MPM – Master of Project Management

DOES SIMULATION IMPROVE LEARNING OUTCOMES FOR PROJECT MANAGERS?

IF SO WHICH COMPETENCE AREAS OF THE EYE OF COMPETENCE ARE AFFECTED THE MOST?

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ABSTRACT

Demands in the labour market are developing rapidly with increasing emphasis on skills and competences. The teaching methods and assessment in the educational system must change in parallel to these changing demands from only being knowledge-based to being based more equally on knowledge, skills and competences. This paper describes the effects of using a simulation teaching method to improve the learning outcomes for students in a Master of Project Management (MPM) programme in Reykjavík University. In a cohort of 26 MPM students, using a series of four simulation exercises led to an incremental improvement in all intended learning outcomes, based on knowledge, skills and competences in project management. The students, when interviewed, described a wish for increased use of simulation in their teaching and more varied simulation subjects, the importance of debriefing after each exercise and a perceived highest impact on the People and Practice areas of competency in the Eye of Competency.

1. INTRODUCTION

Demands on skills and competencies, relative to pure knowledge, have become significantly more prominent in most jobs over the last decades as new technologies and various social factors have led to substantial changes in the labour market. As a response to these changes, demands on the content and structure of education as well as the evaluation of performance within the educational system has also changed. As part of these changes, new technologies call for diverse new teaching methods to respond to the new demands of the labour market (Henard & Leprince-Ringuet, 2008). The teaching of project management is not excluded from these changes. In order to accommodate the increasing demands on skills and competencies of project managers it is necessary to evaluate the performance of teaching methods other than didactic lectures. Simulation is a teaching method that is based on mimicking real-life circumstances for training purposes or to solve a problem. It has been used for educational purposes for centuries (Bradley, 2006). The purpose of simulations is for the student to develop critical thinking, decision-making capacity and/or procedural skills through techniques such as the use of devises, interactive videos or mannequins and role playing (Jeffries, 2005). The effectiveness of simulation as a teaching method is assessed by measuring the learning outcomes. A simulation method is considered effective if learning has occurred (Sørensen, e.d.). Research on medical education has shown that number of hours of practice in medical simulations have a strong association with standardized learning outcomes (McGaghie, Issenberg, Petrusa & Scalese, 2006). In physical therapy education using simulation teaching methods have been shown to have high impact on professional development (Sabus & Macauley, 2016). Both students and teachers seem to improve learning outcomes when using game simulation and both cognitive and affective learning outcomes can be induced and facilitated through simulation (Sørensen, e.d.). The International Project Management Association or

IMPA has published its *Individual Competence Baseline* (ICB) defining the competencies required for individuals working in the fields of project, programme and portfolio management. In the fourth version of ICB, published in 2015, the IPMA redefined its main competence elements which are now divided into 29 competence elements in three competence areas. This included defining in more detail the required knowledge, skills and abilities and specifically increasing the emphasis on skills and abilities. The definition of competence used in ICB 4.0 is "the application of knowledge, skills and abilities in order to achieve the desired results" (IPMA, 2015 p.15). According to the IPMA, the 29 required competence elements are set up as "the eye of competence" and divided into three competence areas, Perspective, People and Practice. Different skills are required in each area, and together create the whole, balanced individual (IPMA, 2015).

The purpose of this study is to evaluate if the simulation teaching method improves learning outcomes for project managers and if so to quantify the relative effect of the method on the three competence areas of the Eye of Competence from IPMA.

2. LITERATURE REVIEW

For students to be well prepared when they enter the labour market, education must strive to fulfil the demands of the market. Therefore, teaching methods in higher education need to be continuously improved (Byrne & Flood, 2018). Such continuous improvement has been found to be play an important role in preventing that the labour market or the school system becomes stagnant and is thought to play a big part in advancing both areas. This is of increasing importance with the current rapid increase in technological advancement and the rapid changes, increased demands and challenging economic realities of the labour market (Lucena, Downey, Jesiek & Elber, 2008).

Knowledge

Students generally find animation learning with simulation more interesting and therefore show more enthusiasm for learning than with didactic lecture simulation. The knowledge acquisition from simulation teaching is considered to be in the form of active absorption of knowledge by the student compared with passively instilling knowledge in students when using traditional teaching methods (Xu, Li & Lou, 2018). They further found that using 3D visualization dynamic simulation in teaching engineering students deepened the understanding of the theories and methods of engineering project management and helped students to understand the material flow, cash flow, workflow and information flow in project management (Xu et al., 2018). A study on project managers and project engineers working in the oil and gas sector also showed that collaboration of academic institutions and practitioners using real cases in simulation, role modelling etc. better prepared project manager students to become creators of knowledge rather than just knowledge recipients. The authors further emphasize the importance of the academic institution, in collaboration with practitioners, allowing students to become proactive problem solvers and critical thinkers instead of passive recipients of theories and generic knowledge (Ramazani & Jergeas, 2015).

Skills

Research on simulation from the Creighton University School of Nursing has shown that using simulation teaching creates continuous learning activities related to different learning objectives producing dynamic and continuous student learning. It

was also found that the simulation goes beyond skill acquisition leading to more nursing experience. (Hawkins, Todd & Manz, 2008). Lectures and paper-based materials are effective when teaching declarative knowledge. However, when teaching more complex skills to prepare students for the labour market, simulation training more effectively instils the necessary knowledge and skills (Salas, Wildman, Piccolo & College, 2009). Using simulation can help students with communication management, project operation, managing project stakeholders, organizational strategy, decision making and more (Xu et al., 2018). A recent review found that simulation methods lead to better communication skills and that these skills could be translated into the workplace. (Jolly, Bowie, Dawson, Heslington & Dinwoodie, 2019).

Learning outcomes

Research has shown a strong correlation between time spent in high-fidelity simulation practice and standardised learning outcomes in medical education (McGaghie et al., 2006). A study carried out in Switzerland on simulation teaching showed a clear improvement on the learning outcome. The method also affected the student's development of critical thinking skills. In addition, the study suggests that the role of motivation inherent in simulation teaching is influencing the students learning outcome (Gatti, Ulrich & Seele, 2019). In 2008 the European commission for Education and Culture published The European Qualifications Framework for Lifelong Learning. The purpose with this publication was to promote citizens mobility between countries and to facilitate their lifelong learning. The framework defines learning outcomes as a combination of what learner knows, understands and is able to do on completion of a learning process. The learning outcome is specified in three categories, knowledge, skills and competence. Using theoretical knowledge, practical and technical skills and social competences are crucial to have the ability to work with others (European communities, 2008).

Debriefing

Debriefing is a highly valuable part of simulation teaching that sometimes is overlooked. During debriefing the teacher leads the group in discussing the process, outcomes and applications of the simulation exercise. The discussion allows the participants to reflect on their experience during the simulation, practice critical thinking, link the relevant theory to practice and discuss how to intervene in very complex situations (Rauen, 2001). During the debriefing when students rethinks the simulation session and discuss their experience, they learn from the event that occurred (Arafeh, Hansen, & Nichols, 2010; Decker, 2007; Dreifuerst, 2009; Fanning & Gaba, 2007). Students have a positive learning experience and a more likely to reach the desired learning outcome when debriefing is used (Dreifurest, 2009). David Crookall claims that the learning take place during the debriefing at not during the game itself and that it is a processing of the game experience during debriefing that turns it into learning (Crookall, 2010). The debriefing should be guided in such a way that it is related to the desired learning outcomes with an aim to facilitate students to achieve them (Crookall, 2010).

3. RESEARCH METHOD

The study was performed using a mixed research method based on quantitative methods with added qualitative interviews to provide more depth (Hesse-Biber, 2010). The cohort of the study was 33 second year master's students in project management (MPM) in Reykjavík University. The students participated in four simulations, with different topics during one teaching weekend. Before the

simulations started, the students were randomly divided into teams, with each student being assigned to a different team for each simulation. During each simulation the students were presented with a case used during that specific exercise. The first simulation was a role-play-based simulation where the participants were divided into different roles as sponsors, portfolio managers and project managers and were given different information about the project dependent on the role assigned. The main goal of the exercise was to finish a given project with the given instructions by analysing, communicating and decisions making. The other three simulations used simulation software from Prendo simulations (for further details see; prendo.com). The second simulation was centred on the integration of two virtual banks simulating a merger. The main objectives of that simulation were leading change, implementing strategy, influencing skills and post-merger integration. The third simulation was about a shale gas operation, the main subjects were crisis management, managing trust and reputation, stakeholder management and responsible leadership. The last simulation was on building a sports stadium, the main objectives were advanced project management, risk managing and uncertainty, and implementing strategy. The simulation software recorded the teams' decisions and resulting project performance after each decision-making round. Recording the events and decisions in real time, is thought to be useful for debriefing and analysis purposes (Martin, 2000). At the end of each simulation the cohort collectively analysed the results using the software and a short debriefing session about the simulation was conducted by the teacher.
Before and between the simulations the students answered surveys created in SurveyMonkey (SurveyMonkey is a cloud-based online survey development software company). The first survey was introduced before the first simulation started, and subsequently surveys were introduced at the end of each teaching day (after simulation one, three and four), a total of four surveys, each containing the same questions. A link to the questionnaire was sent to students through Canvas, which is a learning management system used in the Reykjavík University.

The survey contained 19 questions with answers graded on a Likert scale, see figure 1. Possible answers were; very little, could be better, fair, good and excellent indicating the student's perceived understanding of a given learning outcome. The answers were subsequently assigned a number from one to five, one for very little and five for excellent. The questions were written with the learning outcomes as reference, see appendix 1. One question was related to each objective to analyse whether the simulations had any effect on the perceived development of the student, as defined by the learning outcomes. See figure 1.

Questions	Very little	Could be better	Fair	Good	Excellent
1. Explain multiple facets of different roles in projects, such as the sponsor role, the project manager role and the client/contractor role					
2. Explain the advantages and limitations of project simulations as a training and teaching tool					
3. Do a detailed project situation analysis					
4. Judge stakeholder-driven trade-offs					
5. Map and use influence networks in a project context					
6. Plan and coordinate effective communication in projects					
7. Adapt to new information and make rapid decisions in projects					
8. Take decisions in a complex scenario					
9. Optimise a post-merger integration plan					
10. Manage the media in a project context					
11. Protect shareholder value & corporate reputation in a project setting					
12. Develop an optimal contract strategy in a project setting					
13. Map the value of a business change					
14. Analyse and manage project related risks					
15. Analyse the full range of human interests & motives in a project context					
16. Develop detailed stakeholder analyses					
17. Develop effective communication strategies					
18. Develop trust with stakeholders					
19. Craft a change management strategy					

Figure 1- Questionnaire

During the interpretation, the questions were categorized by the competency areas of the ICB4, Perspective, People and Practice, see appendix 2. Four questions were related to the Perspective area, eight to the People area and seven questions to the Practice area. The purpose of categorizing the questions was to analyse if simulation has different impacts on the different competence areas.

To gain a more detailed understanding of the responses to the surveys six students from the cohort were asked to join a discussion group to answer a list of questions that arose from the results. The interview was performed using a semi structured approach. The six students were chosen based on their answers to the surveys with three students who answered below group average and three who answered above group average being selected. An effort was made to keep the atmosphere relaxed during the discussion so that the participants would be comfortable and feel free to speak their mind. At the beginning of the discussion all participants consented to the session being recorded.

4. RESEARCH RESULTS

4.1 Quantitative results

Seven students who did not attend all the simulations or did not answer all the surveys were eliminated from the cohort, leaving answers from 26 students for the analysis. The answers to each question in the first survey were compared to each subsequent survey.

A paired sample t-test was performed for each of the question, to find statistically significant differences between individual student's answers after each round of simulation. The understanding of the learning objectives, mean improvement and variance for the questions was calculated after each round, see table 1. After the first round, the perceived understanding of eight learning objectives had significantly improved. After round two the perceived understanding of 14 learning objectives had significantly improved and after the last round the perceived understanding of all 19 learning objectives had significantly improved.
The mean perceived understanding of the combined learning objectives increased after each day as seen in table 1. In addition, the variance of perceived understanding for each question decreased after each round of simulation, see table 1.

	Day 1	Day 2	Day 3
Improved understanding of learning objectives, n	8	14	19
Mean improvement on Likert scale	0,249	0,546	0,872
Mean decrease in variance between students	0,106	0,186	0,358

Table 1 - Statistically significant differences

The average improvement on the Likert scale for questions related to the Practice competence area was 0,990, on the Perspective competence area 0,893 and on People competence area 0,871. See figure 2.

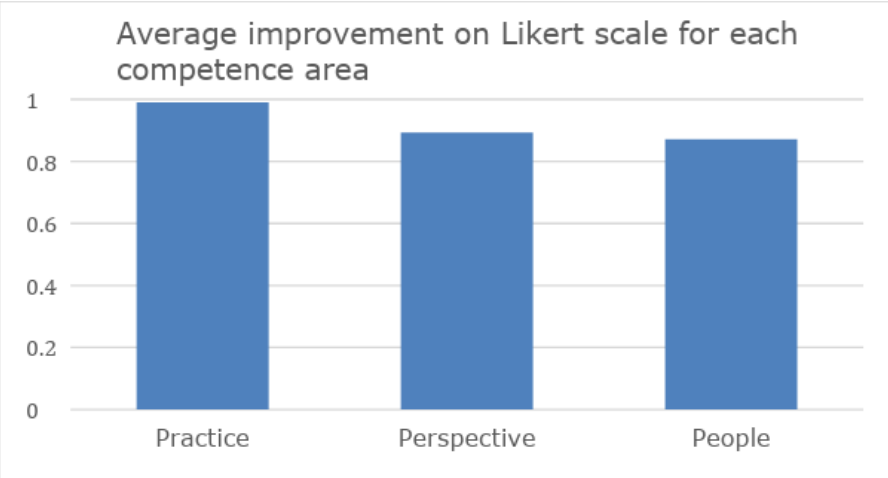

Figure 2 - Improvement on Likert scale

4.2 Qualitative results

The responses from the discussion group revealed three main themes:

1 Most perceived improvement in People competency area, specifically the importance of communication in project management.
2 The importance of diverse topics in simulation and more frequent sessions.
3 The importance of debriefing.

The first topic discussed in the group was the students perceived main learning points during the simulations. The group felt that they had learned most about the importance of communication in project management. The discussion group believed that their learning during the simulations had most improved their understanding of the People area in ICB4 but also felt improvement in the Practice area. Working with different stakeholders and working on many tasks at the same time was felt to be very instructive during the simulations. They also mentioned that it was good to practice their ability to think a few steps ahead and to see the big picture of the entire project. One of the participants mentioned that it was very positive to receive the response from the simulation software instantly.

The discussion group talked about the need for more diverse simulation topics, such as art festivals, concerts, event management etc. The group was very enthusiastic about this point. They said that they wished to have the possibility to choose simulation topics, and self-assign to simulation exercises according to their interests. The group would like to do simulations more often during their master's studies, for example two times each semester after the first semester thus participating in a total of six simulation sessions each spanning one teaching weekend. One student said that you could learn how to plan projects, but you must practice human skills, as you do in simulation in order to become an effective project manager.

The group also emphasized that they wanted more and deeper debriefings after the simulation exercises. The debriefing was felt to be too short and that students only received the results of the simulations and not a more detailed discussion about the simulation. The group expressed a wish to analyse more the discussions that

occurred during the simulation within their teams, what affected the decisions they took regarding the project and what they have could have done better.
The students added to the discussion that they thought that the teams that they had been assigned to were too large (each group contained four or five participants), leading to difficulties in ensuring that every student could actively participate in the simulations. The result was that frequently two or three individuals took control of the simulation. In addition, it was felt to be difficult to have five people working in front of one computer screen. It was the opinion of the discussion group that they would have learned more if there had only been two or three students in each team.

5. DISCUSSION

The results of this study show that simulation positively affected the learning outcomes for students in the MPM program in Reykjavik University. This is in agreement with the results of other studies on university students for example in medical education (McGaghie o.fl., 2006 and Gatt, Ulrich og Seele, 2019). Simulation can thus be considered an effective teaching method for high level education and it can be utilized in the education of many different professions. It would be interesting to further investigate if simulation is gaining importance as a teaching method in higher education, since studies show that simulation improves not only knowledge but also skills that prepare students better for the current demands of the labour market (Salas, Wildman, Piccolo and College, 2009).
This study did not show any statistical difference between improvement in the different areas of the eye of competence. This is consistent with the previous knowledge that simulation can affect a wide range of competencies such as communication management, project operation, stakeholders, strategy, critical thinking, finance decision making (Xu et al., 2018, Gatti, Ulrich & Seele, 2019).
The results from the quantitative and qualitative methods did not reveal the same outcome. It was interesting that during the discussion group, all the participants agreed that the simulation had the strongest effect in the People and the Practice area while no such trend was detectable in the answers to the surveys. It may be a sampling error due to the modest size of the discussion group resulting in the students in the discussion group having more knowledge in the Perspective area before the start of the simulations than other students in the cohort. It is also possible that the design of the simulation exercises was such that they were most challenging in the People and Practice competency areas.
It was also interesting that the discussion group emphasized debriefing and its importance for reaching the learning objectives and that they wanted more debriefing after each simulation. Crookall says that we must take debriefing seriously if we are going to make simulation a serious teaching method (Crookall, 2010). The discussion group's emphasis on debriefing is consistent with other studies on debriefing after simulation. One study for example showed that it is during the debriefing that students learn from the event that occurred (Arafeh, Hansen & Nichols, 2010)

6. CONCLUSIONS

The main objective of this study was to evaluate if the simulation teaching method improves learning outcomes for project managers and if so to quantify the relative effect of simulation teaching on the three competence areas of the Eye of Competence from IPMA. In this study simulation improved all the 19 learning

outcomes with a clear increase with increased number of simulation exercises. The result from this study shows that simulation is an effective teaching method in MPM and should be used more often during the studies. The students achieved increasing understanding of the learning objectives with concurrent decreasing variance in understanding creating a strong argument for increased use of simulation teaching. It would be interesting to conduct further studies into the use and effects of simulation as a teaching method in MPM internationally as well as investigating the possible underlying reasons behind obstacles for the increasing use of the method.

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Appendix 1

Learning outcomes

After having concluded the course, the student shall have the **knowledge** to:

- Explain multiple facets of different roles in projects, such as the sponsor role, the project manager role and the client/contractor role.
- Explain the advantages and limitations of project simulations as a training and teaching tool.

After having concluded the course, the student shall have the **skills** to:

- Do a detailed project situation analysis.
- Judge stakeholder-driven trade-offs.
- Map and use influence networks in a project context.
- Plan and coordinate effective communication in projects.
- Adapt to new information and make rapid decisions in projects.

- Take decisions in a complex scenario.
- Optimise a post-merger integration plan.
- Manage the media in a project context.
- Protect shareholder value & corporate reputation in a project setting.
- Develop an optimal contract strategy in a project setting.
- Map the value of a business change.

After having concluded the course, the student shall have the **competence** to:

- Analyse and manage project related risks.
- Analyse the full range of human interests & motives in a project context.
- Develop detailed stakeholder analysis.
- Develop effective communication strategies.
- Develop trust with stakeholders.
- Craft a change management strategy.

Appendix 2

Eye of competence

Perspective	Practice	People
1. Explain multiple facets of different roles in projects, such as the sponsor role, the project manager role and the client/contractor role 9. Optimise a post-merger integration plan 12. Develop an optimal contract strategy in a project setting 19. Craft a change management strategy	2. Explain the advantages and limitations of project simulations as a training and teaching tool 3. Do a detailed project situation analysis 7. Adapt to new information and make rapid decisions in projects 11. Protect shareholder value & corporate reputation in a project setting 13. Map the value of a business change 14. Analyse and manage project related risks 16. Develop detailed stakeholder analyses	4. Judge stakeholder-driven trade-offs 5. Map and use influence networks in a project context 6. Plan and coordinate effective communication in projects 8. Take decisions in a complex scenario 10. Manage the media in a project context 15. Analyse the full range of human interests & motives in a project context 17. Develop effective communication strategies 18. Develop trust with stakeholders