The Transformation Challenge of IT Education and Training in Higher Education and Industry

Anne-Maarit Majanoja, Ville Taajamaa, Ville Leppänen and Erkki Sutinen
Department of Information Technology, University of Turku, Turku, Finland

Keywords: Learning, Expectations, Transformation, Teaching Methods, Communication and Interaction, Skills and Capabilities.

Abstract: Globally, several self-organized training arrangements are implemented in industry with varying outcomes. The target of these training initiatives is to achieve transformation. The practices and teaching methods during higher or academic education (HE) can impact on the industry training situations. However, few studies have dealt with the possible impact of academic technical and IT education and training practices on industry based training arrangements. We analysed two independent sets of interviews, one on industry-based global selective outsourcing environment (GSOE) training arrangements and another on IT education at a Finnish university. We found that the GSOE training arrangements heavily relied on the lecturing-based methods instead of hands-on practicing. Similarly, the IT education at the university also relied on theory-based lecturing. There is also a need to transform passive interaction to active where students and actors are responsible for their own learning and building their own skills and capabilities to succeed in working life.

1 INTRODUCTION

Nowadays it is difficult to ignore the impact of Information Technology (IT) on our daily life. We have entered the era of digitalization where industry is increasingly information-intensive. The rapid development of new technologies and the online world change the way we work and also where we work from. Yet, IT system and information-centric operations can cause risk situations, such as jeopardized patient safety in hospitals. The new information-sensitive world sets new demands to individuals, organizations, and societies. Therefore, IT education and training have to develop and meet the needs of the society.

Transformation means changing (something) completely and usually in a good way (Merriam-Webster dictionary, 2016). Change and education have been widely studied by several researchers (e.g., Graham 2012, Crawley et al., 2014, and Englund et al. 2016). The topics include practical implementation elements, and therefore, a bottomless pit to several consultancy-books and enterprises. Now, education is becoming a global service (Pucciarelli and Kaplan, 2016).

Education (i.e. aims to a certain degree) and other types of training situations (e.g., short courses and personnel development activities without degree targets) need to incorporate the expected changes into the schemes of thinking and acting. The challenge is that typically we build our transformation based on specifications describing existing systems or way-of-working approaches, thus the old approaches are implemented into new IT solutions. Therefore, nothing truly changes and the expected transformation and holistic understanding are not achieved.

Despite of the extensive knowledge of change and education (e.g., Froyd, 2012), IT education still includes traditional post-positivistic natural science based approaches that do not always promote the true level of on-going transformation in society and working environments. IT operations and education include also human-centered elements. It already has been found that, for example, organizational learning can be enhanced by systems thinking (e.g., Senge, 1996). Still, emotional motivation is needed to ensure successful and sustainable transformation.

Despite of the new activating teaching methods, previous studies have found that lecturing is still one of the primary teaching methods for example in universities (Petrović and Pale, 2015). It is notable

Majanoja, A-M., Taajamaa, V., Leppänen, V. and Sutinen, E.
The Transformation Challenge of IT Education and Training in Higher Education and Industry.
DOI: 10.5220/0006257302400247
In *Proceedings of the 9th International Conference on Computer Supported Education (CSEDU 2017) - Volume 2*, pages 240-247
ISBN: 978-989-758-240-0

that lecturing includes also positive aspects that increase social and formal learning settings. Also, various activating and phenomenon-based teaching approaches are used in Finnish primary and secondary schools. However, current working population has not yet been fully familiarized to apply these new activating approaches in industry.

Unlike the mainstream of outsourcing training and personnel development activities (e.g., Gainey and Klaas, 2003, Galanaki et al., 2008 and Chaudhury and Bartlett, 2014), this paper focuses on analysing self-organized training arrangements in a global selective outsourcing situation. The operational level problem studied in this paper originates from insufficient self-organized IT service training outcomes in industry case. The target is to analyse can similar kind of challenges be identified already from university studies.

In this paper, we study what kind training, competences and skills the IT unit (one of the Nokia Devices' IT units) expected from its supplier in the global selective outsourcing environment (GSOE). We also analyse what kind of training method is applied during the self-organized training sessions: practical-focused or dominated by lecturing types of methods. We identify potential similarities in challenges and teaching methods used in IT and engineering education in university studies (e.g., computer science and software engineering). This is examined by analysing two sets of independent theme-based interviews from the service purchasing company and a Finnish university.

The rest of the paper has been divided into four parts. Section 2 deals with existing research and the theoretical dimensions of systems thinking and education. Section 3 describes the research design. Section 4 presents the findings. Section 5 includes the conclusions and introduces a few tasks for further research.

2 LITERATURE REVIEW

In the IT field we are used to the idea of continuous improvements and providing new solutions and services to users and business representatives. Reacting to various changes is considered to be part of IT development and service activities. As a consequence, it seems like there are no sustainability in the middle of endless changes or time to evaluate whether the implemented changes truly have the expected effects. Based on Boron et al., (2016) and Graham (2012), this situation applies to education as well. Senge (1996) wrote that most people have grown up in an authoritarian environment, and they expect that people above them give answers, know what is going on, and what is expected in the future. However, when systems and challenges became increasingly complex and wicked, no-one has the correct answers and uncertainty is part of life (Senge, 1996, Weber and Khademian, 2008). Instead of paralyzing, it should lead to enthusiasm to experiment (Emerson and English, 2016). Senge (1996) wrote that the current mind-set needs to be changed. Making failures should not be scary, because mistakes are part of experimental life. People need to be active, experimental and be responsible for their own activities.

Earlier studies found that a majority of the change projects fail (e.g., Beer et al., 1990, Kotter, 1995, Kotter, 2008, Senturia et al., 2008, Keller and Aiken, 2009). Based on Graham (2012) there is a proven tendency of returning to the way things were before. Smith (2002) reported that only 33% of major organizational change activities succeed. However, cultural change (19%) was more challenging than a strategy deployment (58%) (Smith, 2002). Both in-house and external training activities are needed in successful change implementation and transformation. Chen and Huang (2009) and Shipton et al., (2005) wrote that participating in training and education programs stimulates employees to become learning oriented, and the employees produce greater innovative outcomes (Birdi et al., 2007).

Systems thinking is a method to define problems, raise questions, and make proficient decisions (Arnold and Wade, 2015). Systems thinking is the approach to understand how different things influence on one another within a complete entity or ecosystem. Systems thinking has also been applied in education during the past decade. Based on five studies of Ayers (2002), Córdoba and Midgley (2006), Houston et al., (2008), Samanakoopt et al., (2015), and Rakbamrung et al., (2015), the five main findings were: 1) The desired outcome needs to be inclusive, promote participatory and reach consensus among the members. 2) The boundaries need to be expanded to include a wider range of knowledge and take stakeholders' needs into account. 3) Success requires inter-disciplinary skills and competences. 4) Various interdependencies, impact factors, distinctions, boundaries, and concerns need to be identified and acknowledged. 5) Efficient feedback loops are needed to systematically solve and prevent problems by identifying the root-cause elements. As an outcome, these elements should also be part of education and training targets.

3 RESEARCH DESIGN

The target of this case study is to get insights into the training structures, practices, and non-conformances in the GSOE based self-organized training situation. The phenomenon is studied by analysing and comparing the findings with the teachers' perception of technical fields' training in a Finnish university at the department of Information Technology. This research is based on two sets of interviews done independently in 2012.

From the university's side, six audio recorded and transcribed semi-structured interviews were selected for closer analysis. These six teachers were selected as they taught Master of Science Engineering (M.Sc. Eng.) students, and therefore, they were able to analyse the curricula and courses. The interview transcriptions were coded based on the following themes: 1) IT/engineering education demands, characters, and skills, 2) teaching methods, courses and capabilities, and 3) potentials and challenges.

At Nokia Devices, the internal IT unit and the supplier jointly operated in the GSOE based on jointly designed 30 ITIL (Information Technology Infrastructure Library) processes and way-of-working practices to ensure successful cooperation and service deliveries. The IT unit's roles included, e.g., team leaders, contract managers, product and service managers, and other internal IT specialists responsible for databases, networks, solutions, etc. The IT supplier's onsite and offshore specialists were responsible for service development and maintenance activities, such as, project management, coding, testing, documenting, end-user support, etc. The supplier was also responsible for operational level training activities.

The industry case included interviews and several discussions with the service purchasing company's and the supplier's representatives. At Nokia Devices, some interviewees did not want their interviews recorded (especially the representatives in Asia), and it was decided together with the IT unit's leaders that the interviews would not be recorded. After this decision, all IT unit members globally agreed to participate in the interviews, and they freely shared their perceptions. The interview notes were written down by the interviewer (one of the authors of this paper) during the interviews by capturing the main message and idea. The interviews in Europe were conducted face-to-face, and phone interviews were used with the representatives working in Asia and Americas. It is notable that Nokia Devices (later acquired by Microsoft) and the IT supplier restrictive in making public their successes and failures. For confidentiality reasons, it is not possible to present all results in full detail.

In this paper, we used existing interview materials. First, we analysed and theme-based coded GSOE interview notes (competence development, level of competences, and expectations). Second, the six teachers' interviews were analysed and coded. Third, the findings were analysed and compared. In Section 4, Tables 1-4 have the following structure: first field provides the category Id, category name, and identified terms. The examples field provides citations.

It is notable that both interviews targeted at identifying improvements and development focus areas. Therefore, the interviewees focused on highlighting challenges instead of success, which can reflect to the findings of this study.

4 RESULTS AND ANALYSIS

4.1 The GSOE Training Outcomes

The supplier was responsible for the operational level GSOE training activities, which were held at the supplier's premises. Based on the observations and discussions with the IT unit's and the supplier's representatives, the in-house based self-organized training followed the trainer-centered teaching approach in a meeting-room type of premises.

The trainers introduced the jointly defined GSOE mode-of-operation practices, provided a quick introduction to the business environment, and trained the common ITIL processes and tooling. The approach was theory-orientated by sharing 'what' and 'how' elements (e.g., daily activities, tooling, and ITIL process). Less focus was given on practical adaptation, activating people, sharing operational level knowledge and experiences, and how to interact with customers and stakeholders.

The IT specialists joined the IT services after the training session. It was found that the IT specialists did not have the needed practical knowledge to operate based on the GSOE practices or solve various non-conformance situations. Instead, the supplier expected the IT unit to provide detailed lists of tasks, activities, and instructions how to solve the cases, and then the IT specialists in offshore centers would follow the lists step-by-step. Providing these kinds of lists was not possible. The basic idea of the global IT services was to continuously improve the operation and to react various, unforeseeable change needs and non-conformances coming from customers and other stakeholders. Following pre-defined lists would not be sufficient. Instead, success would require

proactive approach and taking responsibility.

The IT unit's representatives were dissatisfied with the training outcomes. Eventually, the IT unit's representatives had to re-train the new IT specialists one-by-one. This time, the training was practical hands-on training and the IT unit's representatives explained the 'why' elements of the operation, process, customer interaction, and business environment.

Analysis of the GSOE Training Outcomes. Based on the interviews, the IT unit's members highlighted the insufficient level of the supplier's training and knowledge transfer activities (Table 1). "*The transition time is not long enough*" and "*They are trained, but still lacking of knowledge*." It was found that training did not provide the needed operational level knowledge and skills to succeed in implementing the IT services' activities.

The IT unit's members were interested in knowing how the supplier developed their IT specialists' competences. "*We don't know how suppliers develop their competencies and we would like to know how we could support them.*" The IT unit wanted to support and increase motivation, because it would improve service outcomes.

The supplier's IT specialists worked hard and possessed good technical competences: "*Very technical people, working very hard when we tell exactly what to do*"; Still, the level of practical competences depended heavily on the specialists' prior working life experience. The specialists who came directly from schools (such as, universities) had gaps in their technical skills and practical know-how. The IT specialists also needed a lot of guidance and direct instructions from the IT unit's members to succeed in operational level activities.

There were challenges in communication and interaction (Table 1). Typically, there were communication gaps between the onsite and offshore teams, and the IT specialists used too technical terms and language with non-technical end-users and stakeholders. It seemed that the IT unit's members maintained the IT services' communication and interaction, not the supplier.

The IT unit's members expected proactive and interactive approach from the supplier to provide added value by sharing ideas, improvement proposals, feedback, and innovation (Table 1). The supplier was expected to focus more on outcome and ensuring requirements deliveries. The supplier's specialists were expected to be more open-minded and thinking out-of-the-box instead of waiting for the IT unit to tell them what needs to be done. The supplier should also take the ownership of their activities and provide consultancy services, and share ideas how to develop the IT services further.

Table 1: The IT unit's expectations of the non-technical competences after the supplier's training.

C1.1 Communication and interaction: Consulting services, Communication, Technical terms, End-users, Stakeholders, Business-like, Follow-up
Examples - They do not to provide real consulting services - End-users are confused when communication is not clear enough or includes too many technical terms - Communication is business-like - Challenges in follow-up or replying proactively
C1.2 Proactivity: Proactive, Value, Comments, Feedback,
Examples - They could be more proactive and provide added value - They are really passive - Be proactive, and say if something could be improved, give comments. This could be a cultural issue
C1.3 Outcomes: Expectations, Delivery, Innovative, Open-minded, Responsibility
Examples - They should think what is expected from them based on the requirements and then deliver it - More innovativeness, open-mindedness ideas, seeing the whole service packet, taking the responsibility - Seeing the big picture, bring their ideas to the playground

4.2 The University's Findings and Challenges

4.2.1 Skills to be Learned During Studies

Based on the theme-based analysis of the IT department's teachers, three main justifications for offering M.Sc. (Eng.) degree in Information Technology were identified: 1) The need and demand comes from industry. 2) It is the university's demand and decision. 3) The M.Sc. (Eng.) is valued as a professional degree, and the degree provides good working life possibilities.

The teachers perceived that IT education was characterized by technology and natural sciences, especially mathematics and physics. However, it would be important to teach technical topics in a broader scale. The teachers perceived the profession profile and image of the M.Sc. (Eng.) degree to be better than the M.Sc. degree, because the M.Sc. (Eng.) was seen more professionally oriented. The teachers highlighted the engineering-like

way-of-thinking and acting approaches (Table 2).

The teachers considered life-long learning, critical thinking, and working-life readiness capabilities (Table 2) as necessities to succeed in working life. Especially communication and interaction skills were considered as important, but practicing those skills were in a minor role during the courses. The main focus was still on technical and theory-based aspects.

Table 2: The characteristics and working life necessities of M.Sc. (Eng.) education.

C2.1 Professional culture: Engineering-like, Attitude, Way-of-Thinking, Way-of-Acting
Examples - Teaching the engineering-like thinking and attitude - The way of thinking is different (because of mathematical base) - Engineering-like/technical way of thinking, being an engineer, and being proud of it - Engineers must understand what they are doing - Rational-based thinking - Engineers have a lack of understanding what other way-of-thinking "worlds" means - Engineers have a more systematical problem-solving approach, which is the engineering-type of thinking
C2.2 Life-long learning: Learning, Development
Examples - Life-long learning skills to learn new things - Learning to learn - Taking responsibility of one's own learning
C2.3 Critical thinking: Responsibility, Self-guidance, Criticality, Evaluative, Critical thinking
Examples - Critical thinking, assessing and evaluating skills - Students need to take responsibility of their own thinking and evaluate information - Ability to evaluate own actions, see development and changes, and being self-guided
C2.4 Working-life readiness: Social skills, Communication, Roles, Presenting skills, Interaction
Examples - Social skills/Communication skills - Working-life readiness skills and competencies - Interaction skills: how people interact in different roles, and how to present things (verbal/written) - Ability to act together

4.2.2 Used Teaching Methods

The teachers used different kinds of teaching methods during their courses. Quite many times the teaching approaches were teacher-centered lecturing due to the need to share extensive amounts of substance related knowledge and information to the students. Lecturing was considered as the most cost-effective approach since the amount of students was not limited. Some of the teachers recognized the challenge to combine theory and practical work during their courses. Other typical methods were group-assignments or practical work, such as capstone projects, problem-based learning, project-based courses, essays, course diaries, self-study courses and guiding sessions. The teachers wanted more contact-based (i.e. meeting the students) teaching to support and mentor students, which would also develop the students' communication and interaction skills (Table 3).

The teachers identified that pedagogical skills and capabilities would give them more tools to implement courses (Table 3). Pedagogical skills combined with practical knowledge and know-how would provide better outcomes and motivated students (Table 3).

Table 3: The teachers' perceptions of the teaching approaches and competences.

C3.1 Teaching methods and focus: Lecturing, Teaching method, Substance, Theories, Practice
Examples - Mainly lecturing-based methods - Using old-fashioned teaching methods - Focus is on substance based knowledge - Focus is on enduring knowledge and theories - Topics have been narrowed during the years - Challenge to combine both theories and practical - Not enough focus on communication (verbal/written), not practiced during courses - More contact-based teaching to support and mentor students, and to develop communication skills to avoid tongue-tied graduates
C3.2 Pedagogical skills: Pedagogical, Competences
Examples - Teachers' pedagogical competences should be valued - Having knowledge what you can do during courses - How to teach and manage the courses - Students need to participate, teacher needs to be up-to-date, and have good lecturing skills

4.2.3 Enablers and Challenges

The teachers proposed that the IT department could have a bigger role in training the entire university, for example in technical topics and competences. Having this kind of role increases the university's image. In addition, a multidisciplinary university would have better possibilities to provide professionals with different kinds of profiles and skills, and thereby efficiently answer to the demands of society and industry.

Challenges were identified that impacted on working and teaching. One major challenge came from resources, mainly financial and human resources. Cost cuttings had negatively impacted on the courses and resources. As an example,

demonstration-sessions were reduced, which decreased students' motivation to acquire sufficient technical and working-life skills. The teachers also identified challenges that originated from the students (Table 4). They perceived that some students had gaps in preliminary skills to succeed, such as the lack of mathematical skills. In addition, some students did not want to work towards a degree, for instance to read course materials and books. Instead, the students expected ready-made solutions from the teachers and were passive during the courses. Some even refused to participate in group works, which caused frustration among the teachers.

One major challenge was the lack of active feedback-loop and connection to industry representatives (Table 4). Also various quality system related aspects were not in place, and better descriptions, guidance, and documentation were needed (Table 4).

Table 4: The teachers' perception of the challenges.

C4.1 Resources: Financial, Human resources Resources
Examples - Not able to make hands-on learning based elements - Not able to have both demonstrations and lectures - Not able to guide or mentor students - Not able to show what students really know and are able to do, lectures are boring as the focus is on theoretical aspects
4.2 Students: Way-of-studying, Broad overview, Readiness, Resistance, Preliminary skills
Examples - Students are not ready to read anymore, they want fast and prepared solutions - Students know how to use tools, but not the broader overview and connections of things - Working-life readiness capabilities are insufficient - Some students refuse to participate in group-works - Inadequate level of mathematical skills (some students)
C4.3 Quality and process: Metrics, Quality system, Process, Documentation
Examples - Unclear/lack of metrics and measuring practices - Quality handbook/Quality system not in place - Description of what and how (e.g., content, process, and methods) - Clear documentation of the courses and materials, and overview of the education/degree (quality)
C4.4 Industry connections: Feedback, Updating-education, Needs, Demands
Examples - We do not have active feedback loops from industry - We could have a bigger role in industry, but we do not know what they want (weak feedback-loops) - No-one knows future competence needs in industry

4.3 Analysis

Technical and substance knowledge. It was identified that the IT specialists were technically skilled with good substance level knowledge (i.e. hard skills) to succeed. These findings correspond with the findings from the university's teachers. The main focus during studies was on substance level knowledge (Table 3). In technical fields the current and future problem is the enormous amount of substance knowledge that needs to be shared during studies. The amount of topics will not decrease in future. Instead, new topics and fields should be included. Therefore, teachers and universities face a dilemma how to share a great number of topics within a limited amount of time and courses.

Communication and interaction skills. One major challenge originated from soft skills: communication, proactivity, responsibility, and consultancy-type of approach and mind-set (Table 1). The IT unit expected successful deliveries, open-minded ideas, and proactively taking responsibility. Instead, the IT unit felt that the supplier failed on its operational level responsibility, which decreased the service purchasing company's satisfaction.

The university's teachers identified similar kind of working-life skill needs as the IT unit (Table 2). Various critical thinking and working-life readiness skills need to be learned during studies, such as social skills, communication (verbal/written), interaction, and taking responsibility and being self-guided. Some of the identified challenges (Table 4) originated from the students, such as being passive, waiting for ready-made solutions or not being responsible for their studies.

Training methods and approaches. The GSOE training outcomes were inadequate to be able to succeed in operational level activities. The GSOE training mainly focused on familiarizing the new practices and working culture. The main teaching approach was teacher-focused approach instead of using practical and hands-on methods. As an example, there was a lack of connection between the training topics (such as processes) and real-life daily activities and situations with end-customers and stakeholders. Therefore, the training did not build proactive way-of-working approach although it was needed to succeed (Table 1).

The university teachers also identified challenges to combine theory and hands-on practicing during courses (Table 3). The main focus was on ensuring substance related competences instead of practical adaptation and enhancing communication skills. Due to cost savings, various group-works and

demonstrations were decreased were students could practice the needed competences and interaction skills (Table 4).

Pedagogical skills and experience. We identified gaps in pedagogical skills and teaching experience in the GSOE training situation. More focus was needed on training methods, arrangements, targets, content, and pedagogical competences. It is possible that the GSOE trainers used teacher-centred lecturing method, because they were accustomed to it during their own studies. It is notable activating teaching methods and approaches have increased in universities significantly during the past few years. However, the GSOE trainers had not adopted activating teaching methods.

Similarly, the university teachers also brought forth the need for pedagogical skills to support their teaching arrangements (Table 3). The pedagogical skills would provide competences to use a wider scale of methods instead of relying only on lecturing types of solutions. It is notable that in university, pedagogical qualification is not required in addition to substance level knowledge.

Measuring effectiveness. In the IT unit's case, measuring the training effectiveness and conducting follow-up practices were missing. Clearly, in this kind of situation the service purchasing company should be an integral part of the training implementation, because they have the business, practical, and tacit knowledge of the operation.

Similar challenges were identified in the university's case, because the university did not have a clear idea of how useful and effective the courses were at working life (Table 4). Also an active feedback-loop to industry was lacking.

Overall summary. More focus was needed on building communication and interaction competences. The passive communication and interaction challenge was visible in both of the cases. However, the challenge is not only on developing communication and interaction skills, because the passive approach needs to be transformed into active approach, and students and actors need to be responsible for their own learning and willingness to take responsibility to learn. Teachers are not anymore leading the learning situation, instead they operate as coaches and facilitators and students and actors are responsible for their own learning and skills. In recent years, universities have implemented activating teaching methods, which have not yet been transferred to business environments. The situation is changing in a near future when students move to working life and apply these activating practices also in industry.

5 CONCLUSIONS

The purpose of this paper was to identify and analyse factors in self-organized training arrangements in a global selective outsourcing situation and the correspondence of those on a university's findings. This was examined by analysing two sets of independent interviews. In this case research we found similarities with the industry and the university findings.

Providing good technical and substance level knowledge is one of the main requirements for IT education. Also, communication and interaction skills are considered as fundamental. Both industry and education require proactivity. Therefore, passive approach needs to be transformed into active, and people need to be responsible for their own learning and actions. It was found that lecturing was the primary teaching method and lecturing method includes also several good aspects. Practical hands-on knowledge and pedagogical skills were identified as critical to ensure successful knowledge transfer. Activating methods would provide better operational level skills and mind-set in the industry case.

We acknowledge the limitations of this study as the results come from only one university and one industrial training case. At the same time, however, the results are well aligned with the existing research and discourse, especially in the university case. Also the case industry company and its IT supplier were global companies and familiar with outsourcing arrangements and training activities. Therefore, this case study can provide valuable findings from in-house based training situations.

Future research should be reflected to a larger set of educational innovations, in terms of structure and methods. One of the arising hypotheses for future research is to study and design educational interventions and methods to be used in-house and self-organized training arrangements in industry. We argue that university education could play a bigger role in this than it does now. There is also a need to develop training practices to become more transformative. This would enable more active feedback-loops between university level education and the industry. Higher education could have a significant role in transformations. One future research area could be to study how universities can provide education and training solutions to industry needs, and how universities could arrange more advanced studies and carry out project type studies in cooperation with companies.

REFERENCES

Arnold, R.D. and Wade J.P. (2015). A Definition of Systems Thinking: A Systems Approach. *Procedia Computer Science, Conference on Systems Engineering Research*. 44, 669-678,

Ayers, D.F. (2002). Developing climates for renewal in the community college: A case study of dissipative self-organization. *Community College Journal of Research and Practice*. 26(2), 165-185.

Beer, M., Eisenstat, R.A. and Spencer, B. (1990). Why change programs don't produce change. *Harvard Business Review.* 68(6), 158–166.

Birdi, K. S., Patterson, M. G. and Wood, S. J. (2007). Learning to perform? A comparison of learning practices and organizational performance in profit- and non-profit-making sectors in the UK. *International Journal of Training and Development*. 11, 265-281.

Boron, S., Murray, K.R. and Thompson, G.B. (2016). *Sustainability education: towards total sustainability management teaching* in W. Leal Filho et al. (eds.), Handbook of Theory and Practice of Sustainable Development in Higher Education, World Sustainability Series. Springer International Publishing AG. Switzerland.

Chaudhury, S. and Bartlett, K.R. (2014). The relationship between training outsourcing and employee commitment to organization. *Human Resource Development International*. 17(2), 145-163

Chen, C. J. and Huang, J. W. (2009). Strategic human resource practices and innovation performance: The mediating role of knowledge management capacity. *Journal of Business Research*. 62, 104–114.

Córdoba, H.R. and Midgley, G. (2006). Broadening the boundaries: An application of Critical Systems Thinking to IS planning in Colombia. *The Journal of the Operational Research Society*. 57(9), 1064-1080.

Crawley E.F., Malmqvist J., Östlund S., Brodeur D. R., Edström K., 2014. *Rethinking Engineering Education. The CDIO Approach*, Second Edition, Springer.

Emerson, T. and English, L. (2016). Classroom experiments: Teaching specific topics or promoting the economic way of thinking? *Research in Economic Education*. 47, 4, 288-299.

Englund, C., Olofsson, A.D. and Price, L. (2016). Teaching with technology in higher education: understanding conceptual change and development in practice. *Higher Education Research & Development.* 36(1), 73-87.

Froyd, J.E., Wankat, P.C. and Smith, K.A. (2012). Five major shifts in 100 years of engineering education. *Proceedings of the IEEE.* 100, 1344–1360.

Gainey, T. and Klaas, B. S. (2003). The outsourcing of training and development: Factors affecting client satisfaction. *Journal of Management*. 29(2), 207–229.

Galanaki, E., Bourantas, D., and Papalexandris, N. (2008). A decision model for outsourcing training functions: distinguishing between generic and firm-job-specific training content. *The International Journal of Human Resource Management*. 19(12), 2332-2351.

Graham, R. (2012). *Achieving excellence in engineering education: the ingredients of successful change*. The Royal Academy of Engineering. London.

Houston, D., Robertson, T. and Prebble, T. (2008). Exploring Quality in a University Department: Perspectives and Meanings. *Quality in Higher Education.* 14(3), 209-223.

Keller, S. and Aiken, C. (2009). *The inconvenient truth about change management*. McKinsey and Company, Chicago.

Kotter, J.P. (2008). *A Sense of Urgency*. Harvard Business School Press, Boston.

Kotter, J.P. (1995). Leading change: why transformation efforts fail. *Harvard Business Review*. 73(2), 59–67.

Merriam-Webster Dictionary. (2016). Available at: http://www.merriam-webster.com/ (Accessed 2.8.2016)

Petrović, J. and Pale. P. P. (2015). Students' perception of live lectures' inherent disadvantages. *Teaching in Higher Education*. 20(2), 143-157.

Pucciarelli, F. and Kaplan, A. (2016). Competition and strategy in higher education: Managing complexity and uncertainty. *Business Horizons*. 59(3), 311-320.

Rakbamrung, P., Thepnuan, P. and Nujenjit, N. (2015). Use of a System Thinking Learning Force and Motion Concept in Physics for Nurse Course. *Procedia – Social and Behavioral Sciences, 7th World conference on Educational Services (WCES-2015)*. 197, 126-134.

Samanakoopt, N., Songkram, N. and Thongdeelert, P. (2015). Online collaboration model using systems thinking to enhance leadership of agricultural undergraduate students: the conceptual model. *Procedia – Social and Behavioral Sciences*. 174, 1085-1089.

Senge P. (1996). Systems thinking. *Executive Excellence*. 13(1), 15-16.

Senturia, T., Flees, L. and Maceda, M. (2008). *Leading change management requires sticking to the plot*. Bain and Company. Available at http://www.bain.com/publications/articles/leading-change-management-requires-sticking-to-the-plot.aspx (Accessed 22.2.2017)

Shipton, H., Fay, D., West, M., Patterson, M. and Birdi, K. (2005). Managing people to promote innovation. *Creativity and Innovation Management*. 14, 118–128.

Smith, M.E. (2002). Success rates for different types of organizational change. *Performance Improvement*. 41(1), 26-33.