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# **Design principles for introducing 21st century skills by means of game-based learning**

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## **Abstract:**

Educators are drawn into a battle for student attention and engagement in any learning environment.

This article describes how a learning environment can be changed into a game-based activity to

ensure student engagement. Modules aimed at the professional development of students present

numerous challenges in the structuring of learning environments that develop communication,

collaboration, creativity and critical thinking skills; the 4Cs of 21st century skills. This article is

based on an activity designed for 145 engineering students and intended to habituate them to the

university while simultaneously exposing them to opportunities for the development of the 4Cs.

During the design, execution and refinement of the learning environment in five consecutive years,

15 design principles that could be employed to facilitate the implementation of a game-based learning activity emerged. Student reflection essays, lecturer observations, fieldnotes and a focus group interview conducted with tutors and colleagues were analysed qualitatively to inform the investigation into students' experiences of a game-based learning environment aimed at their professional development. The voices of the students were used to confirm the value of this environment. The design principles can be employed in other learning environments to support practitioners' game-based learning efforts.

**Keywords:**

Communication, collaboration, creativity and critical thinking, game-based learning, design principles, graduate attributes

**Background and context**

*Career readiness of students*

The challenges faced by employers in the 21st century demand a change in the traditional, pedagogically sound education approaches that have been in place for many decades now. The emphasis is no longer only on the need for content knowledge, but also and increasingly on specific skill sets that are needed in the new era brought about by technological development.

Career readiness is an all-inclusive term that is not easy to define. Tony Wagner (2008) called the attributes needed to succeed in the 21st century workplace 'survival skills'. The seven attributes he identified correspond with the research findings of other organisations such as the North Central

Regional Educational Laboratory (NCREL) and Metiri Group (NCREL & Metiri Group, 2003) and the Partnership for 21st Century Learning (P21, 2015). In the context of the engineering profession, it is said that higher education institutions prepare their engineering graduates for the object world and not for social processes (such as discussion, negotiation, knowledge exchange, integration and consensus-building) that form an integral part of the design phase of any project (Bucciarelli & Kuhn, 2018). In some cases, stakeholders offer advice regarding the focus of educational programs: they should aim to develop critical thinking skills; to optimise the students' communication skills; and to foster the ability to apply fundamental knowledge in the everyday tasks they encounter (Wyman, 2018).

### ***Role of higher education institutions***

Higher education institutions, being “in the business of developing the whole person, including all facets of their lives” (Van Breda, 2018, p. 1121), are compelled to deliver employees who are able to meet the challenges of the ever-evolving 21st century workplace (Murali & Rajaram, 2015; Pegg, Waldock, Hendy-Isaac & Lawton, 2012). In South Africa, where the school system is failing the majority of learners (Spaull, 2013), the obstacles faced by higher education institutions call for special measures to prepare students for the workplace. Students arrive ill-prepared as a result of the quality of the education system, as illustrated by the fact that South Africa is rated 146th out of 148 countries in terms of education in the World Competitiveness Report 2013 (DHET, 2013). Socio-economic and historical factors further convolute the educational set-up (Kraak, et al., 2013). Therefore, the dropout rates are high, and the skilled graduates emerging from these institutions are not found to be job-fit by employers (Kraak, et al., 2013).

## ***Challenges***

Since higher education institutions not only have to but want to deliver employable graduates (Bridgstock, 2009), they have been forced to take extra measures, especially in the South African context. Foundation programs were introduced to bridge the gap between the lack of preparedness of students, due to challenges in the schooling system, and the demands of a tertiary learning environment (Grayson, 2010). Foundation programmes are structured to assist students who do not meet the entry requirements to go directly into a qualification. During the foundation phase mainstream subjects are augmented with additional modules to fill in the gaps in students' conceptual understanding of the learning content.

Apart from challenges regarding the level of preparedness of students, the demographic cohort (Generation Z) further complicates the educational playfield. The typical Generation Z student challenges the traditional style of knowledge delivery and demands a new, innovative approach to learning (Duderstadt, 2009). They need to be actively engaged and motivated before meaningful learning can take place (Figueroa-Flores, 2016). Interesting choices, desirable outcomes, instant feedback on performance and opportunities for these students to develop and evaluate their progress in the learning environment (Prensky, 2005; Sogunro, 2015) are only a few of the aptitudes that higher education teaching strategies must address.

## ***Learning environments***

Educators are continuously searching for strategies to increase student engagement and enhance learning in their teaching environments (Ozcelik, Cagiltay, & Ozcelik, 2013). Especially in skills development modules, the search for effective mediums that would engage students in meaningful

learning continues. Environments in which students are actively engaged and in which effective learning takes place (Astin, 1999; Prince, 2004) often have challenge, fantasy, curiosity and control (Malone & Lepper, 1987) as common denominators. These environments also seem to be able to grab students' attention and, in the process, motivate them to engage (Deci & Ryan, 1985; Lepper & Cordova, 1992). Another advantage of these types of learning environments is that it is relevant to the student's milieu and promotes student confidence and provides satisfaction (Keller, 1987).

Numerous researchers (Figueroa-Flores, 2016; Garris, Ahlers & Driske, 2002; Romero et al., 2015) agree that a game-based learning environment would satisfy students' inclination towards active learning environments. Games pose opportunities to develop students' skills without them being aware of the time that has elapsed during their involvement (Csikszentmihalyi, 2008). By participating in a game, students are offered the opportunity to be part of an imaginary world in which people have fun while at the same time concentrating intensely on problem-solving (Prensky, 2001b). A game-based approach could, aside from realising the educational outcomes of a specific learning event, also enhance the learning experience of students. Students have to communicate with each other to be able to collaborate effectively and they lean on their ability to think critically and creatively to excel in a game (Mallory & Guadagno, 2016). As such, games seem to be the perfect solution to realise the learning outcomes in a module aimed at skills development.

### ***Context of the game-based learning environment***

Considering the challenges to deliver employable graduates and students' aptitude for active learning opportunities, the question is: how do you design a learning activity that would promote the development of the 4Cs? The first activity in one of the first-year modules in a five-year

extended degree program for engineering students served as the basis of this inquiry. The module in question is specifically designed to prepare students to be successful in their studies and eventually as professionals in the workplace.

Rieber, Smith and Noah (1998) noted that games provide a socially acceptable platform to practise skills needed in real life. Furthermore, game-based teaching approaches are appealing to 21st century learners and, apart from transferring knowledge, the game-based environment serves as a motivating factor to engage in the extension of problem-solving, collaboration and communication skills (Figueroa-Flores, 2016). Social and emotional skills are practised in a safe environment without the agony that arises from failure in real-life situations (Figueroa-Flores, 2016). Strategies to engage students in activities through which they can practise these skills include discussion, role-play and problem-solving (Hromek & Roffey, 2009). Therefore, a game-based learning environment entitled *The Amazing Race for Engineering* was designed with the aim of habituating the students while simultaneously providing them with an opportunity to develop the 4Cs.

The *Amazing Race for Engineering* activity sends students on an exploratory journey across campus to familiarise them with the services rendered and facilities available. Similar to the television reality series, *The Amazing Race*, students are guided by clues to reach different destinations. They encounter roadblocks (tasks) that they must complete before receiving the clue to the next destination. Exposure to the 4Cs was built into the game by adding opportunities in the clues and roadblocks that required students to effectively communicate and collaborate to solve problems by using creative and critical thinking. Students who arrive at the final destination first

win the race and receive the grand prize: a food voucher from one of the vendors on campus.

The Amazing Race activity used in this study had a dual purpose. It was meant as an ice-breaking activity through which students could familiarise themselves with the new environment and the peers with whom they would share the new life experience of being a first-year student. However, primarily it served as the first introduction to the 21st century skills needed to be successful as a student and in the 21st century workplace. Students' interest in the new environment was aroused by including novel and authentic events whereby they could gain knowledge about both the environment and the people with whom they were going to spend their tuition years. They had to find answers to the tasks structured as roadblocks and clues to progress in the game. In this way, they had to be inquisitive and apply critical and creative thinking skills. Since the learning environment focused on the completion of small tasks to move to the next stage of the race, the students could experience the immediate and positive experience of success in each of these actions. They commented that they were gratified by completing the tasks in the correct way, based on the immediate feedback that allowed them to continue in the race. What is more, they were intrigued by the food voucher prize which was offered as an extrinsic motivation. More information on the design of the activity and a description of the students' responses to the activity can be found in the PhD thesis "Design principles to create an enabling game-based learning environment for the development of 21st century skills" (Robberts, 2019).

This study is based on the transformation of an existing game, The Amazing Race, to suit an academic purpose in a higher education context and reveals useful principles in the design of an activity aimed to develop communication, collaboration, creativity and critical thinking skills in

ill-prepared students. The design principles that surfaced could be useful for lecturers who want to transform traditional learning environments into game-based learning opportunities.

## **Method**

Since we wanted to understand the interplay of different elements in the learning environment, a qualitative interpretive stance (Merriam & Tisdell, 2016) sufficed. This approach afforded us the opportunity to understand the phenomena through the meanings that all of the stakeholders assigned to them (Merriam & Tisdell, 2016). Furthermore, in taking this stance we could use a variety of data sources (Denzin & Lincoln, 2000) and provide a rich description of the scenario at hand (Creswell, 2013).

The process of developing a conducive learning environment demanded a search through the literature to identify the types of learning environment that would be beneficial for the development of the 4Cs and that would engage Generation Z students. The learning environment was constructed as proposed by the literature consulted. Observations and student experiences further shaped the refinement of the environment. The reasoning went from examining existing theories to proposing “hypotheses” that led the investigation (Gabriel, 2013). In this case, our hypotheses were that a gaming learning environment would provide an opportunity to develop 21st century skills, and that there were certain design principles that could be employed to ensure the success of the environment. The top-down approach (Byanjankar, 2016) results in either the confirmation or rejection of the hypotheses, based on the observations and data gathered regarding the influence of the learning environment, typical of a deductive process.



### ***Case study***

A cross-sectional case study (Longhofer, Floersch, & Hartmann, 2017; Merriam & Tisdell, 2016), was employed to explore the suitability of a game-based environment for academic purposes in a higher education setting. The data garnered could shed light on the students' experiences of the game and aid in the evaluation of the influence of the learning environment on the acquisition of communication, collaboration, critical thinking and creativity skills.

### ***Participant (subject) characteristics***

All of the first-year engineering students enrolled for the module Professional Orientation, together with the tutors for the module, the lecturing team and an assistant lecturer acted as the sample of the study. The sampling methodology followed to select the participants in the project can therefore be labelled as convenient (Salkind, 2010).

The students in the sample, of whom 118 were male and 27 were female, had diverse interests as demonstrated by the choice between the nine fields of study offered in the engineering faculty. Most were between 18 and 19 years old; five students were younger than 18, and six were 20. They belonged to different ethnic groups and originated from nine different provinces, and 14 different languages were indicated as mother tongues. Even the area in which a student attended school, whether city, town, rural or township, added to the diversity of the group, especially in terms of their level of preparedness for tertiary studies. The initial sample consisted of 145 students, of whom six did not complete the reflective essay.

### ***Sampling procedures***

All the first-year engineering students at the institution in the year of the study served as the

population of the study (n = 1500). The sampling procedure followed for this study could be therefore be considered as being both convenient (Salkind, 2010) and purposive (Patton, 2015) in nature. Students (S) who had enrolled for and were accepted into the five-year engineering program at the institution (n=145), and the five tutors (T), together with the assistant lecturer (AL) and three lecturers (L), of whom the first author is one, involved in teaching the module at the time of the research were sampled. The colleagues [C] stationed at the destinations visited during The Amazing Race also formed part of the sample. The participating students applied for admission or were placed, based on their results, into this program since they did not qualify for access into the mainstream four-year program.

### ***Instruments***

Three instruments were used to investigate the influence of the learning environment. Students had to write a reflective essay after The Amazing Race to reinforce learning (Berdrow & Evers, 2011) and to articulate the intuitive knowledge gained during the activities they were involved in (Hetton & Smith, 1994). These reflective essays (n = 139), in which students had to respond to the questions “what happened?”, “so what?” and “now what?” (Reed & Koliba, 1995), provided useful information regarding their experiences during The Amazing Race activity. A focus group interview with the tutors and the assistant lecturer involved (n = 6) was conducted to gather more insight into the principles that constituted a successful game-based learning environment and to confirm the students’ experiences of the environment. The focus group interview was recorded so that it could be transcribed and analysed in the next phase of the research. Finally, lecturers’ observations triangulated the information gained from the other two instruments.

### ***Data analysis***

The data analysis was done in different phases. Initially, all the students' comments regarding the 4Cs were grouped together to look at their experiences in this regard. Then the 12 characteristics of games as depicted by Prensky (2001b) were used as an organising principle. To ensure that the assertions generated were true to the data and to avoid overlapping, the data were scrutinised from the different angles offered by the aforementioned organising principles. During the investigation into the opportunities rendered by the game-based learning environment to develop the 4Cs, 15 design principles for transforming learning environments surfaced. These principles are outlined in the findings section of this paper. We compared these findings with the data garnered from the focus group interview with the tutors and assistant lecturer, which was specifically constructed to ensure the correct interpretation of student's comments and to refine the findings of the research. The observations of the lecturers were thereafter incorporated and the findings were revisited to clarify any ambiguous statements and ensure a true reflection of the students' experiences (Merriam & Tisdell, 2016). At this stage we evaluated the data, considering the interdependence of the whole and the parts and compared the data with information gained during the literature review. By using this analytical method, we aimed to gain knowledge that could be beneficial to educators in other contexts as well (Lichtman, 2013).

### ***Limitations***

There were shortcomings and biases that had to be considered. Longhofer et al. (2017) note that the fallibility of the reflective practitioner is one of the characteristics of a qualitative inquiry; the intention is not to tell only one story, but to elaborate on the scenario from many different

viewpoints. Peshkin (1988) actually sees the researcher's subjectivity as a virtue, arguing that "it is the basis of researchers' making a distinctive contribution, one that results from the unique configuration of their personal qualities joined to the data they have collected" (p. 18).

We full-heartedly echoed Peshkin's (1988) wish to be aware of the enabling and disabling potential of our own biases and orientations that shaped the observations we made and the subsequent interpretations. Since we were involved in all of the aspects of the research, we had to reflect on our values, our view of how the world is known, and also on the suitability of the context and the consent of the participants and the types of reflexivity, or self-awareness, identified by Lichtman (2013). We consequently had to carefully and critically analyse ourselves, especially in light of the fact, as pointed out by Mertens (2018), that we, as constructivist researchers, had to be acutely aware of the influence our values and biases might have on the research scenario.

Another limitation of this research project is the question of generalisation. The fact that a qualitative, interpretive research approach was followed in The Amazing Race study already reveals our intention: we did not want to discover what was true for everybody – the focus was on an in-depth understanding of the particular (Merriam & Tisdell, 2016). Nonetheless, the findings of this research project might be useful in other contexts in which educators also aim to instil certain qualities in their students. The game-based learning environment created to expose students to opportunities to develop 21st century skills could easily be adapted to fit a broader group of educators and institutions.

## **Results**

The students' reflection essays and the transcription of the focus group interview were analysed from three different perspectives. Firstly, the data were scrutinised for students' experiences regarding the context of the game in terms of destinations visited, the clues and the roadblocks that they needed to decipher. Thereafter, their comments regarding the 12 characteristics of games (Prensky, 2001b) were analysed, and finally the exposure that the game-based environment provided to the attainment of the 4Cs was explored, using students' comments.

### ***Context of the game***

Students commented that The Amazing Race activity helped them with navigating to their classes and pointed out that the activities during the race allowed a better understanding of the physical surroundings:

‘All tasks during the race provided me with a better understanding of all my surroundings which at the end of the day really benefited me in more ways than one and allowed me to know where I have to go for my classes.’ (RE(reflection essay)\_S80)

Students mostly commented on the navigational clues and the roadblock tasks in a positive way. They also reported that participation in The Amazing Race was conducive to the development of effective teamwork:

‘Navigating to the different landmarks was in my opinion, the greatest individual challenge but through the help of a teammate, this became a seamless exercise.’ (RE\_S78)

### ***Game characteristics***

Students enjoy playing games. The numerous comments regarding the characteristics of the game attest to this:

‘The part I enjoyed most was when we had to figure out where the clues were directing us and at the meantime we were in a race, not only against each other but also a race against time, so we had to think of our toes.’ (RE\_S51)

‘The fact that it was a race was a factor that made the whole activity more enjoyable because I am a very competitive person.’ (RE\_S1)

This comment says it all:

‘I am grateful for this Amazing Race, because the students didn’t realise that they are learning while having fun.’ (RE\_S25)

More information regarding the findings according to the 12 characteristics can be found in Robberts (2019).

### ***Exposure to the 4Cs***

Even though students were not informed about the dual purpose of the race, most commented on its value regarding their professional skillset:

‘I thought the Amazing Race was a great activity to participate in because we got to meet new people and make friends while working on the Amazing Race. Aside from meeting new people and making new friends, it also gave me an opportunity to get to know the campus a little better as I was still new to the university and did not know where all the

buildings are.’ (RE\_S59)

It became evident from the comments that the students needed challenges, and even more so engineering-specific ones, to stay motivated to proceed in the race:

‘I do wish they had more interesting challenges with specific engineering themes. All in all, it was a very good idea that can be very well received if a few tweaks are made to make it feel more like an “Engineering Amazing Race”.’ (RE\_S12)

### ***Summary***

The appreciation of the students regarding the effort that was needed to achieve a successful event serves as a strong motivation to include innovative methods in the normal educational sphere:

‘The amazing race allowed for a good team working opportunity and helped in improving our communication and thinking skills. Overall, I feel that the amazing race was a fun and creative activity.’ (RE\_S59)

### **Discussion**

Work can be turned into play (Lepper & Cordova, 1992). The value of the game-based approach to teaching that allows the development of skills such as critical thinking, group communication, debate and decision-making, pointed out by Pivec et al. (2003), was confirmed by the results of this study. Much is said in literature about the characteristics of games (Prenski, 2001b), the principles that could influence the design of the game-based learning environment (Squire, 2013) and the notion of values that influence the implementation thereof in educational settings by using

Roger's attributes of innovation (Emin-Martinez & Ney, 2013), but there are relatively few practical suggestions that could ease the process of transition to a game-based learning environment.

During the investigation of the influence of a game-based learning environment on the exposure and attainment of the 4Cs (communication, collaboration, critical thinking and creativity), we ascertained specific design principles that influence the successful implementation of a game-based learning environment. These are detailed below.

### *Student characteristics*

It is important to take stock of the characteristics, prior-knowledge, implicit proficiencies and needs of the students at the stage at which you want to implement the intervention. In our case, the students were first-years, new to campus and in many cases underprepared for the challenges posed by a higher education environment. The game scenario can level the educational playfield so that all the students, regardless of their level of preparedness for the higher education arena, can participate without a feeling of inferiority and can benefit from the exposure to the game (Gardner, 2000). We also needed to consider alternatives for students with physical handicaps. To successfully execute a game-based activity, you need to take stock of the unique characteristics of your student body.

### *Infrastructure requirements*

The game, as we played it, did not require the students to have any props or technology. However, in future versions we may introduce the use of mobile devices to streamline some of the gaming aspects. It is important to consider the hardware and software requirements, since successful and meaningful participation depends in part on the availability of the devices or instruments needed. These could entail having access to a smartphone, having enough airtime or access to wireless



Internet services to search for solutions online. We often forget to consider the obvious necessities, and although these may seem trivial, considering the hardware and software requirements to take part in the game is necessary as it could have a considerable influence on the successful execution of a learning event.

### ***Organisational support structures***

Factors such as the facilities available and the time available for the activity also need consideration in the planning phase of an educational event (Arnold, 1991; Marklund & Taylor, 2015). The context of this study called for a game that would orientate the students on the physical campus while simultaneously exposing them to opportunities to practise the 4Cs. The campus environment opened up certain possibilities but also posed some challenges. Furthermore, the time constraint of 100 minutes had to be taken into account. The Amazing Race scenario was found to be a good fit with regard to the physical learning environment, but other games, such as Scavenger Hunt or Survivor, could have been used as well. One needs to look at the possibilities to adapt an existing game, or to create a customised game, that could optimise the learning experience by matching the characteristics of the learning environment to a relevant game.

### ***Gaming context***

There is a complex interplay between the learning outcomes, the context of the game and the design of the activities that the participants have to complete in the resulting learning environment. That environment should preferably be closely connected to the context of the students so that it appeals to them. By narrating the context, situated learning that ‘involves adapting knowledge and thinking skills to solve unique problems’ (McLellan, 1996, p. 9) is ensured.

Since we were working with engineering students, the context of the game needed to be authentic and the clues and roadblocks had to be specifically engineered to fit their repertoire. For example, in the roadblock activities students had to use different navigational systems, to explain certain scientific phenomena, to apply trigonometric principles in their calculations and more. As noted by Keller (1987), the learning environment had to grab their attention, be relevant and provide opportunities for the students to experience success and a feeling of accomplishment after their involvement. You have to contextualise the game environment to fit your circumstances.

### ***Mechanics of the game***

The mechanics of the game include the key role players, how the players interact and how they win (Hunicke, LeBlanc, & Zubek, 2004). All of these aspects need attention before any game could be staged. The motivational theory of Keller (1987) proved to be extremely informative during the planning phase of the event. Specific activities had to be developed to awaken student interest, to establish relevance, to amplify the students' expectation of success and to enhance a sense of satisfaction through intrinsic and extrinsic rewards. Furthermore, all the activities in the game had to be directly connected to the outcome. The gaming environment has elements such as obstacles, extra lives and more that could be exploited to optimise learning gains (Prensky, 2001a). The winning state is important as everybody likes to win, even if it is an imaginary badge or small but tangible prize, such as a chocolate (Prensky, 2001b). Winning drives participation (Mallory & Guadagno, 2016).

Decisions regarding the campus destinations visited, the clues to these destinations and the roadblocks to be executed at each of them were carefully considered as part of the mechanics of

the game that needed attention before it could be initiated. Furthermore, the types of interaction between the students and their environment, their teams and the lecturing staff, the rules of engagement, how the students' progress through the race and how they win all play a crucial part in the planning phase of a game such as The Amazing Race. You have to develop the whole experience by keeping the mechanics, the dynamic interplay of the elements and the emotional experience of the players in mind.

### ***Affective gaming elements***

Words such as sensation, fantasy, fellowship, discovery, expression, challenge and drama describe the emotions encountered when playing games (Hunicke et al., 2004). To create a fulfilling gaming experience, it is imperative to look at all the characteristics of games as specified by Prensky (2001b) and to aim at incorporating activities that conscientiously add pleasant emotions during the learning event. The game needs to feel like a game from the perspective of the designer and, most importantly, from the perspective of the player.

Students experienced success just by being able to complete The Amazing Race activity. Their comments on The Amazing Race learning environment, even though they were not explicitly prompted to respond on the appropriateness of a gaming environment and its characteristics, confirmed that the affective game elements had an influence on the overall experience. It is therefore important to retain the gaming elements of passion and engagement.

### ***Level of challenge***

Challenges that are too difficult could discourage students from taking part in a game and might influence the outcome in terms of the time needed to complete it (Cornelisz & Van Klaveren, 2018;

Sweetser & Wyeth, 2005). On the other hand, if the challenges are too easy, students may lose interest because they do not need to think creatively (Funke, Fisher & Holt, 2018) or communicate with each other to solve problems. It seems that the extent of collaboration and communication among team members depends on the difficulty of the challenges they face.

In The Amazing Race activity, we considered the fact that the students were all enrolled for engineering. Therefore, we included engineering-specific challenges that were based on the students' prior knowledge of mathematics. We carefully balanced the questions in the roadblocks to be challenging enough, but not too challenging. There were opposing views regarding the difficulty of the activities the students had to undertake during the race. Students variously found the game too easy (no need to collaborate and communicate to be able to succeed) and too difficult (the purpose of The Amazing Race was not to struggle). Some were doubtful at first about their abilities to succeed, some enjoyed the challenge and others really struggled and eventually just gave up. It is crucial to find a balance between the level of difficulty posed by the challenge and the students' skills, since this will influence the students' experiences while they are immersed in the game. Students' comments underlined the notion of the experience of flow as described by Csikszentmihalyi (2008). We needed to strike a balance between the level of difficulty of the challenges and the sense of success for the students.

### ***Learning opportunities***

Student choice provides learning opportunities that could be exploited in the design of a game. As an educational event it is important to ensure that all students can partake fully and complete the whole activity. To this effect, special measures need to be taken to monitor student progress and to

intervene where and if necessary. Students learn individually and incidentally through the choices that they have to make during a game.

To kick-off The Amazing Race we provided students with a hand-out that contained a description of the event, the rules of engagement, a map of the campus and their first clue. Students had to organise themselves in teams of two and read through the instructions before they could start. Since they had to interpret the clues, they could make mistakes and end up at the wrong location. When this happened students could look at the problem at hand again, evaluate their thinking pattern, adjust and try to catch up. We need to provide opportunities for students to learn individually and incidentally by their choices.

### ***Game objectives and rules***

Clear, specific objectives for a game are needed to motivate students to participate (Sweetser & Wyeth, 2005). Rules and success criteria provide structure, and the prospect of winning and receiving a prize intrigues most people and serves as motivation to complete an activity successfully (Prensky, 2001b). The prizes can be small; the prospect of winning something seems to enthrall almost everyone. A mechanism to reward good performance and penalise students who do not adhere to the rules needs to be in place.

The rules of The Amazing Race broadcast had been adapted to fit to the circumstances in the new environment. Some of the students' comments revealed the seriousness with which they approached the activity. Some said that they had felt discouraged at times when the rules were not applied explicitly, which resulted in some students progressing in an unfair way. Such comments demonstrate that the students not only needed the structure provided by the rules but also valued

the fact that the rules were strictly applied. The comments regarding their experiences underlined that they wanted to engage in something meaningful (Garris et al. 2002). One student stressed that overemphasising the competition factor ran the risk of overpowering the goal of the activity – namely the realisation of the learning objectives. This calls for careful consideration of the interplay between all factors in planning and executing the activity. We need to define the rules of the game, set clear success criteria (learning aims) and, if possible, provide rewards.

### ***Instructions***

At the onset of the event the students need to receive clear instructions as to what is expected of them; the rules need to be spelled out and they need to know the rules of engagement and where they can find help. It is always advisable to check the instructions for any event with colleagues or tutors before the activity starts so that items that might be misunderstood can be refined. During the introduction to the event chaos and confusion among students can be prevented by walking the them through the process and addressing problems that might arise. Students need to receive clear instructions and communication with regard to rules and code of conduct.

During the activity the progress of the students need to be monitored and, since some may look for ways to fast-track through the event, measures to ensure that they complete every instruction need to be taken so that every student is exposed to the educational experiences planned for them. It is always beneficial to have a back-up plan or solution ready to use should problems arise.

### ***Feedback***

Even though the students were only playing a game, they wanted feedback on their progress and the problems that they encountered (Van Eck, 2006; Sailer et al., 2013). Students wanted model

answers and recommended methods to achieve success in every activity. If feedback is provided, all students can benefit from the game (Baron, 2012). It seemed that the participants wanted a sense of closure after the completion of the game, and a feedback session completed the circle of events. Students' comments in their reflective essays confirmed that they wanted elaborate feedback on every element of the game.

### ***Safe environment***

One of the greatest advantages of a gaming environment is that students can learn by making mistakes and re-learn without any detrimental influence on their studies (McGonical, 2011). Students need to feel safe to be able to fully engage in any learning environment. Personal and immediate feedback at points in the game and not being at risk of exclusion offer safety in the gaming environment.

The game environment lends itself to learning without the fear of making a mistake. No mistake should be detrimental to the game; no player should be excluded based on wrong choices. Mistakes must lead only to an adaptation and adjustment of thinking patterns.

### ***Logistical factors***

Planning is essential for the successful execution of a game. Arnold (1991) described planning as being positioned to act; doing whatever you are able to do beforehand rather than facing challenges as they surface. Logistical issues, such as the compilation of the teams, the set-up of the clues and roadblocks, administrative issues and staff support requirements, all need a hands-on approach to ensure the seamless execution of an activity (Arnold, 1991).

The planning for The Amazing Race started with consideration of the implications of the

number of students enrolled in the specific year as this influences the number of routes that needs to be configured to minimise the impact of the activity on other activities on campus, to devise clues to navigate safely, to configure the roadblocks to showcase the university's facilities and to stimulate exposure to the 4Cs. These administrative tasks included the preparation of the map and instructions, clues and roadblocks, using different colours to avoid confusion that would result in chaos. Additionally, the logistics of the game needed to be verified by walking every route as a student, ensuring accessibility, completing all the activities in the specified time and eliminating possible pitfalls due to miscommunication among the stakeholders. Everybody involved needed to be well informed, to know the different routes that students had to follow and to understand how to prompt students to find solutions to the clues and roadblocks. Many of the factors that had the potential to derail the event could be eliminated, or their effect could be lessened, by careful consideration of possible problems during the planning phase. The success of any intervention can be enhanced by ensuring that the activity is executed seamlessly in terms of the logistical aspects associated with it.

### ***Game knowledge***

A problem in South Africa is that students do not arrive at higher education institutions equally prepared for their studies. By using a game-based scenario, the educational playfield was levelled since all students, regardless of background or experience, could play the game with success. Since there were only two students per team, the input of every student was important to proceed in the race. By using small teams, students had to rely on each other and, in this way, both team members had opportunities to develop the 4Cs. It is advisable to execute the game that you choose in such a



way that students do not need prior knowledge about the nature of the game to play.

### ***Reflection***

Reflection, or metacognition, leads to full mastery (Bruner, 1996) since students evaluate their actions and how to improve them (Rotherham & Willingham, 2009). Therefore, reflective moments should be built into the process but should also be used as a final activity to conclude the learning experience. Questions should force students to reflect on their thinking and in this way further the learning process. We can support better the transferability of skills by introducing an interleaved practice of reflection.

### **Conclusion**

There is a place for game-based learning in higher education curricula despite omnipresent time constraints. These gaming activities do not have to be big, disruptive exercises. They can be played in a lecture venue, or even be hosted as a virtual activity. The learning outcomes define the type of environment that would best facilitate the learning that has to take place.

The Amazing Race is not the only game that provides lecturers with an opportunity to design a learning environment to achieve specific learning outcomes. Other game scenarios, such as Survivor, Scavenger Hunt and Who wants to be a Millionaire, or even board games, such as Monopoly and Risk, could be customised to serve as vehicles to achieve learning objectives, as long as the same principles that ensure the engagement of the students are applied. Alternatively, a custom-made game can be developed for the same purpose: this, however, demands considerable energy and creativity, but it remains a possibility that could be investigated. It is normally much easier, though, simply to alter an existing game. The challenge, however, is to find a game that

lends itself to adaptation so that students will be able to reach the learning outcomes by playing it.

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