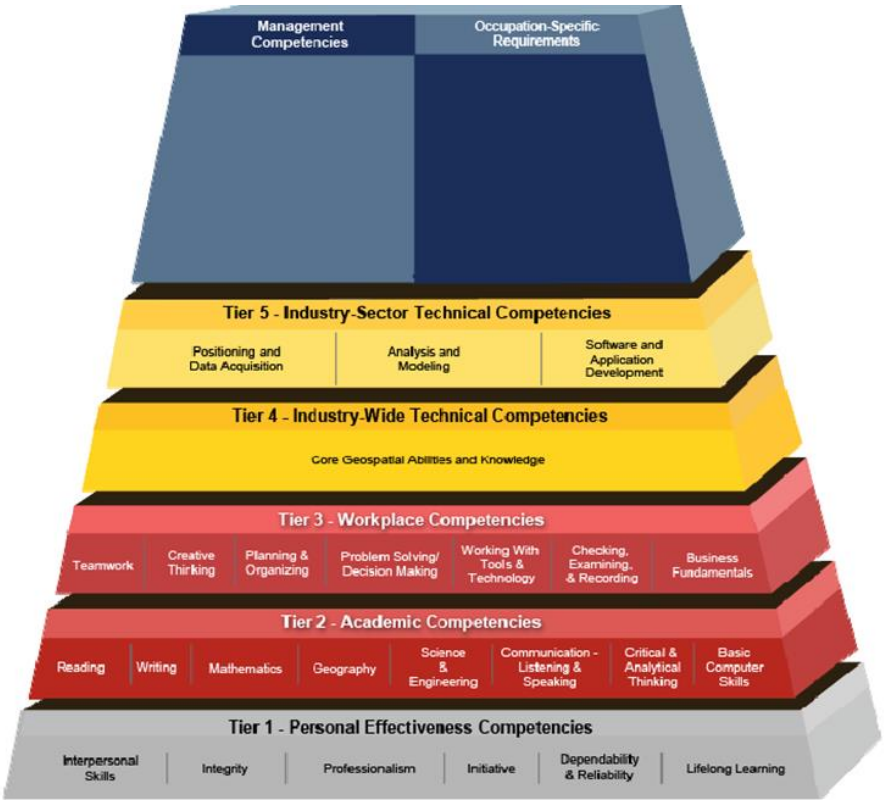
Higher education in many disciplines is affected nowadays by an evident orientation to assist students in developing a certain set of skills required by the labour market. This trend is visible also in the field of Geographic Information Science and Technology (GIS&T). The composition of competencies encompasses, apart from industry-specific technical competencies, also soft skills related to personal effectiveness, academic and workplace competencies. Moreover, soft skills are gaining in importance, being identified as future work skills. As a result, students may search for certain skills when they come into contact with a particular learning content. In this study, we investigated how the motivation to acquire specific skills influences students' behaviour on the e-learning platform. As a case study, we selected a study programme in land management carried out at the Institute of Geography and Spatial Management (Jagiellonian University in Cracow, Poland). Several different motivating factors, like GIS&T skills and the ability to co-operate, were identified and compared with students' behaviour on the e-learning platform in certain modules of the study programme. The results indicated that students only partially prospected for certain competencies during their work with the content of the e-learning platform. Students' motivation was more evident in their on-line behaviour when they wanted to acquire technical skills than when they planned to develop soft skills.

Keywords: *E-learning, motivation, geoinformation, skills.*

1. INTRODUCTION

Higher education in many disciplines is affected nowadays by an evident orientation to assist students in developing a certain set of skills required by the labour market (Industry models, 2016). This trend is visible also in the field of Geographic Information Science and Technology (GIS&T). The composition of GIS&T skills evolves similarly to changes observed in the development of the GIS&T field. In the first half of the last decade, analysis and modelling skills were the most important in the geospatial technology labour market, but nowadays their significance is similar to software and application development skills that seem to be equally important for employers. At the same time, the importance of cartography and visualization skills was steadily declining (Hong, 2016). Currently, parallel to the development of web applications and mobile devices, the demand for web, mobile and programming competencies is increasing among GIS&T graduates (Rip et al., 2014; Barnikel and Ploetz, 2015). Over the last ten years soft skills have also gained importance in the composition of geospatial technology competencies (Hong, 2016; Comparative analysis on the state of the art of soft skills and soft skills 2.0, 2015).

Therefore, the composition of technical competencies, characteristic for the geospatial field of industry and education is increasingly being accompanied by soft skills (Figure 1). Technical competencies cover industry-sector and industry-wide technical skills. The former focus on positioning, data acquisition, analysis, modelling, software and application development skills while the latter are defined as core geospatial abilities and knowledge. Technical competencies comprise only one fourth to one third of the entire geospatial technology competencies pyramid. The remaining part belongs largely to soft skills (e.g. team work, planning and organizing, initiative, dependability and reliability, interpersonal skills) and academic competencies composed, among others, of mathematics and geographical knowledge together with critical and analytical thinking (Geospatial Technology Competency Model, 2014).



Source: Geospatial Technology Competency Model, 2014.

Figure 1. Geospatial technology competencies

The novice GIS&T students may be motivated by the above mentioned trends in geospatial technology competencies models. During their studies, they may focus on gaining those competencies with an overall goal to improve their employment prospects. Motivation is a crucial success factor for the students' performance. Both intrinsic and extrinsic motivation helps students to achieve their learning goals (Ryan and Deci, 2000). A considerable amount of work was devoted to the topic of motivation (Buckmaster and Carroll, 2008) and its influence on e-learning effectiveness (Kizilcec and Schneider, 2015; Hasan et al., 2010; Keller and Suzuki, 2004; Littlejohn, 2016). However, these studies rarely refer to a certain discipline of studies, a study programme and its specifics.

The learning goals, although generally common for a given field of study, may vary considerably between students and be oriented towards technical competencies, soft skills or academic competencies. The differences may be more significant at the post-graduate (Master of Science, MSc) level in comparison to the undergraduate (Bachelor, BSc) level. That is why at the MSc level it may be required to offer more individualized and personalized ways of providing learning content to students. E-learning content usually helps students to personalize their learning process and gives them a chance to achieve the learning goals sometimes even to a broader extent than during traditional classes (Swan, 2003). The e-learning environment facilitates students' interaction with course content and student-centred learning. On the e-learning platform it is possible to address different learning styles and students are provided with choices, for example through including additional resources for further study and allowing them to spend as much time on a given subject as needed (Waterhouse, 2005). Additionally, the online environment of study facilitates and promotes training of soft skills like communication and collaboration. Conditions for gaining these skills in the e-learning environment are potentially increased compared with traditional classes, because they are time and place independent (Peters, 2000).

In the context of the current model of geospatial competencies and their trends it is interesting to investigate if, and how, e-learning helps to acquire this kind of competencies. Various aspects of this generic problem are included in the following questions:

- Is students' motivation towards their studies convergent with current models of competencies and needs related to positions in the geospatial technology market?
- Do students prospect for certain competencies consistent with their motivation during their online part of studies?
- Do the module assessment requirements influence the online behaviour of students?
- Does the e-learning mode of studies allow students to effectively interact with learning content relevant to certain requested competencies?

To answer these questions, students' motivation to choose a specific study programme was first investigated. Then students' behaviour on an e-learning platform was traced and compared with their declared motivations during the studies. Finally, results were discussed, taking into account also instructors' observations on students' in-campus behaviour.

2. CASE STUDY

In 2015 a new study programme called "e-Spatial Management" was prepared in the Institute of Geography and Spatial Management (Jagiellonian University, Cracow, Poland). Students are taught how to use geospatial tools, data and methods in this discipline mainly using the project approach. Quite a substantial amount of attention is also paid to students' professional development and project management competencies, which consists mainly of different kinds of soft skills, for instance team work, planning, organizing and interpersonal skills. Such a

composition of competencies was elaborated in close cooperation with representatives of employers, who gave their opinions on learning aims (Kozak et al., 2016). Thereby the curriculum of the studies focuses on such educational outcomes that coincide with labour market needs with an expectation that graduates of the "e-Spatial Management" study programme will cope better in the labour market than graduates of traditional study programmes in geography (Piróg, 2015).

The study programme consists of 25 modules (Table 1). Some modules are organized in a bimodal form which includes e-learning and face-to-face classes. E-learning content is provided via the university platform maintained in the open-source Moodle environment.

Table 1. Programme of the studies "e-Spatial Management"

No.	Modules	ECTS	E-learning		Face-to-face classes	
			hours	*%*	*hours*	*%*
1	MSc tutoring - I year	3	0	0	30	100
2	Distance learning methods	3	35	100	0	0
3	Philosophy of science	3	9	30	21	70
4	Spatial data models & geodatabases	6	33	55	27	45
5	Data acquisition & GI infrastructures	6	18	30	42	70
6	Models and tools of spatial management	6	20	25	60	75
7	Environmental aspects of spatial planning	6	0	0	70	100
8	Local and regional development	6	0	0	70	100
9	Spatial analysis and geovisualization	6	30	34	60	66
10	Ecophysiography	6	0	0	25	100
11	Environmental impact assessment	6	0	0	33	100
12	Spatial planning documentation	6	0	0	30	100
13	MSc tutoring – II year	3	0	0	30	100
14	Urban revitalization	6	0	0	70	100
15	Professional development	6	0	0	36	100
16	Project management	6	0	0	63	100
17	Protected areas	6	5	14	30	86
18	Geomarketing	6	0	0	45	100
19	Decision-making support tools in regional planning and business	6	0	0	60	100
20	Transport	6	0	0	70	100
21	Environmental forecasting	6	0	0	80	100
22	Land management in mountain areas	1	0	0	10	100
23	Spatial planning in the Cracow metropolitan area	1	0	0	10	100
24	Land management in upland areas	1	0	0	10	100
25	Optional courses	12	0	0	120	100

In most of the modules the e-learning platform is used as a repository for the learning content. In seven modules e-learning is practiced more interactively, in the form of high-technology constructivist courses (Weller, 2002), where students are provided with advanced e-learning content (text, graphics, hyperlinks), with knowledge-checking possibilities (tests and

quizzes) and actively used discussion fora. Although interactive online learning constitutes only 10% of the study time, a separate module called Distance learning methods devoted to this type of learning was elaborated and offered to students. Development of such a module was intended to prepare students to learn at a distance during the studies and subsequently during their future lifelong learning activities.

3. DATA AND METHODS

The motivation of students was examined during the module *Distance learning methods*. One of the assignments in this module aimed at preparing a mind map that describes the student's motivation to take the study programme in question. It was recommended by the module instructor to look widely at that topic and to include both intrinsic and extrinsic (Davidson-Shivers and Rasmussen, 2006) motivating factors. Thirty-four students prepared the motivation mind maps. Six students, who had already completed similar modules during their previous studies, were excluded from the analysis as their records could be influenced by prior experience. Finally, 28 mind maps were taken into account. All the desired skills and competencies depicted by students on the mind maps were collected and divided into six motivating factors. The first group of GIS&T skills covered competencies allowing students to use GIS software (e.g. ArcGIS, AutoCAD, QGIS) to solve various tasks. The next group of competencies (GIS&T knowledge) was connected with students' motivation to extend their knowledge of technology and computer science. Students' indications associated with their participation in field classes, meetings with employers, projects, classes on urban planning, regional politics and spatial management were gathered in the third group of motivating factors – spatial management competencies. The next two groups of competencies represented soft skills. Students oriented towards co-operation and networking skills were seeking opportunities of teamwork, exchange of experience and information, meeting new people, help and support. Another group of soft skills (self-organization skills) was defined by flexibility, connectivity and time management skills. Finally, the sixth group of motivating factors (academic competencies) were of a general character (neither definitely technical or soft) and comprised students indications associated with gaining a diploma of higher education, a job, training opportunity, career development and a better position in the labour market (promotion, satisfactory earnings).

In order to examine the relationship between students' motivation and their behaviour on the e-learning platform we assigned specific e-learning content to the above six groups of motivating factors. Four out of the total eight modules led in the first semester of studies with the highest e-learning hour ratio were selected for the analysis: *Distance learning methods* with content related to cooperation and networking skills as well as self-organization skills, *Philosophy of science* with the content related to general academic competencies, *Spatial data models & geodatabases* and *Data Acquisition & GI infrastructures* with the content related to GIS&T skills and knowledge. E-learning content related to spatial management skills was not investigated as this type of content was not substantially used in the modules devoted directly to spatial management topics.

As a proxy of students' interest in the particular content, we assessed for every student the number of logs on the e-learning platform. The logs were counted separately for each module's content related to a given motivating factor, in the period when the selected modules were taught (October 2015 – February 2016). Then the correlation between indications of certain motivating factors by students on the mind maps, and the number of their logs in a given module's content related to specific competencies were analysed. Spatial management skills were combined with indications related to GIS&T skills and knowledge and correlated with the respective logs in the e-learning content.

The relationship between students' motivation and their behaviour on an e-learning platform may be disturbed by module assessment requirements, as certain tasks that students have to perform may cause a more frequent use of some e-learning resources, irrespective of the students' initial interest and general motivation. To investigate if the module assessment requirements influence the online behaviour of students we correlated the number of logs for every student in a given module's content with students' grades in that module.

4. RESULTS AND DISCUSSION

Overall, soft skills were indicated by students on their motivation mind maps much more frequently than technical and general skills, which were in total indicated by students with a similar frequency (Table 2). Among all motivating factors related to technical competencies, the spatial management skills were indicated much more often than GIS&T skills. In turn, in the group of soft skills, cooperation and networking skills were more frequently indicated by students than self-organization skills. It seems that motivating factors indicated by students are to a large extent convergent with current models of competencies and needs related to positions in the field of geospatial technology. What is particularly interesting is that these factors reflect the increasing importance of soft skills among geospatial competencies. In particular, cooperation and networking skills are in high demand among students of the 'e-Spatial Management' study programme.

Table 2. Occurrence of motivating factors on the analysed mind maps

No.	Motivating factor	Number of indications
Technical skills		***58***
1	Geographical Information Science and Technology skills (GIS&Ts)	12
2	Geographical Information Science and Technology knowledge (GIS&Tk)	5
3	Spatial Management competencies (SM)	41
Soft skills		***73***
4	Cooperation and Networking skills (C&N)	52
5	Self-organization skills (Org)	21
General skills		***56***
6	Academic competencies (Ac)	56

We found a statistically significant correlation between the combined number of indications of motivation focused on gaining GIS&T skills and knowledge and spatial management skills, and the usage of the e-learning content devoted to GIS&T skills and knowledge (0.41, Table 3). A similar correlation value (0.44) was found between the combined number of indications of motivation focused on GIS&T and spatial management skills, and the usage of the e-learning content devoted to GIS&T skills. The correlation values may indicate that some of the students interested in GIS&T skills and spatial management competencies worked more frequently with the e-learning content focused on GIS&T skills.

Table 3. Correlation between motivating factors and the online behaviour of students

No.	Motivating factor / e-learning content	Correlation coefficient	Statistical significance
Technical skills			
1	GIS&Ts / GIS&Ts	0.36	-
2	GIS&Tk / GIS&Tk	0.21	-
3	GIS&Ts + GISTk + SM / GIS&Ts + GISTk	0.41	+ (0.05)
4	GIS&Ts + SM / GIS&Ts	0.44	+ (0.05)
Soft skills			
5	C&N / C&N	0.01	-
6	Org / Org	0.21	-
General skills			
7	Ac / Ac	0.32	-

We found low and statistically insignificant correlation values between several other pairs of motivating factors and the usage of the specific e-learning content (correlations between motivation focused on GIS&Ts, and the usage of the e-learning content devoted to GIS&Ts, between the number of indications of motivation focused on GIS&Tk and the usage of the e-learning content devoted to GIS&Tk as well as between motivation focused on Ac and the usage of e-learning content devoted to this kind of competencies were not statistically significant). We found also no significant correlation between the number of indications of motivation related to soft skills (especially C&N) and the usage of the e-learning content devoted to this group of skills. The results showed that the behaviour of students on an e-learning platform did not entirely reflect their motivation related to acquire soft skills and academic competencies, and only partially reflected their motivations to acquiring technical skills.

In the module *Distance learning methods*, where students could find e-learning content related to cooperation, networking and self-organization skills we found a relatively strong correlation (0.71, Table 4) between module assessment requirements and the online behaviour of students. A lower correlation value (0.40) between module assessment requirements and the students' online behaviour was found in the module *Spatial data models & geodatabases*, in the case of the e-learning content devoted to GIS&T skills and knowledge. This finding confirms that module assessment requirements may significantly interfere with the ways how motivation drives the usage of the specific e-learning content. Students may pay more attention to the content which at the beginning of the studies was less interesting for them, yet they found it useful and necessary to fulfil assessment requirements.

Table 4. Correlation coefficients between module grades and the usage of e-learning content by students

No.	Module	Correlation coefficient	Statistical significance
1	Distance learning methods (C&N, Org skills)	0.71	+ (0.01)
2	Philosophy of science (Ac)	0.02	-
3	Spatial data models & geodatabases (GIS&Ts, GIS&Tk)	0.40	+ (0.05)
4	Data acquisition & GI infrastructures (GIS&Ts, GIS&Tk)	0.09	-

The answer to the question whether the e-learning mode of studies allows students to effectively use learning content relevant to their motivation, and permitting them to acquire specific requested competencies is not straightforwardly positive or negative. For example, within the module *Spatial data models & geodatabases* students who had better grades spent more time with the compulsory and additional e-learning content. Organizational resources of the course helped some students to better understand the course aims, structure and assessment requirements and as a result, their performance was better than in the case of students who did not pay much attention to this content. In reference to technical skills, it seems that the e-learning mode of studies rather improved the efficiency of acquiring technical competencies by students.

However, the effectiveness of e-learning in acquiring technical competencies may also depend on the difficulty level of a given topic. The difficulty level is in turn closely related to the knowledge already possessed by students. In the e-learning environment, the learning is more successful when students can refer to their background and prior knowledge. On the one hand, if the given topic refers too much to what students already know they may feel bored. On the other hand, if the instructor has high expectations as to the prior knowledge of students necessary to understand a new topic while the level of this knowledge is rather low, such a situation may cause frustration on their side (Simson et al., 2006). The observations made by the instructor in the module *Spatial data models & geodatabases* confirmed this relationship. Students had problems coping with newly introduced topics related to eXtensible Markup Language (XML) and Structured Query Language (SQL). Half of the students responded to the relatively difficult XML topic by skipping it, definitely proving that e-learning failed in that case. The SQL topic was more successfully studied – the e-learning content allowed students to work on the assignment individually as long as they needed, and to complete the work. Interestingly, some students managed to cope with the topic on the basis of cooperative work and therefore the use of e-learning content expressed as the number of logs was limited. It was observed that several students preferred to receive instructions from other students than to look for the original documents on the e-learning platform. Such behaviour that in practise means a lack of students' online presence is annoying for the module instructor and difficult to interpret. It may suggest students' anxiety about the usefulness of computers (Bach et al., 2007) or just manifest their strong preference towards face-to-face learning.

A similar preference may mean that students interested in acquiring academic skills and soft skills were rarely searching for them on the e-learning platform. It is really a question whether students perceive it is easier for them to acquire specific skills in distance learning than in face-to-face learning, and based on their attitude they just choose a more straightforward solution. As part of the e-learning content in the analysed modules was marked as mandatory, it is difficult to confirm clearly the above assumption. Although sometimes practised, a forced choice of e-learning for some parts of the classes as the only method of learning may cause an increase in students' frustration, a decrease in their motivation and a high risk of poor learning,

and for these reasons it is not recommended (Bach et al., 2007). To answer this question, the simplicity or complexity of acquiring technical and soft skills should be addressed. It seems that the e-learning platform was more often successfully used by students to assist tasks focused on technical skills, because of the rather simple nature of these tasks. It was quite quick and easy for the module instructor to distribute online spatial data, software and instructions which were needed to accomplish technical tasks. On the one hand, to benefit from these possibilities students do not need to possess any advanced online skills. Additionally, distribution of this kind of materials outside the e-learning environment would be rather problematic.

Activities that support students in the process of acquiring academic and soft skills are more complex, especially with reference to tasks that encourage collaboration between students and supervise their progress. Provision of such a support on an e-learning platform is, therefore, more time-consuming for the course instructor and requires him or her to consider in advance several possible scenarios. At the same time, students need to be more patient, assiduous and more experienced in online learning. Therefore without any direct advantages or evident incentive on both sides – instructors and students – online learning may not be an interesting alternative to the face-to-face classes and may not be successfully practised.

5. CONCLUSIONS

The study confirmed that motivating factors indicated by students of the "e-Spatial Management" study programme are rather convergent with current models and needs related to the competencies in the field of geospatial technology. They reflect the increasing importance of soft skills, especially in relation to cooperation skills. However, according to the analysis of students' online behaviour, students do not keenly seek this kind of skills on the e-learning platform. Also, general academic competencies are not practised online as a preference. It seems that technical skills are more likely trained at a distance than soft skills, because the nature of this kind of competencies is rather simple in comparison to the complexity of soft and academic skills. Also in this case, however, the potential of e-learning is associated with the level of difficulty of a given topic. Topics already familiar to students were more successfully studied further online than new complex issues.

It was shown that module assessment requirements could influence the relationship between students' declaration towards motivating factors and their behaviour on an e-learning platform. Therefore further work is recommended to investigate how this factor relates to the online behaviour of students and how it means that they adopt the proposed learning strategies allowing them to complete the course and obtain a good grade rather than follow their motivating factors. It seems that a balanced composition of both these driving forces could have a positive effect on the learning performance even if a considerable amount of the learning process within a module is moved to the e-learning environment.

REFERENCES

Bach S., Haynes P. and Smith J.L. 2007. *Online learning and teaching in higher education.* London, Open University Press

Barnikel, F. and Ploetz, R. 2015. The acquisition of spatial competence – fast and easy multidisciplinary learning with an online GIS. *European Journal of Geography* 6 (2): 6-14.

Buckmaster, D.R. and Carroll, N.J. 2008. Student motivation - A literature review. *American Society of Agricultural and Biological Engineers Annual International Meeting*

Comparative analysis on the state of the art of soft skills and soft skills 2.0. 2015. eLene4Work, available online at:

http://elene4work.eu/project-outputs/comparative-analysis/ [31.10.2016].

Davidson–Shivers, G.V. and Rasmussen, K. 2006. *Web-based learning Design, implementation and Evaluation.* New Jersey, Pearson Education Inc.

Geospatial Technology Competency Model. 2014. Employment and Training Administration United States Department of Labor, available online at:

https://www.careeronestop.org/CompetencyModel/competency-models/geospatial-technology.aspx [31.10.2016].

Hasan, A., Imran, A., Muhammad, A.K. and Kashif, H. 2010. A Study of University Students' Motivation and Its Relationship with Their Academic Performance. *International Journal of Business and Management*: 5 (4): 80-88.

Hong, J.E. 2016. Identifying Skill Requirements for GIS Positions: A Content Analysis of Job Advertisements. *Journal of Geography*.115 (4): 147-158.

Industry Models. 2016. Employment and Training Administration United States Department of Labor, available online at:

https://www.careeronestop.org/CompetencyModel/competency-models/pyramid-home.aspx [31.10.2016].

Keller, J. and Suzuki, K. 2004, Learner motivation and e-learning design: A multinationally validated process. *Journal of Educational Media*: 29 (3): 229-239.

Kizilcec, R. and Schneider, E. 2015. Motivation as a Lens to Understand Online Learners: Toward Data-Driven Design with the OLEI Scale. *ACM Transactions on Computer-Human Interaction*: 22 (2)

Kozak, J., Balon, J., Gwosdz, K., Piotrowicz, K., Szablowska-Midor, A. and Trzepacz, P. 2016. Nowe studia z gospodarki przestrzennej w Instytucie Geografii i Gospodarki Przestrzennej Uniwersytetu Jagiellońskiego (A new study programme in spatial management at the Institute of Geography and Spatial Management, Jagiellonian University). *Roczniki Geomatyki* 14 (73): 375–386.

Littlejohn, A., Hooda, N., Milligan, C. and Mustain, P. 2016. Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *Internet and Higher Education*: 29: 40–48.

Peters, O. 2000. Digital Learning Environments: New Possibilities and Opportunities. *International Review of Research in Open and Distance Learning*: 1 (1).

Piróg, D. 2014. Do geography degree programmes facilitate a smooth transition to the job market? Reflections of working and job-seeking graduates in Poland. *Journal of Geography in Higher Education:* 38 (2).

Rip, F., Wallentin, G. and Van Lammeren, R. 2014. *Integrated analysis of the demand for and supply of geospatial education and training: Results of the GI-N2K Surveys,* available online at: http://www.gi-n2k.eu/publications/ [31.10.2016].

Ryan, R.M. and Deci, E.L. 2000. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology:* 25, 54–67, available online at: http://www.idealibrary.com [31.10.2016].

Simonson, M., Smaldino, S., Albright, M. and Zvacek, S. 2006. *Teaching and learning at a distance.* New Jersey, Foundations of Distance Education, Pearson Education Inc.

Swan, K. 2003. Learning effectiveness: what the research tells us. In *Elements of Quality Online Education: Practice and Direction,* Ed. J. Bourne, J. C. Moore, 13-45 Needham. MA: Sloan Center for Online Education.

Waterhouse, S. 2005. *The power of e-learning: The essential guide for teaching in the digital age.* Boston, Pearson Education, Inc.

Weller, M. 2002. *Delivering learning on the Net.* London and New York, Routledge Falmer Taylor & Francis Group.