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Didactical concept for teaching applied content using a simulation game in a virtual distance learning scenario

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ABSTRACT

During the Corona pandemic, existing and successfully used didactic concepts for applied teaching at universities must be re-evaluated concerning their suitability for distance-based virtual teaching concepts. Teachers taught applied content mainly with the help of case studies, laboratory exercises, or simulations, which in the past were realized through presence at the universities. To cope with the pandemic situation, we initially adapted our former didactic concept to meet proposed requirements for a virtual distance-based learning scenario that helps students to apply theory using a simulation game. Next, we evaluated the learning objectives and successes through a survey. Results indicate the successful adaptation of our didactical concept for a virtual distance-based learning setting and the usability of the simulation game to educate economics, information systems, and computer science. Further, the critical elements for virtual distance-based applied teaching are the means and understanding of why specific content is part of the learning objectives.

Keywords

Simulation game, didactical concept, applied content, virtual distance-based learning.

INTRODUCTION

The Coronavirus pandemic increased the need for distance learning concepts to maintain sustainable education (Sharma et al. 2021). Results from previous research indicate that during the pandemic, a lower number of students attendances in online sessions (Marczuk et al. 2021). However, using gamification elements like simulation games in education increased participants' motivation – especially in teaching applied content (Alsawaier 2018). In addition, simulation games enable students to engage in experiential learning, which is hardly possible in conservative lectures (Pongpanich et al. 2009; Saenz and Cano 2009).

However, further research needs to analyze how simulation games enrich higher education (Pongpanich et al. 2009) in a pure virtual and distance learning environment, while some aspects of digital distance learning concepts are known (Norman 1997; Wiggins 2016). Further, from a didactical point of view, the question arises whether the learning outcomes have changed due to the pandemic situation and to what extent a didactic concept for a virtual distance-based learning setting and associated methods need modification (Norman 1997; Svinicki and McKeachie 2011). More specifically, educators with applied content must enrich their content with distance learning elements such as videos, chats, or flipped-classroom elements, while the appropriate usage of new elements and the new teaching format using online media such as Zoom or WebEx to guarantee the achievement of learning objectives still need to be fully understood.

In the past four semesters, a self-developed simulation game acted as a vehicle for the applied and practice-oriented transfer of knowledge in a virtual and distance learning setting from the field of business and information systems in the context of the lecture "Information Management" and "Supply Chain Management." Thus, to evaluate the appropriateness of the virtual distance-based learning didactic concept, around 70 students answered a questionnaire. The first results show positive tendencies as well as areas for improvement.

THEORETICAL BACKGROUND

Frontal teaching is nowadays, even in physical lectures, no longer state of the art (Murphy and Sharma 2010), as mutual engagement of teachers and students (Murphy and Sharma 2010; Snell 1999) is the success factor for learning through audience responses (Murphy and Sharma 2010), breaking the class into small groups (Svinicki and McKeachie 2011), and simulations (Snell 1999).

The didactical concept for virtual distance-based learning

Every week, the adapted didactical concept requires students in teams of four to six to understand and apply theoretical content using the simulation game as a base for self-evaluating their results. Thereby, the simulation game represents a supply chain with six nodes.

Each node represents a firm being connected in-line (supply chain): The teacher uses the first node (OEM: Original Equipment Manufacturer) to customize the game and send orders to the second node (supplier 1) in exchange for (virtual) finished goods. To fulfill the orders, as in reality, students have to develop, apply and self-evaluate a business strategy, manage business processes such as planning, sourcing, production (operations), and delivery (distribution), create data analytics solutions, establish business intelligence and risk management processes and policies, decide on aspects of sustainability (vs. a higher performance), setup (or not) collaboration patterns among nodes, and consider knowledge management approaches. The connections are as follows: Each node is played by a team of students (except node 6/Supplier 5 [simulated node] and the OEM): OEM – Supplier 1 – Supplier 2 – Supplier 3 – Supplier 4 – Supplier 5. Hence, students exchange (virtual) finished goods and transactional information and can opt for exchanging operational and/or strategic information (Klein and Rai 2009).

The taught topics build up on each other weekly, being assessed, graded, and discussed. Assignments differ by individual vs. group assignments to manage students´ workload. For example, successful teams have a good strategy that relates and connect topics using KPIs (key performance indicators), creating an integrated view of their business activities within their team (here: firm/node) and providing the possibility to integrate collaboration aspects with supply chain partners. Hence, as business strategy is the main element related to all other taught topics (such as planning, business intelligence, or risk management), it is classified as a group assignment. In contrast, risk management is an individual assignment. While it helps improve financial performance, its application quality does not hinder other students from complementing individual assignments.

Each new topic and assignment are presented at the end of the lecture, complemented by videos, quizzes, and articles in our learning management system. Students have one week to complete the assignment individually or in a group and submit their results. Each lecture unit consists of three equal time slots: The first hour starts with the presentation and discussion of the results of the assignments providing evidence for the student´s learning success (Svinicki and McKeachie 2011), followed by playing the simulation game (60 minutes represent 60 days [three months]), and finally, the educator introduces the new topic in the last hour.

Research model and survey

Creating valid research constructs from scratch can be time-consuming and demanding (Straub et al. 2004). Therefore, we used proven constructs from the literature (see Table 1). Within our research model (see Figure 1), we re-arranged them to understand if we can use our simulation game and the adapted didactical concept to be usable in a virtual distance-based learning environment for applied teaching of economics, information system, and computer science.

The construct of perceived subject-matter learning (PSML) assesses the students' general perceived level of knowledge regarding the topics that can be learned, such as business strategy, data analytics, or risk management, by playing the simulation game. The construct learning orientation (LO) tries to identify the general interest and learning behaviors of students, while the team learning climate (TLC) analyzes the culture within the team (e.g., errors as a source of learning or not?). The construct team commitment (TC) asses how the team inspires students' commitment. The construct knowledge management (KM) asks about enablers for sharing knowledge, the used infrastructure, cultural aspects, knowledge acquisition, and its application. The construct business process knowledge (BP knowledge) creates transparency about the students' theoretical knowledge in the field of supply chain management – covering the information flow, information systems, and the material flow (here: virtual flow). In addition, the construct business processes (BP) realization and behavior assess how the teams apply theory in practice, such as information usage, e.g., to develop forecasts, build and evaluate artificial intelligence/machine learning solutions, or use robot process automation (RPA) technologies, the information accuracy, availability, and completeness to develop dashboards, relational aspects in regards to their upstream and downstream supply chain partners, or inventory levels as an example to measure their financial performance. The final construct business process (BP) performance measures how students perceive their success in financial regard or their improvement over time. As students must develop a profit and loss (P&L) statement, teachers can compare the systems' P&L results to the student's P&L results and reflect it with their survey answers.

Construct	Variable	Reference
Perceived Subject-Matter Learning	PSML	(Alavi et al. 2002)
Learning Orientation	LO	(Santhanam et al. 2008)
Team Learning Climate	TLC	(Maruping and Magni 2012)
Commitment	TC: Team Commitment	(Bishop and Scott 2000)
Knowledge Management	KM: Knowledge Management	(Zellmer-Bruhn and Gibson 2006)
	KMECC: Knowledge Management Enablers: Culture: Collaboration	(Lee and Choi 2003)
	KICC: Knowledge Infrastructure Capability: Culture	(Gold et al. 2001)
	KPCAC: Knowledge Process Capability: Acquisition	(Gold et al. 2001)
	KPCAP: Knowledge Process Capability: Application	(Gold et al. 2001)
Business Process Knowledge	SCRAIO: Supply Chain Risks and Issues Orientation	(Bode et al. 2011)
	SCKU: Supply Chain Knowledge Usage	(Bode et al. 2011)
	SCKQ: Supply Chain Knowledge Quality	(Bode et al. 2011)
Business Processes Realization and Behavior	FOIEBOIE: Facets of Information exchanged: Breadth of Information exchanged	(Malhotra et al. 2005)
	CN: Cooperative Norms	(Malhotra et al. 2005)
	SCPIPFI: Supply Chain Process Integration: Physical Flow Integration	(Rai et al. 2006)
	IOTSCR: Importance of the Supply Chain Relationship	(Hult et al. 2004)
	RSCMCIIA: Realized Supply Chain Management Capabilities Instrument: Internal Analysis	(McLaren et al. 2011)
	RSCMCIOE: Realized Supply Chain Management Capabilities Instrument: Operational Efficiency	(McLaren et al. 2011)
	RSCMCIEA: Realized Supply Chain Management Capabilities Instrument: External Analysis	(McLaren et al. 2011)
	RSCMCIP: Realized Supply Chain Management Capabilities Instrument: Planning	(McLaren et al. 2011)
	ISC: Information System Capabilities	(Zhou and Benton Jr 2007)
Business Process Performance	OB: Operational Benefits	(Subramani 2004)
	P: Performance	(Lechner et al. 2010)

Table 1. Constructs

In the summer semester of 2022, 67 students answered the survey after removing partially answered questionnaires, whereby 38 female students, 27 male students, and one diverse student answered the questionnaire. The mean age is 22.75 years, while 73% are in the 6th semester vs. 27% are in the 4th semester.

As for the survey, there are varying numbers of survey items for each variable listed above. We used LimeSurvey to arrange the items according to the logic of the research model using a five-point Likert scale for the responses plus the option "no answer". Hair states that PLS-SEM is useful when the survey's structural model contains many constructs and items to test a theoretical framework in case of small sample sizes small (Hair et al. 2019). In addition, using bootstrapping helps to check for significance between constructs. To ensure the validity of the results (Straub et al. 2004), we used the guidelines of Hair (Hair et al. 2019): Establish item reliability, assess internal consistency reliability, evaluate convergent validity, and assess discriminant validity.

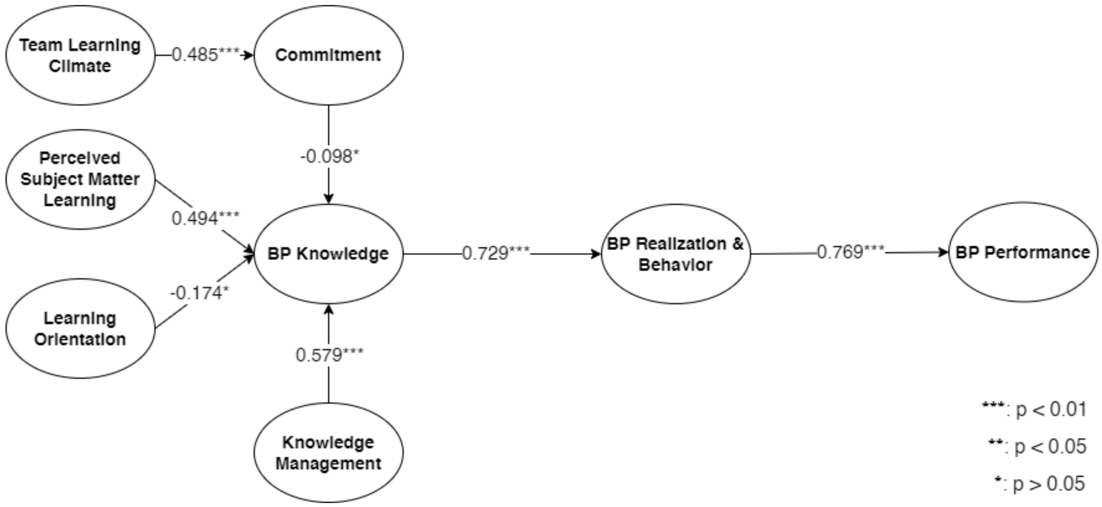

Figure 1. Research model – Path Coefficients and Significances

DISCUSSION OF RESULTS, LIMITATIONS AND FUTURE RESEARCH

The results of this research are two-fold: First, the survey implies a successful adaptation of the didactic concepts towards a virtual distance-based learning didactical concept. Second, the results also indicate the usability of the simulation game to educate students in economics, information systems, and computer science.

As the construct perceived subject matter learning (PSML) assesses the students' general perceived level of knowledge regarding the taught topics learned during the simulation game, the construct BP (business process) knowledge aims to determine whether students gained specific knowledge about business processes. The p-value of less than 0.01 indicates a highly significant relationship between those two constructs requesting instructors to ensure that students have prior knowledge about business processes and learn how to translate general knowledge into specific business process knowledge. Interestingly, the constructs of commitment and learning orientation have a negative relationship with BP knowledge. One explanation for learning orientation is that students must take the subject. On the contrary, this might indicate less interest in expanding the given objectives. In addition, we thought commitment positively related to BP knowledge. At the same time, it plays a crucial role in socialness within the team and does not influence the expansion of BP knowledge. In addition, the high significance of Knowledge Management to BP Knowledge indicates that students exchange their knowledge within their group resulting in a substantial increase in BP Knowledge.

The constructs of BP knowledge, BP realization and behavior, and BP performance are highly significant to each other, having high path coefficients. The positive relation of the dependent constructs provides evidence that the virtual distance-based learning didactical method we chose and the set learning objectives help students to gain detailed experience in various business processes using the simulation game in a virtual and distance learning format. For example, general knowledge of risk management enriched with specific learning material helps students to create new insights on the inter-dependence of risks and its opportunity to minimize them by cooperating with partners using data analytics and business intelligence solutions to measure their solo and mutual performance.

As we realize the simulation game as a digital game (vs. offline simulation games), educators can ensure applied teaching. For example, students can generate simple forecasts using the linear regression model or even use more sophisticated tools to transform data in advance and execute, e.g., machine learning algorithms before visualizing the results in dashboards. Students also learn interdependencies within firms and their departments, how information system solutions are helping to improve communication, and thereby how decisions result in higher financial performance. In addition, collaboration aspects also arise and allow educators to introduce, e.g., game theory, the usefulness of inter-organizational information systems, or concepts of KPIs. Specifically, KPIs as the base for business intelligence solutions allow the discussion of, e.g., data accuracy or alignment and the necessity of KPIs for business strategy and decision-making. Further, repeating tasks generate the possibility to apply robot process automation (RPA) solutions and thereby discuss the value (of information systems/technology).

To summarize, the presented results indicate the applicability of the simulation game for educating economics (e.g., strategy or supply chain management), information systems (e.g., knowledge management, business intelligence, or database access), and computer science (e.g., artificial intelligence or machine learning). Further, survey results suggest the successful implementation of the virtual distance-based learning didactical concept, while further research, i.e., should investigate the influence of learning orientation on the construct PSML. Moreover, running the questionnaire in the middle of a course and at the end to compare changes over time is meaningful. In addition, re-evaluating the questionnaire with more students (vs. bootstrapping) will provide more precise insights.

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