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Kortmann, L.J.; Scholten, L.

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GAME-BASED LEARNING OF MULTI-CULTURAL TEAM COMPETENCIES THE EFFECTS OF PLAYING BAFÁ BAFÁ ON ATTITUDES AND SKILLS OF FUTURE ENGINEERS

R. Kortmann[1]
Delft University of Technology
Delft, the Netherlands

L. Scholten
Delft University of Technology
Delft, the Netherlands

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ABSTRACT

Learning multi-cultural team competencies is important for engineering students to prepare for an increasingly global workspace. We evaluated the game BAFÁ BAFÁ with groups of Master students from varying engineering programmes using a mixed-methods approach. The game experience of 118 participants was measured. These participants experienced the game overall positively, although difficulties to understand other players in the game triggered mild stress and confusion. 91 respondents also completed questionnaires before and after the game about certain attitudes, skills, and values related to working with people from other cultures: willingness (attitude) and ability (skill) to understand those people; and appreciation (value) of working with them. We used paired t-tests and qualitative analysis to determine the game's effectiveness: after playing the game the players' willingness increased significantly ($t(90) = 3.6$, $p=.001$), but their ability to do so decreased significantly ($t(90) = 3.3$, $p=.001$) and their appreciation remained constant ($t(90) = 1.3$, $p=.195$). The qualitative responses supported our quantitative results: after playing the BAFÁ BAFÁ game, players were more willing to understand people from other cultures. Moreover, players had become more aware of their own shortcomings in understanding people from other cultures. Finally, the learning effects were likely not caused by a test effect, since the appreciation (value) of working with people from other cultures had not increased after playing the game. We concluded that the BAFÁ BAFÁ game is a powerful instrument to embark upon

[1] *Corresponding Author*
Rens Kortmann
L.J.Kortmann@tudelft.nl

teaching multi-cultural team skills, and therefore, to train more culturally aware engineers.

1 INTRODUCTION

Engineering traditionally focuses on addressing applied problems through technology. However, as we come to understand the complexity, interconnectedness and interdisciplinarity of most engineering problems, we realise that future engineers need to be prepared to work as multi-disciplinary problem-solvers with people from very different cultural backgrounds. This calls for new learning domains and learning approaches.

1.1 Multi-cultural teams and intercultural learning

Cultural backgrounds shape how people think, feel, and act across a range of professional and life situations. Culture determines what is perceived as good or bad, forbidden or permitted, abnormal vs. normal, or irrational vs. rational [1]. The difficulty that arises in working with culturally diverse others is that what one assumes as normal and proper can be completely the opposite for someone else. And even if we see and interpret obvious aspects of culture as expressed in particular behaviours, customs or language, we remain blind to the underlying unspoken assumptions, values and ways of thinking. This can easily lead to misunderstandings and wrong interpretations, hurt feelings, if not a breakdown of collaboration in culturally diverse teams. The negative impacts of ignoring substantial differences in cross-cultural team work and business, even among well-trained top-level managers, are well-known [1,2].

Intercultural learning, gaining awareness of one's own and others' culture, does not come easily. Cultural change and learning is *"[…] intrinsically difficult, because the re-examination of basic assumptions temporarily destabilizes our cognitive and interpersonal world, releasing large quantities of basic anxiety"* [3]. To unlock culture, it is important to look beyond national culture to explain differences and commonalities between people. Research supports that any social group has cultural traits that distinguish it from other comparable groups, be it a family, organization, or society at large. Also, professions like engineering or economics are considered to have particular and distinguishable cultures [4,5]. For instance, the distinguishing characteristics of engineers mentioned in the literature include being technophile and practical while also holding analytically-minded and substantial scientific expertise, being competitive, technically self-confident and valuing individual autonomy, next to uncommunicative and socially awkward tendencies [6].

Concluding, multi-cultural teams are at risk of collapsing if team members with different national, professional, or other cultural backgrounds are not equipped for intercultural learning. If even culturally-trained top-level managers struggle to overcome issues in multi-cultural interaction, how can we effectively bring such learning to the MSc engineering classroom? Below, we will explore the opportunities for this provided by immersive teaching approaches such as a game.

1.2 Game-based learning with BAFÁ BAFÁ

BAFÁ BAFÁ is a well-known simulation/game to learn about culture and diversity [7,8]. Various studies have been conducted to evaluate the BAFÁ BAFÁ game and its effects on players. For instance, Glover *et al.* [9] found significant increases in tolerance for ambiguity and significant decreases in dogmatism among undergraduate educational psychology students who played the game. Pruegger and Rogers [10] compared two methods of training cross-cultural sensitivity: playing BAFÁ BAFÁ vs listening to a presentation about cultural differences. Although quantitative measurements could not show a difference between the two methods, a qualitative comparison did signal greater effects of the experiential approach using BAFÁ BAFÁ. More recently, Ong-Flaherty *et al*. [11] performed a qualitative study on using BAFÁ BAFÁ to raise cultural awareness among students of health professions, which supported earlier work about the game's effectiveness. Finally, Wendorf Muhamad and Yang [12] analysed quantitatively how the game influenced players' intercultural sensitivity and intercultural communication competence. They found significantly higher sensitivity and competence amongst players who had played the game when compared to a control group.
Concluding, the game BAFÁ BAFÁ was shown to be effective in teaching multi-cultural team competencies to students of various backgrounds, such as educational psychology and health care professions. In this paper we will aim to answer the question to what extent the game is effective when applied to groups of engineering students. Below, in section 2, we outline our methodology for studying the effects of the BAFÁ BAFÁ game on engineering students. In section 3, the results are presented followed by a brief discussion in section 4. Finally, we draw conclusions in section 5.

2 METHODOLOGY

We played BAFÁ BAFÁ with three different student groups from Delft University of Technology in the Netherlands. The first group consisted of second-year Masters students subscribed to the course Joint Interdisciplinary Project (JIP). JIP students worked with other engineering students from all over the world and from and a wide range of engineering disciplines and played the game as part of the project kick-off. The second group consisted of first-year Civil Engineering students from the Master track on Environmental Engineering (EE) who played the game as part of the course Integrated Project. The third group comprised first-year Masters students from the Engineering and Policy Analysis (EPA) programme who played the game as part of their onboarding activities.

2.1 Game session design

Each game session begun with a 5-minute ice-breaker game and a plenary briefing after which the game was started. In the game, players are randomly assigned to either of two groups or 'cultures': the Alpha Culture is oriented towards strong social relationships, hierarchy, and close physical proximity; whereas the Beta Culture is more egalitarian, competitive, and distant. The game starts with both cultures, in separate rooms, getting themselves familiar with the habits, rules, and interaction

patterns of their culture. For this we had developed video clips to explain the rules of the players' new culture in English. The videos were supplemented with English subtitles to support non-native English speakers. Game facilitators then helped the players to practice interacting with other members of their culture according to the rules that had been explained.
In the second phase of the game, both cultures exchange group members with the other culture. In the first exchange round, an observer visits the other culture, watches the members of the other culture interact with each other, and reports back their observations. In subsequent rounds, small groups of players exchange with the other culture and interact with their hosts. The players are explicitly requested not to explain the rules that govern the behaviour of members of a culture. Instead, visitors should learn these rules through trial and error. Every time a group has visited the other culture, they report back to the members of their own culture. Although the rules for behaving in each culture are relatively easy to learn, the resulting behaviour looks rather complex to an outsider who is not familiar with them: it is very difficult to deduce the rules from the observed behaviour. Moreover, if visitors do not know how to follow the social codes of the other culture, they run the risk of being ignored by their hosts or even expelled from the room. As a result, visitors need to be very attentive and careful when trying to interact with the other culture.
After all players had visited the other culture, the game was ended and all players were gathered in the plenary space. Here, a debriefing session was held consisting of two phases: first we gathered qualitative data on the players' game experience; second the players held small group discussions about the cultural differences in the game followed by a plenary discussion. At the end of one of the courses (EE students), feedback about the course learnings were collected in-class as well as via individual written reflections.

2.2 Research design

Following the framework by Mayer *et al*. [13], we applied a mixed methods approach to studying the effects of the BAFÁ BAFÁ game both quantitatively and qualitatively. First, we used questionnaires before and after the game to quantitatively measure:

- Several background variables of players (age, gender, frequency of playing games in their daily lives; pre-questionnaire only)
- Seven dimensions of the players' game experience [14] (post-questionnaire only): five positive dimensions (competence, immersion, flow, challenge, and positive affect) and two negative dimensions (tension and negative affect). Each dimension was measured by averaging the scores on two items provided by participants through self-report (scores on 5-point Likert scales). The overall game experience was calculated by averaging over the scores for the five positive dimensions and the inverted scores for the two negative dimensions.
- Changes in certain attitudes, skills, and values that resulted from playing the game. To measure the latter changes we developed three constructs: (1) willingness (attitude) and (2) ability (skill) to understand team members from

other cultures; and (3) appreciation (value) of working with them. Each construct was measured through self-report by scoring multiple items on a 7-point Likert scale in the pre- and post-questionnaires.

We used paired t-tests to determine the significance of changes in players' attitude, skill, and value and thus measured the effects of the game sessions for the complete sample of students (N=91). Independent-samples median tests were applied to determine the effect of the game sessions and background variables on the game experience and game effects. We used this non-parametric test instead of the more common ANOVA due to the relatively low number of respondents in one of the game sessions.

In addition to the quantitative measurements, we asked players qualitatively about their learning experience through open questions during the plenary game debriefing (immediately after the game), in the online post-questionnaire (individually and anonymously), and during the course evaluation (EE students only).

3 RESULTS

A total of 118 participants from all game sessions completed the Game Experience Questionnaire. 91 participants completed the attitude, skill, and value measurements in both the pre-survey and post-survey. The age of respondents ranged from 20 to 33 years old (M=24, SD=2). Of all respondents 28% were female and 47% were male (25% gender diverse or unknown). Below we report on our respondents' game experience (Section 3.1) and the measured game effects (Section 3.2).

3.1 Game experience

During the post-game debriefing sessions students were asked about their experiences when visiting the other culture in the game. The great majority reported mild stress (such as feeling 'awkward', or 'not belonging') or indicated confusion ('confused', 'weird').

The scores on all seven dimensions of the Game Experience Questionnaire [14] as well as the overall game experience, averaged over the entire sample, are shown in Fig. 1.

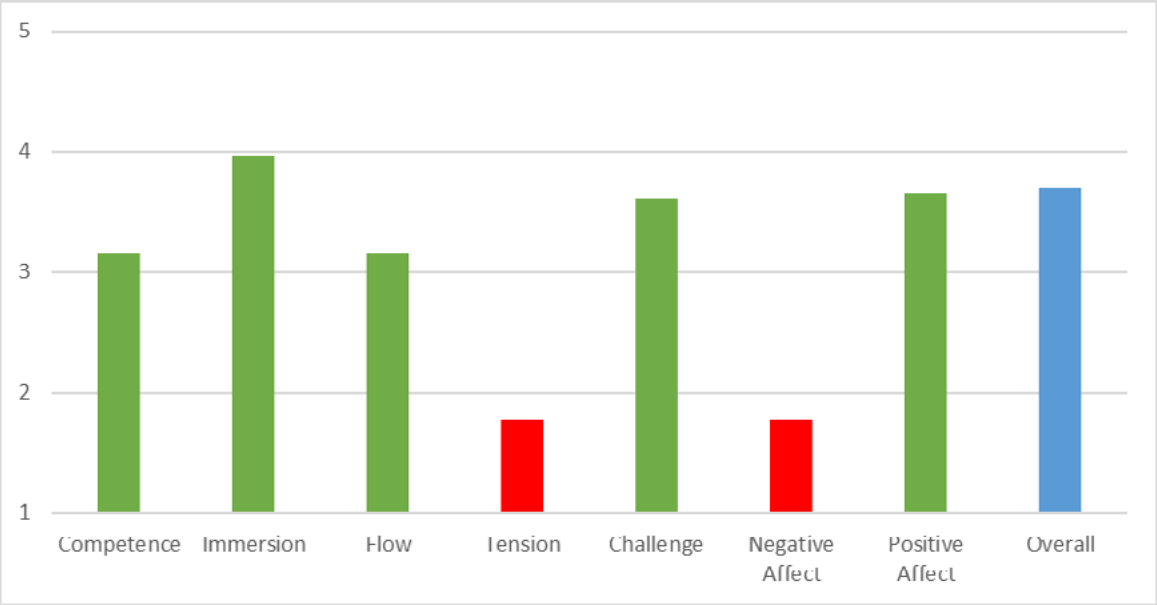

Fig. 1. Sample averages for seven dimensions of the Game Experience Questionnaire [14] (five positive dimensions (green) and two negative dimensions (red)) and the overall score (blue). Items were scored on a 5-point Likert scale ranging from 1 (low) to 5 (high).

The figure shows that all positive dimensions (green) score on or above the theoretical average value of 3 (possible scores range from 1 to 5). Immersion has the highest average score (M=4.0, SD=0.6), whereas the negative dimensions (red) have the lowest averages (both Tension and Negative affect: M=1.8, SD=0.8). This means that respondents reported on average a more positive than negative game experience.

Independent-samples median tests were conducted to determine the effects of the game session, the frequency of participants playing games in their daily lives and the participants' age, country of origin, and gender on the overall game experience. No statistically significant effects were found at the $p<.05$ level.

3.2 Learning effects

We measured learning effects of the game in two ways. First, participants reported several types of take-home messages in the post-game questionnaire. Some mentioned quite specific learning outcomes, while others stated more general insights they had gained. Examples of specific learnings are:

- *"It's very hard to live under a brand new culture. It's common to make mistakes and offend others."* - female Chinese student, age 22.
- *"The difference between an intrinsically competitive society and a social dynamic driven society is high."* - female Indian student, age 24.

Examples of more general insights are:

- *"It is important to spend time learning about other cultures before pursuing your own goals."* - male South African student, age 22.
- *"When you go into another culture you try to understand them but you are only looking for the things that you find important in your own culture."* - female Dutch student, age 21.

Some respondents referred explicitly to what they learnt during the debriefing after the game had ended (when they discussed the rules of the different cultures):

- *"It is good to explain how things work in your culture."* - male Dutch student, age 23.
- *"Talking about differences is essential to gaining understanding [of other cultures]"* - female Canadian student, age 30.

Second, as part of their course evaluation, the EE students highlighted the importance of including intercultural and team work training into their studies and how the game had left a lasting impression. The individual reflections illustrate the intercultural learning outcomes obtained during the course that started with playing BAFÁ BAFÁ.

- *"Being in an international group that you do not know even their culture, it was so stressful for me but in the next steps, I became able to adapt myself to these situations."* – male Iranian student, age unknown.
- *"[…] I experienced both the difficulties and power of combining people from different cultures."* – female Chinese student, age unknown.
- *"I did learn a lot on different cultures and how to tackle problems within a project group. […] now I will have some understanding of how to deal with it or even resolve the problems."* – female Dutch student, age unknown.
- "*The differences in culture is something that should be always on your mind. It's applicable in almost every situation and really helped our team work together very pleasantly. […]*" – female Dutch student, age unknown.

3.3 Effects on willingness, ability, and appreciation

The willingness and ability to understand team members from other cultures and the appreciation of working with them, are reported in Table 1.

Table 1. Willingness, ability and appreciation averaged over the entire sample before and after the game session. Also shown are the results of student-t tests to determine the significance of the differences between the average values before and after the game session.

	Before		After		t(90)	p-value
	M	SD	M	SD		
Willingness	4.6	0.8	4.8	0.8	-3.603	0.001
Ability	5.0	1.0	4.7	1.1	3.320	0.001
Appreciation	4.9	1.0	5.0	1.0	-1.305	0.195

We conducted student-t tests to determine the significance of the differences between the average values before and after the game session. The results, shown in Table 1 above, indicate that the average Willingness score has increased significantly from 4.6 to 4.8. In contrast, the participants reported a

significant *decrease* of Ability from 5.0 down to 4.7. Finally, Appreciation increased from 4.9 to 5.0, but not significantly at the $p<.05$ level.
As was done in the analysis of game experience, we conducted independent-samples median tests to determine the effects of the game session, the frequency of participants playing games in their daily lives, and the participants' age, country of origin, and gender on the (change in) willingness, ability, and appreciation before and after the game session. No significant effects were found.
The results bear three main implications. First, after playing the game participants were on average more willing to understand team members from different cultures. Second, after playing the game participants felt on average less able to understand team members from different cultures. Third, after playing the game participants did not appreciate working with people from different cultures more or less than before the game.

4 DISCUSSION

Our results suggest that playing BAFÁ BAFÁ leads to deeply felt, lasting, affective experiences, both positive and negative. Recent research by Tyng *et al.* [15] shows the importance of affective experiences for learning and memory development. Negative affect, such as confusion or frustration, serves to increase focus and attention, where mild-intensity, short-duration stress facilitates learning [16]. In contrast, positive affect triggers self-motivation and satisfaction [17] thus enhancing curiosity and exploration, preparing one to learn and remember. Therefore, the affective experience of playing BAFÁ BAFÁ is likely an important factor in the learning effects of the game.
Also, we noticed that the game triggered thought processes beyond the direct experience of players, inviting them to elaborate on the message of the game. Many of the reported take-home messages related to the debriefing phase of the game session, which marks the importance of a debriefing to make tacit learnings explicit [18].
Comparing our results directly to earlier work, such as the recent study by Wendorf Muhamad and Yang [12], is difficult due to differences in experimental designs and measurement instruments. However, comparing interpretations of the studies is feasible. For instance, like in the earlier work, our results suggest that the game motivates players for intercultural learning: we measured a significant increase in willingness to understand people from other cultures, where Wendorf Muhamad and Yang found significantly higher engagement, communication motivation, and interaction attractiveness scores (i.e. proxies of learning motivation), next to high interaction enjoyment (positive affect). However, when looking at skill development our study may have yielded other outcomes than the earlier work. Our qualitative and quantitative measurements showed a decrease in the players' ability to understand people from other cultures after playing the game. We interpret this outcome as follows: players had become increasingly aware of the difficulties they encounter when they interact with people from different cultures. Or, in terms of the "conscious competence" learning model [19]: players had become *consciously*

incompetent after playing the game. This finding may contrast the results of Wendorf Muhamad and Yang [12]. The latter reported higher intercultural communication skills in the group that played the game when compared to the control group. This could mean that playing the game *in*creased the ability to communicate with people from other cultures in the earlier work, where it *de*creased the ability to understand people from other cultures in our study. More research is needed to understand the difference. It could be due to various factors such as the slight difference in the constructs that were measured, the differences in the participants' background, or the ways in which the game and debriefing were facilitated.
Finally, we found that the reported value of working with people from other cultures did not change after playing the game. This absence of change can be interpreted as a sign of the reported learning effect not being caused by a 'test-effect' [20]. A test-effect in questionnaire research causes items in a post-questionnaire to be scored higher than similar items in a pre-questionnaire, for the simple reason that attention has been devoted to those items in the pre-questionnaire.

5 CONCLUSIONS

We used a mixed-methods approach to explore the effectiveness of the BAFÁ BAFÁ simulation/game to teach multi-cultural team competencies to MSc engineering students. Our respondents reported an overall positive game experience, although the game also triggered some negative emotions when it concerned players' abilities to understand other players in the game. We argued that these mild intensities of stress contributed to deep learning experiences at multiple levels of abstraction, ranging from rather specific lessons learnt to more general insights about multi-cultural teamwork. In line with the qualitative outcomes, our quantitative analyses showed significant increases in players' willingness to understand people from other cultures, after playing the game. In contrast, players reported a significant decrease of their ability to do so, which may be interpreted as players becoming *consciously incapable*, which is the first step towards mastering multi-cultural team skills. Finally, players reported no significant change in their appreciation of working with people from other cultures, which was expected from the experimental design and likely rules out possible test-effects in the response to our questionnaires. We concluded that the BAFÁ BAFÁ game is a powerful instrument to embark upon teaching multi-cultural team skills, and therefore, to train more culturally aware engineers. Based on the findings, to create intercultural awareness and facilitate learning, we suggest to include games such as BAFÁ BAFÁ ideally during early stages of a programme or course. Closer study of the mechanisms underlying BAFÁ BAFÁ outcomes and their effect on learning is needed for evidence-based design of intercultural training as part of engineering programmes. Other opportunities for future work include the use of more established scales for intercultural sensitivity and intercultural communication competence in our quantitative measurements, in order to compare our outcomes to those of other authors. Also, we recommend to study in more detail why, after playing the game, respondents reported a decrease in their ability to understand team members from other cultures.

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