Renewing Systems Analysis: The Impact of Game-Based Learning on Repeating Students

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Abstract: Systems Analysis and Design, a second-year subject offered over two semesters, is experienced as challenging. The subject is offered at a South African university and form part of several baccalaureus courses, of which the BSc. Information Technology course is the most prominent. Several reasons contribute to the situation where a substantial percentage of students struggle to pass the first of two modules; the extensive theoretical concepts covered, the necessity to understand their implementation, and the ability to apply the theory in real-life scenarios simulated in a learning context. To address this issue, the class was split, to afford repeating students inverted learning with a gaming focus. The selection of games was aiming to suit the type of learning that was expected to take place. In support, students competed in their project groups. Students new to the module were taught as per the status quo. The mixed method enquiry of this changed setting focused on the group of repeating students. Quantitative data extracted focused on the success of students as repeaters, and their evaluation of the module compared to newcomer students. Qualitative data was gathered using interviews with purposively selected participants who passed the first semester as a repeating student and improved much based on the difference in participation marks, before and after the intervention. Qualitative data analysis focused on identifying codes to allow the categorization of responses into categories to elucidate the value of this endeavour. The participants on which reporting of this paper focuses, formed part of a larger study with a wider perspective. In this paper the focus is on the impressions of the individual regarding this experience. The intervention reported on occurred over a four-year period and was concluded six years ago. This allowed participants to complete their studies and start a career. Results show that the intervention did have a substantial impact on the progress of these students' studies and helped them to overcome study and work-related obstacles. The approach to this game-based may guide future lecturers experiencing similar challenges.

Keywords: Game-based learning, Systems Analysis and Design, Inverted Class

1. Introduction

In a context where many students come from disadvantaged communities, students who fail a module is oftentimes neglected, because the focus is on successful students. In addition, to motivate students who failed a subject seems like a difficult endeavour. In this paper the focus is on students enrolled for Systems Analysis, the first semester of a subject offered over a year, where a substantial number of theoretical concepts are covered, and students are expected to apply the theory in a practical group setting. A substantial percentage of students fail the module, which causes several challenges, such as a ballooning class, repeated fails, and repeating students influencing students new to the class.

When the opportunity arose to split the class due to limitations in practical venues, it was decided to do so logically, allowing a special focus on both new students and those repeating the module. The lecturer continued to prepare the new students in the conventional way, with the option available for the repeating students to also attend the theory class. Practical classes were split, and new students continued with the conventional class work and assignment sessions, while a class with a gaming focus was designed. The class was inverted to allow students to build new knowledge on exiting knowledge acquired before entering the class (Talbert, 2012). A second practical session for repeaters were spent in groups taking turns to present their projects. Project groups could only be formed within each class group, which only allowed repeating students to form a project group with other repeating students, and the same in the newcomer group. The lecturer focused on relieving the pressure associated with theoretical work, to focus on practical activities, and doing it in a fun way. Material applicable to each group were made available to all students. Games were selected to accommodate the underlying focus of the material included in a particular study unit, and therefore the learning to take place, namely (1) focused on facts, (2) facts and the application thereof, and (3) implementations where the interpretation of scenarios were the focus.

This case is the focus of this paper, while the success of the intervention is interrogated form the perspective of repeating students. Mixed methods are utilised, including quantitative and qualitative data to learn about the challenges students face, and how the intervention helped them to overcome them.

Subsequent sections discuss the theoretical foundation of the study (Section 2), namely game-based learning, Systems Analysis and Design, and the inverted class. Next, the problem is explained (Section 3), and in Section

4 the design of the research is discussed in terms of the case followed and its mixed method nature. Findings are relayed in Section 0, and the paper is concluded in Section 6.

2. Theoretical Foundation

The theoretical underpinning includes the subject matter covered in the first semester, namely Systems Analysis (SA&D-I), the first module of the subject Systems Analysis and Design (SA&D), game-based learning (GBL), and the essence of inverted classes as underlying assumption to the approach followed in the class of repeaters.

2.1 Systems Analysis

The book, Systems Analysis and Design for the Global Enterprise, compiled by Bentley and Whitten (2007) was prescribed as text book. In SA&D-I, the focus of the first semester on systems analysis, includes background information, project management, and the activities addressed by the phases of systems analysis, including requirements gathering, use-case modelling, data modelling and the analysis of the data, process modelling, and feasibility analysis. To place this semester in context; the second semester focuses on systems design, namely application modelling, database design, output design, input design, and user interface design. Although one could argue that system construction and implementation, and systems operations and support, are strictly not SA&D phases, they are addressed to allow students to experience the effects of analysis and design on the resulting system.

2.2 Game-based Learning

In earlier studies on SA&D and the closely related field of Software Engineering, to improve teaching and learning of material, a card game (Baker et al., 2005), game design (Claypool and Claypool, 2005, Cagiltay, 2007), and a real-life project (Gnatz et al., 2003) was used. These studies focused techniques to improve student involvement not only to improve learning of knowledge, but also skills and attitudes of students. Saleem et al. (2022) posit that gamification, although it may not resonate with all students, does motivate students, promote student interaction, and has a social impact. Work done by Nyahuye and Steyn (2022) found that gamification fosters teamwork, which links with the promotion of interaction. In addition to these benefits, Venter and Swart (2019) indicate that gamification can be used to strengthen the sense of community among students and supply immediate feedback on learning taking place. Game-based learning has links with gamification since it may include the allocation of points and stars for the completion of activities, but it would also involve redesigning activities to introduce rules of play to stimulate conflict – to make learning more interesting and engaging (Plass et al., 2015).

2.3 The Inverted Class

Akçayır and Akçayır (2018) claim that teacher-centred teaching is treating students as empty vessels that passively absorb information, while an inverted approach focuses on students. Therefore, student-centred learning theories, such as active learning, peer-assisted learning, and collaborative learning matches inverted settings well. Pashler et al. (2008) claim that optimal teaching methods would vary from one discipline to another. Willingham et al. (2015) came to a similar conclusion – that there are discipline-specific ways in which to teach its concepts. On a micro level this assumption was applied to different study units of the same subject, by using different games to promote learning of differentiated material.

3. The Problem

The SA&D-I class grew substantially, partly because of a yearly group of repeating students – because of the challenging nature of the module, but also because the campus numbers ballooned. In addition, the largest practical venue at the time, was a venue with ninety-nine seats, and at the start of 2015 the class grew to 114 students. The obvious solution was to split the class, in two equal parts, but the lecturer did not find the idea appealing. Conversations with management opened an opportunity to split the class in a logical way, instead of forming two equal sized classes; a class for students new to the module, the newcomers (class N), and another class for those repeating the module, the repeaters (class R). This option was considered since the lecturer perceived the repeating students to have negative influence on students new to the module – "*this is a very difficult module; expect to struggle!*", and in the groups that formed, the inclusion of repeating students did not allow new students to be confronted with the wow factor of analysing, designing and coding a system.

From an opposing perspective, the repeating students had a fair knowledge and understanding of the material but lacked the impetus to pass the module.

It is now ten years after this intervention was started and six years after it was discontinued, a substantial period, which allowed these groups of repeating students to complete their studies, find a suitable job, and establish themselves as computing specialists. As point of departure quantitative data is presented from the course results to facilitate understanding regarding how the progress of repeating student compared to students passing the module on their first enrolment. The questions arising, namely "How successful was this intervention from the students' perspective?" and "Did this intervention have a long-term impact on these students' lives?", was asked in interviews to obtain qualitative data. The content analysis technique was used to make sense of the data; immersion in the data allowed the researcher to identify codes, and form categories, which was grouped into themes (Kleinheksel et al., 2020).

4. Research Design

A larger study found that game playing motivated students, but here the focus is on drilling down in terms of whether game playing had an impact on the individuals' future studies and career. This study is treated as a case study as it explores a single phenomenon by obtaining knowledge by using multiple methods (Collis and Hussey, 2013). Being an explanatory case study, it explains how the intervention was experienced by participants, and why it is viewed as successful in the real-life situation (Myers, 2019). The mixed method approach was followed in this study to present a rich depiction of the environment by gathering quantitative and qualitative data sequentially, with the purpose to integrate it (Tashakkori and Teddlie, 2003). This results in triangulation of data, with two points known – to determine the position of a third unknown point. In this study triangulation is obtained through the following data sources: comparing the pass rate and average of repeating students to when they were newcomers and how repeaters evaluated the lecturer compared to the newcomers (quantitative focus), and interviews with five purposively selected young working adults who was part of one of the repeating classes (qualitative focus). Therefore multi-facets of research is leveraged to enhance the design to improve capacity to interpret findings (Denzin, 2017).

4.1 The Context of Students Repeating Systems Analysis

The period this study reflects on, includes the years 2015 to 2018. The focus of this paper is on an aspect of a bigger study where action research cycles were implemented to identify problems associated with the teaching of SA&D – to allow the emancipation of the participating students. The lecturer wanted to support individual students, by making multiple focused resources available. Support was planned to manifest in encouraging active student participation, and eventually stimulating growth of everyone to his/her full potential. This intent was amplified by splitting the class.

The newly created situation opened an opportunity for redesign, while retaining the underlying material, which was already considered pre-knowledge of the students repeating SA&D-I, anticipated to support the scaffolding of new knowledge. In support the group of repeaters were small, which facilitated this intensified approach. It also supported the underlying critical perspective that, per definition, these students have been negatively affected and is therefore in need of additional attention. Repeating students did not pass the module due to any of several reasons including financial difficulties, personal problems, low motivation, or other obstacles. At the time the focus was not on the pass rate of the group per se, but rather on a broader perspective, as promoted by Bunce and Bennett (2019), as well as Nixon et al. (2018), where the class design intended the creation of a positive and rich learning environment.

The prominent formative assessment opportunities such as the semester tests and group project were required by all students, while the smaller weekly assessments were focused on each class, and new instruments had to be designed in accordance with the repeating students' needs. The instruments that were contributing to the participation mark of the group of repeating students, is shown in Table 1.

Table 1: Instruments contributing to the participation mark.

Semester 1 Group: repeating students	Number	Weight
Quiz	4	
Happy hour	2	10
Expert witness	4	
Big assignment	1	10
Semester tests	2	50
Group project:		
1. Weekly presentation	1-3	
2. Consultation	1	30
3. Final presentation & demonstration	1	

The three points of differentiation, namely the games (10%), one assignment (10%) which asked these students to reflect on their own learning, and the weekly presentations (5%, not identified) was not substantially contributing to participation marks, yet the impact on students were large, as is evident from the results.

4.2 Games Included to Suit the Learning Material

Systems Analysis study units were grouped into three distinct categories which were matched to three different games. It should be accented that these repeaters were students of technology, and the use of electronic gaming would have been an option, but a decision was made that games should be far removed from technology. The intention with this approach was to strengthen the bonds between members of each project group, which were also game groups, to get students involved actively, to require their attendance in class, and to pull them into learning about subject matter without realising it. The three games associated with the grouped chapters are *quizzes*, *the happy hour*, and *expert witnesses in a court of law*. The implementation of each is discussed and illustrated below.

Figure 1Figure 1 shows how *quizzes* were conducted to cover theoretical concepts with little potential for practical application; the value of SA&D, the components of Information Systems (IS), developing ISs, and Systems Analysis (Bentley and Whitten, 2007).

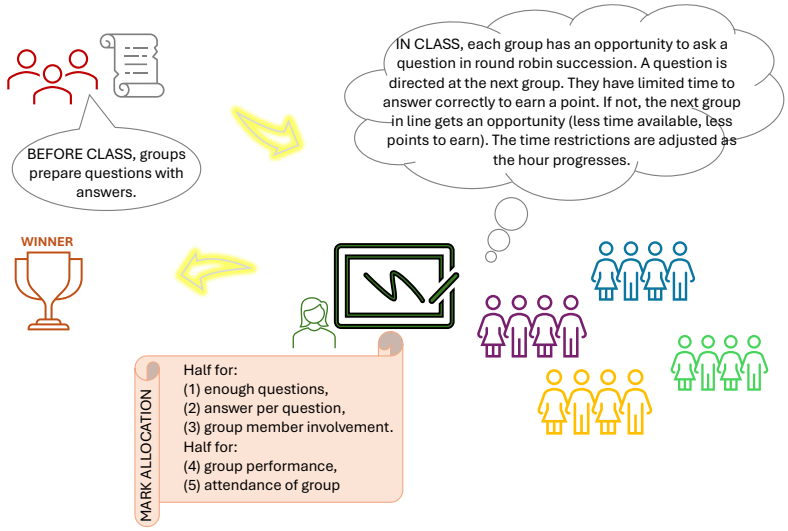

Figure 1: Format and assessment of quizzes.

With the help of the lecturer, the students managed each quiz, and they decided on mark allocations. In many cases it meant arguments regarding the facts as answers. The goal of each game was to announce the winning group. To allow this to be done at the end of a class, the lecturer allocated marks to preparatory work before

the start of the class and did the allocation of quiz marks as the questions were answered. The announcement of the winner was accompanied by a show of we-are-the-best, lots of applause, each winning member receiving a lollipop from the lecturer, and photographing the group members in attendance – in front of the evidence of their win. An example is shown in Figure 2. Photographs were shared on the WhatsApp group formed to serve the purposes of class R.

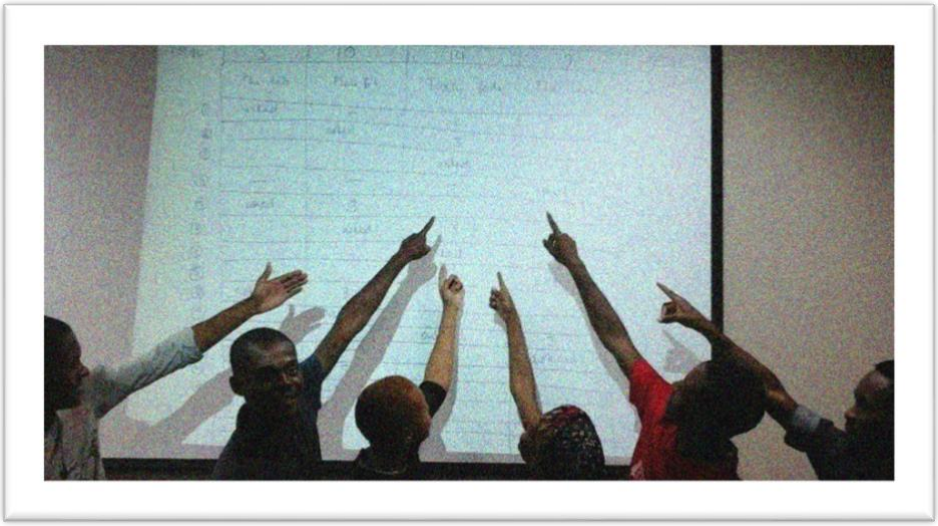

Figure 2: Quiz winners, Team Toxic Code (study unit 2 of 2016).

Subject matter that emphasizes theory and its implementation equally, includes the project management cycle and the implementation of its tasks, and the techniques pertaining to data gathering for the discovery of requirements (Bentley and Whitten, 2007). Each *happy hour* was directed by a set of Microsoft PowerPoint slides, with the slide shown in Figure 3, a reminder of the rules of the game. In preparation, the compilation of (1) a succession of questions slightly more involved than a typical quiz-question, and (2) its accompanying answers prepared by a student assistant and checked by the lecturer.

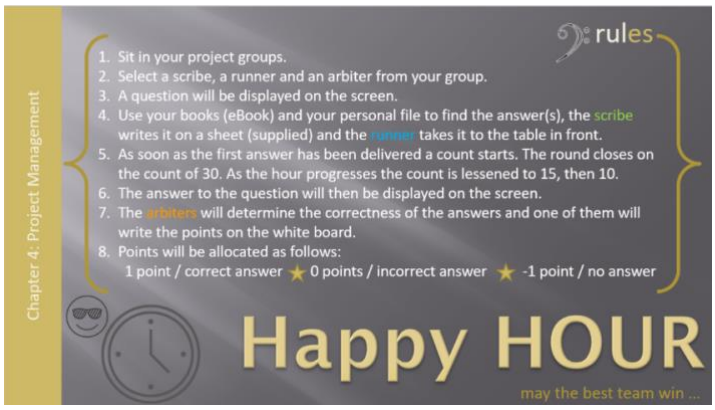

Figure 3: Happy hour game rules, as shared with students (study unit 4 of 2017).

This game created many fun moments because it required members acting as runners to physically move from where their group were sitting in the class to a table in front of the class where arbiters from each group sat. In this game the arbiters collectively decided on the mark allocation earned by each group for each question. The end goal was the same as for the quizzes, finding the winning group for each happy hour.

Regarding the physical setting; facilities were not ideal for the happy hour game, because the venue was a practical class with fixed desks that made movement difficult. Figure 4 shows a suggested setup that will work well for this game; each group should have a sitting area removed from other groups, which allow them to use their prepared material, talk, and to write out their answer. All groups should be removed from the arbiter table the same distance, and there should be no obstacles along the way.

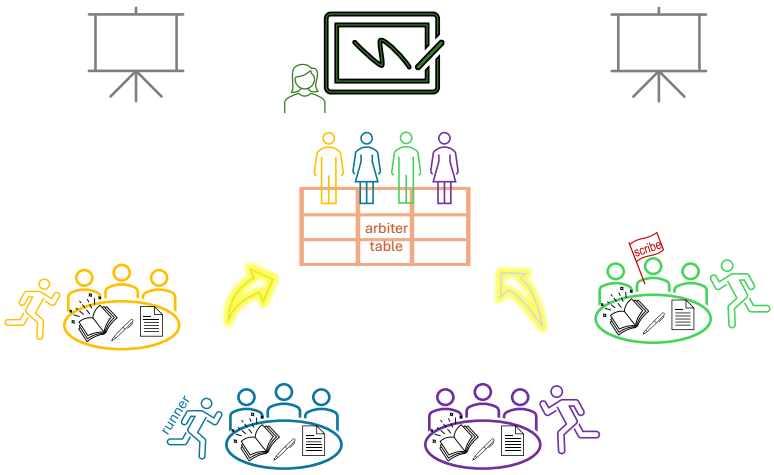

Figure 4: Suggested venue layout for happy hour game.

Practical implementations with little theoretical knowledge associated with it include: the development of use-cases, data modelling and data analysis (split in two sessions, because of the work load associated with it, process modelling, and feasibility analysis (Bentley and Whitten, 2007). Each *expert witness court session* was also directed by a set of Microsoft PowerPoint slides, with the slide shown in
Figure 5, reminding students of the rules of the game. In preparation for these games, (1) a scenario, typically from a previous year's test or examination was presented in the context of the material under discussion, with one or two practical analysis questions listed, and (2) its accompanying model answers were prepared by the student assistant and checked by the lecturer.

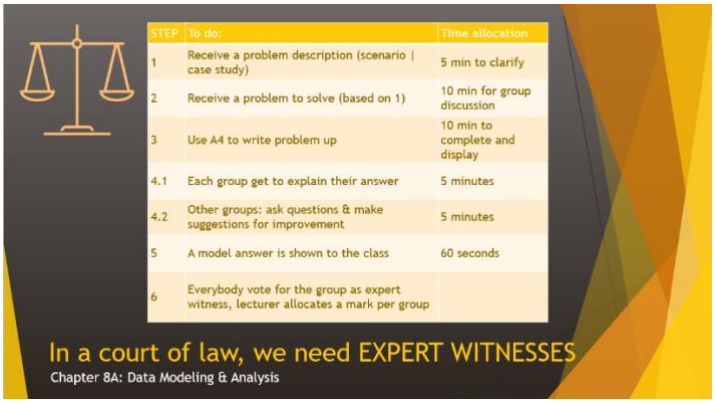

Figure 5: Expert witness game rules, as shared with students (study unit 8A of 2016).

According to the rules stated above, the slides were shown to the class in a pre-determined succession, with time allowed after each display for students to work on their answers. As soon as the allocated time has passed, prepared answers were displayed on the wall at the back of the class, and each group had an opportunity to present their answer, explain it, and the assumptions they made to get to their answer. Other groups could ask questions. Voting was used to determine the winning group. The class situation mimicked a court of law, where an expert may be called to state an expert opinion, be questioned, with a verdict as result. After the class, the lecturer allocated marks to each group's answer. In many cases the highest marks were not allocated to the winning group, since the lecturer did not interfere with the voting, as it was driven by the success of the presentation of each answer, while the marks were determined by how well the question was answered.

4.3 Quantitative Data Collection

The story the data tells from quantitative data on the performance of the students in the year preceding their inclusion in class R – as part of class N – compared to the year in which they participated in class R, the number of students who passed, and how repeaters evaluated the module compared to the newcomers.

4.3.1 Compare the Average of Repeating Students to When They Were Newcomers

Since students are allowed to move from one campus to another, and some students took breaks between academic years, not all students were in a preceding year's class. In a small number of cases, students moved from one class R to a next, in which case they were not distinguished from class N students when it came to the previous year's data. Therefore, the average of the students who were part of the previous year's class N were calculated using the sum of their marks, divided by the number of students. Note that only the students who earned a participation mark and qualified to write examination were included in the calculation, since only the final mark was used in the comparison. This comparison is relayed in Figure 6 which shows that the performance of these groups of students improved close to 10%, represented by the following respective percentages; 9.3% (2015), 7.7% (2016), 11.6% (2017), and 11.3% (2018).

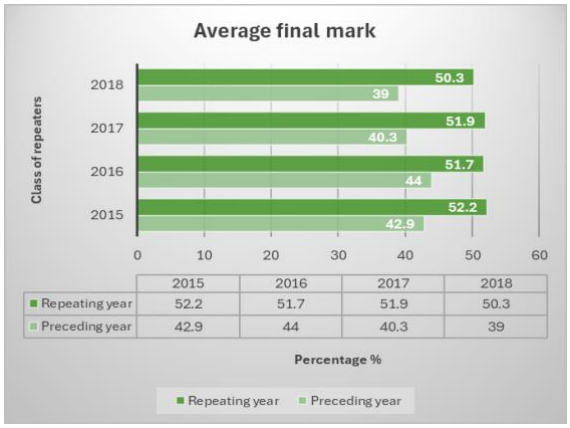

Figure 6: Comparing the average final mark of the repeating class with the previous year 2015-2018.

The next section allows us to drill deeper, in terms of the students' success in class R.

4.3.2 The Success of Repeating Students in Class R

Since a student's inclusion in class R meant that the candidate failed SA&D-I in the preceding year, the focus moves to how well the pass rate was in each year's class R. The figures relayed in Figure 7 shows the growth of class R, reflecting the increased student intake at the university, 26 in 2015, 31 in 2016, 32 in 2017, and 41 in 2018. It is clear from the graph that a substantial percentage of each class passed the module. This is supported by the percentiles of; 76.9% in 2015, 74.2% in 2016, 68.8% in 2017, and 65.9% in 2018. These figures are higher than that of the larger class (classes N and R combined) of; 66.7% in 2015, 62.3% in 2016, 65.8% in 2017, and 55.8% in 2018.

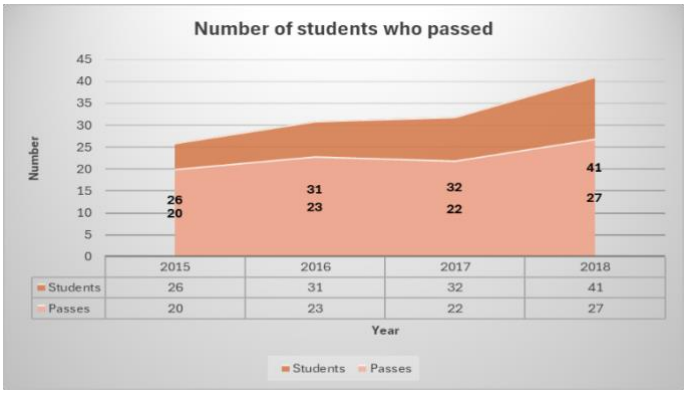

Figure 7: Performance of class R in terms of pass rate.

In addition to the data showing that students performed better in class R, their evaluation of the module is higher as seen in the next section.

4.3.3 How Class R Evaluated the Module Compared to Class N

The two years in which students could evaluate the SA&D-I module, class R shows a higher rate of satisfaction. Figure 8 shows a rate of 89.5% for class R compared to 78.3% for class N in 2015, and 84.8% and 75% respectively for 2016.

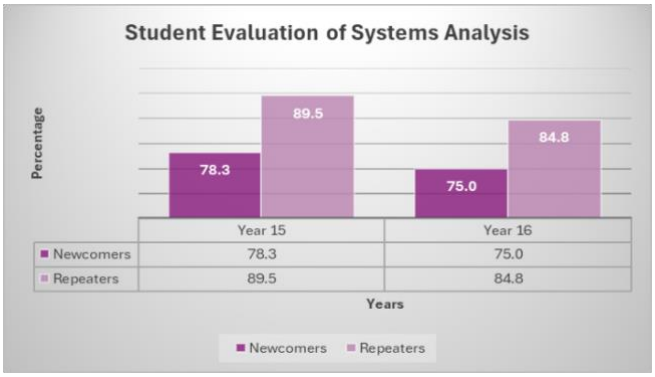

Figure 8: Students' evaluation of their SA&D-I class experience.

From the quantitative data it may be deducted that the setting created in class R was well suited to support the repeating students, with improved performance, a better pass rate compared to class N, and their indication that they were more satisfied with their class compared to class N.

4.4 Qualitative Data Collection

Interviews were scheduled for online sessions on the Zoom platform. Three groups of questions allowed participants to reminisce on their gaming experience and the influence it had on success in the module and beyond. With the computing technology environment known for being constantly changing at a rapid pace, it is expected that people working in this industry are placing a high priority on the constantly renewing of their knowledge. Along with this, one associates gaming with technology, and many students relating to this application field, either to become a game developer, or being an avid gamer. The list of open-ended questions used as instrument are shown in Table 2.

Table 2: Open-ended questions asked in interviews.

Category	Question
A. The games we played	
	In your view, was the games we played suitable?
	As a student in technology, are you critical of the fact that we did not use gaming computing technology?
B. Your experience regarding playing games in SA&D	
	Why did you struggle in SA&D?
	Did gaming facilitate your learning?
	Was gaming instrumental in your success as a repeater?
C. Effects of gaming beyond SA&D-I as module	
	Was the success you experienced as a repeater facilitating success in your studies as a senior?
	Are you using SA&D in your job?
	Were the success as repeater facilitating success in your career?

With interviews conducted online, the Zoom platform allowed its recoding and the compilation of transcriptions afterwards – with the intention to formalize the recordings – in support of the researcher familiarizing herself with the data. Codes were formed as a first step, then categories were formed, and lastly these were grouped into themes.

4.4.1 Participants

Eight young working adults were invited, with two being selected from each repeating class offered over the four-year period the arrangement was active; namely 2015, 2016, 2017, and 2018. The invite reached five, who responded and were interviewed. Interviews were built around the needs of the participants, with some as short as 30 minutes, and others as long as 90 minutes. The selection of participants approached to participate in an interview was done purposively based on their participation mark improvement from being a newcomer, to being accommodated in one of the repeating groups.

To create context, biographical information was gathered, and Table 3 shows the participants' biographic information. Participants were listed according to the order of their interviews, and were named P_1 to P_n, to protect their identities.

Table 3: SA&D repeating students as participants.

Participant	Gender	Active year	Level of education	Current age	Current job focus	Years working
P_1	F	2015	BSc in Information Technology	32	Robotics Process Automation (RPA)	7th year
P_2	M	2017	BSc Hons in Computer Science & Information Technology	29	Automation Engineering	5th year
P_3	F	2015	BSc in Information Technology	32	Business Analysis	8th year
P_4	M	2016	BSc in Information Technology	29	Software Engineering (with Software as a Service focus)	7th year
P_5	F	2017	BSc in Information Technology	29	Business Intelligence Development	5th year

When evaluating this group of participants beyond the formal reporting; only one has a qualification beyond degree level, with the remaining four indicating that they are thinking of continuing their studies soon. All participants started out at a company other than the one they are currently working at. All the participants are working at a prominent and established consulting company, software house, or company with an in-house computing department. They all indicate that they are in positions where they are challenged. All of them recognise the need for amending their knowledge continuously, and they are being aware of their need to stay abreast of changes to be relevant in their environment. Learning includes formal training. Interestingly, except for a limited time per week spent at the office for some of them, they are all working remotely. Appreciation for the flexibility their situation offers is evident, but all of them acknowledge that their job environments are stressful and require them to work long hours. Therefore, they recognise the need to actively manage their work-life balance. Participant P_3 excels at being a business analyst with a solid technical underpinning, but she expresses the wish to work in a software development environment soon. Participant P_4 uses his free time to develop Software as a Service applications to prepare himself for a future business which would provide opportunities for application development as well as a passive income.

4.4.2 Data Analysis

The aim of the data acquisition was to triangulate the quantitative data, as is evident from the open-ended questions asked. The codes and categories were guided by the open-ended questions (Table 4). All participants indicated that the semester spent as repeater in the SA&D-I class had them fully emersed in the hands-on approach of the games we played <GAME_GOOD – GAME_SUIT, GAME_FRMT>.

Table 4: Code table from category X questions – X.

Category	Code	Description	Occurrences
GAME_GOOD	GAME_SUIT	Games were suitable	5
	GAME_FRMT	The game format not important	5
JOB_USE_SAD	SAD_JOB	Use SA&D in my job	4

Category	Code	Description	Occurrences
	XSAD_JOB	Do not use SA&D in my job	1
STRUGGLE	WORK_STD	Paid my own way, alternated years of study and work	5
	MRE_WORK	Increased workload caught me by surprise	
	FIN_LATE	Financial constraints caused late start to semester	
	TECH_FCS	Could not find technology focus	
	FACT_MCH	Facts to learn were overwhelming	
OVERCOME	LOST_FEAR	Lost my fear of failure	5
	ACT_LRN	Active learning helped me	
	PRP_NTS	Prepared well and taking notes	
	LOST_SHY	Managed shyness	
	CRIT_WORK	Be critical of my work	
SUC_BEYOND_SAD	SUC_REP	Enhanced learning, success as a repeater	5
	SUC_SEN	Success as senior student	5
	SUC_CAR	Success in my career	5

Only P5 is not using the concepts addressed in SA&D directly in her job, but all participants relate the learning that took place in this class and in particular the games we played – about subject matter, skills and attitude – with their success in the class under discussion, the subsequent year, and their progress in their career <JOB_USE_SAD – SAD_JOB, XSAD_JOB>.

Beyond support of literature (Huizenga et al., 2017, Liu et al., 2020, Loderer et al., 2020), participants indicate being involved in the material, preparing for class, changing the way they prepared for assessments and events in their job environment, changing the way they learn effectively, building bonds among group members in such a way that these peers are now part of their career network, building confidence in presenting their case, speaking their mind, and making presentations, and being mindful of keeping up with technology changes – as lifelong learners <codes associated with OVERCOME>. They claim that they are confident young workers who is comfortable among the users they serve, they are not fearful of having a difference of opinion with users and are intent on working towards a mutual understanding resulting in a product serving the user excellently <OVERCOME>. Making mistakes are not the end of the world, but an opportunity to learn, and doing the job better because of learning <OVERCOME>.

Success beyond class R is evident, and participants indicated that the class stands out among other classes in their memory, and they linked successes in their senior year(s), and job environments to what they learned here <SUC_BEYOND_SAD – SUC_REP, SUC_SEN, SUC_CAR>.

5. Findings

Two related themes could be extrapolated from two categories, namely the major challenge experienced by each participant, and how the games we played helped each participant to overcome these obstacles. Figure 9 shows the failure identified by each participant, and it being turned into success.

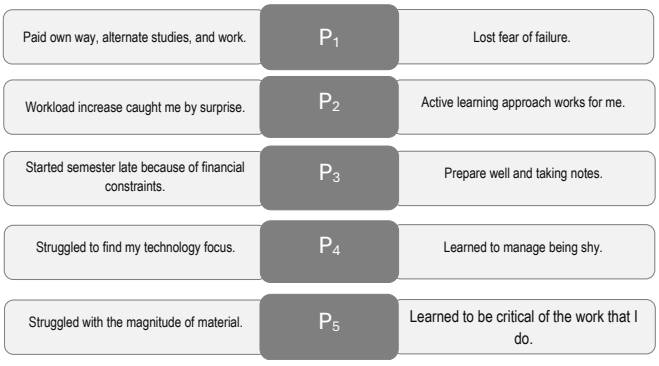

Figure 9: Participants' failures turned into successes.

The reason each participant listed for failing SA&D-I as first attempts differs for each participant: P_1 indicated that she paid her own way in her studies and alternated years of study and work <WORK_STD>, which distracted her focus, P_2 had a background in computing and comfortably passed his first year, but the increased workload of the second year of study caught him by surprise <MRE_WORK>, and by the time he realised his mistake it was too late to remedy the situation, financial constraints caused P_3 to start her semester late <FIN_LATE>, with too little time to build a participation mark, P_4 were struggling to find his technology focus <TECH_FCS>, which distracted him from his studies, and P_5 found the facts to learn in SA&D to be overwhelming <FACT_MCH>. Each participant could list one prominent positive feature that they took from playing games: P_1 lost her fear of failure <LOST_FEAR>, and learned that one should turn failures into opportunities to improve oneself – also in the workplace, P_2 found that active learning helped him more than reading through the material <ACT_LRN> and he changed his approach to learning to this day, P_3 learned that taking notes is her superpower <PRP_NTS> and she still uses notebooks in stand-up meetings and to plan her day, P_4 managed his shyness and learned to project himself <LOST_SHY> in his job environment and in presenting material to users, and P_5 acquired the skill of being critical of her work <CRIT_WORK> in order to determine problems before they occur. These experiences are aligned with the findings of Mao et al. (2022) who found that "*GBL had a large, significant positive effect on students' critical thinking*". It explains the ability of participants in the study to identify core challenges in their learning journey, and then address these with innovative solutions that ensured success in the years of study beyond the gaming intervention, as well as their work life.

6. In Conclusion

This study reflected on a scenario where the lecturer saw an opportunity to turn a bug into a feature – to use computing terminology. It was a situation to be opportunistic in taking an opportunity when a problem presented itself – in the form of the physical practical class not large enough to accommodate all the students of a growing class. In the subsequent class of repeating students that was formed, the inverted offering was made possible by the pre-knowledge of these students, and individuals could build on their knowledge in a non-conventional way. The paper-based games were only possible because of the small number of students in the class. Most of the students who participated in this class benefited from the more focused approach afforded by a small class.

After the four-year period of offering SA&D as two classes, circumstances changed sufficiently to allow the two classes to be merged once again. From the experience, computerised game-based learning was incorporated in this class, in the form of the Quizizz application.

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