How should we teach the logic of BPM? Comparing e-learning and face-to-face setting in situated learning

Full Research

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Abstract

Knowing the fundamental logic of Business Process Management (BPM) is essential for students to understand and connect concepts of BPM and to develop appropriate information systems (IS). The logic of BPM refers to how organizations and processes should be designed to be efficient in general. Yet the question arises how to enable students to learn the logic of BPM. We conducted an empirical study with 150 graduate students separated into e-learning and face-to-face groups. The results show that both learning settings are effective, but the effect of the face-to-face setting is almost double. We propose to use situated e-learning as a short introduction for beginner courses in IS. Thus, students can quickly accumulate a sufficient level of knowledge. A situated face-to-face setting is then helpful to deepen the knowledge in a course on specific concepts of BPM.

Keywords

e-learning, technology-enabled active learning, business process management (bpm), tacit knowledge

INTRODUCTION

Learning the logic of process orientation is an important key to apply Business Process Management (BPM) to organizations. Process orientation refers to the cross-functional perspective that processes and supporting IT systems run horizontally through organizations (Hammer and Champy 1993). A process-oriented design of organizations implies certain principles and concepts for managing processes. The logic of BPM contains how processes and process-oriented organizations should be designed. Getting this logic allows to understand BPM concepts (such as service-oriented architecture) as well as the purpose and context of information systems better.

Understanding how the logic of BPM can be taught is of major importance for practice as well as for research (Brazanga and Korac-Kakabadse 2000). Literature on teaching the logic of BPM is still rare. Authors either develop conceptual models about how to achieve this goal with a specific learning style (e.g. Krumeich et al. 2012) or provide empirical evidence on different learning modes (e.g. Letmathe et al. 2011). The focus of such work is on teaching-specific process execution knowledge. Furthermore, the results cannot be transferred to other domains as the usefulness of a learning style is context dependent (Sadeghi et al. 2012).

E-learning provides an opportunity for another venue for such learning. It creates a rich learning environment with the goal to enhance individual and organizational performance (Rosenberg 2006). E-learning encompasses a wide set of applications such as computer-assisted learning, distance education, virtual classrooms, web-based training, and mobile learning. However, studies on incorporating e-learning into situated learning programs are limited to initial conceptions and pilot studies (Wang et al. 2013). Further studies are needed to investigate the effects of these methods on learning performance. Hence, the research question of this contribution is how e-learning in comparison to a face-to-face setting in the classroom allows students to learn the logic of BPM.

DIMENSIONS OF THE LOGIC OF BPM

The logic of BPM covers how processes should be designed and executed in an organization (Davenport and Short 1990; Hammer and Champy 1993). It involves the organization as a whole, i.e. the network of processes, employees, machines, and IT systems (Lindau 1997). According to this view, organizations should be designed along their value chain. The dimensions to describe the logic of BPM are depicted in Figure 1.

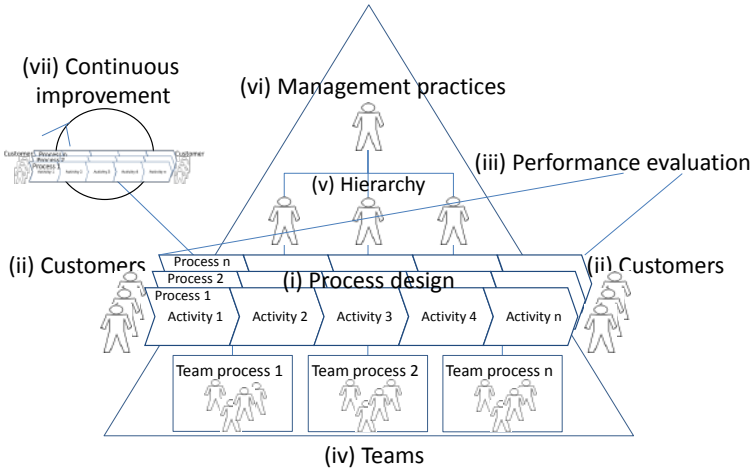

Figure 1. Dimensions of the logic of BPM in an organization

The dimensions can be described as follows (Davenport and Short 1990; Hammer and Champy 1993):

i. Tasks should be ordered properly, handovers and employees involved are to be kept to a minimum, and goals should be aligned to one category such as time, cost, or quality (Leyer and Wollersheim 2013).

ii. Starting and end point for a process should be the customer, i.e. his/her order (Bowen and Youngdahl 1998). The process should then include every activity, which is necessary to fulfil the order.

iii. The individual goals of employees to evaluate their performance should be aligned to the goals of the process the employees are working in (Trebble et al. 2010).

iv. Team building should not arrange employees according to functions (de Souza and Pidd 2011).

v. The number of hierarchical levels ranging from team members to the top management should be kept to a minimum (Hammer and Champy 1993).

vi. Managers should mainly be coaches enabling the employees to perform the tasks independently (Jolayemi 2008). Accordingly, the operative working time of managers should be kept to a minimum.

vii. Permanent improvement of processes should be cross-functional to avoid uncoordinated improvements (Maleyeff 2009).

SITUATED LEARNING FOR BUSINESS PROCESS EDUCATION

Approaches for learning tacit and highly contextualized knowledge (e.g., the logic of BPM) can be referred to as situated learning, which is defined as learning through executing tasks and solving problems in a professional environment (Brown et al. 1989). In situated learning, learners build their knowledge in a specific context and within a social environment (Levitt and March 1988). The most relevant instructional design theory based on situated learning is cognitive apprenticeship (Collins et al. 1991), which claims that traditional instruction often fails to consider the implicit processes involved in carrying out complex tasks. Therefore, it is important to identify the processes of abstract tasks and make thinking involved in these tasks visible to learners.

In business process education, several pedagogical strategies such as project work, integrated case studies, and simulation games have been initiated in some universities in response to the practice-oriented nature of BPM knowledge (Bandara et al. 2010; Recker and Rosemann 2009). However, there is little known on the empirical evidence of such practices regarding the logic of BPM (Seethamraju 2012), except a recent study that explores the effects of the learning-by-doing approach in learning process-oriented thinking (Leyer and Wollersheim 2013). The authors gathered empirical evidence with regard to the process design. This study reveals that situated learning is generally more effective than using documented knowledge.

Concerning e-learning, the focus does not only involve the adoption of new technology together with its impact on learning and teaching, but also the instructional strategies and methods for an effective integration of new technology and learning programs (Graham 2011). With respect to situated learning, e-learning allows for flexible ways for learners to access task-oriented learning activities, to reflect on their actions, and to discuss issues and problems with fellow members in a learning community (Wang 2011).

As prior work (Feng et al. 2012; Wang et al. 2013) proposes a positive effect of e-learning in a situated learning program the following hypothesis is formulated:

H1: Applying e-learning in a situated learning environment for building up knowledge on the logic of BPM leads to a significant increase of knowledge.

An extensive meta-analysis on empirical studies conducted by Means et al. (2010) comparing 27 studies on online and face-to-face settings comes to the conclusion that typically pure online instructions are similarly effective as classroom settings. The meta-analysis did not analyse if there are any differences regarding the learning style related to situated learning. In addition, the learning contexts were different from knowledge on the logic of BPM. Based on this general finding we formulate the following hypothesis:

H2: An e-learning setting leads to the same learning effect as a face-to-face setting regarding situated learning of knowledge on the logic of BPM.

The meta-analysis of Means et al. (2010) also considers learning time of participants as an important moderator of learning performance. They found that in one third of the analysed studies the learning time in e-learning was lower than in face-to-face settings. However, more time spent leads to a higher learning effect in average. Thus, the third hypothesis is formulated as follows:

H3: The more learning time participants invest in the e-learning setting the higher is the increase of knowledge.

DESIGN AND IMPLEMENTATION OF THE LEARNING ENVIRONMENT

Curriculum

The curriculum of teaching the logic of BPM follows the dimensions described in the previous section. For each dimension an experiential task was given to the participants: (i) Order activities, assign roles to activities, set goals for roles in activities, (ii) Identify where the customer is relevant, (iii) Assign on which goals performance evaluation should be based on, (iv) Assign employees to teams, (v) Select a hierarchical structure in which the teams are operating, (vi) Define distribution of average working time of managers, (vii) Select projects.

The tasks related to process design follow the approach of Leyer and Wollersheim (2013) from which also the training example of a loan application process has been adopted (Figure 2). Participants were asked to order given activities to generate a reasonable process. Afterwards, a role had to be assigned to each activity. The possible roles were provided, but it was not necessary for the participants to assign every one of them. The last step was to define goals which the employees should follow while performing the respective activities. Goals had to be assigned freely (no definition) and the same goal could be assigned more than once.

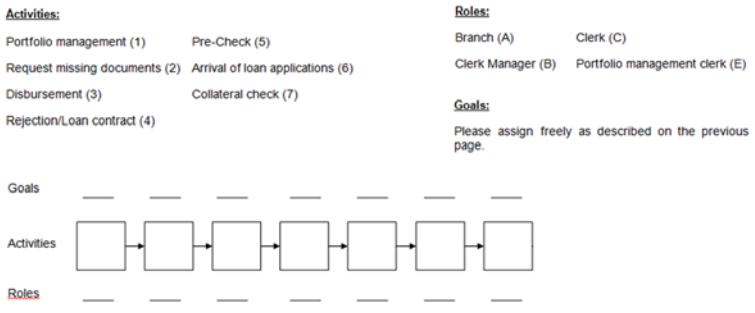

Figure 2. Structure of the training task related to process design (Leyer and Wollersheim 2013, p. 469 f.)

The next tasks went beyond a single process. With regard to the organizational structure another example was chosen to provide two different contexts. This ensured the independency of answers between the process and the organizational level. Figure 3 shows the example of a hospital with three operating processes, three functional areas, and nine employees working in this (fictitious) hospital.

The first task in this environment was to define where the customer focus is seen as relevant: before each process (three options), after each process (three options), and during the process (three options).

The second task was to indicate which goals should be used to evaluate the performance of employees. Options were provided for each function (three options) and for each process (three options). To ensure interest of employees in an efficient process, the evaluation should be based on the overall process goals.

The third task was to arrange the nine employees to teams with each team consisting of two employees as a minimum. Thus, the minimum of teams was two and the maximum was four teams.

Depending on the previous number of teams, participants were provided options to build a hierarchy. For two teams chosen, two options with one (CEO is the direct head of teams) and two hierarchical levels (additional team managers) were provided. In case of three and four teams, an additional option with three hierarchical levels (CEO, department leaders, and team managers) was added.

Regarding management practices, the participants were asked to allocate total daily working time to supervise employees, for coordination with other managers, for project tasks, for operative work related to selling and processing products, and for administrative work (Tsang and Antony 2001). While the time spent for coaching employees should be maximized, operative working time should be minimized.

Finally, participants were asked to decide how a budget for continuous improvement projects should be spent. The following five options were given: (1) one project with the aim of a massive reduction of working time in the process "Children" focusing on the function "Admission", (2) three projects with the aim of reducing working time in every functional area of the process "Children", (3) five projects with the aim of a minimal reduction of working time in every functional area of the process "Children" as well as in the function "Admission" across all three processes, (4) two projects aiming at reducing the waiting time between the functions in each process, and (5) one project with the aim of reducing the overall cycle time in each process. Evaluation ranges from option 1 being the worst to option 5 being the best alternative.

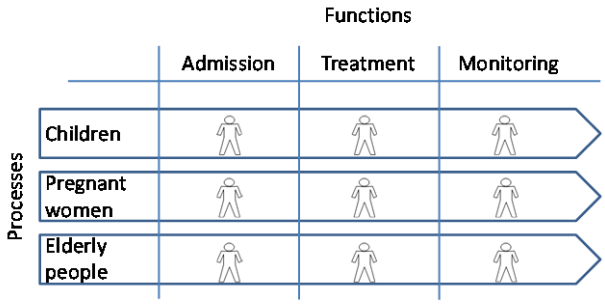

Figure 3. Structure of the training task related to organizational design

Schedule

The schedule was integrated in an academic course on Principles of Management. Regarding the topic of BPM logic the students were separated into an e-learning group and a face-to-face group. Participation was incentivized with receiving 10% of the overall grade when fully participating. Within the e-learning setting certain time periods were defined in which participants could access the learning environment flexible according to their individual time schedule. Contrary, there were fixed time periods for the face-to-face setting. Participants had as much time as required for the pre- and post-test but the training phase was limited to 70 minutes. In both cases, the post-test took place one week after the training phase to avoid a repetition bias.

The phases were executed as follows:

- *Pre-test:* Participants had to conduct a pre-test to determine the level of existing knowledge. Participants had to perform each of the tasks described in the previous section in the given order. The examples regarding the process and organizational structure had a higher complexity than in the training phase, but the logic as described in the previous section was the same. Thus, within the process design twelve activities had to be ordered, a maximum of six roles to be assigned to these activities, and twelve goals to be defined. The example chosen was a customer serving process in a restaurant (activities: prepare table, hand out menus, take order, prepare ordered drinks, serve drinks, prepare required ingredients for meals, cook ordered meals, arrange meals on plates, serve meals, remove plates, bring the bill, collect money; roles: manager, guests, bartender, kitchen help, cook, waiter). Regarding the organizational design, a repair shop was chosen with four processes (motor bikes, cars, trucks, and busses) and four functions (receipt, inspection, repair, and delivery) resulting in a total number of 16 employees.
- *Training phase:* The tasks followed the curriculum described in the previous section and could be accessed independently for e-learning and in the described order for the face-to-face setting. Thus, only

the e-learning participants were allowed to repeat them and to choose their own order. After performing each task, the participants were provided a visual best practice solution from a process-oriented point of view. Additionally, an explanatory text was added and the reasons for the best practice were explained based on the chosen example. Thus, an experiential environment was provided in which participants were allowed to experience first and to receive feedback afterwards. In both settings exchange was enabled (forum resp. classroom discussion) triggered by sample solutions (not the best practice).

- *Post-test:* The post-test had the same structure as the pre-test to ensure comparability. However, other examples were used to avoid that the participants simply repeat their answers from the pre-test. Regarding the process design, an examination process was used (activities: design exam exercises, design exam, adjust layout, prepare sample solution, copy exams, hand out exams, collect exams, sort exams, mark exams, record grading, control grading, publish grading results; roles: lecturer, examination office, invigilator, secretariat, student assistant, students) following the setting of Leyer and Wollersheim (2013). Concerning organizational design, the example of a parcel delivery company was applied based on four processes (letters, parcels, bulky goods, express documents) and four functions (acceptance, routing, transport, distribution).

Setting of the Learning Environments

The e-learning environment was set up in a combination of the e-learning platform Moodle and the online survey tool Unipark. Moodle provides an e-learning environment. Within the learning phase, participants could log into the Moodle system, access the learning material and the discussion forum, and the experiential learning tasks by direct link on the Moodle pages. Unipark was used to implement the experiential learning tasks for the pre-test and post-test. The participants were provided with a link and the personal log-in data to conduct the pre- and post-test. The participants could use drag-and-drop features to perform their tasks.

Within the face-to-face setting, the participants performed each task, including the training, on paper. After each step the documents were gathered to prevent participants from looking into previous material which was also not allowed in the e-learning setting. Sample solutions were displayed using a beamer so that everyone could join the discussion at the same time.

The main differences between the e-learning and the face-to-face setting are depicted in Table 1. The first three differences are related to the individual learning process while the following three refer to the exchange of learners with their peers and the instructor.

Table 1. Differences between e-learning and the face-to-face setting

E-learning	Face-to-face
Flexible learning time within a given period	Fixed learning time
Individual learning order	Fixed learning order
Possibility of repeating training tasks	Each training task is performed once
Indirect contact to instructor and participants	Direct contact to instructor and participants
Delayed feedback from instructor and participants	Instant feedback from instructor and participants
Explanations limited to provided content	More explanation from instructor

Measures

Independent measures: The first independent measure is the learning setting (nominal variable: e-learning and face-to-face) following hypotheses 1 and 2. The second independent measure is the learning time in the e-learning setting according to hypothesis 3.

Dependent measures: The dependent measures indicate the level of knowledge regarding the logic of BPM. They are linked to the tasks described in the curriculum section. Each measure is represented on a scale from 0 to 1 to allow for comparison and aggregation. A complete process-oriented view leads to 1, a function-oriented view to 0, and a neither-nor-decision to 0.5. The dimensions are measured as follows (in case of sub measures the average is calculated):

- *Level of knowledge regarding the logic of BPM:* This variable is calculated as the average of process design, customers, performance evaluation, teams, hierarchy, management practices, and continuous improvement.

- *Process design:* We follow the approach of Leyer and Wollersheim (2013). This measure is the average of the sub-measures sorting activities into the required order, assigning roles, and assigning goals.
  - Ordering activities: The participants' results are compared with a best practice process using a conformance technique from the field of process mining (Rozinat and van der Aalst 2005). This technique can calculate a similarity measure between two processes.
  - Assigning roles: The average is calculated for the percentage of reasonably assigned roles (according to a best practice), the percentage of using the provided roles, and the percentage of interfaces (according to the minimum of two and the maximum of eleven) between the roles.
  - Assigning goals: We calculate the average for the percentage of goals assigned to activities, the percentage of reasonable assigned goals (whether it belongs to one of the efficiency categories of time, cost, and quality), and the percentage of used categories.
- *Customers:* The first task is evaluated by two sub-measures. The first sub-measure covers if the view towards the customer is process-driven or function-oriented. For every assignment of customers before and after the four provided processes 0.125 is added (process-driven). 0.25 is subtracted in case of customers assigned to the four functions (function-oriented). If the score is negative, it is set to 0. The second sub-measure covers the end-to-end view. Thus, 0.25 is added for each process to which customer relevance is assigned before and after each process.
- *Performance evaluation:* Each single selection of a process goal being relevant for evaluating the performance of employees is rated with 0.25. In case of a functional goal the score is reduced by 0.125 and set to 0, if the overall score is negative.
- *Teams:* The number of teams the 16 employees can be allocated to ranges from two to eight. Two sub-measures are used: Each employee in a team working in the same process (minimum two) is rated with 0.0625. Within the second sub-measure, the percentage is calculated how many of the chosen teams consist of employees working in one process only.
- *Hierarchy:* Two to four teams can be managed in an organizational structure with one to three hierarchical levels (rating 1, 0.5, and 0; ascending) while five to eight teams can be managed with one to four hierarchical levels (rating 1, 0.66, 0.33, and 0; ascending). The best solution always was one hierarchical level as a ratio of up 1:16 can be seen as reasonable to handle for one manager in small firms (Colombo and Delmastro 1999).
- *Management practices:* This measure is the average of time assigned to "supervising employees" and 1 minus the "operative working time".
- *Continuous improvement:* The five options for projects are rated as follows: option 1 – rating 0; option 2 – rating 0.25; option 3 – rating 0.5; option 4 – rating 0.75; option 5 – rating 1.

Data analysis

We apply the modified Kolmogorov-Smirnov test of goodness of fit to check whether our data is normally distributed. To test the first hypothesis (including the sub-measures), we apply a pairwise t-test for normally distributed data and the Wilcoxon signed-rank test for non-parametric data (Ruxton and Beauchamp 2008). As both variables are metric regarding the second hypothesis, it is tested with linear regression integrating post-test results as dependent, learning time as independent, and pre-test results as independent control variable. The third hypothesis is tested with a linear regression model the same way but replacing learning time with the setting as a dummy variable. Thus, individual learning effects taking the previous knowledge into account can be tested pairwise. In addition to using the mentioned tests to check for robustness of the results, the mediating effect is tested with the indirect plug-in for SPSS from Preacher and Hayes (2008) (if 0 is between LLCI and ULCI, there is no statistically significant effect). In case of unpaired data, a t-test and the Mann-Whitney U-test are applied.

RESULTS

Descriptives

A total of 150 graduate students participated in the learning phase with 80 students in the e-learning setting and 70 in the face-to-face setting. Gender is almost equally distributed with 55.3% being male and 44.7% female. As the study was conducted at a business school with a strong professional focus, the majority of participants (95.1% of 143 as 7 were not answering this question) has already gained solid professional experience (M = 24.81 months, SD = 20.67, Min = 1, Max = 108). Average training time of the participants in the e-learning

setting is 23.1 minutes (SD: 14.5 minutes). There is almost equality between the time spent for the process design (11 minutes) and for the organizational design (12.1 minutes). The average repetition of training units is 1.17 (SD = .32) indicating a low desire of repeating the training content. In the face-to-face setting the learning time was fixed to 70 minutes without any repetition opportunity. Active exchange in the e-learning setting was done by 18 participants (22.5%) who contributed 37 comments. However, 51 participants (63.8%) had a look into the forum comments and on the provided sample answers. In the face-to-face setting 32 participants (45.7%) had an active part in the discussion with everyone listening.

Robustness tests

First, the previous knowledge on the logic of BPM is on the same level in both learning settings ($T(128.8) = 1.926$, ns). This holds true for all dimensions (process design: $T(133.6) = 1.599$, ns); customers: $U(2429.5)$, ns; performance evaluation: $U(2473.5)$, ns; teams: $U(2620.5)$, ns; management practices: $U(2636.5)$, ns; continuous improvement: $U(2526)$, ns) except hierarchy ($U(2279)$, $p < .05$). Thus, achieved learning effects can be compared directly, but a difference of prior knowledge (12.3 % in the e-learning setting) should be taken into account for the comparison of results regarding hierarchy building. Second, learning time could be a mediating factor, i.e. participants simply achieve better results in the face-to-face setting by investing more learning time. Although learning time is significantly higher ($U(70)$, $p < .001$) in the face-to-face than in the e-learning setting ($M = 23.08$, $SD = 14.5$), there is no statistical significance regarding learning time spent as a mediator (LLCI -.0248; ULCI .3014, $p < .001$). Third, there is no moderating effect of previous work experience (ns (-0.386), $R^2 = 0.065$) on the learning effect. This effect holds true for both settings as the work experience ($T(134) = 0.282$, ns) is quite similar. Fourth, the gender distribution is the same in both groups ($X^2(1) = 3.006$, ns).

Hypotheses

Mean values and standard deviations of the performance scores as well as differences between the pre-test and post-test in both settings are reported in Table 2.

Table 2. Performance scores of the measures in both settings

Measure	E-learning					Face-to-face				
	Pre-test		Post-test		Difference [%]	Pre-test		Post-test		Difference [%]
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Level of logic of BPM knowledge	.488	.109	.596	.176	18.1	.477	.142	.677	.161	34.0
Process design	.711	.087	.705	.098	-0.9	.689	.106	.681	.138	-0.7
Customer	.299	.316	.379	.331	21.2	.280	.367	.504	.389	44.4
Performance evaluation	.289	.351	.444	.395	34.9	.200	.303	.609	.463	67.2
Teams	.387	.372	.480	.456	19.4	.340	.350	.568	.442	40.1
Hierarchy	.486	.324	.714	.327	31.9	.363	.334	.788	.289	54.0
Management practices	.515	.158	.647	.153	20.4	.503	.163	.716	.176	29.7
Continuous improvement	.725	.237	.816	.241	11.2	.746	.281	.875	.247	14.7

Hypothesis H1, that applying e-learning for understanding the logic of BPM leads to a significant increase of knowledge, can be confirmed ($T(79) = -5.709$, $p < .001$). Each dimension except "team arrangement" ($W(769.5, 1121.5)$, ns) and "process design" ($T(79) = 0.462$, ns) shows significant results (end-customer focus: $T(79) = -1.861$, $p < .05$; goals compensation: $W(285, 750)$, $p < .01$; hierarchy building: $W(319.5, 1391.5)$, $p < .001$; management practices: $T(79) = -6.150$, $p < .001$; continuous improvement projects: $W(221, 682)$, $p < .01$).

Hypothesis H2 stating that an e-learning setting leads to the same learning effect than a face-to-face setting cannot be confirmed ($p < .001$ (3.805), $R^2 = 0.163$). This result holds true for the following dimensions (end-customer focus: $p < .05$ (2.264), $R^2 = 0.075$; goals compensation: $p < .01$ (2.631), $R^2 = 0.049$; management practices ($p < .001$ (3.381), $R^2 = 0.180$)). Only for continuous improvement projects ($p < .001$ (5.439), $R^2 = 0.176$) a significantly higher learning result is achieved in the e-learning setting. The results for the other three

dimensions are not significant (process design: ns (-0.802), $R^2 = 0.92$; team arrangement: ns (1.276), $R^2 = 0.008$; hierarchy building: (ns (1.772), $R^2 = 0.023$).

The third hypothesis, more learning time in e-learning leads to a higher increase of knowledge, cannot be confirmed (ns (1.729), $R^2 = 0.180$). This result holds true for each dimension (process design: ns (-0.677), $R^2 = 0.04$; end-customer focus: ns (0.006), $R^2 = 0.058$; goals compensation: ns (0.571), $R^2 = -0.014$; team arrangement: ns (0.136), $R^2 = -0.014$; hierarchy building: (ns (-0.610), $R^2 = -0.011$; continuous improvement projects: ns (0.186), $R^2 = -0.016$) except management practices ($p < .02$ (2.480), R2 = 0.101).

DISCUSSION

The results show that situated learning via e-learning is helpful to learn the logic of BPM. The effect is quite convincing as the learners' knowledge on the logic of BPM can be increased by almost 20%. However, the achieved learning level of 59.6% still leaves room for improvement. In comparison to a face-to-face setting the learning effect was almost half which is contradicting the result of Means et al. (2010). One explanation might be the findings of those studies that there was a positive impact of learning time by students in e-learning settings. The authors of the meta-study state that they are not sure whether the effect is time-driven or due to the learning setting itself. This connection of time and learning effect could not be found in our context of learning the logic of BPM.

Another difference between our study and previous studies is that knowledge on the logic of BPM is more focused on learning how something should be designed. The 27 relevant studies analysed by Means et al. (2010) comparing situated learning settings (e-learning and face-to-face) focused mainly on learning how to perform concrete tasks in different contexts. Having a look at the highlighted differences between different settings, it seems that learning a certain way to think requires more personal exchange. Other students and the instructor are available the moment they are needed to support the learning process. Also feedback can be provided without significant delays. It seems that the advantages of e-learning with regard to repeating learning content and flexibility with regard to the learning order appear to be promising but are not intensively used in the given context.

More explanation or exchange between the participants could be helpful to enhance the learning effect in an e-learning setting. As there was not much discussion in the forum, this could be a starting point to promote an exchange of logic there. Although there were several attempts to engage students in an exchange, it seems that this aspect could be improved.

In any case, other ways to create a further learning effect have to be found for both settings. Special attention should be paid to the organizational context of BPM. Students had relatively high previous knowledge with regard to process design (except continuous improvement projects). This knowledge has not been enhanced but had been already on a sufficient level. The other dimensions of the organizational design should be promoted more intensively to increase the understanding of the organizational role of BPM.

Regarding learning time, it is revealed that participants spent less learning time in the e-learning setting than in the face-to-face setting. However, learning time is not an issue as the learning effect does not increase significantly through spending more learning time. Thus, applying situated learning in e-learning seems to be a useful addition to a regular curriculum in IS. Students do not have to spend too much time in learning knowledge on the logic of BPM which helps them to understand and link further concepts better.

Having a look at the seven dimensions, there is no learning effect at all related to "process design" in both settings. The level of previous knowledge is comparably high in the pre-test (only continuous improvement has a higher average) and the post-test (only continuous improvement and hierarchy building have a higher level; additionally hierarchy building in the face-to-face setting). Thus, it seems that a learning effect can be achieved up to a certain level with the chosen setting. This is underlined by the already existing high level for process design as the pre-test indicates. However, there is the exception of continuous improvement with a higher level of previous knowledge but a significant learning effect is observed.

Despite the promising results, some limitations should be taken into account. Firstly, the data analysis is based on quantitative data from the e-learning system only. Further data from the participants with respect to their learning experience, motivation, and exchange outside of the e-learning system could be added. Secondly, different contexts have been used in the pre-test and post-test. There could be an influence that some participants have a better understanding of one of the two settings. But settings should not be the same as there could be a memorizing bias. Thirdly, a long-term learning effect was not investigated. While a one-week pause was used to assure that participants still remember the logic, it could be that after a month or half a year participants have (partly) forgotten the logic of BPM.

CONCLUSION

With regard to the design of an IS curriculum, the results lead to two main implications: (1) Beginner courses in IS should be accompanied with situated e-learning on knowledge about the logic of BPM. Situated e-learning is a feasible alternative to a situated face-to-face setting for learning tacit knowledge of BPM, which is an important part of an IS curriculum. But e-learning requires less time and allows for more flexibility. Students should complete such an e-learning module before the course starts to understand the context of IS better and how information systems should be designed to support business processes. (2) A course on BPM should start with a face-to-face session on the topic to deepen the knowledge on processes and allow for a more profound understanding.

As a result teaching time can focus on the core content of courses related to BPM and the understanding of the BPM logic can be achieved by students individually. Regarding the practical implementation, the core learning content of both settings is the same but more examples and explanations by the instructor are needed in a face-to-face setting. Thus, instructors have to spend little extra time with running face-to-face and e-learning modules on the topic at the same time. Consequently, the effort to implement an e-learning environment is limited to the technical implementation which is feasible as many academic institutions already use e-learning systems.

Overall, the results can be considered as strong due to the relatively short period participants' spent for learning, the low number of repetitions in the training phase, and the little usage of the forum exchange. It seems that situated learning via e-learning is a promising setting to learn the logic of BPM but possibilities for personal exchange should be enhanced. Additional qualitative analyses how the learning effect can be increased should be conducted. Here, the focus should be put on how participants could be encouraged to exchange ideas online and whether this facilitates learning the logic of BPM.

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