

Hofbauer, Florian; Putz, Lisa-Maria

## Conference Paper

# Can gamification reduce the shortage of skilled logistics personnel?

### Provided in Cooperation with:

Hamburg University of Technology (TUHH), Institute of Business Logistics and General Management

*Suggested Citation:* Hofbauer, Florian; Putz, Lisa-Maria (2019) : Can gamification reduce the shortage of skilled logistics personnel?, In: Kersten, Wolfgang Blecker, Thorsten Ringle, Christian M. (Ed.): Artificial Intelligence and Digital Transformation in Supply Chain Management: Innovative Approaches for Supply Chains. Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 27, ISBN 978-3-7502-4947-9, epubli GmbH, Berlin, pp. 331-354,  
<https://doi.org/10.15480/882.2475>

This Version is available at:

<https://hdl.handle.net/10419/209377>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by-sa/4.0/>

Florian Hofbauer and Lisa-Maria Putz

# Can Gamification Reduce the Shortage of Skilled Logistics Personnel?



CC-BY-SA 4.0

Published in: Artificial Intelligence and Digital Transformation in Supply Chain Management  
Wolfgang Kersten, Thorsten Blecker and Christian M. Ringle (Eds.)  
September 2019, epubli

# Can Gamification Reduce the Shortage of Skilled Logistics Personnel?

*Florian Hofbauer<sup>1</sup> and Lisa-Maria Putz<sup>1</sup>*

1 – University of Applied Sciences Upper Austria

**Purpose:** The logistics sector faces a worldwide shortage of skilled personnel. Gamification represents a new approach to attract people's interest by applying game elements in a non-game context. In our study, we develop a theoretical framework to improve the image of the logistics sector using gamification for future studies.

**Methodology:** Based on the findings of the literature review, we discuss gamification and its potential to improve the image of the logistics sector. Moreover, the core of this paper is to develop a theoretical framework to apply career choice theories for gamification to attract logistics personnel.

**Findings:** In total, six career choice theories were identified as appropriate for a theoretical framework. We suggest using these six theories for future empirical studies to measure how gamification influences people's career choices.

**Originality:** This paper introduces gamification to attract people to the logistics sector as a new approach with substantial potential. It provides an initial valuation of the potential of gamification to improve the image of logistics jobs. Due to the novelty of the topic, the theoretical framework provides a starting point for future empirical studies.

**Keywords:** Logistics, Career choice, Theoretical framework, Gamification

**First received:** 17.May.2019    **Revised:** 29.May.2019    **Accepted:** 20.June.2019

## 1 Introduction

Logistics represents a worldwide growth sector in terms of activity and expenditure. The logistics sector plays a vital role in the European economy, with approximately 7% of the total GDP generated in the EU-28. The transport sector, which is part of the logistics sector, accounts for more than 11 million jobs in Europe (Ecorys, et al., 2015). Despite other sector facing a jobs reduction due to automation and digitalization, the vast majority of logistics jobs are still done by humans. In fact, logistics activities are labor-intensive on both operational and managerial levels (McKinnon, et al., 2017). The logistics performance of companies is highly dependent on the availability and quality of skilled people (Gravier and Farris, 2008; Ecorys, et al., 2015). However, current studies suggest that there is a global shortage of people with interest and skills within all areas of the logistics sector (Fawcett and Rutner, 2014; McKinnon, et al., 2017). For example, Dubey and Gunasekaran (2015) and Maloni, et al. (2016) report a lack of junior, middle and senior level supply managers. Staats, et al. (2017) emphasize the shortage of truck drivers, who are urgently needed worldwide. The situation is similar for order pickers, who play a pivotal role in logistics (Grosse, Glock and Neumann, 2017).

Previous studies claim that one reason for the shortage of skilled people is the poor image of the logistics sector. To ensure the worldwide competitiveness needed in the logistics sector, the attraction of people into the logistics industry represents a major objective of the European Union (Ecorys, et al., 2015). One new approach to inform people and attract them to the sector could be gamification. Gamification is defined as "the use of game design elements in non-game contexts" (Deterding, et al., 2011). It is a new

approach that aims at engaging people using game elements such as competitions, feedback functions or social elements within a non-game context, instead of full-fledged games (Huotari and Hamari, 2012; Treiblmaier, Putz and Lowry, 2018). Previous studies found that gamification can be efficiently used to motivate people into adopting a certain behavior and influence their attitude regarding a certain topic (such as e.g. sustainability) (Corner, Kane and Owen, 2017; Kasurinen and Knutas, 2018). Up to now, gamification has been repeatedly applied in operational logistics processes such as picking. In fact, game elements are used to make order picking more fun and thus increase employees' engagement and retention to the company (Warmelink, et al., 2018; Putz, Hofbauer and Mates, 2019).

It has been proven that gamification can increase educational performance and information gain (Kapp, 2012), that behavior and attitude can be positively changed (Marcucci, Gatta and Le Pira, 2018). Moreover, gamification has been successfully implemented in the logistics sector (Warmelink, et al., 2018; Putz, Hofbauer and Mates, 2019). In this paper, we follow a new approach: We suggest that gamification can influence people's career choice, help to attract people to the logistics sector and support the reduction in the shortage of skilled workers.

Previous empirical studies on gamification and its impact on the attitude towards career choice show that gamification has the potential to increase interest in specific job sectors. Pérez-Manzano and Almela-Baeza (2018) used gamification-based applications to increase participants' interest in science and to promote scientific and technological careers. McGuire, et al. (2017) created gamified workplace simulations to increase student motivation and awareness of career opportunities. Their mixed results show that

a well-designed tutorial is required to make sure that the purpose of the gamified information system is clearly communicated to the participants. Furthermore, the empirical studies show that appropriate measurement tools are required to measure the impact of gamified information systems on the attitude towards career choice as compared to non-gamified systems.

The goal of this paper is to develop a theoretical framework for future studies into the investigation of gamification and career choices in the logistics sector. This paper is organized as follows: In the methodology section, we describe how we proceeded to develop the theoretical framework. Subsequently, we present the theories and a comprehensive summary of our findings. We conclude the paper by highlighting several recommendations that might serve as a starting point for future research.

## 2 Method

The investigation of the impact of gamification on the attitude towards career choice requires a theoretical framework as a basis for further research. As expected, no such framework has been found in our literature search. Therefore, we decided to focus on theories which have been used in the context of the attitude towards career choice. The literature search was carried out in April 2019 using the SCOPUS database. We used the search term “*theor\**” in combination with several synonyms of “career choice” (Datta, 2017). The search was limited to title and resulted in 103 hits which were further inspected for inclusion or exclusion as shown in Fig.1. As a first step, we limited our search results to papers written in English that comprise the

term "attitude" in their full-text. The remaining 25 papers were further examined regarding their content relevance. Eight studies are not concerned with the attitude towards career choice and were therefore excluded. Four studies used theories which seemed to lack sufficient scientific support to have an impact on career choice. Further literature search and analysis of these theories confirmed this assumption, therefore the four studies were excluded. 13 papers were identified for full analysis and for the creation of a theoretical framework.

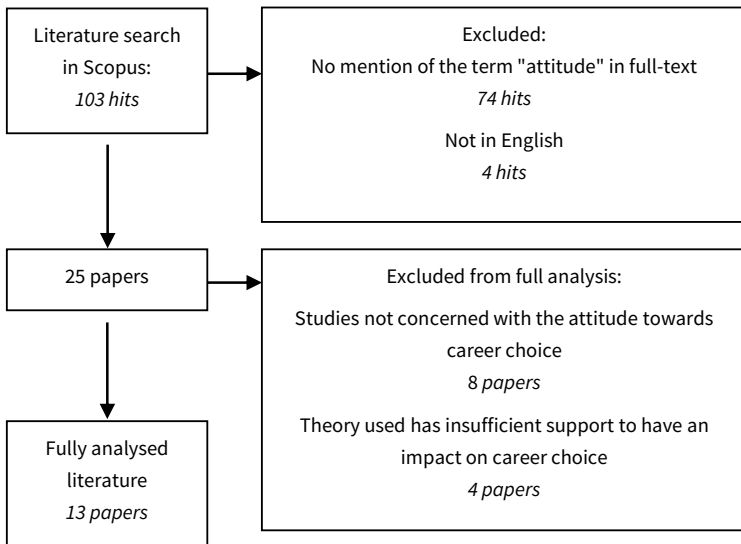


Figure 1: Flow chart of the literature search procedure following the approach of Warmelink, et al. (2018).

### 3 Results and Discussion

13 papers were identified as relevant for further investigation, resulting in six career choice theories. These six career choice theories are: Social cognitive career theory (SCCT), technology acceptance model (TAM), social cognitive theory (SCT), theory of reasoned action (TRA), self-determination theory (SDT) and Hollands' theory of career choice (RAISEC). Table 1 represents a list of the 13 papers identified for full analysis and shows their respective research focus and theories used. The papers were analyzed regarding the applied research area and the theories which were used to identify the career choices. 11 of the 13 papers were applied in the research area of education. The most used theories are the SCCT and the RAISEC (both applied in 4 out of 13 papers), followed by the TRA theory (with 3 out of 13 papers).



Table 1: Theoretical framework

Source	Research area	S C C T	T A M	S C T	T R A	S D T	R I A S E C
Ray, Bala and Dasgupta, 2019	Education (technical studies)	X	X				
Gewinner, 2017	Education			X			
Zhang, Rashid and Mohammed, 2017	Education (tourism)				X		
Rosenkranz, Wang and Hu, 2017	Education (medical)					X	
Kaminsky and Behrend, 2015	Education (STEM)	X					
Rajabi, Papzan and Zahedi, 2012	Education (agriculture)	X					
Monson, 2012	Dental hygienists						X
Law, 2010	Education (accounting)				X		

Source	Research area	S C C T	T A M	S C T	T R A	S D T	R I A S E C
Perdue, Reardon and Peterson, 2007	Telecommunications			X			X
Cunningham, et al. , 2005	Education (sports and leisure)	X					
Felton, Dimnik and Northey, 1995	Education (accounting)				X		
Guthrie and Herman, 1982	Vocational maturity						X
Laudeman and Griffith, 1978	Education						X

The six theories are briefly described in the following section. The theories are analyzed regarding their practicability for gamification to reduce the shortage of skilled personnel in logistics.

### 3.1 Social cognitive career theory

Social cognitive career theory developed by Lent, Brown and Hackett (1994; 2000) is based on Bandura's (1986) social cognitive theory and aims to ex-

plain “three interrelated aspects of career development: (1) how basic academic and career interests develop, (2) how educational and career choices are made, and (3) how academic and career success is obtained” (Lent, Brown and Hackett, 2006, p. 750). The focus lies on the cognitive-person variables self-efficacy, outcome expectations and goals, and how they interact with other personal and environmental factors (e.g. gender, ethnicity, social supports, barriers) to make educational and career choices (Lent, Brown and Hackett, 2000).

In the studies from the literature review, SCCT has been mainly used as a starting point to test the impact of additional specific factors on career choice. Ray, Bala and Dasgupta (2019) used SCCT in combination with the technology acceptance model (TAM) to test the role of authenticity and perceived benefits of online courses on career choice. The conclusions were that personal input strongly influences the learning experiences and authenticity and perceived benefits from the course are crucial factors for course choice and the associated career choice. Kaminsky and Behrend (2015) expanded the SCCT model with the factor “calling”, as a predictor of career outcome expectations, interests and goals. The conclusions were that calling provides more predictive power than self-efficacy in terms of career outcome expectations and interests but is a weaker predictor of goals. Rajabi, Papzan and Zahedi (2012) used SCCT to test the cognitive and personal factors for career choice intentions of agricultural students. The conclusions were that the personality factors extraversion, openness, conscientiousness and agreeableness play a significant role for career choice intention along self-efficacy belief and career outcome expectations, while personal factors such as gender, major, average grade and neuroticism had no significant impact. Cunningham, et al. (2005) used SCCT to investigate

student intentions to enter the sport and leisure industry. The study generally supports the SCCT model and showed that a multifaceted approach to measure outcome expectations is beneficial because various types of outcome expectations, such as expected power and satisfaction with the job environment differ significantly regarding their impact on choice goals.

The results of these studies and the frequent use of the theory indicate that SCCT is well-suited for the investigation of specific occupational fields and can be expanded with additional factors. With regard to the logistics industry, this model offers the opportunity to investigate the reasons for skilled labor shortage in detail. Self-efficacy expectations could give insight into whether logistics jobs are perceived as too difficult. The model could reveal existing barriers and clarify if outcome expectations (e.g. salary, decisive power, and satisfaction with the job environment) from respondents differ from what the logistics industry currently offers. SCCT is also perceived as a suitable theory for measuring the impact of gamification on the attitude towards career choice because gamification could be easily implemented as an influencing factor on learning experiences.

### **3.2 Technology acceptance model**

The technology acceptance model from Davis (1989) „theorizes that an individual’s behavioral intention to use a system is determined by two beliefs: perceived usefulness, defined as the extent to which a person believes that using the system will enhance his or her job performance, and perceived ease of use, defined as the extent to which a person believes that using the system will be free of effort” (Venkatesh and Davis, 2000, p. 187).

Ray, Bala and Dasgupta (2019) used TAM in combination with SCCT to consider the technological and educational factor of online courses towards

career choice. They combined intention and interest from the respective model in one variable. Perceived usefulness and perceived use from TAM were included in the perceived benefits variable. They conclude that individuals' intention to learn a course for their career choice is strongly influenced by perceived benefits (Ray, Bala and Dasgupta, 2019).

In the logistics industry, TAM is frequently used to measure the acceptance of newly implemented technologies (Qi, et al., 2009; Chen and Chao, 2011). As for gamification, TAM could be a suitable approach to measure the impact of gamification on perceived ease of use, when gamification is combined with new technologies such as augmented reality (Bräuer and Mazarakis, 2019; Logistikum Steyr, 2019).

### **3.3 Social cognitive theory**

Social Cognitive Theory from (Bandura, 1986) theorizes that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior. Individuals observe the behavior of others and the related behavioral consequences, remember the sequence of events and use this information as guidance for their own behavior. Depending on whether the behavior is rewarded or punished, the observer will choose to replicate the behavior or not (Bandura, 1986).

Gewinner (2017) used SCT as a basis for development of a theoretical approach for gendered occupational choices and stereotypes. Perdue, Reardon and Peterson (2007) explored the relationship between person–environment congruence, self-efficacy, and environmental identity and job satisfaction in a multinational telecommunications corporation. They concluded that self-efficacy was significantly related to job satisfaction. Self-

efficacy is strongly linked with social cognitive theory because it is developed from external experiences and self-perception and has a strong impact on human thought, motivation and action (Bandura, 1991).

Similar to SCCT, SCT could provide information for the logistics industry about which environmental factors turn out to be supportive or barriers for a career choice in logistics. In addition, the behavioral factors could give an insight into which behavior or public appearance of the logistics industry would lead to an improvement in the image and, subsequently, to an increasing interest in working in the logistics field. In terms of gamification, SCT could be used to verify whether observation of gamified actions are perceived as more likely to be replicated than non-gamified actions.

### **3.4 Theory of reasoned action**

The theory of reasoned action by Fishbein and Ajzen (1975) describes the behavioral process in which attitudes and subjective norms determine an individual's intention to demonstrate a certain behavior. The attitude towards a behavior is determined by the individual's belief on the likelihood of the behavior to generate the desired outcomes. Subjective norms are a product of the consumer's perceived social desirability of the observed behavior and the motivation to meet the social requirements (Fishbein and Ajzen, 1975).

Analysis of the respective studies from our theoretical framework showed that the TRA model is an appropriate choice to measure the influence of the attitude towards a profession and subjective norms on intention of career choice. Law (2010) used the TRA model to examine factors influencing the accounting student's career choice in public accounting practices. He concluded that his results support the TRA model and that intrinsic factors,

flexibility of career options, gender and parental influence had significant influence on the decision to choose a career in public accounting, while financial rewards and high school accounting had no influence. Felton, Dimnik and Northey (1995) used the TRA model to examine the factors of student's choice of a career in chartered accountancy. The study supports the TRA model and concludes that the students' choice of a chartered accountancy career depends on the attitude towards this profession, which in turn is determined by the expected outcomes. Most relevant outcomes of a career as a chartered accountant are long-term earning, advancement opportunities, variety in the work, chance to make a contribution and flexibility of career options, which should be promoted by accounting recruiters. Zhang, Rashid and Mohammed (2017) used the social norms variable from the TRA model as orientation for creating a simplified research framework to measure parental factors on student's career decision to enter the hospitality industry in China.

The positive results of the studies indicate that the TRA model would be well suited to measure the influence of attitude towards logistics professions and social norms on intention of a career choice in the logistics field. An analysis of these variables could identify the causes of logistics' image and could give insight into whether the reasons lie more in the expected outcomes when choosing a logistics job or the social environment of individuals. Results from this analysis could be used as guidance as to what the logistics industry should focus on in the future to attract skilled workers. In addition, the TRA model can be used to measure the impact of gamification on the attitude towards career choice. Gamification could be implemented as an influencing factor on the determinants of the attitude towards a logistics profession and subjective norms.

### **3.5 Self-determination theory**

The self-determination theory (SDT) by (Ryan and Deci, 2000a; 2000b) focuses on intrinsic motivation and the associated factors that cause a person to make decisions without external influence. SDT identifies autonomy, competence and relatedness as main factors for intrinsic motivation. Autonomy is defined as an individual's estimate of the extent to which the outcome of actions can be determined and controlled. Competence means that the individual has goals and the skills to achieve them. Relatedness refers to the feeling of being respected and cared for (Ryan and Deci, 2000a; 2000b).

Rosenkranz, Wang and Hu (2015) use SDT to identify the factors that motivate and demotivate medical students to do research. They concluded that students with practical experience and research experience in group work have a more positive attitude towards research. Furthermore, the motivation to do research is especially associated with the following intrinsic motivators: confidence, clinical relevance and research as a social activity. SDT could also be used to identify and measure the factors of intrinsic motivation for logistics professions. Based on the findings, gamification could be used to positively influence these factors making the occupation more fun and interesting and to create relatedness with the job.

### **3.6 Theory of vocational choice**

The Holland Codes (RIASEC) refer to Holland's (1997) theory of vocational choice. The term RIASEC refers to the initials of the six personality types: Realistic, investigative, artistic, social, enterprising and conventional. Holland sees interests as basic personality orientations. Accordingly, the ca-



reer choice is influenced by the individual's characteristics. The best fit between a person and a job is when the individual orientation is congruent with the orientation of the job. A good fit leads to higher job satisfaction, more career success and greater career development stability. (Holland, 1997)

Analysis from our body of literature revealed that RAISEC is frequently used to determine the personality types for specific professions. Monson (2012) used RAISEC to identify the characteristics of dental hygienists. He concluded that Holland's six personality types can help students as a guide for their career choice. Perdue, Reardon and Peterson (2007) used RAISEC to evaluate the congruence between interests and job (person-environment congruence) of employees in a multinational telecommunications corporation. Against their expectations, person-environment congruence showed no significant relation to job satisfaction. They concluded that missed moderating factors might be the reason for this result. Guthrie and Herman (1982) determined the relationship of vocational maturity with Holland's theory of vocational choice. Therefore, they used RAISEC to identify the personality type of students enrolled in high- and mid-level programs in two post-secondary institutions. Results showed that congruency was significantly related to vocational maturity. Laudeman and Griffeth (1978) tested the validity of the Holland codes by identifying the personality type of college students with the RAISEC model. Their results generally supported Holland's postulated personality typologies and value dimensions.

The application of Holland's six personality types for the respective logistics professions could give potential candidates information on whether

their own interests are congruent with the orientation of the job. In addition, the information could be used for the targeted search and recruitment of individuals with the desired characteristics. Gamification can be used to facilitate the identification of individual's personality types and to compare them with the orientation of logistics jobs.

## 4 Conclusion and further research

In this paper, we analyzed the existing empirical literature about career choice theories. We found six appropriate theories that are suitable for investigating the effects of gamification on the image of the logistics sector. The six theories are (1) the social cognitive career theory (SCCT), (2) the technology acceptance model (TAM), (3) the social cognitive theory (SCT), (4) the theory of reasoned action (TRA), (5) the self-determination theory (SDT) and (6) Hollands' theory of career choice (RAISEC). The vast majority of the theories were applied in an educational context.

SCCT is well-suited to investigating the reasons for skilled labor shortage in the logistics industry in detail. Furthermore, the model can easily be expanded with additional factors, such as gamification, which could be implemented as an influencing factor in learning experiences. TAM could be used to find out whether newly applied technologies are perceived as a support or a barrier, in terms of career decision making and to measure the impact of gamification on the perceived ease of use of new technologies. As gamification has no direct impact on career choice in this theory, we recommend to combine TAM with other theories to measure the direct impact of gamification on the attitude towards career choice. SCT could provide

information on which behavior or public appearance of the logistics industry would improve the individual's interest in working in the logistics field. Furthermore, SCT could measure whether gamified actions are more likely to be replicated than non-gamified actions. TRA is also a suitable option to identify the causes of logistics' image and could give insight into whether the reasons lie more in the expected outcomes when choosing a logistics job or the social environment of individuals. Additionally, the TRA model can be used to measure the impact of gamification on the determinants of the attitude towards a profession and subjective norms. SDT could be used to identify and measure the intrinsic motivators of logistics professions and the impact of gamification on these intrinsic factors. Holland's six personality types are well-suited to checking whether individuals' interests are congruent with the orientation of the job. Gamification can help to facilitate the identification of individual's personality types and to convey the work environment type of a profession. Furthermore, it can be tested if specific personality types show a more positive reaction on the use of gamification. Job sectors with these personality types should consider the implementation of game elements in the promotion of their specific profession.

As with any research, ours has limitations. The literature review was limited to the Scopus database. While we are confident of the comprehensiveness of our literature search, it is possible that publications have been missed due to the lack of a listing in the database or due to indexing errors.

Based on the identification of appropriate theories, the next step would be to develop metrics for measuring the respective constructs. We would suggest beginning with multi-item scales that researchers can derive from existing research. Collecting empirical data in longitudinal studies, as claimed

by Nacke and Deterding (2017), to investigate how gamification influences people's career choices would be the next step. With this paper, we hope to inspire the academic community to investigate gamification, particularly in a logistics career-oriented context. We would encourage this work to be considered as a starting point for conversations that re-think, re-contextualize, and challenge new (career) theories for logistics. At the same time, this paper represents a deepening of the research within the gamification field in such a way that the topic of career choice is theoretically prepared for future research.

We hope that the theoretical framework provided will serve as a basis for investigation of whether gamification can help to moderate existing barriers before and during career choice, or if it can help to improve self-efficacy expectations. Furthermore, we would like to obtain further insights into whether gamification can add additional value to technologies which support career choice and if gamer types could be linked with Holland's six personality types.

## **Financial Disclosure**

This paper is part of the research project REWWay which was funded by viadonau and is part of the research field 'sustainable transport systems,' which was funded by the State of Upper Austria as part of the research program 'FTI Struktur Land Oberösterreich.'

## References

- Bandura, A., 1986. *Social Foundations of Thought and Action. a Social Cognitive Theory*. Upper Saddle River, NJ: Prentice Hall.
- Bandura, A., 1991. Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, [e-journal] 50(2), pp. 248–287. [http://dx.doi.org/10.1016/0749-5978\(91\)90022-L](http://dx.doi.org/10.1016/0749-5978(91)90022-L).
- Bräuer, P. and Mazarakis, A., 2019. Badges or learderboard? How to gamify an augmented reality warehouse setting. In: J. Koivisto, and J. Hamari, eds. 2019. *Proceedings of the 3rd International GamiFIN Conference: CEUR-WS*, pp. 229–240.
- Chen, C.-F. and Chao, W.-H., 2011. Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit. *Transportation Research Part F: Traffic Psychology and Behaviour*, 14(2), pp. 128–137.
- Corner, A., Kane, G. and Owen, P., 2017. *Behaviour change for sustainability*. London: Routledge.
- Cunningham, G. B., Bruening, J., Sartore, M. L., Sagas, M. and Fink, J. S., 2005. The application of social cognitive career theory to sport and leisure career choices. *Journal of Career Development*, [e-journal] 32(2), pp. 122–138. <http://dx.doi.org/10.1177/0894845305279164>.
- Datta, P., 2017. Supply network resilience. A systematic literature review and future research. *The International Journal of Logistics Management*, [e-journal] 28(4), pp. 1387–1424. <http://dx.doi.org/10.1108/IJLM-03-2016-0064>.
- Davis, F. D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), pp. 319–340.
- Deterding, S., Dixon, D., Khaled, R. and Nacke, L., 2011. From game design elements to gamefulness. In: A. Lugmayr, H. Franssila, C. Safran, and I. Hammouda, eds. 2011. *Proceedings of the 15th International Academic MindTrek Conference Envisioning Future Media Environments*. New York, NY: ACM, p. 9–15.
- Dubey, R. and Gunasekaran, A., 2015. Shortage of sustainable supply chain talent: an industrial training framework. *Industrial & Commercial Training*, [e-journal] 47(2), pp. 86–94. <http://dx.doi.org/10.1108/ICT-08-2014-0052>.

- Ecorys, Fraunhofer, TCI, Prognos and AUEB-RC/TRANSLOG, 2015. Fact-finding studies in support of the development of an EU strategy for freight transport logistics. Lot 1: Analysis of the EU logistics sector. <<https://ec.europa.eu/transport/sites/transport/files/themes/strategies/studies/doc/2015-01-freight-logistics-lot1-logistics-sector.pdf>> [Accessed 19 September 2018].
- Fawcett, S. and Rutner, S., 2014. A longitudinal view of supply chain education. *The International Journal of Logistics Management*, [e-journal] 25(1), pp. 180–201. <http://dx.doi.org/10.1108/IJLM-07-2012-0061>.
- Felton, S., Dimnik, T. and Northey, M., 1995. A Theory of Reasoned Action model of the Chartered Accountant career choice. *Journal of Accounting Education*, [e-journal] 13(1), pp. 1–19. [http://dx.doi.org/10.1016/0748-5751\(94\)00027-1](http://dx.doi.org/10.1016/0748-5751(94)00027-1).
- Fishbein, M. and Ajzen, I., 1975. *Belief, Attitude, Intention and Behavior. An Introduction to Theory and Research*. Reading, Mass. Don Mills, Ontario, ON: Addison-Wesley Pub. Co.
- Gewinner, I., 2017. *Gendered career choices and stereotypes: A theoretical approach*: Emerald Group Publishing Ltd.
- Gravier, M. J. and Farris, M. T., 2008. An analysis of logistics pedagogical literature: past and future trends in curriculum, content, and pedagogy. *The International Journal of Logistics Management*, [e-journal] 19(2), pp. 233–253. <http://dx.doi.org/10.1108/09574090810895979>.
- Grosse, E. H., Glock, C. H. and Neumann, W. P., 2017. Human factors in order picking: a content analysis of the literature. *International Journal of Production Research*, [e-journal] 55(5), pp. 1260–1276. <http://dx.doi.org/10.1080/00207543.2016.1186296>.
- Guthrie, W. R. and Herman, A., 1982. Vocational maturity and its relationship to Holland's theory of vocational choice. *Journal of Vocational Behavior*, [e-journal] 21(2), pp. 196–205. [http://dx.doi.org/10.1016/0001-8791\(82\)90029-X](http://dx.doi.org/10.1016/0001-8791(82)90029-X).
- Holland, J. L., 1997. *Making vocational choices. A theory of vocational personalities and work environments*. 3rd ed. Lutz, Fla.: Psychological Assessment Resources.

- Huotari, K. and Hamari, J., 2012. Defining gamification - a service marketing perspective. In: . 2012. 16th International Academic MindTrek Conference, pp. 17–22.
- Kaminsky, S. E. and Behrend, T. S., 2015. Career Choice and Calling: Integrating Calling and Social Cognitive Career Theory. *Journal of Career Assessment*, [e-journal] 23(3), pp. 383–398. <http://dx.doi.org/10.1177/1069072714547167>.
- Kapp, K. M., 2012. *The gamification of learning and instruction. Game-based methods and strategies for training and education*. San Francisco, CA: Pfeiffer.
- Kasurinen, J. and Knutas, A., 2018. Publication trends in gamification. a systematic mapping study. *Computer Science Review*, [e-journal] 27, pp. 33–44. <http://dx.doi.org/10.1016/j.cosrev.2017.10.003>.
- Laudeman, K. A. and Griffeth, P., 1978. Holland's theory of vocational choice and postulated value dimensions. *Educational and Psychological Measurement*, [e-journal] 38(4), pp. 1165–1175. <http://dx.doi.org/10.1177/001316447803800438>.
- Law, P. K., 2010. A theory of reasoned action model of accounting students' career choice in public accounting practices in the post-Enron. *Journal of Applied Accounting Research*, [e-journal] 11(1), pp. 58–73. <http://dx.doi.org/10.1108/09675421011050036>.
- Lent, R. W., Brown, S. D. and Hackett, G., 1994. Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance. *Journal of Vocational Behavior*, [e-journal] 45(1), pp. 79–122. <http://dx.doi.org/10.1006/jvbe.1994.1027>.
- Lent, R. W., Brown, S. D. and Hackett, G., 2000. Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology*, [e-journal] 47(1), pp. 36–49. <http://dx.doi.org/10.1037/0022-0167.47.1.36>.
- Lent, R. W., Brown, S. D. and Hackett, G., 2006. Social cognitive career theory. In: J. H. Greenhaus, and G. A. Callanan, eds. 2006. *Encyclopedia of career development*. Thousand Oaks, Calif.: SAGE Publications, pp. 750–754.
- Logistikum Steyr, 2019. LOGISTIFY – understand the world of logistics! - REWWay. [online]. Available at: <<https://www.rewway.at/en/logistify-learning-app/>> [Accessed 14 May 2019].

- Maloni, Scherrer, Campbell and Boyd, 2016. Attracting students to the field of logistics, part 1. *Transportation Journal*, [e-journal] 55(4), p. 420–420.  
<http://dx.doi.org/10.5325/transportationj.55.4.0420>.
- Marcucci, E., Gatta, V. and Le Pira, M., 2018. Gamification design to foster stakeholder engagement and behavior change: an application to urban freight transport. *Transportation Research Part A: Policy and Practice*, 118, pp. 119–132.
- McGuire, A., Broin, D. O., Power, K., White, P. J. and Deevy, C., 2017. Increasing student motivation and awareness of career opportunities through gamification. In: M. Pivec, and J. Gründler, eds. 2017. *Proceedings of the 11th European Conference on Game-Based Learning. ECGBL 2017*. Reading, UK: Academic Conferences and Publishing International Limited, pp. 898–906.
- McKinnon, A., Floethmann, C., Hoberg, K. and Busch, C., 2017. Logistics competencies, skills, and training: a global overview: The World Bank.
- Monson, A. L., 2012. Characteristics of dental hygienists based on Holland's career choice theory. *Journal of dental hygiene : JDH / American Dental Hygienists' Association*, 86(2), pp. 141–149.
- Nacke, L. E. and Deterding, S., 2017. The maturing of gamification research. *Advanced Human-Computer Interaction*, [e-journal] 71, pp. 450–454.  
<http://dx.doi.org/10.1016/j.chb.2016.11.062>.
- Perdue, S. V., Reardon, R. C. and Peterson, G. W., 2007. Person - Environment congruence, self-efficacy, and environmental identity in relation to job satisfaction: A career decision theory perspective. *Journal of Employment Counseling*, [e-journal] 44(1), pp. 29–39. <http://dx.doi.org/10.1002/j.2161-1920.2007.tb00022.x>.
- Pérez-Manzano, A. and Almela-Baeza, J., 2018. Gamification and trans-media for scientific promotion and for encouraging scientific careers in adolescents. *Comunicar*, [e-journal] 26(55), pp. 93–103. <http://dx.doi.org/10.3916/C55-2018-09>.
- Putz, L.-M., Hofbauer, F. and Mates, M., 2019. A vignette study among order pickers about the acceptance of gamification. In: J. Koivisto, and J. Hamari, eds. 2019. *Proceedings of the 3rd International GamiFIN Conference: CEUR-WS*, pp. 154–166.



- Qi, J., Li, L., Li, Y. and Shu, H., 2009. An extension of technology acceptance model: Analysis of the adoption of mobile data services in China. *Systems Research and Behavioral Science*, [e-journal] 26(3), pp. 391–407. <http://dx.doi.org/10.1002/sres.964>.
- Rajabi, S., Papzan, A. and Zahedi, G., 2012. Application of Social Cognitive Career Theory to investigate the effective factors of the career decision-making intention in Iranian agriculture students by using ANN. *SAGE Open*, [e-journal] 2(4), pp. 1–13. <http://dx.doi.org/10.1177/2158244012467024>.
- Ray, A., Bala, P. K. and Dasgupta, S. A., 2019. Role of authenticity and perceived benefits of online courses on technology based career choice in India: A modified technology adoption model based on career theory. *International Journal of Information Management*, [e-journal] 47, pp. 140–151. <http://dx.doi.org/10.1016/j.ijinfomgt.2019.01.015>.
- Rosenkranz, S. K., Wang, S. and Hu, W., 2015. Motivating medical students to do research: A mixed methods study using Self-Determination Theory Career choice, professional education and development. *BMC Medical Education*, [e-journal] 15(1). <http://dx.doi.org/10.1186/s12909-015-0379-1>.
- Ryan, R. M. and Deci, E. L., 2000a. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, 25(1), pp. 54–67.
- Ryan, R. M. and Deci, E. L., 2000b. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, 55(1), pp. 68–78.
- Staats, U., Lohaus, D., Christmann, A. and Woitschek, M., 2017. Fighting against a shortage of truck drivers in logistics: measures that employers can take to promote drivers' work ability and health. *Work (Reading, Mass.)*, [e-journal] 58(3), pp. 383–397. <http://dx.doi.org/10.3233/WOR-172626>.
- Treiblmaier, H., Putz, L.-M. and Lowry, P. B., 2018. Research commentary. Setting a definition, context, and theory-based research agenda for the gamification of non-naming applications. *AIS Transactions on Human-Computer Interaction*, [e-journal] 10(3), pp. 129–163. <http://dx.doi.org/10.17705/1thci.00107>.

- Venkatesh, V. and Davis, F. D., 2000. A theoretical extension of the technology acceptance model. four longitudinal field studies. *Management Science*, 46(2), pp. 186–204.
- Warmelink, H., Koivisto, J., Mayer, I., Vesa, M. and Hamari, J., 2018. Gamification of production and logistics operations: status quo and future directions. *Journal of Business Research*, [e-journal] in press.  
<http://dx.doi.org/10.1016/j.jbusres.2018.09.011>.
- Zhang, H., Rashid, B. and Mohammed, A. A., 2017. A theoretical model of parental factors and students' career decisions to join the hospitality industry in China. *Geojournal of Tourism and Geosites*, 19(1), pp. 133–141.