Gamifying a Learning Management System: Narrative and Team Leaderboard in the Context of Effective Information Security Education

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Abstract

Gamified learning management systems (LMS) can be effective in case game-design elements (GDE) address users' motivation to engage with the topic and lower barriers to learning. In the context of Security Education, Training, and Awareness (SETA) programs, gamification is stated to be a major success factor. However, there is scarce research about the relationship between GDE and learning outcomes such as information security awareness. The evaluation of GDE regarding the application context is important because inappropriate gamified approaches can lead to negative outcomes, e.g., anxiety or inappropriate behavior. Thus, we first derive narrative and team leaderboard (TL) as appropriate GDE for the context of SETA. Second, Spearman correlation analyses indicate positive significant relationships between the experience of narrative and team leaderboard with information security awareness. Therefore, we implicate integrating narrative and team leaderboard within an LMS in the context of SETA programs.

Keywords: SETA, gamification, narrative, team leaderboard, success factors

1. Introduction

Appropriately gamified Learning Management Systems (LMS) are stated to increase the engagement of students with the learning content (Chen et al., 2018; Raharjo et al., 2021). But in case gamification is inappropriately applied and designed, a lack of intrinsic motivation may lead to aversion or demotivation, overstimulation, boredom, and even anxiety instead. These adverse effects are reported most in the field of computer science education, according to the literature review of Almeida et al. (2021). Thus, game-design elements (GDE) have to be chosen cautiously in order to avoid triggering these negative side effects. But, although gamification approaches have been subject of research for years, less is known about the correlation between specific GDE and learning goals (Chen et al., 2018; Hamari et al., 2014; Sailer, 2016). Instead, a majority of research articles evaluate the gamification approach only within specific use cases and focus exclusively on measuring either perceived experiences or success metrics, such as through key performance indicators (Mora et al., 2017). Moreover, the evaluation of these approaches is often vaguely depicted or investigates gamification as a whole concept. The link between the implemented design elements and learning outcomes remains unclear. (Mora et al., 2017; Nah et al., 2013) Thus, an educator does not know whether the implementation of a specific GDE within an LMS correlates with a learning goal or rather leads to negative side effects, e.g., aversion. Considering this, systematically designing effective gamified learning environments for computer science lectures is challenging (Mora et al., 2017).

Within this field, (Information) Security Education, Training, and Awareness (SETA) programs represent a subdomain, where achieving learning objectives is particularly important. However, SETA programs are still far often stated to be ineffective (Hu et al., 2021). Consequently, SETA programs do not meet their intention to counteract a rising number of cyberattacks which in turn results in tremendous costs as well as threats to human life (IBM Security, 2021; Ralston, 2021). In order to achieve a major learning goal of SETA programs, namely a high information security awareness (ISA), gamification is stated as an important design factor (Holdsworth & Apeh, 2017; Silic & Lowry, 2020). A major reason for this is that appropriate gamification increases the motivation of users to actively engage with the topic, even with perceived to be burdensome content like in SETA programs (D'Arcy et al., 2014). Further, gamification is stated to foster the experience of flow. Flow is in turn an essential factor for effective SETA programs and security compliance. (Yoo et al., 2018) Thereby, according to Yoo et al. (2018), flow can be achieved if the following preconditions are considered during the design of SETA programs: (user) autonomy, challenge, feedback, immersion, and social interaction.

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In conclusion, for effective gamified SETA programs, GDE should address these preconditions and we suggest the well-accepted GDE narrative and team leaderboard (TL) that are both promising to do this. In this context, an LMS enables educators, e.g., to implement these GDE, or structure and deliver the learning content. Therefore, this article strives to derivate findings for basic research as requested by T. A. Nguyen and Pham (2020), in order to increase clarity on the correlation between these game-design elements and the learning goal. This is essential knowledge to successfully implement GDE within an LMS and to build effective SETA programs in the future. Our research question is:

To what extent are the GDE narrative and team leaderboard positively related to ISA, when implemented within an LMS?

In order to rigorously answer this question, we analyze the relation of experience (with corresponding subscales flow, gameful experience, user experience, and engagement) of narrative and TL first. Therefore, we can deduce whether narrative and TL are well combined within LMS in the context of SETA. We further analyze the relation of narrative/TL experience with the learning goal, which is ISA. These insights offer first impressions of whether narrative and TL are positively related to ISA. For better comprehensibility, we summarize all variables included in our study in table 1, showing their abbreviations and Cronbach's Alpha values. For a better overview, we assigned the variables to the used questionnaires and focus areas.

This article is based on an overarching research project with iterative design cycles, where our overall objective is to develop new and gamified collaboration methods using information systems, e.g., an LMS, in order to effectively build ISA. Therefore, we apply the Design Science Research Methodology of Peffers et al. (2007) to organize our approach. The addressed problem space for this article is outlined at the beginning of this chapter. This article contributes to existing design research both, as a rigorously evaluated instance of an appropriate implementation of gamification elements in the context of SETA (Peffers et al., 2018) and as the subject of theoretical discussion, in particular, setting a basis for further research e.g., deriving design principles (Gregor & Hevner, 2013). Our immediate application context for our analysis is a digitized lecture at a German state university within a bachelor's program, focusing on the topics of data privacy and information security (DPIS) from a broad perspective. We delivered the learning content through our LMS, providing knowledge, instructions for our gamified in-depth exercises as well as the GDE itself. A further description of the artifact and application domain is outlined in chapter 3. Before we discuss the artifact in detail, we introduce the theoretical foundation for the context of gamified SETA programs.

2. Theoretical foundation

In the following, we outline the theoretical background and related work as theoretical knowledge base for our approach. Research on gamification is not a new phenomenon. The more it is surprising that there is no dominating definition of gamification (Mora et al., 2017). However, Mora et al. (2017) state that a majority of current research relies on the definition of Deterding et al. (2011) who in turn state*: Gamification is using GDE in a non-game context*. For a common understanding of this article, we specify, that our gamification approach can be considered as such as we implement GDE within an LMS in the context of a university lecture that has a focus on lecturing DPIS.

One major factor for effective gamification and successful implementation of GDE is the experience of flow (Matallaoui et al., 2017), according to the Theory of Flow which is largely based on the work of Csikszentmihalyi (1990) but also Csikszentmihalyi et al. (2014). The kernel theory describes a highly focused psychological state of mind, where an individual experiences high enjoyment and is intrinsically motivated while executing any specific and even difficult task at hand, without hesitation to continue or repeat this activity. This subjective state is represented by, e.g., losing track of time, being fully engaged in an activity, and the feeling of control over the recent activity. (Csikszentmihalyi, 1990; Csikszentmihalyi et al., 2014) In a gamified learning environment this can be interpreted in such a way that GDE should foster a state of flow so that an individual feels joy and is intrinsically motivated during learning activities.

However, the Self-Determination-Theory (SDT) according to Ryan and Deci (2000) is a further well-known underlying theory of gamification (Matallaoui et al., 2017) which highlights the importance and consideration of extrinsic motivation among other points. Besides similarities in emphasizing the relevance of self-determined forms of motivation, the Theory of Flow does not differentiate more or less volitional forms of extrinsic motivation among other points (Deci & Ryan, 2000). In conclusion, the SDT entails a more differentiated perspective on extrinsic motivation and therefore, complements the Theory of Flow in that it can function as antecedents for a state of flow (Kowal & Fortier, 1999) Thereby, extrinsic motivational preferences should be considered in a way that they address self-determined motivational preferences (Tondello et al., 2016). So far it is known that intrinsic as well as extrinsic motivational preferences can be supported by implementing

appropriate GDE (Tondello et al., 2016). Therefore, GDE are an important factor to create immersive, motivating, and engaging learning environments. For this, we define our understanding of GDE: These are patterns and basic game components, e.g., a narrative or a leaderboard which are implemented to address the fundamental needs of players during gameplay. (Deterding et al., 2011; Sailer, 2016)

However, there is a lack of theoretical grounding, on whether GDE can be used to reach specific learning outcomes. As a first step toward theorization, Nacke and Deterding (2017) emphasize isolating individual GDE and building on theories in order to derive and evaluate gamification approaches. In addition, Hamari et al. (2014) claim that outcomes of gamification are specific to the context which makes it challenging to select beneficially GDE in particular for SETA programs.

Mora et al. (2017) state in their review on gamification design frameworks that there are only a scarce number of frameworks for gamification available in the context of learning. Hence, there is no broadly accepted overarching framework. And those which are available, are use-case specific but without considering the context of SETA and often based on experiences (Mora et al., 2017). Therefore, Chen et al. (2018) and Sailer (2016) highlight the need for research on investigating the relation between GDE and learning outcomes in order to implement the right elements by evidence-based choice instead of ad hoc or random selection. Brühlmann et al. (2013) summarize this well, saying that just implementing some gamification elements in a non-game context is not a success factor for achieving a state of flow, nor for learning outcomes.

This in turn affects research on effective SETA programs. In general, several research contributions highlight the importance of gamification (Boopathi et al., 2015; Hu et al., 2021) because effective gamification is stated to encourage learning, engagement, and compliance behavior (Silic & Lowry, 2020) even though the content itself is often perceived as burdensome and not motivating (D'Arcy et al., 2014). However, to the best of our knowledge, there is a lack of evidence-based recommendations regarding which GDE should be implemented in order to lead to effective SETA programs. For instance, a review of the literature within the databases ACM, IEEE Xplore, and Business Source premiere resulted in only one article which focused on analyzing specific GDE in regard to learning outcomes, particularly investigating the effects of visual-based interactive storytelling and progression, in the context of SETA (Dincelli & Chengalur-Smith, 2020). However, to build effective SETA programs, Yoo et al. (2018) propose to address five dimensions of flow ((user) autonomy, challenge, feedback, immersion, and social interaction). We argue that these dimensions can be addressed if GDE are selected under consideration of intrinsic and extrinsic motivational preferences. In conclusion, we see our research approach as necessary basic research within an evolving field of gamification research and an important next step toward a theorization of good gamification practice examples, instead of "just reporting a new ad hoc example of gamification".

But, besides current gamification research and the five dimension of flow for the context of SETA, gamifying, e.g., LMS, remain challenging, because many different elements are mentioned in literature such as exploratory tasks, challenges, narrative, points, leaderboards, and TL (Sailer, 2016; Tondello et al., 2016). Furthermore, these GDE differ in the way how they are appropriate to address the motivational preferences of a target group. To be more precise, according to Tondello et al. (2016), GDE are either able to support intrinsic or extrinsic motivational preferences. For instance, exploratory tasks, challenge, and narrative foster intrinsic motivational preferences, e.g., enabling autonomy within the learning process and giving it a purpose. But points and leaderboards address extrinsic motivational preference, e.g., expecting a reward or change of state during learning. However, GDE with a focus on extrinsic motivational preferences can be integrated into intrinsic motivational preferences if the reason for the use is self-determined. Such as Dincelli and Chengalur-Smith (2020) state that the GDE "visual-based interactive storytelling" has the best outcomes for SETA effectivity, and in addition "progression" is promising to address both intrinsic and extrinsic motivation as it transforms the extrinsic motivation stimulus into an intrinsic motivation stimulus, e.g., in form of raising a desire to complete the remaining parts of the training and reach the end of the story (Dincelli & Chengalur-Smith, 2020). Furthermore, when implementing gamification within an information system, e.g., an LMS, Marczewski (2015) proposes to focus on learners who are highly intrinsically motivated. He additionally emphasizes keeping extrinsically motivated learners involved in a controlled way, by creating a system that converts them to intrinsically motivated users. In conclusion, we strive to investigate GDE which offer the potential for both motivational preferences and successful learning outcomes. Therefore, we outline our gamification design and the application context in the following.

3. Artifact and application context

We classify our contribution to design science research (DSR) by following Gregor and Hevner (2013): The major objective of this article is to demonstrate an *evaluated instance* of game design

elements within an LMS for the purpose of *improving* the effective use of gamification in a way that it fosters students to achieve the learning goals in the *context* of SETA programs. Therefore, this article contributes to the existing knowledge base by adding *descriptive knowledge,* e.g., through our systematically derived and evaluated *artifact that is based on two GDE which are implemented in an LMS*, but also *prescriptive knowledge*, e.g., as one part of empirical evidence. The latter is important to further extend and conceptualize knowledge, e.g., to derive design principles for gamified LMS in the context of SETA programs or other educational application domains. Therefore, e.g., the work of A. Nguyen et al. (2021) could be a guiding example to propose and validate design principles.

3.1 Narrative and team leaderboard within learning management systems

We outlined in the previous section that our proposed artifact exists out of GDE and that there are many possible GDE named in the literature. We follow the consideration of Mazarakis and Bräuer (2022) who recommend that a selection of GDE should only contain one or two primary elements because of increasing costs for implementation per element and the risk of interfering elements in case of evaluation. In addition, a rigorous evaluation of more GDE could lead to a long list of questions and therefore foster aversion and research bias. In conclusion, the number of evaluated elements is going to be small in order to achieve more rigor and generate findings that are more likely to be transferred into practice.

In addition, for our application context which is a gamified lecture on data privacy and information security, where content is provided via an LMS, the GDE have to align with these technological preconditions. We implemented our gamified approach within our LMS which is based on the Stud.IP framework. This means that the selection of GDE is somehow limited to the features of the LMS. In the case of Stud.IP, the implementation of the framework at our university offers very limited gamification features, e.g., in the form of quizzes or "like-buttons". In conclusion, we state that for extended generalizability, GDE have to be lightweight and transferable to other contexts in a way that they can be used with any other LMS. Regarding our knowledge base of effective gamified approaches which we describe in section 2, GDE should be able to address intrinsic as well as extrinsically motivated individuals to meet the basic needs of different users and in turn generate flow. Furthermore, GDE for extrinsically motivated individuals should be chosen in a way that they are likely to increase intrinsic motivation so that they can be used for individuals with heterogeneous motivational preferences. (Tondello et al., 2016) To be more precise, for the context of effective SETA, the following dimensions and antecedents of flow should be considered (Yoo et al., 2018): autonomy, social interaction, challenge, immersion, and feedback.

Based on this, we see narrative and TL to address these dimensions of flow. Both are already implemented in successful exploratory gamification research approaches. The narrative is defined as a frame story that is told in a real or game context. We found that narrative is stated to be one of the most cited GDE (Mazarakis & Bräuer, 2022; Sailer, 2016). In this way, narrative can enrich boring and unstimulating contexts, e.g., SETA, and inspire and motivate users (Nicholson, 2015). Thus, narrative helps to transform an unstimulating experience into a meaningful experience for users (Laschke & Hassenzahl, 2011). This can lead to a narrative presence when users bring in their personal investments and engagement. Therefore, using a narrative is also applicable to collaborative learning scenarios because it can be a foundation for social interaction. The narrative presence is considered a component of immersion, that is, entering a virtual environment or story (Lombard & Ditton, 1997; Ryan et al., 2006). Thereby, the narrative addresses intrinsic motivational preferences, such as the feeling of autonomy, social interaction, and immersion which are antecedents of flow as part of effective gamification and SETA programs (Lombard & Ditton, 1997; Yoo et al., 2018). However, the narrative does not address extrinsic motivational preferences to a greater extent.

Thus, we selected TL as a second GDE for students who are more extrinsically motivated. TL references the performance of a group and compares it to different groups of people. It provides feedback to users because the result of working together toward a goal is recorded and represents progress which can contribute to peer support and motivation. Generally, gamification is often used in the sense of pointsatisification to trigger competition. In consequence, this may imply a negative aspect of points and leaderboards according to Almeida et al. (2021) which is the social isolation of, e.g., low performers. To limit these negative side effects, we suggest TL instead of leaderboards. This goes in line with Sailer (2016) who states that TL is likely to overcome negative feelings caused by individual knowledge gaps and in accordance, feelings of failure. Therefore, in order to enable rankings, we implemented points as an underlying game mechanic which has already been proven to work in combination in other contexts (Arai et al., 2014). TL offers the possibility of social comparison, social interaction, competition, and feedback. By addressing the dimension of feedback and social interaction, we assume that this GDE also

addresses intrinsically motivated students. Furthermore, the competition to achieve a high number of points can address the challenge dimension which is important in the context of effective SETA (Yoo et al., 2018). Consequently, we select narrative and TL representing intrinsic and extrinsic game design elements for further application as main GDE and rigorous evaluation because they address the five dimensions of flow for effective SETA programs.

3.2 Application context

In order to provide a more tangible understanding of our implementation and the application context, we outline a short summation of our implementation of narrative and TL within Stud.IP-based LMS. First, we implemented a narrative in form of a fictional story which evolves week by week with the aim to achieve one common goal. We used a plugin for Stud.IP to provide this narrative, including text and pictures. Basically, this could be also realized with any other HTML editor. For instances, we introduced specific tasks with a short fictive story, e.g., that the major of the fictive world, who is represented by a computer graphic, has recognized cyberattacks and therefore, urges the players to check all their technological devices for software updates and to enable automatic updates. Second, we used group symbols in form of individual emblems per group to foster a stronger identification of the individuals with the group and thus, for the TL. These symbols have been designed by using open-source software for visual editing. The TL is based on a visually improved version (lines are reduced, high scores are highlighted, etc.) of a screenshotted spreadsheet file and shows the progression through listing achieved points and an updated high score of each group by week. Therefore, the precondition was, that the tasks are prepared to be challenging but with the possibility to buy in hints to the right solutions for a minor decrease of achievable points, so that every group had the chance to reach at least a medium level of points. Moreover, the TL enables social comparison on a group level, and thus, in combination with points, it offers feedback for any individual on whether the personal skill level is somehow appropriate or not. The implemented TL, included the distribution of points per week as well as the overall ranking and positions at the end of the lecture for the five teams which are represented by different emblems for identification.

However, stating clear learning goals is also important for effective gamification (Mora et al., 2017). Therefore, we align our learning goals to measurable learning categories of the HAIS-Q (Parsons et al., 2017), a well-accepted questionnaire for assessing the level of individual ISA (see next chapter for details). By following the structure of the HAIS-Q we also follow the recommendations of NIST SP 800-50 (Wilson & Hash, 2003) as we ensure to base our lecture content on the most important topics regarding basic knowledge and awareness of DPIS issues.

4. Artifact evaluation

4.1 Evaluation methodology

Our methodological approach for the evaluation of our artifact examines whether the provision of narrative and TL through our LMS are positively related to the learning goal of high cybersecurity awareness. To investigate this relationship, we surveyed participants in our lecture. We acquired a total of 43 participants for our survey with a distribution of 61% male and 39% female. They are bachelor students of business administration, business information systems engineering, and industrial engineering with an age range of 18 to 24 years.

To examine the relationship of narrative and TL with ISA, we used the Spearman correlation analysis. We summarize all variables included in our study in table 1. To analyze this relationship, we collected data for ISA of the participants with the "Human Aspects of Information Security Questionnaire (HAIS-Q)", as well as the experience of narrative and TL using the "Internal Gamification Questionnaire (IGQ)" questionnaire. The HAIS-Q according to Parsons et al. (2017), measures the state of ISA. The questionnaire consists of 63 questions which were divided into seven focus areas. We focus on the four focus areas of *password management*, *e-mail use*, *social media use*, and *information handling* (table 1) because these categories were addressed to a larger extent within the lecture. Each of the four topics mentioned consists of three subscales with three associated items by using a five-point Likert scale, resulting in a total of 36 items. The IGQ (Kettner et al., 2015) was used to measure the experience with narrative and TL. We limited the survey of the IGQ to the *experience* focus area which is crucial in order to assess the effectiveness of gamification and to derive design implications for effective SETA programs (Cechanowicz et al., 2013; Jung et al., 2010; Yoo et al., 2018). Further, we state that due to the already implemented 36 HAIS-Q items, including more IGQ focus areas, could have led to a strong decrease in user participation within the survey and thus, diminish important findings for design knowledge. The *experience* focus area is composed of the subscales *Flow Experience*, *Engagement*, *User Experience*, and *Gameful Experience*, based on 22 items, and measured using a six-point Likert scale (table 1).

By measuring the awareness of our focus topics (HAIS-Q) and by measuring the experience of the GDE narrative and TL (IGQ), we are able to examine our gamification approach for a positive relationship to our learning goal of high ISA. The constructs of HAIS-Q and IGQ with corresponding subscales and Cronbach's Alpha are shown in table 1.

4.2. Results

To answer our research question "*To what extent are the GDE narrative and team leaderboard positively related to ISA, when implemented within an LMS?*" we conduct Spearman correlation analysis. The correlation analysis with significant correlations as well as the descriptive results, can be found in table 2.

We first investigate whether the combination of narrative and TL relates to a high experience in the context of gamified SETA approaches in order to foster learning outcomes in the form of ISA. Therefore, we first examine the relationship between narrative and TL. We expose, the higher the NFE, the higher the TLUE ($r = .358$, $p<.05$) and TLGE ($r = .318$, $p<.05$) as well as the higher the NE, the higher the TLGE ($r = .430$, $p<.01$).

As a result, we prove evidence of a systematic correlation between constructs of the experience of narrative and TL. Based on this statistical correlation, we deduce that narrative and TL can be used in combination as a tendency for good practice to gamify an LMS system reducing the risk of negative effects for a high level of security awareness and promising high levels of awareness on the other hand. We further investigate the relationship between narrative and TL with constructs of HAIS-Q mapping ISA. We show that the higher the NUE, the higher the awareness of USP ($r = .337$, $p<.05$), as well as the higher the NGE, the higher the awareness of OAUS ($r = .498$, $p<.01$). Further, we examine that the higher the TLGE, the higher the awareness of LSM ($r = .336$, $p<.05$). Consequently, our data show that there is a systematic relationship between ISA and narrative as well as between ISA and TL which we both incorporated into our LMS. We show that narrative and TL can be used confidently in the context of SETA. Correlations provide evidence that narrative and TL are important elements in our application context. In addition, our analysis of the response behavior by means (n=43) shows that there is a high level of awareness for all focus areas of the HAIS-Q. The constructs of TL experience and narrative experience were also rated highly without major outliers.

4.3 Discussion

Even though applying gamification within SETA approaches is stated to increase the motivation of user engagement, there are to the best of our knowledge only a low number of articles available that focus on the implementation and evaluation of GDE. And even less research is available in particular considering intrinsic and extrinsic motivation as well as relations between GDE and learning outcomes within an educational context using an LMS. For this reason, we strive to derive and evaluate a gamified approach, with the GDE narrative and TL in regard to a high experience of narrative / TL and high ISA.

Table 1. Focus Areas with related subscales and Cronbach's Alpha values according to HAIS-Q and IGQ (Parsons et al., 2017) and (Kettner et al., 2015).

Questionnaire	Focus Area	Subscales*	Cronbach's Alpha
HAIS-Q	Password management	Using same password (USP) Sharing password (SP) Using strong password (USTP)	.82
	E-Mail Use	Clicking links from known senders (CLKS) Clicking links from unknown senders (CLUS) Open attachments from unknown senders (OAUS)	.78
	Social-Media Use	SM privacy settings (SPS) Considering consequences (CC) Posting about work (PAW)	.75
	Information Handling	Disposing of sensitive printouts (DOSP) Inserting removable media (IRM) Leaving sensitive material (LSM)	.79
*Items formulated negatively were coded positively. High values of the constructs consequently represent a high level of awareness.			
IGQ	Experience (Narrative = N; Team leaderboard = TL)	Flow Experience (4 Items)	.78
		Engagement (5 Item)	.87
		User-Experience (6 Items)	.93
		Gameful Experience (7 Items)	.86

We see our gamified approach successful as we investigate narrative and TL and show positive relations with the learning objective which is a high level of awareness and knowledge for DPIS at the end of the semester. Therefore, we examine both, narrative and TL and derive it as a possible combination of GDE within LMS, concluding that this combination is able to address intrinsic as well as extrinsic motivational preferences. In addition, this combination of GDE meets the defined SETA success factors for delivery of the learning content (Challenge, Feedback, Autonomy, Immersion, Social Interaction) measured by the efficacy of SETA. The first indications that our gamification approach is successful are evident from the response behavior of our 43 students by considering the mean values (table 2). We confirm consistently high mean values for the experience category of narrative and TL without outliers. Accordingly, we can infer initial trends that narrative and TL provide high experience in the SETA context within LMS. Specifically, this means that narrative and TL within an LMS provide a high flow experience, user experience, gameful experience, and engagement. We can also confirm consistently high mean values for all four focus areas of the HAIS-Q. It can be concluded that students have a high level of awareness in the four measured focus areas. At this point, the before-and-after comparison of ISA can further strengthen evidence of learning progress through implementing narrative and TL.

However, these correlation analyses show systematic correlations between certain constructs of narrative experience and TL experience. Consequently, we were able to confirm that both, not only produce high mean values but are positively connected to each other. By integrating the TL into the narrative, we respond to the recommendation of Marczewski (2015) and prioritize intrinsic preferences. These promote the information system, while extrinsic ones are disruptive. Extrinsic individuals are still retrieved by TL but may be converted into intrinsic through the use of narrative. Finally, we can state particularly that the combination of TL and narrative is important for a general audience in the SETA context. A short qualitative evaluation of the lecture measuring overall satisfaction at the end of the semester confirms that the implementation of TL and narrative has been enjoyed by the students. For instance, students state "the interactive part through gamification and the resulting engagement as a personal highlight", as well as "Gamification was interactive and combined with practical use cases". At the same time, it is worth mentioning that students emphasized the need for a frame story with more reference to reality in the future.

Table 2. Descriptive Results and Spearman rank correlations between constructs of HAIS-Q and IGQ (*p < .05; **p < .01; ***p < .001; M: mean SD: standard deviation).

Construct	(M)	(SD)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) NFE	3.05	.72																
(2) NE	3.91	.61																
(3) NUE	3.70	.51																
(4) NGE	3.98	.51																
(5) TLUE	3.93	.67	.358*															
(6) TLGE	4.19	.66	.318*	.430**														
(7) USP	4.70	.56			.337*													
(8) SP	4.70	.56																
(9) USTP	4.49	.67																
(10) CLKS	4.53	.67																
(11) OAUS	4.44	.73				.498**				.426**								
(12) SPS	4.12	.76							.325*				.360*					
(13) PAW	4.72	.50									.346*							
(14) DOSP	4.49	.67																
(15) IRM	4.84	.43							.393**							.325*		
(16) LSM	4.65	.48						.336*			.390**							

Another finding was the significant relationship between constructs of narrative experience and ISA as well as between TL experience and ISA. Thus, we confirm that a high experience of narrative and a high experience of TL is associated with a higher rating of ISA. This reconfirms the importance of a conscious gamification approach for ISA, as high awareness can be achieved by a positive gamification experience with the help of tailored GDE. Based on this relationship, there is a tendency for narrative and TL to be essential GDE for a gamified SETA approach within an LMS.

Overall, the correlations show differences in the strength of the correlation and significance levels. There are 3 medium correlations ($r \geq .04$) with stronger significance (**$p < .01$) but the majority indicates weak correlations with low significance. We confirm the strongest correlations for TLGE and NE ($r = .430$**) as well as OAUS with SP ($r = .426$**) and NGE ($r = .498$**). From the correlation of TLGE and NE we deduce that a positive experience with the narrative and a positive game experience with the TL depend on each other and might be important for a strong positive correlation to awareness. For the design of the narrative, we deduce that the story should provide a high gameful experience for the users, e.g., in the form of exciting tasks, gaining a positive awareness. For the gameful experience of the TL the weekly releases probably promote the playful character which is important as the feeling of progress, team competition and team cohesion are stimulated. Thus, we confirm that the combination of narrative and TL is important for gamifying an LMS in the context of SETA programs. Moreover, the correlation of OAUS and SP show that different areas directly relate to each other. This may indicate a didactic synergy effect if both are connected, e.g., by a meaningful narrative, and thus, should be further analyzed. Regarding the medium significant correlations, we should further analyze their practical implementation in LMS. From this, we can derive indications on how they could reach a higher experience and obtain stronger correlations.

5. Conclusion and outlook

Our findings provide educators with reasoned information about the integration of narrative and TL within LMS in the context of a DPIS lecture. For the gamification approach of our LMS system, we select the GDE narrative and TL based on addressing SETA success factors for delivering learning content (challenge, feedback, autonomy, immersion, social interaction) as well as different motivational preferences (intrinsic and extrinsic). This allowed us to address the high experience of narrative and TL as well as high ISA in our lecture. We can contribute that narrative and TL can be used without hesitation in the context of SETA within an LMS. The positive relationship between narrative and TL indices that the integration of TL and narrative in combination within LMS is important.

Beyond this, our study is limited to a small response rate for the quantitative survey. In addition, we do not have a before-and-after comparison of ISA. Thus, we do not know about the learning progress of ISA before the lecture versus compared to the final level of awareness after the lecture and therefore cannot provide any inferences about the measurement of ISA due to the lecture. Despite this, we assume that at least not all participants started with high SETA values based on statistical expectations, e.g., Gaussian normal distribution. However, repeating this study with a before-and-after comparison would lead to more empirical validation of our findings, including further studies to rigorously derive design principles for gamified SETA approaches and thus, further contribute to DSR (Gregor et al., 2020).

However, our results, provide the first evidence that narrative and TL are important elements in our application context. It can be deduced that narrative and TL are effective in combination, and both are positively related to high awareness after a SETA intervention. In addition, we state that our implementation of the GDE narrative and TL is transferable to other LMS and therefore, extends generalizability, e.g., by using a spreadsheet to display the weekly TL and a HTML editor to provide the fictional frame story.

We implicate educators in the context of SETA to combine narrative and TL and integrate both into an LMS system. After correlations only consider the direction and not causality, further analyses can investigate the underlying reasons and influences of this relationship in more depth. For further research, we see the need to explore the combination possibilities of TL and narrative in more detail. Our study is the first contribution to a larger DSR project on a lecture in form of a SETA approach for university students, now further investigating TL and narrative as gamification elements. Thus, this article contributes to existing DSR through a rigorous and novel evaluation of these GDE in relation to learning outcomes in the context of SETA programs. We see our article as the first step toward the theoretical grounding of gamification design guidelines for the context of SETA programs. Therefore, we want to encourage other researchers to repeat our study design in order to derive prescriptive statements for gamification design principles (Gregor et al., 2020). In this context, our results indicate that a high ISA positively relates to

narrative and TL. In addition, we outline a) the support of gamification as a success factor for SETA and highlight b) the lack of reasoned recommendations for choosing motivating GDE in the context of SETA. Thus, with our study, we see a grounded foundation for future research to expand the combination of narrative and TL in order to develop innovative approaches for DPIS teaching. These approaches can apply to LMS design, app design, or face-to-face instruction, as TL and narrative are applicable in multiple ways.

6. References

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