Branded Gamification in Technical Education

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***Abstract*— Brand identification has the potential of shaping individuals' attitudes, performance and commitment within learning and work contexts. We explore these effects, by incorporating elements of branded identification within gamified environments. We report a study with 44 employees, in which task performance and emotional outcomes are assessed in a real-world assembly scenario – namely, while performing a soldering task. Our results indicate that brand identification has a direct impact on individuals' attitude towards the task at hand: while instigating positive emotions, aversion and reactance also arise.**

Keywords*— *Gamification, Branded Gamification, Affective Computing, Emotions

I. INTRODUCTION

A fundamental change in work covering almost all industrial sectors impends. The combination of digitalization and automation creates new demands for the job markets while some qualifications, especially activities prone to standardization, are rendered obsolete. However, this process is not only about machine learning, artificial intelligence and robots replacing human work through automatization and robotics [8]: It is also a revolution towards creating more valuable and enjoyable working spaces.

As entrepreneurial digital natives now enter the job market, digitalization needs to become an essential part of corporate culture. Generation Y employees care much more about "fun" at work and an adequate work-life-balance than the previous generations [24]. While status symbols and wages still play a role, they are no longer sufficient to compensate a work experience perceived as shallow or restrictive. Gamification provides an opportunity to create motivation and engage people, which in turn leads to a deepened understanding of tasks and processes. Additionally, by using the corporate design of a company for the user interface of a gamification application, it can be used as an additional means of brand communication.

In the overarching context of this study, we use the prototype of a context-aware assistive system described in previous work [15, 21]. This system is designed to become a digital coach, adapting interventions in real-time. It is designed especially for activities in the STEM area (Science, Technology, Engineering, and Math) like soldering, which other frequent repetition to become proficient and thus are prone to boredom. Thus, gamification plays an important role in this system to motivate users to keep on exercising: elements from video games are added to increase the user's motivation and transfer fun elements from gaming to the potentially boring work reality [1]. The whole experience is focused on the user, as the interactive system recognizes emotions as well as errors during work. Accordingly, it adapts both the difficulty and gamification elements.

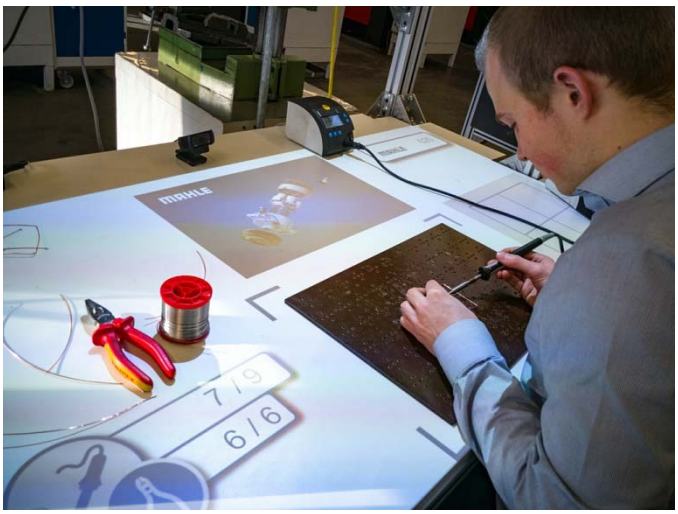

Fig. 1. Participant soldering a grid of copper wire. The branded gamification is projected in-situ.

In this paper, we present an empirical study on "branded gamification", addressing the question if the positive emotional effects of such work-integrated gamification are increased if it elements from the corporate design of the users' company are integrated. The following hypothesis are investigated:

- H1: Users experience more positive emotions, if "branded gamification" creates a connection with the enterprise.
- H2: The learning process as well as the work performance is increased with branded gamification in comparison to generic gamification.
- H3: The effect of branded gamification is stronger, the higher the users' identification with the company.

II. Related Work

In this section, we focus on work relevant to assess the effects and the acceptance of gamified interventions within corporate environments.

A. Gamification in the STEM area

Gamification refers to the use of "video game elements to improve user experience and user engagement in non-game services and applications" [6]. However, the pervasion of different domains by gamification differs strongly. As explained in a recent meta-analysis on the success of gamification based on the Gartner hype cycle diagrams [23], this method may be well on its way to what Gartner calls the "plateau of productivity" in health and specific areas of education like knowledge acquisition. A good overview of educational games is provided in [39]. However, when it comes to actual skills as required in the STEM area, gamification is still at an early stage of the "slope of enlightenment".

When gamification reached a first peak in interest in 2009, Reeves and Read already described what "ingredients" would help to gamify work and thus increase engagement [33]. It maps existing game elements like avatars, leaderboards, leveling and reputation to general business processes. However, most applications use only few of these elements: As a 2013 blog post on gamification puts it, "employers use gamification to incentivize employees by establishing clear goals and rewarding those employees that achieve those goals" [38]. This is easy if the goals are more abstract than in the STEM area: For example, it is easier to measure the number of completed contracts (i.e. submitted files) than the number of correct soldering points on a circuit board. To analyze work processes outside of the digital domain, additional sensors are required, as real-time feedback is required to efficiently gamify work tasks.

From 2012 to 2015 three designs for gamification in the STEM area have been proposed (Fig. 2): the Tetris design [17], the circle design [20] and the pyramid design [14]. All three designs are based on the assumption that the real-time feedback regarding progress can incite a state of flow [5] where concentration and engagement rise. The evaluations showed a tendency towards increased work speed and motivation while quality slightly decreased if no counter measures were taken (a typical speed-accuracy tradeoff).
A comparative study on the designs from 2015 [14] showed that users with high significance prefer the pyramid design to the two alternatives. These results were complemented by a study with instructors of a large automotive manufacturer [16] who also preferred the pyramid design with high significance and recommended it for inclusion in corporate education.

It was during the discussions with these instructors that the idea of a gamification design adapted to the automotive brand and thus "branded gamification" came up.

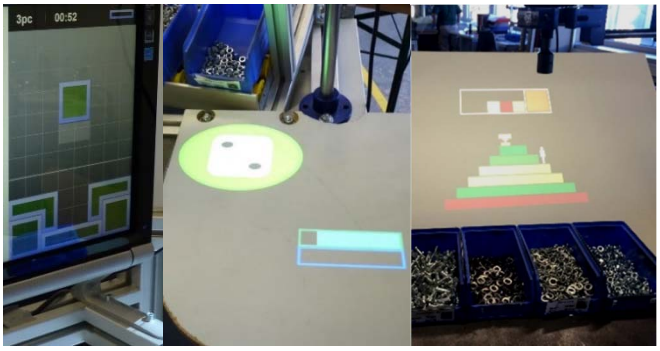

Fig. 2. Three gamification designs in the STEM area (from left to right): Tetris design (2012), Circle design (2014), and Pyramid design (2014).

B. Gamification and Emotions

Already in a 2012 work on gamification in production and technical instruction, the importance of real-time feedback has been expressed [18]. While recognizing human movements or motions is enough to generate gamified feedback on tasks, recognizing emotions generates a "backchannel" [12] which allows to measure the effects of gamification and adapt it to the context and the user requirements. For example, intricate gamification mechanisms that work well with routine tasks might draw too much attention if the user is under stress. This concept has been formalized in the "Context-Aware Assistive Systems model" (CAAS, Fig. 3) [11, 13].

An established way to measure emotions are facial expressions. Already in the seventies, Ekman and Friesen [7] presented the facial coding system (FACS) which establishes facial muscle groups called "Action Units" (AU) and attributes them to basic emotions. Although this system of basic emotions has been criticized [27] and today other models like the "circumplex model of affect" by Posner et al. [31] are preferred, the AU-system is still well-established and used in several algorithmic solutions for facial expression analysis.

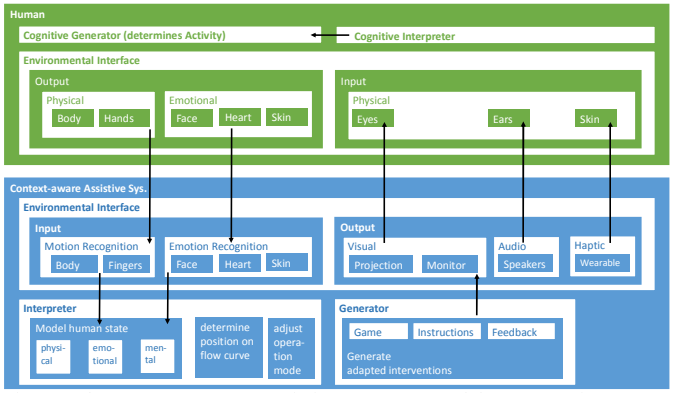

Fig. 3. The Context-Aware Assistive Systems model (CAAS) features an "interpreter" that analyses human states on the physical and emotional level to generate adapted interventions.

In the paper "The Effects of Gamification on Emotions" Korn et al. [19] use facial recognition based on the "Sophisticated High-speed Object Recognition Engine" (SHORE) [25] to determine the effects of gamification. In the experiment, the users had to build an intricate LEGO model with or without gamification – and this boring task was repeated 20 times. The results indicate that gamification increases the emotionality altogether, so there were both more "happy" and more "unhappy" expressions if gamification was used. This approach is the basis for the research presented here, although the modality of facial expression analysis in our work is complemented by an analysis of electrodermal activity to gain more reliable results on the users' affective states.

Recently, facial expression measurements have been incorporated in applications to adapt content and gamification in real-time. Zatarain-Cabada et al. [43] developed *EasyLogic*, an online learning system trying to map emotional intelligence skills similar to those of humans and adapt content to the users' emotional state. *EasyLogic* continuously analyzes users' facial expressions while performing courses. Depending on their emotional state, gamification elements like trophies and points, may be added to the displayed content. A study showed an increase in performance when the gamification interventions were tailored to the facial expressions.

C. The Employer Brand

According to the American Marketing Association (AMA), a brand is "a name, term, sign, symbol, or design, or a combination of these elements intended to identify and differentiate a product in the minds of concerned subjects". Whereas a few decades ago, a brand was mainly used to identify a product or a service, it now directly influences an enterprises' reputation [30]. Brands are attached to consumer expectations, public confidence, and to the overarching core values of a corporation [2].

Several empirical studies have highlighted the power of corporate brands. Branding has been found to be positively linked to the financial performance of corporations [9], their reputation [41], and marketing outreach [26].

A major focus of these studies has been placed on the relation between a corporative brand and its customers. Fournier (1998) examined the nature of relationships that customers have - as well as want to have, with companies. Fournier views brand-relationship quality as multifaceted, varying across six factors: self-concept connection, commitment, behavioral interdependence, passion, intimacy, and brand-partner quality [37]. Schmitt further explored customer experience with a product or company [35]. According to him, brands can help create five different types of experience: sense, feel, think, act, and relatedness.

While a plethora of research can be found the relation between brands, and customers, less empirical focus has been placed on the connection between a service brand and its employees. Ambler and Barrow [1] have defined this relation as the "functional, economic and psychological benefits provided by employment, and identified with the employing company". Punjaisri and Wilson [32] found internal branding not only directly influences the extent to which employees perform their role in relation to the brand promise, but also the attitudes employees have towards the brand, affecting, in turn, employee performance.

III. Study

A. Method and Apparatus

Participants were asked to perform a soldering task, with the goal of producing two rectangles, in a square grid (see Fig. 3, bottom right section). This task was split into two distinct parts. First, participants were asked to cut copper wire into sections of similar length. This was followed by the soldering of the copper wire, to forming two rectangles, in a square grid. These tasks were deliberately set to be repetitive in nature. Participants were asked to cut the copper wire respectively - into six distinct parts, and place nine solder bumps on them, to form the grid. By repeatedly engaging within cutting and soldering, we intended to mimic actual processes in both manual assembly work, where components often come with similar parts but in different variants.

Prior to performing the task, we measured participants' personality traits, their identification with their employer as well as their previous experience with the task at hand. These details were gathered through three questionnaires. The first consisted of the Big Five personality questionnaire [34]. The Big Five also known as OCEAN-model classifies one's personality regarding five different characteristic traits - Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. The second questionnaire asked participants to rate their identification with their employer with the Organizational Identification Questionnaire (OIQ) [29], which measures individual's commitment to an organization through 22-point items (e.g. "I am proud to be an employee of ___"). The third questionnaire inquired into participants' previous experience towards soldering. All questionnaires were responded on a 5-point Likert scale: "very slightly or not at all", "a little", "moderately", "quite a bit", and "extremely".

The task was conducted on a worktable. Participants were provided with a soldering iron, tin-solder and a gripper to cut the wire. During this process, an interactive system projected instructions and feedback into participants' workspace (Fig. 1).

Two cameras were used to record participants' behaviors. One camera was aimed at participants' faces, recording their facial expressions. The second was placed above participants' left shoulder, recording the soldering task.

The participants' emotions were continuously measured throughout the task: *Emotient FACET* automatically detected facial action units, as well as head pose and head position [7]. The emotions are condensed into seven base categories (Joy,

Anger, Sadness, Surprise, Fear, Contempt, Disgust), as well as the emotional valence (Positive, Negative, Neutral) [40]. We tracked the total time spent in each of these categories during the total recorded time.

We analyzed the data with the *iMotions Biometric Research Platform*. Through this software, participants' recordings streams were matched to their respective emotions streams (see Fig. 4). Markers were used to divide the streams into individual segments, regarding the task at hand.

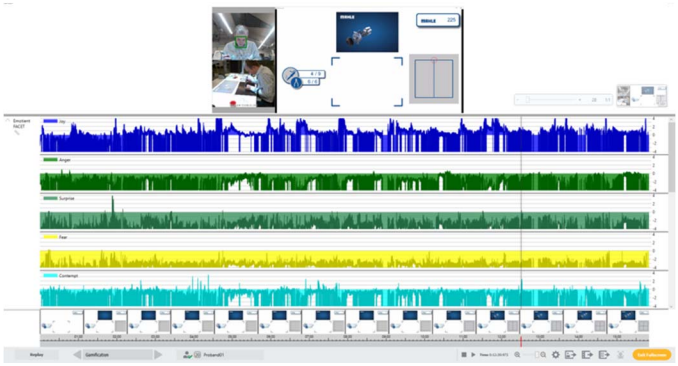

Fig. 4. iMotions Biometric Research Platform showing camera perspectives while participant is soldering and emotion.

B. *Assistive Interfaces*

The assistive application was implemented with *Construct 2*, a software development kit (SDK) typically used to create HTML5 games in 2D [36]. We chose this SDK because it claims no coding experience. With this, we intended to keep development efforts at a low, focusing on the affect measurement. We created two distinct interfaces where participants received feedback on their progress through: a *branded gamification*, and a *generic gamification*. A between-subjects approach was adopted. Participants were evenly assigned to each condition.

Both interfaces display the participant's progress using:

- Numerical feedback on the number of performed tasks (e.g. 0/9 solders placed).
- A score, regarding the completion time of each task. Auditory, and textual feedback were further provided, during each step of the task.

According to the completion time of a step, textual feedback is provided, e.g. "Excellent", with clapping and cheering sound, for faster than 30 seconds, "Good" with a typical video game sound collecting points for 30 to 45 seconds, "Okay" with a typical sound for a new message for 45 seconds to 60 seconds, "Average" with a hollower "new message sound" for 60 to 75 seconds and "Slow" with the sound of a horn for 75 to 90 seconds. Besides, textual feedback and sound were displayed if an error occurred, or if the time required for a single step exceeded 120 seconds.

As mentioned in the introduction, our goal was to assess the impact of branded gamification on the users' performance and their emotions while completing a prescribed task. To this end, we developed two versions of the interface. While both contained the previously described feedback, their designs differed.

1) *Generic Gamification*

In the generic gamification design (see Fig. 5), a pyramid was used to visualize progress (see Related Work section). The pyramid contained 9 levels, with each level representing a step of the soldering task. A trophy was placed on the pyramid's top. It could be gained after a successful task and dissolved when an error occurred.

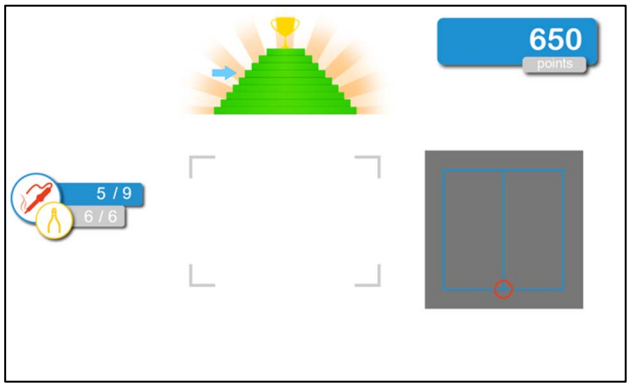

Fig. 5. Generic gamification design using the established generic pyramid visualization.

2) *Branded Gamification*

The branded version (see Fig. 6) visualizes progress through the image of a compressor, which gradually builds while the participants work on the soldering task. With each completed step, a new part of the compressor appears. A DNA strand, a frequent element in the communication of the enterprise, appears when participants complete a task. These elements were purposely used to create an identification between the task at hand, and the enterprise where participants worked.

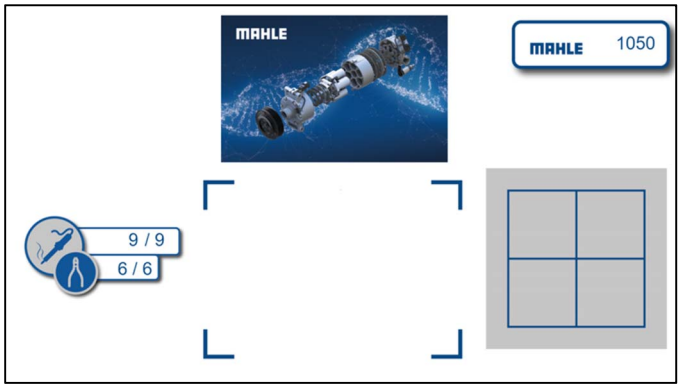

Fig. 6. Branded gamification in the corporate design of the company MAHLE International GmbH.

C. *Participants*

Forty-four individuals took part in the study (31 male, 13 female, median age=22, min=16, max=32). All were trainees or students at MAHLE International GmbH, a German automotive

supplier. Participants were recruited through local mailing lists and direct approach.
77% of all participants (34 of 44) described having no – or little previous experience with soldering. The remaining 23% (10 of 44) ranked themselves as proficient with soldering (4, or 5 in 5-point Likert scale).

Participants were distributed equally among both interfaces, regarding their previous experience with soldering. Regarding the branded gamification interface, 82% of participants (18 of 22) had little – or no experience with soldering, while 73% (16 of 22) had the same level of experience in the generic gamification group. A Mann-Whitney U test revealed no significant differences in the level of proficiency among both groups (U=210, p=0.4).

Participants were also equally distributed regarding their identification with the enterprise. Regarding the branded gamification interface, 77% of participants (17 of 22) rated high identification with the corporation, while 73% (16 of 22) rated the same level of identification in the in the generic gamification group. A Mann-Whitney U test revealed no significant differences in the level of identification among both groups (U=241, p=0.8).

Participants were also distributed similarly regarding their personality traits, according to the Big Five (see table 1). Agreeableness was the most distinctive personality trait among both conditions, followed by extraversion, openness, conscientiousness, and neuroticism.

TABLE I. PARTICIPANTS WERE DISTRIBUTED SIMILARLY REGARDING THEIR PERSONALITY TRAITS, WITHIN BOTH CONDITIONS.

	Generic Gamification	***Branded Gamification***	
Trait	**Median percentiles of traits (IQR)**		**p**
Agreeableness	78 (70-80)	78 (72-88)	0.44
Extraversion	69 (60-76)	69 (60-78)	0.95
Openness	62 (58-69)	62 (52-68)	0.48
Conscientiousness	60 (53-70)	53 (45-64)	0.16
Neuroticism	42 (35-53)	35 (25-50)	0.15

D. Results

1) Personality Traits

The participants' personality traits were found to play an important role regarding the emotions experienced by participants. Participants with high extraversion, and openness, experienced less emotions – both, positive and negative. A negative Pearson correlation (of -.49) was found between the characteristic Extraversion and the percentage of negative emotions while soldering. With $T(21) = -5.33$, $p<.05$ a high dimension of Extraversion leads significantly to reduced negative emotions.

The same applied to the characteristic Openness for Experience. Between that dimension and the percentage of negative emotions, the Pearson correlation amounted -.43 ($T(21) = -5.36$, $p<.05$). The dimension Openness also showed a negative correlation (of -.56) with the percentage of positive emotions during a soldering exercise. Thus, personalities with a high value of Openness seem to feel generally less emotions with generic gamification – both, positive and negative.

2) Overall Performance

Participants took, on median, 396 seconds (IQR= 321-685) to complete the entire soldering task with the generic gamification condition, and 495 seconds (IQR= 367-833) with the branded gamification condition. Although the medians differ by almost 100 seconds, a Mann-Whitney U test revealed no significant differences regarding the time spent in each condition (Mann-Whitney U=181, p=.15). This was also evident within each individual step of the task. No significant differences were found between each condition, regarding the time spent in any of the soldering and cutting tasks (see Table 2).

Participants were found to spend less time within the soldering task, as they progressed to the completion of the study. A significant negative correlation was found between the time spent soldering and the steps in the soldering task, both in the generic gamification ($r=-.27$, $n=220$, $p<.01$), as well as branded gamification ($r=-.13$, $n=220$, $p<.05$).

One can attribute such an outcome to the repetitive nature of the soldering task: individuals have been found to improve productivity and performance, when executing the same task repeatedly over a short period of time [3]. However, a further extension of repetitive tasks can lead to boredom and increased error rates.

TABLE II. MEDIAN TIME SPENT IN EACH TASK, WITH GENERIC AND BRANDED GAMIFICATION CONDITIONS.

	Generic Gamification	***Branded Gamification***	
Task	**Median time spent in task, in seconds (IQR)**		**p**
Cutting	63 (50-86)	62 (44-81)	0.54
Solder 1	60 (48-74)	63 (50-100)	0.39
Solder 2	36 (30-44)	46 (35-86)	0.06
Solder 3	43 (33-61)	46 (32-78)	0.67
Solder 4	40 (15-65)	38 (23-57)	0.90
Solder 5	40 (30-61)	56 (33-78)	0.27
Solder 6	24 (25-45)	25 (16-46)	0.88
Solder 7	47 (31-62)	43 (32-52)	0.46
Solder 8	27 (18-31)	29 (20-59)	0.27
Solder 9	21 (14-32)	29 (20-55)	0.10

Interestingly, participants found the task easier, and relied less on instructions, within the branded gamification condition (see Fig 7). 73% of participants described having little – or no reliance on the instructions, as compared to 60% within the generic gamification (Mann-Whitney U=444, p<.05).

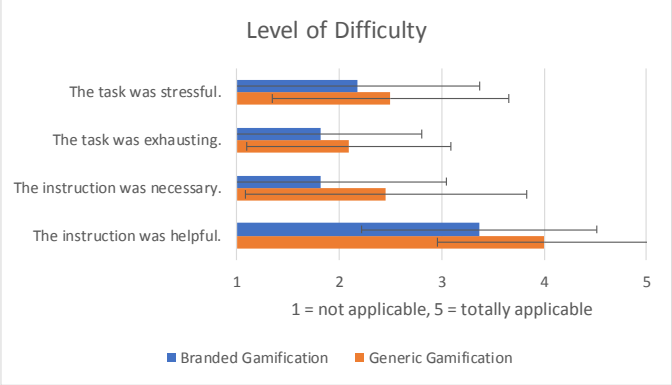

Fig. 7. Perceived level of difficulty of the groups with branded and generic gamification.

3) Dual Nature of Branded Gamification

Overall, the branded gamification led to more pleasurable experiences. Participants experienced a greater percentage of joy (median=35%, IQR=20-47%) and positive time (median=25%, IQR=9-40%) within this condition, as compared to those assigned to the generic gamification (median joy=20%, IQR=10-42%, Mann-Whitney U=696, p<.05; median positive= 12%, IQR=7-25%, Mann-Whitney U=370, p<.05). As illustrated in Fig. 8, with T(9)=-8.08, p<.01 there are highly significant more positive emotions with the usage of the Corporate Design.

While the branded gamification highlighted positive emotions, the same applied for negative emotions. Participants experienced a greater percentage of anger (median=31%, IQR= 22-46%) and negative emotions (median=22%, IQR=13-36%), within this condition, as compared to those assigned to the generic gamification (median anger=16%, IQR=8-39%, Mann-Whitney U=150, p<.05; median negative=14%, IQR=4-26%, Mann-Whitney U=163, p<.05).

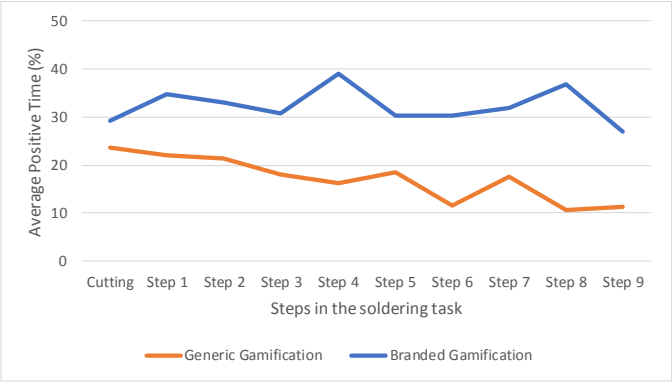

Fig. 8. Mean positive time in percent of the groups with branded and generic gamification during the soldering task.

Overall, our findings highlight a dual nature of branded gamification: While instigating positive emotions, aversion and reactance also arise. These results seem to extend the findings of previous research – while gamified interventions have been found to increase emotionality altogether [22], our results indicate that this effect is heightened when gamification is shaped towards attachment and identification.

Besides, users experienced stronger fluctuations within the branded gamification. A coefficient of variation of 98% was found in terms of the negative feelings, as compared to a 79% variation in the generic condition (F = 4.55, p<.05).

Contradicting our initial assumption, we did not find the intensity of these effects to fluctuate, regarding users' identification with the corporation. No correlation was found between this and the positive (r=0.08, n=22, p=0.6) and negative time (r=0.21, n=22, p=0.3) spent, for participants within the Generic Gamification condition. The same applied to the positive (r=-0.26, n=22, p=0.4) and negative time (r=-0.07, n=22, p=0.8) spent, for participants within the Branded Gamification condition.

4) Handling of Negative Feedback

Participants received textual feedback, in both interfaces, when an error was committed, as well as when taking more than a minute to complete a soldering task.

We found this feedback to cause spikes in negative emotions, for those in the generic gamification condition. Participants' anger time increased to 33% (IQR=26-56%), and 45% (31-85%), respectively, shortly after receiving an error message, or message indicating a task had taken longer than a minute to be performed (see Fig. 7). In both cases, anger time was significantly higher than during the remaining task completion (median = 16%). Interestingly, these results were not replicated within the branded gamification condition. Participants averaged 22% (IQR=15-57%), and 36% (25-68%) of anger time, respectively, shortly after receiving an error message, or message indicating a task had taken longer than a minute to be performed. Anger time was not found to differ to that of the remaining task completion (median = 31%).

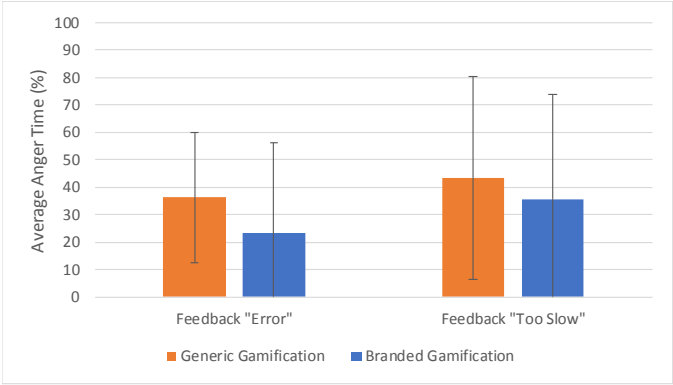

Fig. 9. Percentage of anger time while negative gamification feedback of the group with the branded gamification and the generic gamification.

IV. Conclusion

In this paper, we explored the effects of branded gamification in educational work-oriented contexts (focusing the STEM area). We frame this conclusive discussion in line with our three main hypotheses.

A. *Users experience more positive emotions, if "branded gamification" creates a connection with the enterprise.*

Indeed, participants were found to experience increased emotional reactions when gamification was branded. Besides greater percentages of joy and positive time, participants also experienced higher percentages of negative and angry time. Also, the variation of emotions, the "emotional spectrum" was greater within this condition. Participants varied between positive and negative emotions within short periods of time.

On one hand, this points towards a dual nature of branded gamification: while instigating positive emotions, aversion and reactance also arise. This points to the impact branding has on the users' emotional states. While previous work already has found brand identification to be intertwined with commitment to an enterprise [10], our results indicate that this identification also has a direct influence on individuals' immersion, and feelings towards tasks at hand.

Previous research has highlighted the benefits of such effects within the workplace. Ashforth and Humphrey [4] argue that emotionality and rationality are an integral, and inseparable part of organizational life – and organizational effectiveness may at times be improved by promoting, rather than attempting to suppress emotional variance. While this may be true, emotional variance (especially negative) may potentially lead to detrimental effects in a longer-term. Future research should employ in-situ studies to further inquire into how these effects are moderated through users' subjective experiences.

B. *The learning process as well as work performance is increased with branded gamification in comparison to generic gamification.*

Gamification branding did not seem to have a direct impact on the performance of the task. Participants completed the task in roughly the same amount of time and committed a similar number of errors in both conditions. One must note, however, a limitation in our study. The task conveyed to participants was of short duration, potentially mitigating the effects that branded gamification could have over a longer time frame.

Interestingly, however, participants with the branded gamification described that they had to rely less on the instructions, compared to those presented with traditional gamification. On one hand, this may indicate an increase of self-efficacy, due to brand attachment [28]. Reversely, participants may have experienced a higher need of conveying competence in the task at hand.

C. *The effect of branded gamification is stronger, the higher individuals' identification with the company.*

Branded gamification was found to impact individuals' equally, regarding their identification with the enterprise. No significant variations in task performance, or emotional reactions were found across participants, regarding their identification with MAHLE International GmbH.

One must note that these results may have resulted from a limitation in our study. All participants reported a high identification with the company beforehand, limiting insights towards individuals with lower commitment to the conveyed brand. One has to take into account that not all employees identify with corporations on such a positive level. Variations are likely to occur as a result of individuals' negative beliefs or commitment to a corporation [42]. Future studies should investigate the effect of brands regarding different levels of identification, and on wider spectrum of differences – such as effects of personality and effects of gender.

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