A Dissertation

Entitled

Skill Enhancement and Sales Leadership Development: Case for Evolutionary Software Driven Serious Simulation Games

by

William McCreary

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the Doctor of Philosophy Degree in Manufacturing and Technology Management

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Dr. Jenell Wittmer, Committee co-Chair

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Dr. Paul Hong, Committee co-Chair

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Dr. Ellen Pullins, Committee Member

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Dr. Mike Toole, Committee Member

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Dr. Amanda C. Bryant-Friedrich, Dean
College of Graduate Studies

The University of Toledo

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An Abstract of

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The purpose of this research was to establish a case for the use of serious simulation games as a tool to enhance the learning of sales leadership skills. The study provides taxonomy around serious simulation games as a specific modality at the intersection of serious games and simulation games, which have a focus toward education. A literature review was used to build a research model to explain the factors that contribute to the effectiveness of an SSG deployed in a sales leadership program. In order to test the efficacy of this model, a sales leadership SSG was built for a sales leadership academic program. This SSG was built based on experience developing other programs, one specifically was a manufacturing game developed for Dana corporation. The research model was tested using a survey instrument, which was developed as the sales leadership SSG was being built. This instrument was used to collect self-reported responses from the students in the sales leadership course, which measured the factors around the efficacy of the SSG in this program. 166 students responded to the survey over five (5) semesters, and were analyzed using factor analysis and regression. The results demonstrated the efficacy of the theory, and supported 6 out of 7 of the hypotheses.

I dedicate my dissertation work to my loving wife, Diana, who has stood with me and supported all of my efforts for over 50 years, and my four wonderful children.

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The Greek alphabet

Letter name	Uppercase	Lowercase	Letter name	Uppercase	Lowercase
Alpha	A	α	Nu	N	ν
Beta	B	β	Xi	Ξ	ξ
Gamma	Γ	γ	Omicron	O	o
Delta	Δ	δ	Pi	Π	π
Epsilon	E	ε	Rho	P	ρ
Zeta	Z	ζ	Sigma	Σ	σ
Eta	H	η	Tau	T	τ

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List of Abbreviations

SSG ....Serious Simulation Game

3D/VIR........................Three dimension virtual immersive reality

KPI ....Key Performance Indicator

OEE............................Operational Effectiveness & Efficiency

RCT............................Randomized Controlled Trial

TAM...........................Technology Acceptance Model

GBL............................Game Based Learning

COBI ....College of Business and Innovation

SSPS...........................Schmidt School of Professional Sales

UF ....User Friendliness

AU..............................Academic Usefulness

GPA............................Grade Point Average

SQL ....Structured Query Language

API ....Application Programming Interface

VM ....Virtual Machine

SME ....Subject Matter Expert

KMO ....Kaiser-Meyer-Olkin

VIF ....Variance Inflation Factor

DV..............................Dependent Variable

IV ....Independent Variable

SIG ....Significance Level

List of Symbols

SS ....Sum of the Squares

df ....Degrees of Freedom

F ....F Statistic from the F distribution

p..........P value

α ....Alpha Error

β ....Beta Regression Coefficient

t ....T Statistic

MS......Mean Square

R2.......R Squared (Variance)

R.........R (Correlation)

Z ....Z Transform of a variable (standardization)

INT.....Interactive Variable (prefix)

H(i).....Hypothesis (number described as ith hypothesis)

y..........Dependent Variable also called DV

x..........Independent Variable also called IV

Preface

The topic of simulation games applied to education has been a passion of mine for decades, as I have witnessed the unique way this modality can lead to engaged students of almost any subject. When enhanced with artificial intelligence and evolutionary software these games can provide an even more engaging pedagogical toolset. This is the reason that I chose simulation games as my dissertation topic. This topic is also aligned with my background and career. In my current role as the Vice President CIO/CTO of the University of Toledo, I am involved and responsible for many related functions. One of my responsibilities is overseeing the development of our 3D virtual immersive reality and simulation development, which serves our academic programs. I have done many presentations including keynotes at major industry events on subjects like artificial intelligence, cybersecurity, simulation games and 3D/VR applications. As part of my involvement in this space, I also serve as the co-chair of the Educause Extended Reality committee ("XR"), which has over 450 schools in its membership. This committee covers the full range of technologies around 3D/VR/AR and simulation games. In addition, I serve on senior level advisory boards with Ellucian, Cisco, Gartner and Microsoft. At Microsoft, I have had the opportunity to have extensive interaction with many of the engineers in the XBox division, and gained an appreciation of their view of how games develop certain skills and learning. Finally, I attend and frequently speak at major conferences where simulation games (including 3D/VR) are key elements of the programs. As such, I can be seen as an expert in the area of applying simulation games for learning and training.

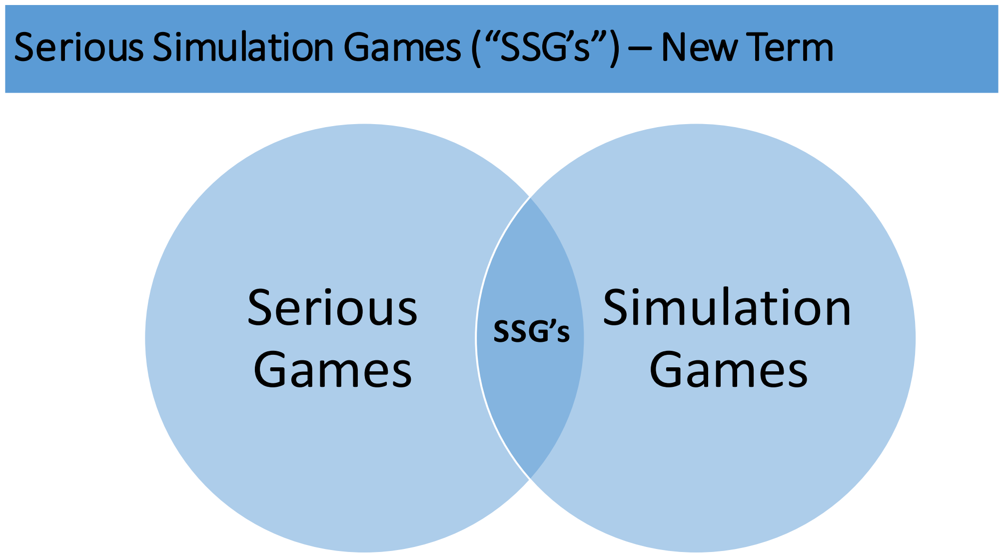
Chapter One

INTRODUCTION

1.1 Background of the Study

It is a commonplace that serious games ("SG's") are a modality used in a variety of situations in both education and industrial applications. SG's have been used synonymously with educational games ("EG's"), in that both have a purpose to education and train. The key component of these games is the intent to educate or train students and/or professionals (Becker, 2012). This contrasts with games whose primary intent is entertainment, which may come in all forms of visual experience. Structurally, these games may be simply an interactive experience that has scaffolding, which allows play to become increasingly more difficult as the player progresses. Alternatively, these games might have a simulation based model that operates recursively and might even have evolutionary aspects, which is typical over very high end entertainment games. These are typically called simulation games ("SIMG's which are also called "SG's" by some authors), and may or may not be for serious educational purpose (Imlig-Iten, 2018). This research will focus on the intersection of SG's and SIMG's, so educationally based game with simulation and recursive models. We will define this game typology as serious simulation games ("SSG's), which represents a new taxonomy for game categories. This is most interesting as previously, an educational or serious game could be built without any complexity, simulation, recursive code or evolutionary aspect. Adding that capability to an educational game can take it beyond a simple interactive experience for the learner. Figure 1 shows the relationship between serious and simulation games, which defines the space of serious simulation games ("SSG's").

Figure 1



Going forward in this research, the term serious simulation games ("SSG's) will be used to describe this modality, even though researchers were not using the term in the literature. Historically, business education has used SSG's as a normal part of the pedagogy, with most accredited programs using one or more of these simulations (Wellington, 2016). The use of the SSG's in business can be attributed to a number of benefits. SSG's require business decisions to be made in the simulation, which leads to outcomes. This leads to the next round of decisions that are recursive and based from the outcomes of the prior decisions. This iterative approach emulates the real world of executive decisions, which represents a different experience for students than traditional modalities and pedagogies. This provides for an environment that resembles executive decision making, which simply cannot be created with traditional face to face classroom program modalities.

Some research suggests that SSG's provide a type of experiential learning, which is enhanced by immersion inside the simulated environment (Hainey, 2011). The growth of advanced technologies has also enabled SSG's to become ever more realistic and immersive. The use meta-heuristics such as genetic algorithms can enable increased complexity and realism in an SSG, which can provide real world decisions and outcomes. The use of advanced visualization tools, such as 3D virtual reality, can provide very immersive experiences that again become near real world. For many students in the current generation, the use of video games as a form of entertainment is a commonplace. Extending these SSG's that may emulate the video game behavior could be a natural evolution to the learning environment. It has been suggested by researchers in the field that experiential complexity that can be achieved in an SSG, could in certain contexts, increase learning of difficult topics (Faber, 2015). Figure 2 shows two examples of simple SSG's involving the task of flying a helicopter from a jungle setting and a acting as a first responder in a disaster scene. Both use recursive models.

Figure 2

1.2 Dana Simulation Game Case Study

In 2013, this researcher completed the design and development of an SSG titled Adventure Capital, which had a storyline about starting and operating a venture capital fund. The model was quite sophisticated, and the SSG was shown to many people. Among those who witnessed this SSG were a group of executives from Dana Corporation, who became very interested in this idea for their plant financial training program. This ultimately led to a project for Dana Corporation to build an SSG for their plant financial system training program. The purpose of this training was to train their plant leadership teams on specific areas of finance that relate to the operation of a typical Dana manufacturing plant. The incite that Dana gained was the direct result of seeing the Adventure Capital SSG.

In 2014, the University of Toledo completed the design and development of this SSG for Dana Corporation, who is a Fortune 500 automotive supplier. The learnings from this project provided further insight into both the technical architecture of an SSG, as well as the potential benefits of their use. Dana's objectives of this SSG were to improve the skills and knowledge of their plant leadership teams in several areas. Their first goal was to increase the knowledge and awareness of financial terms and accounting elements in the Dana plant operating system (known as "DOS"). Their original premise was that if their plant teams improved their understanding of the accounting elements, then they would improve their decisions. During the project, the Dana leadership team concluded that this was not an accurate assumption, as they realized understanding the implications of the manufacturing operation and supply chain impacts on financial results were what they really wanted. Dana leadership felt that increased awareness how each financial element relates to decisions that plant teams make on a daily basis. This turned out to be the critical aspect, which lead the Dana team to explore the use of an SSG to train their plant teams in broader areas. The remaining goals were the direct result of the realization that an SSG was the appropriate modality to deliver this training to the plant teams.

As part of this expanded view of using an SSG, the Dana team considered many new areas to train and develop their plant teams. They felt that an SSG could increase skills in analyzing root causes of financial shortfalls, including how to identify solutions to these problems. Not only were financial skills a target, they felt this would lead to an increased ability for plant teams to explain and present financial changes that are impacted by plant events. A more financially aware plant team could also have increased capabilities to shorten decision latency and improve quality around operational issues, which could lead to improved financial results. Finally, a strong supply chain SSG that related financial results could provide an increased ability to "on-ramp" new employees to any given plant by providing a "pre-arrival" training regimen. Essentially, it would allow new members of a plant leadership team to practice before entering the operations at their new post.

The common theme of Dana's objectives was the desire to link an understanding of plant decisions to financial results for plant leadership teams. This helped define the scope of the SSG. Key scope elements of the Dana SSG included:

- The target audience of this SSG was the plant manager and also their immediate plant leadership team, so this was a leadership training program.
- The target business for this SSG was the Dana Commercial Vehicle Division ("CV") plants globally, as many of the plants were outside the United States. The CV division requirements were quite different in terms of supply chain and

manufacturing setting, versus the other Dana divisions. The supply chain in this business was quite dynamic, with forecasts changing daily. Even though the SSG was setup for global operations, the presumption was that the fictional plant would be United States based, so the choice of language was English, and currency was $US.

- The method of delivery was to be asynchronous and self-paced. The idea was that the plant leaders could utilize the SSG when it was convenient, and would not require a classroom setting. This was also essential to service a global user base, who would be training at different times.
- The SSG was to simulate a monthly increment in terms of decisions. Like most SSG's, the decisions cycle the game forward, and the game logic was recursive, and the system evolutionary . This required that the game intelligence needed to emulate the details behind monthly decisions. For the decisions by plant trainees to emulate monthly decisions, the SSG had to have within its model all the detailed decisions made in the plant during the month. This meant that the decisions a team would make were at a strategic level, and the SSG model would emulate the detailed decisions of the next level in the organization. The strategic decisions in the SSG included supply chain, logistics, purchasing, manufacturing, quality, plant maintenance, training, pricing and overall management. The SSG then applied the strategic decisions and inside the game model, detailed decisions were carried out by the game intelligence (i.e. plant maintenance avatars). This allowed the SSG decisions to be at a high level that resembled monthly levels, and the avatars (next level staff) to execute on a more granular level, which

resembled daily and hourly tasks. This required the avatars to be created with a specific genetic profile, that gave them certain capabilities, strengths and weaknesses.

- The SSG was set-up to be played as a leadership team, so it would be a single set of decisions. That is the team played together, and would agree on a single set of decisions in a given round, versus individual team members functioning independently.
- The play of the SSG was set up for the team to play against the game, and not a zero sum game against the other teams. This required a scoring system, in order to differentiate team performance, which was configurable assessment tool.
- The Dana SSG was setup with a configurable assessment method, which allowed for making different objectives more or less important in the results. The SSG used a weighted factor scoring system, in order to evaluate the performance of teams. By allowing different weightings of the scoring factors, allowed Dana to emphasize different strategic goals (i.e. growth vs short run profit). The elements that were part of this assessment included on a weighted basis:
    - Financial performance in terms of earnings before interest, taxation and after depreciation ("EBITDA"), which was the result of the plant performance in the SSG.
    - Customer satisfaction (from a KPI within the SSG) which was the result of the plant performance, product quality and supply chain in the SSG.
    - Quality of product (from a KPI within the SSG) which was the result of the plant performance factors in the SSG.

  - Safety (from KPI within the SSG) which was the result of the plant performance factors in the SSG.
  - Operational efficiency (from KPI within the SSG) which was the result of the plant uptime, yield and production rates in the SSG.
  - Employee satisfaction (form KPI within the SSG) which was the result of training and operating practices in the SSG.
  - The Dana SSG had a leaderboard that used the configurable assessment tool, and showed the results of the teams relative to each other. So, while the SSG was not a zero sum game, the teams had a type of competition in terms of their results when all were playing the same configuration.
  - Part of the Dana SSG leaderboard also included the attempts and hours played by individuals and teams. This was intended to reward individuals and teams for putting more time in on the simulation.
- The Dana SSG allowed for <u>configuration of all the avatar components</u>, such as plant equipment, customers, suppliers, locations, product and most importantly the avatar skill levels and attributes. This allowed Dana to configure a given simulation that would have a wide range of complexities and difficulties. After the Dana SSG administrator configured the game, the SSG used artificial intelligence to actually write a storyline about their configuration, so that the players would understand the context of the simulation they were about to play.

The Dana SSG currently remains active, and the internal informal assessment of the simulation by their employees who have been played the SSG indicated that they saw it as an effective learning tool, and found this modality an interesting way to train plant staffs. Specifically, Dana suggested that they planned to expand the use of this SSG in other divisions, as a training tool for plant leadership teams. In 2017, members of the Dana CV engineering team demonstrated this SSG to the University of Toledo COBI faculty, and showed the benefits of its use. The experience with the Dana SSG provided insight into this research, as it showed the possibility of a linkage between learning and an SSG, and the possible factors driving the connection.

Another key learning from the Dana SSG was exactly the best way to go about constructing an SSG of this genre. While Dana realized that what they really wanted to do was build a simulation that linked plant decisions to financial results, at the start they found they did not really understand these relationships. Further to the extent there was an understanding of a given relationship, this researcher found that there frequently was disagreement among members of the Dana team. Building the models behind the SSG turned out to be a significant exercise involving many members of the Dana organization, who were subject matter experts (SME's) in their respective areas. A good example of this turned out to be the relationship between plant maintenance strategies and equipment operational effectiveness (OEE). Top management in the CV division believed in the strategy of "fix it when it breaks" versus a "total preventative maintenance" strategy. The plant engineering teams believed in the latter strategy. Extensive analysis by the Dana teams provided a much more complex relationship between OEE and plant maintenance strategy that was moderated by the equipment type, condition and age. This learning was then part of the Dana SSG model. In addition, it was found that the staff capability in plants was an important factor in these results, which most plant managers believed but could not prove. Dana determined that a more preventative maintenance strategy was less effective to impact OEE when the plant engineering teams were less capable. The concept of the plant staff capability was then part of the SSG model such that their attributes were a key part of the SSG model. These concepts helped build the methodology to build other SSG's.

Finally, there were several areas of learning from the Dana project, that helped lay the ground for this research, which is why the case is part of this dissertation:

- The development of SSG models required a comprehensive and diverse set of skills drawing from many areas of Dana. Building an SSG always requires a significant involvement of subject matter experts ("SME's") to construct the models behind the simulation.
- The granularity of decisions and game time need to be designed optimally considering available play time for teams. In the Dana SSG it was decided to keep the game decisions to be at a strategic level, and the detailed decisions would be carried out by the simulation actors (avatars) who make the detailed decisions.
- The system needed to be built evolutionary and configurable to provide practical significance. Configuration allowed for the SSG actors and objects to have attributes that are adjustable. For example, in the Dana SSG, the equipment in the plant could be configured to have different levels of attributes like equipment condition. The evolutionary aspect allowed for these attributes to create an evolutionary behavior in the SSG, which can emulate the real world.
- It was also very apparent that the Dana participants found the SSG user friendly and directly relevant to their business, which came from the realistic immersion of

the game, as well as the competitive nature presented. This drove their interest in participation, and ultimately their learning outcomes from the SSG.

- Finally, it was determined that the traditional regression testing in normal software would not work, so play testing typical of video games was used.

All these learnings were key in the construction of the Sales Leadership SSG, which is the core topic of this research. The Dana SSG also provide the reference application for the faculty of the University of Toledo Schmidt School of Professional Sales to use in considering an upgrade of their current simulation game, which was used in their Sales Leadership course. Having an application of this sophistication helped define the roadmap for this faculty team. It is doubtful that the Sales Leadership SSG would have been developed, without the Dana SSG as its antecedent.

1.3 Research Topic

In spite of the long use of SSG's and the growth of technology to enable more realistic simulations, the validation of the efficacy of SSG's as a learning tool has remained elusive and inconsistent (Girard, 2013). There could be a variety of reasons for the lack of consistent support for the efficacy of SSG's.

The wide variety of academic and commercial applications could confound the ability to discern outcomes based on broad cross-sectional studies. Therefore, there might be a difference in the relative learning efficacy between say a medical simulation and one for a banking application. While a researcher can yield more data points using a broad SSG cross-sectional study, the very use may confound the objectives of the study. Even within a given SSG subject, there could be other effects occurring that influence the efficacy of the simulation. For example, within an SSG there could be unique decision-outcomes in the model that impact the efficacy of the SSG. As SSG models become more close approximations of the "real world", then one might posit that the experiential learning and effectiveness increase. Another impediment to demonstrating the efficacy of SSG's is the lack of true experimental research, which can demonstrate causation. This type of research requires randomized controlled trials ("RCT") and experiments to demonstrate the outcomes associated with interventions. This type of research requires a control group that does not play the SSG, and uses a standard protocol instructional design (i.e. standard classroom and materials). It also requires that there are different levels of interventions, and the data are longitudinal. Causation by definition requires the antecedent to be evaluated. In practice, there have been few attempts to conduct RCT studies on SSG's, due to the complexity of the required experiments in a classroom.

Considering this background, the research topic for this study was more focused. While the efficacy of SSG's was the broad research topic, the more specific focus here was business SSG's specifically focused on sales leadership. Therefore, the research topic of this study encompassed the efficacy of SSG's as a learning artifact in business, specifically sales leadership simulations.

1.4 Research Problem and Objective

The research problem in this study was the lack of knowledge around the efficacy of SSG's as a learning modality, specifically in business sales leadership applications. There has been a paucity of research around the efficacy of SSG's when considering their genre and subject category, across different types of learners (Girard, 2013). Advancing the understanding of the linkages behind sales leadership SSG's, can provide a research model that will develop the insight to design these simulations more targeted toward learning outcomes.

The objective of this research was to demonstrate the efficacy of an SSG applied in a sales leadership program, with different types of students, and delivered both in a classroom setting as well as a distance learning modality. This research objective will enable the efficacy to be studied in a very specific application by utilizing a sales leadership SSG. In addition, the SSG can be designed in such a way to enable future very granular RCT experimental studies, which could further provide the capability for longitudinal pre-post research. This knowledge will enable new SSG's to be designed in this field to optimize the learning effects from the simulation. In addition, this research will add further to understanding the impact of student types, and delivery method.

1.5 General Exploratory Research Questions

The high level exploratory research questions were targeted in line with the objectives of this study. The overall question was whether students who participate in a sales leadership SSG state that the SSG enhanced their learning outcomes of the material in the course. These exploratory questions behind this overall research include:

1) What are the key factors (i.e. drivers, processes, practices and outcomes) in this research model?
2) What are the key drivers that help students generate interest in an SSG used for an academic program?

3) What specific factors motivate students to make efforts to participate in an SSG program, and achieve learning outcomes?
4) Are there contextual differences in the SSG program that influence learning outcomes? Type of students or how training might be delivered.

The specific targeted research questions are developed later in this paper.

1.6 Academic and Practical Significance

The significance of demonstrating the efficacy of an SSG at a granular level was that it can lead to improvements on academic and practical levels. From an academic significance, this study used a configurable SSG, which could provide the basis to advance knowledge around factors that influence the efficacy of SSG's. Essentially, there are a large number of possible studies that could be developed around each unique configuration of the simulation. This SSG could provide a platform for extending research, including as stated previously RCT experimental studies.

The practical significance of this study was that it could advance knowledge toward building more realistic and effective SSG's. Learning more about what factors impact the efficacy of an SSG can provide the knowledge on how to improve these SSG's along with how they are delivered and what type of students may benefit the most as the recipients. For example, understanding how the impact of an SSG's realism impacts the efficacy could help guide the design of future SSG's. Additionally, understanding the difference between how different kinds of students learn from the game and in different delivery models could provide insight into developing optimum games deployments for a given audience.

Chapter Two

LITERATURE REVIEW

2.1 Technology Acceptance Model (TAM)

The technology acceptance model ("TAM") was originally conceived to explain the acceptance of technology by users (Davis, 1989). TAM uses two primary predictors, perceived ease of use ("PEOU") and usefulness ("PU") that indicate an attitude to explain an intent to use a new technology. The intent to use is the antecedent of actual use. While TAM is used to explain the acceptance and usage of a new technology, the model concept could explain factors that might influence the efficacy of an SSG. Research extensions of TAM consider how external variables might also influence the two predictors.

Some research has pointed to a system's features and capabilities being significant explanatory factors in determining PEOU and PU (Chuttur, 2009). Applying this concept to SSG's would suggest that factors behind the ease of use and usefulness could explain how the SSG is perceived by its users. Other researchers have found that a systems functionality and fit to task will influence the PEOU and PU (Dishaw, 1999). Applying this to SSG's, it would suggest that the closer the SSG emulates the real world application, the more likely it would lead to positive perception by its users. Finally, the experience of the users has been found to be a factor toward influencing the PEOU and PU of the system (Park, 2009).

The same concept could be applied toward an SSG user population. Research suggests that the attributes of student players, such as age, gender, experience and specific background may influence not just PEOU/PU, but also can influence motivation to use a technology (DeLeone, 2003). Based on this theory, players with more industry experience would have not only a different PEOU and PU around a given simulation, but also may have different interest and motivation to learn from the SSG. This theory also suggests that the student players who are more concentrated in a field might be more positively interested and motivated to learn from the SSG.

Another body of the TAM research has suggested that the delivery of the technology in terms of system quality, service quality and modality can influence not only PEOU, but also can drive intent to use the technology, which leads to the actual use (DeLeone, 2003; Chen, 2009).

While TAM is meant to explain conventional IT system usage, the underlying models and frameworks could be analogized to suggest usage and learning efficacy of an SSG. Unique factors associated with SSG's could put together and evaluated in a similar model. Therefore, factors associated with usefulness, ease of use, interest, motivation, user attributes, technology delivery and learning efficacy could be modeled through the lens of SSG's. Therefore, while the TAM (and its extension models) does not provide direct support for SSG models, the theories do provide a good structural reference to posit the frameworks that could be applied to the SSG environment.

2.2 Simulation Game Development

The development of the sales leadership SSG was part of this research, and a number of researchers provided insight into the development process. Development of SSG's is also a very practitioner oriented process, so the research cited includes substantial content from the world of commercial games. An example is the testing of games, which requires playtesting processes, versus the traditional regression testing of deterministic information technology systems.

Gold (2001) looked at forty-eight papers in a meta-study on algorithms. He categorized the algorithms by major simulation segments (i.e. finance, accounting, marketing, etc). The first teaching from this research was that it provided insight into the algorithms built for the SSG in the extant research on sales leadership. A second insight that this research covered was around how large complex models are synthesized from multiple pieces of quantitative and qualitative research. For example, an SSG around a finance application might be able to use large scale secondary data, and extensive quantitative research to develop high quality models for an SSG. The development of SSG's are very field and context specific.

Nadolski (2008) did a meta-analysis of development methodologies around simulation in higher education. From this he built a methodology, EMERGO, which has an instructional design focus. That is this research sought to provide prescriptive solutions for direct application in a pedagogical sense. In this way the simulation development follows the outline of the course where it fits. The EMERGO methodology covers case, scenario development, analysis, design, data design, development, testing technical, play testing, evaluation, assessment, user interface and student experience. The methodology does not deal with certain real world problems like integration into a learning management system or the technical architecture of hosting along with user management and authentication. In fact, this research was quite lacking in terms of its operationalizing of an SSG delivery. Further, the research largely deferred to industry practitioners when it came to the playtesting of an SSG.

Stainton (2010) synthesized the literature to develop a methodology framework to develop simulation games that have educational validity. Stainton essentially extended the work of Nadolski (2008). He developed a method to design, develop, implement and assess the validity of the simulation games. The framework provides factors for representation, content and implementation. While it can provide an assessment of validity, this approach still cannot guarantee external validity, which was the author's goal.

Salas (2010) focused on building a methodology for designing simulation games for management development. The author demonstrated the design considerations for an SSG that is aimed for management development. The author made reference to both computer based games, as well as human real world simulation exercises. The complexity of management development and particularly leadership present unique challenges, due to the human factors that need to be modeled. The author suggests that the key to the SSG design in this context is the emulation of the human behavior.

Becker (2012) extended the work of the previous authors to create a generalized methodology for the development of SSG's in business applications particularly. His methodology was comprehensive full cycle from design, development, testing and implementation. One unique aspect from Becker was the consideration of the technical architecture and the long term maintainability of the system. Most authors saw this as an unimportant detail.

Buchinger (2018) provided a study of the development methods of various SSG's in different educational contexts, suggesting that one size methodology does not fit. An element of considerable interest is the guidelines he provided for designing an SSG that involves team competitions where individual play still needs to be used. Prior to Buchinger, nobody had considered the problem of a teams competing, but with individuals playing unique roles inside the teams, and making their own decisions. Previously, the model was simply individuals playing themselves or a team acting as a collective making one set of decisions. This makes Buchinger's contribution significant as a team of "individuals" could be a model for many SSG's.

This research supported the design of an SSG in a business application, and offered a roadmap to the development of a valid tool. However, the research did not address the development of a highly configurable SSG, which would allow a wide variety of possible conditions. Another gap in the methodology research was the complexity of the models, particularly with the use of meta-heuristic evolutionary algorithms that will allow the recursions to lead to human like behaviors of the SSG actors (i.e. customers, suppliers, competitors, employees, etc). This is the key to building a simulation that seeks to emulate the real world, which is important when the simulation involves human behavior and associated ecosystems.

2.3 Meta-Analysis of Serious and Simulation Games

There have been several meta-analysis studies of serious and simulation games with varying results. These meta studies have looked at the type of research, the category of games and the primary objectives of the games.

Connolly (2012, 2015) evaluated 129 studies games during an eight year period. This includes all types of games, including non-computer based simulation exercises. The research found that most games are devoted to knowledge acquisition, and this was independent of genre or game category. Generally, knowledge acquisition is considered a lower level objective than skill enhancement that may be achieved from experiential learning in a game. They also identified research that found that computer games could be associated with perceptions of motivation and outcomes. Results among studies were not consistent, but suggested positive outcomes were possible from playing games, and that there were context factors that may influence these results.

Wouters (2013) reviewed research on the motivational aspects of games and the cognitive results (perceived or measured). Further this research looked at the genre and category of the games, and found that games had a positive effect on motivation. That is some game categories showed more propensity to produce motivation to learn, such as a high visualization anatomy simulation. Overall this research taught that games can drive a positive motivational effect by the genre/category on motivation to learn, which is followed by actual perceived learning. The teaching from this research suggests the connection between motivation from a game and its impact on learning outcomes (perceived or measured). They did not identify any research that sought to model the overall relationship, or to consider the contextual factors like student types.

Girard (2013) conducted a meta-analysis of empirical research on the efficacy of serious games and video games. Their research reviewed thirty (30) studies in that were focused on evaluating the engagement and learning of these games. They then reduced this group to nine (9) that were randomized control tests (RCT experiments). This study attempted to further extend the findings of Wouters (2013) that subject, format and genre can influence these games' effectiveness. Indirectly, this would suggest that motivation can lead to effectiveness. This meta-analysis results were inconsistent over nine papers that used experimental or quasi-experimental methods. None of the papers showed a positive learning effect linked with positive engagement (i.e. motivation). The researchers suggested that more studies needed to be carried out using control groups using a variety of pedagogical formats (i.e. pencil and paper), and utilizing longitudinal data collection, not just pre-post testing. They also pointed out the strong need for validated survey instruments that could be utilized along with experimental instruments to assess student learning that could be linked to game causation.

Laamarti (2014) provided a meta-study of games with a focus on the attributes that make up different game types. This research helped provide the basis for the new game type, serious simulation games (SSG's). This research identified attributes that could be studied as factors in explaining game performance, such as activity, modality, interactive style and environment.

Katasaliaki (2015) conducted a meta-analysis of forty-nine (49) games in the field of sustainability. These games covered a variety of applications including; climate change management, energy management, water and sustainable management, CSR, ecological systems, farm management, sustainable development learning and consumer choices. Data collected on each game included; character role, purpose of game, genre, graphics, availability, number of players, validation, debriefing after play, fundamentals, characterization, learning outcome and developer. This research found that these sustainability games lead to better understanding of issues around sustainability and environmental strategies. Their game classification also provided a way to identify games fit to specific academic programs, and possible taxonomy. They found that games can emulate real world complexity, which leads to improved skills in problem solving, decision-making and team based collaboration. The authors suggested more research on game complexity and game efficacy.

Caballero-Hernandez (2017) provided an empirical study of the assessment methodologies used in games. Researcher found that assessment considers game genre, pedagogical aim or game context. Papers were classified into four categories of assessment; assessment aim, implementation, integration and primary assessment type. This research found the most common assessment is formative with most common method being internal-game scoring. The authors suggested that more granular research around scalable in-game assessment, as most were using manual method to handle scoring.

Lamb (2018) conducted a meta-analysis of forty-six (46) games, with the objective of finding whether the simulation game category would have a moderating effect in the learning outcomes for these simulations. They covered three categories of simulation games; serious games, serious educational games and educational simulations. Studying a cross-section of games and genres, the researchers found that there was no difference in the learning outcomes between the three categories of games. The meta-analysis taught several key points:

- Efficacy of the simulation-games was not impacted by the category of the simulation (SEG, SG, ES).
- A game's efficacy did not depend on context (subject, format and specific segments of the game)
- A game with the right characteristics can emulate real world complexities leading to improved problem solving.

- The efficacy of simulation games that seeks to improve leadership skills, was not evaluated, and considered elusive by most writers on the subject. This is due to the limitation of game capabilities to emulate human leadership of teams.

Zhonggen (2018) evaluated a total of 792 items that included, academic papers, research proceedings, editorials and meeting abstracts. The researcher developed a scoring instrument to evaluate the quality of the item, and focused on the top 275 items. The paper categorized the items into three (3) large groups including; 1) influencing factors, 2) positive findings, and 3) negative findings. They found papers studying influencing factors to include perceived usefulness in the game, goals and ease of use, learning attributes and game mechanics, game easiness, game types, learner age and instructional content. These factors were evaluated, but not necessarily confirmed. Positive findings were variable and included improving cognitive abilities, providing flexible learning, improve some learning outcomes and improvement of some social skills. Negative findings included no significant impact on in-depth learning, aggravated mental workloads and in general variable results on learning outcomes.

2.4 Efficacy of Serious and Simulation Games

There have been a number of researchers who have directly addressed the questions around the efficacy of these games. These studies have sought to measure or evaluate the learning effectiveness of these serious and simulation games. While results have varied, several significant insights can be garnered from these studies.

Adobor (2005) conducted a cross-sectional study of forty-nine (49) teams of one-hundred and four (104) students playing a serious or simulation game. The research used a 5-point Likert scale to self-assess impact of the game on learning outcomes. Students perceived that they had a positive learning associated with the realism of the simulation and its ease of use (PEOU). As the simulations were played from a team perspective, the responses were also team based. Team emotional conflict was negatively associated with perceived learning, while team task conflict was positively associated with learning outcomes. Task conflict was analogous to problems solving, so a positive association was postulated by the researchers. The limitation of this study was it was student focused, and lacked professionals to assess the outcomes. It also provided no variation in the types of students, or the context these games were delivered.

Cook (2006) built a survey instrument that provided a pre-post test to evaluate the efficacy of a market simulation game. The research was not an experimental design, with a control group that did not play the simulation, and a group where playing the game was the intervention with post outcomes. This marketing simulation was a simplistic game compared to what would be considered a high quality simulation game currently. The researcher developed a survey instrument to assess how the students perceived the game. Their central hypothesis was that the simulation game was superior to the textbook as a tool to learn the course material. The results of this research demonstrated that benefits come from the project based learning of the application format, as it emulated real world experiences. Students reported that their learning was via connecting their decisions to outcomes, and that the simulation was superior to only using the textbook. Again, this study did not include professionals, and the student population was homogenous. The delivery context was also a constant, as the students used the simulation locally in the classroom. These researchers used this simulation game to launch a business that marketed the product to universities nationally.

Cronan (2012) evaluated enterprise resource planning users (ERP), specifically using SAP. The users were trained using a simulator (type of SSG), and the results were a self-assessment survey. The results showed that users perceived learning from the simulation. There was no baseline against a traditional method of instruction, in that the proficiency with SAP was tested post-hoc against the results from previous classroom training. The users were professionals and demonstrated they had achieved SAP transactional capability with the system, as well business and enterprise understanding.

Crocco (2016) conducted a quasi-experimental study using 440 students who played an SSG that provided a game based learning (GBL) model to study English, math and science. There was a pre-post testing with a control group using a non-GBL method. The research demonstrated that enjoyment correlated with improvements in deep learning versus non-GBL methods. SSG's increased the enjoyment especially in students with anxiety about the learning experience. Enjoyment also correlated with deep learning and higher order thinking development. This study provided preliminary validation that GBL methods can increase learning via enjoyment. Further research is needed to assess whether certain student types and attributes are more or less impacted via GBL.

Geithner (2016) studied a group of forty-seven (47) professionals who worked in an auto supplier. These subjects played an SSG (project management subject). The subjects completed a pre-post survey regarding their skill levels. The players reported that the SSG increased their project conceptual knowledge, teamwork and soft skills around project management. The researcher posits that this was due to the virtual experiential learning that took place by decisions, results and reinforcement.

Wellington (2017) conducted a pre-post test with a survey instrument to assess decision making outcomes. The dependent variable in this study was the decision making time, which the researcher hypothesized would be reduced through the use of a marketing SSG. This was a single variable, and there was no attempt to address the quality of decisions (i.e. errors). The results interestingly showed that decision time was enhanced (reduced) more in superior students. That is the better the student, the more the SSG benefited their decision timing. For weaker students, the results were mixed.

The efficacy studies have demonstrated that there can be higher perceived learning with simulations that are more realistic. There has also been an association between enjoyment associated with deep learning in a simulation. One might extrapolate that motivation would be an intervening variable, although that was really not studied specifically. Finally, SSG's have been shown to create a project based learning platform that leads to virtual experiential learning. In other words, high fidelity SSG's can emulate real world experience in a way to accelerate the individual experience. One extension of the efficacy research would be to use a population of professionals in the relevant field as well as students from diverse academic programs. All the studies either chose students or professionals as subjects, but not both, so we do not see the contrast in the study. Prior research has also not looked at the attributes of students or the method of delivering the SSG as possible impacting variables on learning efficacy.

2.5 Gaps in the Literature

There are several gaps in the literature as related to the research objectives in this study:

- While there has been research on the learning efficacy of SSG's, none have evaluated an SSG with the aim of improving sales leadership skills. That is partly due to the fact that the architecture to engage human leadership over simulated avatars in an SSG is challenging. There are no models that have been evaluated to allow an SSG to emulate management and leadership.
- While there has been considerable empirical research on assessment, all the outcomes measured learning elements (i.e. subject matter). None of the research covered measurement of performance such as SSG outcomes as a result of the improved learning. Wellington (2017) measured decision time (decisiveness) and was the closest to this idea, but did not cover the quality of decisions.
- Most of the research has been with classroom students from a specific discipline and not blended. This has limited the understanding of how the experience from the specific discipline may play a role in the SSG results. Further the classroom students who were in studies were from homogenous populations (i.e. all mechanical engineering majors). There was a paucity of literature that studied SSG's with varying student types. Crocco (2016) used different students by majors, but they were playing different games aimed at their specialization.

- None of the research addressed the building of a highly configurable simulation game, which could provide a large range of learning experiences, and empirical work to measure the efficacy as a function of micro-attributes (configurable variables). Configurable variables allow the SSG model to create large numbers of different playing experiences in the simulation, so outcomes could be measured as a function of changes in the micro-attributes.
- None of the research addressed SSG's that were built on the principle of meta-heuristic algorithms that allow the recursions to yield evolutionary behaviors in the game objects (avatars). This is a very unique model structure that is not common to most SSG's.
- None of the research addressed the way the SSG would be delivered including; synchronous in classroom, synchronous remote, asynchronous remote from classroom, hybrid and mixed classes. It is possible that the SSG delivery method could be associated with different learning outcomes. Researchers have cited delivery type as a possible confounding factor in some studies.

The implications of these gaps is that the current research will seek to accomplish several goals as follows:

- First, it was necessary to develop a specific sales leadership SSG, which was both configurable and evolutionary such that it emulates reality for students. In the case of the University of Toledo Schmidt School of Sales, they already were using a sales simulation game, so it could have been used for this research. However, that simulation game lacked many of the requirements needed for this research, such as being configurable and deliverable by different methods. Therefore, a new SSG provided a better tool to carry out this research. Also, since the old simulation game was widely used, accepted and validated at many universities, having a new SSG that would be determined to be superior could add to the validity of the new SSG.

- Second, a goal was to confirm the efficacy of the sales leadership SSG for student learning outcomes for different student types (i.e. sales majors) and delivery modalities (i.e. on-line or on-premise). Based on the literature review (Abodar, 2005) and this researcher’s observations, these two factors may impact the efficacy of the sales leadership SSG.
- Third, it was necessary to apply the SSG in a specific course (PSLS 4710) that had used a simulation game before, and had a faculty experienced with putting a game into a class syllabus. In this way it was possible to eliminate factors like the course syllabus, instructional design, faculty experience and pedagogical application from the analysis. This course had used an SSG, in the same classroom and taught by the same faculty for several years, so it was a good fit for the research.
- Fourth, a target was to fill a research gap by developing a research model that brought together learning outcomes, motivation to learn, interest, student type, delivery type, perceived usefulness and perceived ease of use. The research has shown that these factors have been associated in parts of the literature, but not as a

complete integrative research model. Essentially, many individual relationships have been established, but not a complete model.

- Finally, it was necessary to test the research model using survey tools and quantitative methods. The survey tool would be built from the prior research, where individual elements were established, along with observation and student focus panels. The survey would then be used to collect cross-sectional data from the same class over several semesters. The quantitative analysis would ideally involve parametric methods, but that research design would confirm that approach.

Chapter Three

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

3.1 Research Model Interest Factors in a Serious Simulation Game (Curiosity Initiation, Academic Usefulness and User Friendly)

Using the analogy of the TAM framework, the intention to use is the antecedent of actual use of that technology. The antecedent of the intention to use the technology is then the attitude toward that technology. The perceived ease of use (PEOU) and the perceived usefulness (PU) are the drivers of the attitude toward the technology in this framework. These perceptions are then a function of variables associated with the technology (Davis, 1989). While the SSG theoretical model is not directly associated with TAM, there are useful analogies we may extrapolate to consider when evaluating the efficacy of the SSG. With an SSG in an academic program, the students need to use the system, so the outcome is the learning benefit perceived by the students. In the TAM model, intent to use is the antecedent of actual use, so analogizing to the SSG model we consider motivation as the antecedent to learning. The antecedent of motivation would then be interest in the SSG, and analogizing to the TAM, interest in an SSG would be preceded by perceived usefulness and perceived ease of us. Interest in an SSG has been determined to be decomposed into the two factors, ease of use and useful (Abodor, 2005), which analogizes to the TAM structural model. The interest factor was referred to as curiosity initiation in this research. It is noteworthy that Adodor (2005) also analogized to the TAM model in his research on simulation games.

The elements of usefulness in an academic SSG are items that align to the educational purpose of the SSG (Cook, 2006). We refer to this factor as academic usefulness, in order to be more specific. Academic usefulness is a driver that is expected to generate interest in the SSG, based on the literature. The items that define academic usefulness include how well the SSG emulates reality and how relevant it is to the course material. In this research, we measured these items in terms of student perceptions of the SSG used in the course. The first item measured was the degree that the SSG emulates the real world decisions by sales managers, and how closely the results connect to these decisions. Cook (2006) used an item titled "helped understand sales force management", in a survey of their marketing simulation game, which was intended to measure how closely the SSG emulated the real world. The degree that the SSG aligned to the course syllabus in an academic program should be a close proxy for the relevance of the game. Cook (2006) used an item titled "applied what was learned in the class", as a way to measure this item. However, it was just a single item, and was not a factor representing a set of syllabus items, which would be preferred. The degree that the SSG utilized team skills was another element cited by researchers as a component of leadership education. Cook (2006) used an item titled "develop team skills", which was a single item in his survey.

The elements that influence ease of use ("user friendly"), were items that make the SSG easy to use for the students, and can include instructor experience, context, facilities, method of delivery, navigation and technology performance (Crocco, 2016). Abodor (2005) highlighted perceived ease of use as a factor leading to greater learning and enhanced performance of student teams, although he identified no intervening variables. He used a definition of ease of use based on the realism of the simulation game, and actually used the work of the TAM researchers in his citations.

In my research, the SSG used the same faculty member (who was experienced with simulation games), the same facilities, in the same course and delivered in either on-line or on-premise modes. The method of delivery was a distinct variable that was separated from the ease of use. In this sales leadership SSG, the items to be measured in terms of the student perceptions of the SSG, included the user friendly nature of the interface operation, and performance of the technology during play. The degree of the SSG's functionality, specifically around ease of operation of the user interface then represents the "user friendly" item, and the degree of the SSG operation without technical issues represents the technical performance item. The two items together represent the combined user friendliness of the SSG.

3.2 Motivation Factor in a Serious Simulation Game (Motivation Generation)

Motivation in using an SSG has been shown to directly relate to factors that make the SSG enjoyable to play (Wouters, 2013). In this sales leadership SSG, the perceived interest (curiosity initiation) and motivation to play the SSG will be measured. The perceived motivation and interest factors will be measured by a Likert scale. Motivation in this research is named motivation generation, and will be a single item measure. Wouters (2013) used a single item measure to measure motivation in terms the perceived motivation generated by playing an SSG. Both Connolly (2012) and Girard (2013) in their meta-analysis identified that motivation based factors were identified as variables in the analysis of simulation game efficacy. The research supports the consideration of motivation as an outcome of interest in playing simulation games, as well as a potential intervening factor in learning from these games.

3.3 Learning in a Serious Simulation Game (Learning Outcome)

As has been seen in the prior research, measuring learning has rarely used actual pre-post experimental tests to consider the efficacy of simulation games. This is in part due to the fact that most of the research has been conducted in academic contexts where it can be very challenging to maintain a control group where part of the class is not engaged with the technology and part of the class engaged with the technology (i.e. intervention). The cited research has primarily been measuring learning in terms of some self-perception by the students using the simulation. A few researchers have been able to study learning efficacy in terms of quasi-experiments where there is a control group and pre-post measure of learning outcomes, which has required these researchers to develop an instrument to measure learning outcomes of students. Several researchers have investigated learning in SSG's in various contexts, but usually in terms of perceived learning. Abodor (2005) developed an instrument to measure perceived learning around simulation realism, where the greater the realism in the simulation the stronger the learning outcomes. Cronan (2012) developed an instrument to measure perceived improved learning of an SAP training program. Cook (2006) developed an instrument to measure learning based on perceived learning, which used a single item in a survey. Girard (2013), in his meta-analysis identified several researchers who were using some form of self-perceived learning to measure actual learning outcomes. This same finding was further confirmed by Caballero-Hernandez (2017) and Lamb (2018). In this research, I have followed the prior investigators, so the learning outcomes will utilize a perceived learning factor. This factor will be measured using a Likert scale, with self-perceived learning outcomes as a single item measure.

3.4 Moderating Factors

Two moderating variables, which are unique to this research are student type and SSG delivery type. While there has been some prior research that would suggest these factors may play a moderating impact on the model relationships, direct observation by this researcher has identified these possible moderators. Students who were directly in the sales program were visibly more interested and highly motivated during play of the simulation, which showed up during the final term presentations. The students who were sales majors or minors showed superior final presentations than their student peers from other programs. Another noteworthy factor was whether the students were taking the course via distance learning, or as part of the on-premise class. The students who were taking the course on-premise were better able to get questions resolved, and execute the basic processes around the sales leadership SSG. Based on this observation, these two factors these two factors were evaluated in the research model.

Student type has been used as a moderator by many researchers, but they typically used age, experience, gender or some aspect of attitude (Abodor, 2006). In this study, the student type was the academic concentration of the student, based on the observations during the course. Specifically, the student was considered having a sales concentration, if they had a sales major or minor. The idea is that a sales concentration may have a strong positive moderating affect on interest, motivation and learning outcomes.

The delivery type of the of the has been used by researchers usually around the level of realism and immersion in the SSG's (Girard, 2013). These studies used a working assumption that the students were all in the same location, and did not tend to cover virtual delivery (i.e. on-line courses). This study used delivery type to be whether the student took the course as on-premise in a classroom or an on-line distance learning course. This research posits that an in-classroom experience would more positively influence learning outcomes.

3.5 Variables

In this research, the variables were broken into three groups. The first group included all demographic variables associated with the student. These variables were meant to measure the students' attributes, and cover the student's class, college, major, minor and how they took the class (i.e. distance learning). The second group included the variables that were collected from a survey instrument, and measured the students' self-reported perceptions about the SSG. These variables were intended to measure the students' interest, motivation and learning outcomes associated with the sales leadership SSG. The final group of variables included the summated factors, which were derived from items in the survey instrument. There were two latent factors, one to measure user friendliness and the other to measure academic usefulness. The variables and taxonomy are represented in the following tables.

Table 1 – Demographic Variables

Variable Name	Variable Definition and Source	Measurement Scale
College	College where student resides	Response from drop down - text
Major	College major	Response from drop down - text
Minor	College minor	Response from drop down – text
Semester	Semester that class was taken	Semester – auto entered
Sales concentration	Sales major or minor - sorted field	Dichotomous
Non-sales	Students who are NOT sales concentration	Dichotomous
Class Delivery	Distance Learning or On-Premise	Drop Down selection – text
On-line	Students taking class Distance Learning - sorted	Dichotomous
Non-Distance Learning	Student taking class On-Premise	Dichotomous

Table 2 – Variables from Survey

Variable Name	Variable Definition and Source	Measurement Scale
Learning Outcome	SSG enhanced learning	Survey response 1-5
Curiosity Initiation	SSG enhanced interest level	Survey response 1-5
Decisions	SSG enhanced understand sales mgr decisions	Survey response 1-5
Team	SSG used team skills	Survey response 1-5
Connect	SSG decisions and results were connected	Survey response 1-5
User Friendly	SSG was user friendly	Survey response 1-5
Effective	SSG delivered technically effective	Survey response 1-5
Motivation Generation	SSG motivation level	Survey response 1-5
Coach	SSG matched syllabus – coaching of sales team	Survey response 1-5
Training	SSG matched syllabus – training levels	Survey response 1-5
Comp	SSG matched syllabus – compensation	Survey response 1-5
Quota	SSG matched syllabus – quota levels	Survey response 1-5
Motivate	SSG matched syllabus – motivating sales team	Survey response 1-5
Assign	SSG matched syllabus – account assignment	Survey response 1-5

Table 3 – Formative Latent Factors and Associated Survey Items

Variable Name	Variable Definition and Source	Measurement Scale
User Friendliness	Summated from user friendly and effective variables	Summated formative latent construct 1-5 – interval continuous
User Friendly	User friendly from survey	Survey response 1-5
Effective	Technically effective from survey	Survey response 1-5
Academic Usefulness	Summated from syllabus match, decisions, connect and team variables	Summated formative latent construct 1-5 – interval continuous
Team	SSG used team skills	Survey response 1-5
Connect	SSG results connected to decisions	Survey response 1-5
Decisions	SSG increase understanding of sales mgr decisions	Survey response 1-5
Coach	SSG matched syllabus - coaching	Survey response 1-5
Training	SSG matched syllabus – training	Survey response 1-5
Comp	SSGmatched syllabus – comp	Survey response 1-5
Quota	SSG matched syllabus – quota	Survey response 1-5
Motivate	SSG matched syllabus - motivate sales team	Survey response 1=5
Assign	SSG matched syllabus – account assignment	Survey response 1-5

Several variables were controlled, as they did not vary during the data collection. The course, syllabus, room and faculty were constant throughout the data collection. A benefit of using this particular course for the research, was that there already was a history of using simulation games in this course. During the entire time the survey data was gathered, the same faculty taught the course, and he was familiar with using simulation games. Further, this faculty member kept the same syllabus, and used the same room. The SSG used the same browser, and all aspects of the SSG interface never changed. From the lens of the students, nothing changed between any of the semesters where data were collected. All five semesters represented constant and controlled variables. Data were collected during the spring 2020, which would have been a sixth semester, however the COVID-19 shutdown made that completely non-comparable to the previous five semesters.

3.6 Research Questions

The research questions are targeted in line with the objectives of this study. The overall question is whether students who participate in a leadership SSG state that the SSG enhanced their perceived learning of the material in the course. The question derives from the observations by this researcher during the Dana simulation, as well as the development of this sales leadership SSG. These observations along with the comprehensive literature review, have provided the guidance toward the research questions. Not only is the overall question of whether an SSG might provide learning outcomes for students, but also what other variables might be associated with these results. The specific research questions are when students participate in a sales leadership course that utilizes an SSG:

1) Is there a relationship between their self-reported academic usefulness of the SSG and their self-reported curiosity initiation in the SSG?
2) Is there a relationship between their self-reported user friendliness of the SSG and their self-reported curiosity initiation in the SSG?
3) Is there a relationship between their self-reported curiosity initiation in the SSG and their self-reported motivation generation with the SSG?
4) Is there a relationship between their self-reported motivation generation and their self-reported learning outcomes with the SSG?
5) Is there a relationship between their self-reported curiosity initiation in the SSG and the self-reported learning outcomes with the SSG that is mediated by their self-reported motivation generation with the SSG?

6) Is there a moderating effect of student type on the relationship between their self-reported curiosity initiation in the SSG and their self-reported learning outcomes with the SSG?
7) Is there a moderating effect of class delivery type on the relationship between their self-reported curiosity initiation in the SSG and their self-reported learning outcomes with the SSG?

3.7 Hypotheses

This study was focused on demonstrating the efficacy of students' self-reported learning outcomes from using a sales leadership SSG in the context of a sales leadership academic program. Based on the literature review the hypotheses frame a model that intends to demonstrate that a sales leadership SSG will lead to stronger learning outcomes reported by students. The model posits that latent factors representing academic usefulness and ease of use support interest or curiosity initiation in the SSG. Further this interest in the SSG should drive motivation and ultimately learning outcomes from the SSG. These relationships could further be affected or moderated by the type of students and how the SSG is delivered. These hypotheses all refer to when students participate in a sales leadership course that utilizes an SSG, and include the following.

A number of researchers have investigated what elements may constitute academic usefulness. Cook (2006) identified academic alignment as the principle variable associated with academic usefulness. That is if academic usefulness is a latent factor, then items that constitute it would include how well the SSG matched the pedagogical intent or syllabus. Cook (2006) further identified how well the SSG matched the real world decisions by managers as expressed in the pedagogical content, was an element of academic usefulness. Adobor (2005) also identified that realism of the SSG, especially around team skills become important items that constitute academic usefulness. Crocco (2016) identified how interest in an SSG would be related to factors including relevance to the pedagogical purpose, as well as the academic usefulness of the game. King (2006) in his extension of the TAM research from Davis (1992) decomposed the perceived ease of use into several items including task relevance, which is analogous to syllabus alignment for an SSG. Venkatchet (2003) in his proposed TAM2 model further defined the latent construct of perceived ease of using several items including relevance of the technology to the job. This leads to the first hypothesis, which posits the relationship between academic usefulness and the students' self-reported interest or curiosity initiation.

H1) There is a positive relationship between their self-reported academic usefulness of the SSG and their self-reported curiosity initiation in the SSG.

Abodor (2005) found that students perceived positive learning from simulations that were highly realistic, immersive and easy to use. This author identified technology as the principal element influencing the ease of use. This was associated with how well the technology worked and how user friendly the interface and navigation worked.

Wouters (2013) also identified that technology functionality was a factor in creating engagement and interest in a simulation, which principally included system navigation and reliability. King (2006) in his meta-analysis of TAM research, found that most researchers had identified technology attributes as the principle driving elements to ease of use. This leads to the second hypothesis, which posits that the relationship between user friendliness of the SSG and the students' self-reported interest or curiosity initiation.

H2) There is a positive relationship between their self-reported user friendliness of the SSG and their self-reported curiosity initiation in the SSG.

Wouters (2013) in a meta-analysis identified a common thread of the literature that identified a connection between the interest in an SSG and the motivation to apply in a learning environment. Girard (2013) in meta-analysis identified a common thread was that highly immersive simulations provided interest and motivation to learn in an SSG. The work in TAM2 by Venkatchet (2003) provides an analogous view of this relationship as he demonstrated in longitudinal field studies that interest was the antecedent to motivation to use a technology. This leads to the third hypothesis, which posits that interest (curiosity initiation) is an antecedent to motivation.

H3) There is a positive relationship between their self-reported curiosity initiation in the SSG and their self-reported motivation generation in the SSG.

In addition to the work by Wouters (2013), a number of researchers did meta-analysis of SSG's and identified motivation as an antecedent to learning from the SSG. Connolly (2012) found researchers who had empirically verified a relationship between motivation and knowledge acquisition. Caballiero-Hernandez (2017) found several researchers who had identified that in-game scoring (i.e. leaderboards where results are seen by the participants) lead to improved learning results for the participants. These researchers suggested that motivation derived from the visual competition from a leaderboard improved learning results. This leads to the fourth hypothesis, which posits that motivation (motivation generation) is the antecedent to learning outcomes.

H4) There is a positive relationship between and their self-reported motivation generation with the SSG and their self-reported learning outcomes from the SSG.

Crocco (2016) conducted a quasi-experiment to evaluate the efficacy of game-based learning. Among his findings were a connection between enjoyment, motivation and learning results in some cases. Cook (2006) identified interest, motivation and learning in a marketing leadership simulation. While this research did not demonstrate a mediated relationship, the results of this work suggested this to be a possibility. This leads to the fifth hypothesis, which posits that the relationship between interest in an SSG and the learning results, would be mediated by motivation.

H5) Self-reported motivation generation in the SSG fully mediates the positive relationship between the self-reported curiosity initiation in the SSG and their self-reported learning outcomes from the SSG.

A number of researchers have pointed to factors that could confound their conclusions around the relationships described in the previous hypotheses. In the work by Cook (2006), he identified several factors that confounded his results, and needed further investigation. These included variables like student type, university type, technology and how the simulation is delivered. Katsaliaki (2015) suggested that game complexity and delivery format could impact the efficacy as a learning instrument. Abodor (2005) noted that the type of student had a material impact in the learning outcomes of simulations. The attributes that he considered to be part of student type included age, gender, experience and academic concentration. Lamb (2018) conducted a meta-analysis to identify what types of moderators to learning outcomes had been identified by researchers. He found researchers had identified game structure, game type, context, student type and delivery method as possible moderators. This leads to the sixth and seventh hypotheses, which posit moderating relationships between motivation and learning outcomes. The specific moderators are student type and course delivery type, as the other possible moderating factors were constant and controlled over the life of this research.

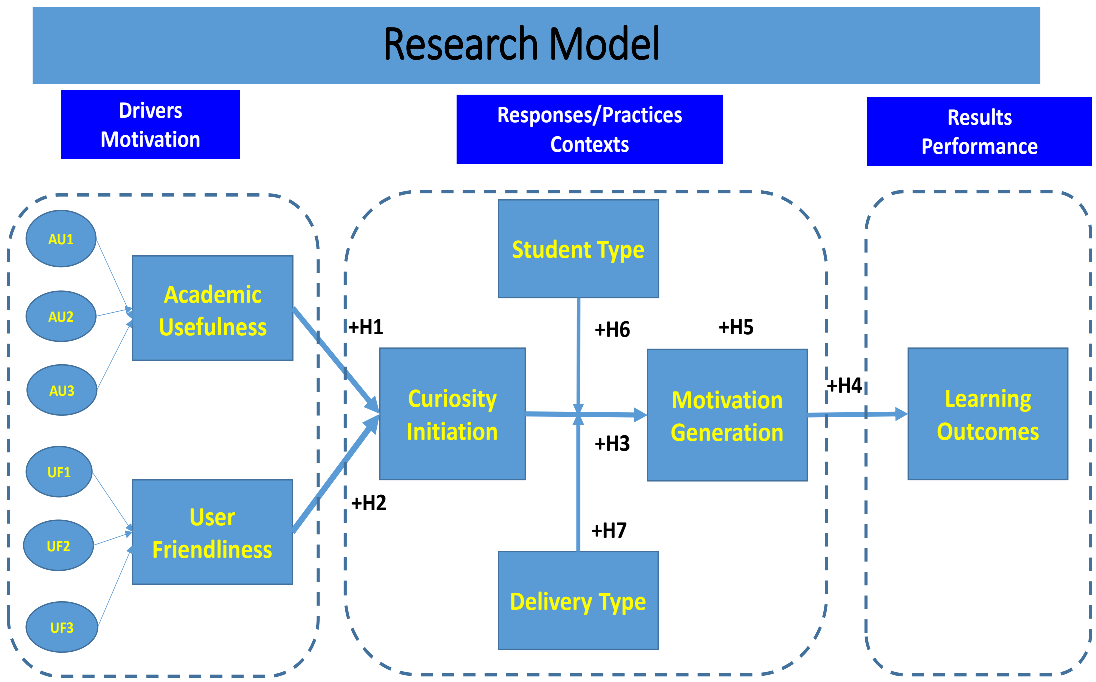
H6) There is a moderating effect of student type, such that for students with a sales concentration, the positive relationship between their self-reported curiosity in the SSG and their self-reported learning outcomes with the SSG is stronger than for students who do not have a sales concentration.

H7) There is a moderating effect of class delivery type, such when students are in an on-premise class, the positive relationship between their self-reported curiosity initiation in the SSG and their self-reported learning outcomes with the SSG is stronger than when students are in a distance learning class.

3.8 Research Model

The overall model is built on the framework found in the TAM structure (Davis, 1989), where the technology ease of use and usefulness act as the drivers to motivation to use a technology. The research model integrates these drivers in the context of an SSG (latent factors user friendliness and academic usefulness), interest (curiosity initiation), motivation (motivation generation), moderators (class type and student type) and learning outcomes. As the literature review has shown, each of these elements have been shown to have incremental relationships, even though this overall model has never been demonstrated. Crocco (2016) demonstrated the relationship between interest in an SSG and the perceived learning outcomes. In addition to the literature, this researcher has observed students engaging with the extant SSG, and how they report a positive experience with the game in the course. The model (Figure 3) shows a positive relationship throughout and moderating factors that posit stronger impacts from on-premise classes and students with sales concentrations.

Figure 3



Chapter Four

RESEARCH DESIGN AND METHODOLOGY

4.1 Approach

The approach to this research was to use an SSG in an actual sales leadership academic program, and measure the results via a survey instrument, in order to test the seven hypotheses. The survey instrument, which had been designed during the development of the sales leadership SSG, contained both closed ended items (Likert 1-5 scale) and open ended questions. The students in the sales leadership course responded to this survey at the end of each semester. The closed ended items were empirically analyzed using five semesters of cross-sectional data derived from the surveys. In addition to the empirical analysis, the open ended survey results were synthesized with the results from the end of a semester student presentations to create a focus group analysis. Similarly, during the development of the SSG, there were numerous faculty group meetings, which were documented and converted to a pre-launch focus group. The student and faculty focus group analysis were used to provide additional context and support for the empirical analysis.

The course that was used was the senior level sales leadership course, PSLS 4710 in the College of Business and Innovation ("COBI"). There were several advantages to using PSLS 4710 for the research, in that key factors remained constant during the data collection. First, this course had a history of using a simulation game as a part of the syllabus. Second, the same faculty had been teaching the course for several years, and therefore had experience using a simulation in the course. Third, the class included both on-premise students as well as distance learning students. Finally, this course used the same facilities and classroom technology during the research timeframe. The fact that all these factors were constant helped eliminate confounding variables in the analysis, which provided a type of data reduction for the analysis.

A survey was given to the students in the PSLS 4710 course at the end of the semester, in order to assess their self-reported interest, motivation and learning experience with the SSG. This survey was developed and validated during the development of the SSG that was used in this course. Data were collected for five semesters.

The SSG was developed during the 2015-16 academic year, and play tested during the 2016-17 academic year with the students in the PSLS 4710 class. The faculty member who teaches this class (Dr. Michael Malin) had been using a simulation in this course, so the students were familiar with using this type of tool. Equally, the faculty member had experience using this type of tool in the class, and had it built into the syllabus from an instructional design standpoint. The testing of the SSG allowed for the students to compare this new SSG with their prior simulation game, which was being played concurrently in the class. Therefore, the students had direct comparison between their old game and this newly developed SSG. They overwhelmingly validated that the new SSG was a substantial improvement over the old game. The old game was being used in several universities, so this helped validate the new sales leadership SSG. In parallel to the SSG development, the survey instrument was also developed and validated by test-retesting multiple times during each semester. Further, it also provided faculty validation of both the SSG and the survey instrument.

The reasons for building a new SSG, versus using the one that had already been used in the course included the following rationale:

- First, building the new SSG provided the platform to build additional SSG's for the remaining courses in the COBI Schmidt of Professional Sales program.
- Second, this provided the basis to improve on the simulation game that was being used in the course. The faculty felt that building a more realistic simulation would help improve the course and learning experience. The simulation game that was being used in the course was used at several universities, so improving the simulation game provided some validation of the new SSG, and improving the experience for students.
- Finally, this SSG provided an SSG that was configurable, which allowed for many scenarios to be established, thereby improving the number of teaching scenarios with the SSG. This allowed for a much more realistic experience with the SSG compared to the old game.

With the SSG developed, tested and the survey validated, the game was then officially launched in the PSLS 4710 course in the 2017-18 academic year. There was one section in the fall and spring semester. This was repeated in the 2018-19 academic year, and again in the fall semester 2019. This provided five semesters of data, including both on-premise and distance learning students in the courses.

At the end of each semester, the student teams presented their results, and there was a focus group discussion about the SSG experience. This focus group information in combination with the open ended survey questions, provided context behind the empirical analysis. This student contextual information was also used to supplement the faculty focus panels used during the SSG development. The faculty focus group were meant to provide a professional academic qualitative validation for the use of this SSG in a sales leadership program, which could be compared to the student views. The student and faculty focus group results helped provide context around the empirical analysis of the hypotheses.

4.2 Development of the Sales Leadership Serious Simulation Game

Overview

The SSG was developed in 2015-16 academic year at the University of Toledo ("UT") for the COBI sales leadership course, PSLS 4710. This course was part of the Schmidt School of Sales professional sales program, which is in the UT College of Business and Innovation ("COBI"). The objective of this SSG was to enhance the curriculum in sales leadership, and provide a tool that provided a type of virtual experiential learning for students in the sales program. While the target audience for this SSG was university business students, it could extend to commercial companies seeking to train their people in sales leadership. Along with traditional classroom training it has been shown that SSG's can lead to a more effective delivery and assimilation of certain course material, compared to just using traditional teaching methods (Connolly, 2012). In order to deliver on that goal, this SSG had to achieve a high level of fidelity and artificial reality, such that the playing experience closely resembled the "real world" of the sales leader. Delivering this SSG via a web platform allowed for the maximum reach and usability of the simulation in a many to one modality. The cloud delivery also provided easy application in an asynchronous pedagogy. The development and implementation of this SSG covered the following steps:

1. Step #1 - Sales Leadership Simulation Game Development
    1.1. Game conceptualization and storyline that described the “day in the life” of the sales leader which was provided by the subject matter experts. This step involved developing storyboards around the sales manager workflow.
    1.2. Technical and Functional Overview which provided the game flow and highlighted the simulation input/output process. This converted the storyline to functional and technical flows.
    1.3. Game Components – Actors, Objects, Resources and Variables were defined structurally along with their attributes. Actors such as sales team members, customers and competitors were defined during this activity.
    1.4. Configuration – defined the game components that were considered configurable such that the attributes could be modified by the game administrators so that the “behavior” could be tuned.
    1.5. Simulation model development consisted of both the game component relationships and the evolutionary algorithms to allow the iterative recursion in the SSG. The required significant work with the subject matter experts to define models both quantitatively and qualitatively. Their knowledge was synthesized into the models behind the SSG.

1.6. Decisions, Outputs and Game Flows were derived from the above components. This step was the natural step that flows after the model development.

1.7. Scoring and Assessment Model was developed to allow the faculty member to configure different factors and importance of outcomes from the SSG. This was similar to what was learned from the Dana SSG, in that it provided a formative construct from the various outputs on a weighted basis.

1.8. Testing was carried out though a game playtest process using students. Playtesting is the common methodology in the game industry, which is the only viable methodology to test a complex SSG. While certain unit and integrated testing was carried out with automated tools, it was not possible to regression test an SSG that used evolutionary architectures. That meant the only remaining option was to use human playtesting as the standard methodology.

1.9. Technical Architecture was a key part of the development. This included the hosting, the database platform, development platform and user interface. For this SSG it was a Microsoft platform including cloud service, MS SQL database, .NET platform and web interface. This technical architecture was conducive to asynchronous delivery for a large class. It also was conducive to the concept that students would be playing in parallel against the game, as opposed to a zero sum game against the other teams.

2. Step #2 -Beta testing took place in 2016-17 academic year, as a "live" test.

2.1. During the beta test, this new SSG was compared to the old simulation game by the students. The student focus group report outs demonstrated a preference for the new SSG, as it was seen as more realistic and aligned to the course objectives much better than the old game.

2.2. The beta was also used to refine the survey, which would be used on future classes to evaluate the students' self-reported interest, motivation and learning. The survey was run through a test/re-test where students responded to the self-reported interest, motivation and learning outcomes. They were tested multiple times over the two beta semesters. In parallel, faculty members also validated the survey items as part of this process.

3. Step #3 - Sales Leadership Simulation Game Implementation – Fall 2017 – Fall 2019

3.1. Production Platform was setup with hosting, operation and support processes like any other University of Toledo information technology system. This also included the game logins to harmonize with the Blackboard LMS. Federated logins were important to insure game accessibility did not become a problem.

3.2. Class Launch included faculty and user documentation along with initial training for the class. The faculty became the trainer for the class.

3.3. Faculty member setup the scoring and assessment system, which allowed for students' results to be computed from the SSG outcomes. The scoring system allowed the faculty to change the weights on different factors including revenue growth, market share, profit, customer satisfaction, employee satisfaction, sales team capabilities and business growth.

3.4. Faculty member determined that the SSG would be played in teams of four students, as opposed to each student playing alone.

3.5. Report outs were done by each team at the end of each semester, and their presentations documented. The key findings in each report out were documented. At the end of the report outs a focus panel discussion method was used to collect more information around the student views.

3.6. Surveys of Student Experience were completed by most students at the end of each semester, which included not only their self-reported interest, motivation and learning outcomes, but also additional information. The students were given both closed and open ended questions about the SSG, and also demographic questions that provided data about their class, major/minor and course type. All data were confidential, so individual student identities were not known as it related to the responses.

<u>General Concepts and Considerations</u>

There were several considerations that needed to be addressed in the creation of this SSG. First, there has to be a clear vision of the learning outcomes from using the SSG (O'Neil, 2016). If there is any lack of clarity in the vision for the use of the simulation, it can lead to significant confusion in the product development phase. A key part of the vision for the SSG usage is how it will fit in the overall instructional design of a course (Kapp, 2014). If there is a lack of clarity how the simulation fits in the overall course syllabus, it will lead to poor scope in the development of the product. A key point in how a simulation will fit into a given course is whether it will be deployed as part of an "in-class" experience, or out of class in an asynchronous delivery (Faber, 2015). Having a clear vision for the time and use of the SSG was critical in supporting a quality product development. Another key consideration for any SSG is where it will fit in terms of student evaluation (Burke, 2014). If a simulation is going to be part of the student grade, it will add to the complexity of the assessment process, and drive key points in the game design. Finally, if the game will be a part of the student assessment, it will be important to determine whether the competitive format is player versus player or player versus the SSG (Boinodiris, 2014). These considerations include deciding whether the game will be zero-sum (i.e. students must compete for a finite capacity so that one student can win only at the extent of other students), and also whether the simulation will be played as teams or individuals. Before any SSG is developed, it is essential to build a clear vision around these concepts. These considerations were key in the creation of this Sales Leadership SSG. Appendix A covers the full development and design of this sales leadership SSG.

4.3 Measurement

The hypotheses were tested using a survey research methodology. The survey questions were aligned to each of the hypotheses by providing the measurement of the associated variables. All the variables were measured using a Likert scale (1-5) using a survey instrument. The variables measured with the survey included:

- <u>Academic usefulness</u> was a latent factor, which is very similar to perceived usefulness ("PU") in a TAM model (Davis, 1989, 1992). This was a latent factor that was not directly measured by the survey instrument. The intent was to have the survey collect the items that would make up this latent factor. The items collected in the survey were possible components for a latent factor that measured alignment to the syllabus, which would be a measure of academic usefulness. Since the idea was to measure alignment, the factors were chosen from the syllabus, and did not actually have to be validated individually. The items included for this purpose were:

- Students self-reported the extent that the SSG followed the content of the course syllabus, which was provided by the faculty:
    - Coaching – this item asked whether the SSG followed the syllabus which taught how to coach members of a sales team.
    - Training – this item asked whether the SSG followed the syllabus, which taught how to develop members of a sales team using different types of training.
    - Compensation – this item asked whether the SSG followed the syllabus which taught how to optimally compensate a sales team member.
    - Quota Assignment – this item asked whether the SSG followed the syllabus on how to assign quotas to a sales team member.
    - Motivation – this item asked whether the SSG followed the syllabus on how to motivate a sales team member.
    - Account Assignment – this item asked whether the SSG followed the syllabus on how to assign accounts to a sales team member.

- Students self-reported whether the SSG enhanced their understanding of the decisions that sales managers make, which aligned to the course syllabus.
- Students self-reported whether the SSG utilized team skills, which aligned to the course syllabus.

- User Friendliness was defined as another latent factor, which was very similar to the perceived ease of use ("PEOU") in the TAM model (Davis, 1989,92). This was a latent factor that was intended to measure how easy the SSG was to utilize. It was broken into three principle areas including whether the SSG was user friendly and whether it worked without technical problems. The following items were collected in the survey as possible components for this factor:
  - User Friendly – Students self-reported whether the SSG was user friendly. This item measured the extent that the SSG was documented and usable without training beyond the faculty member orientation. Since the system was intended to be function without instruction on a self-service basis, it was essential that the user interface was user friendly. Students indicated this was important during the play testing.
  - Technically Effective – Students self-reported whether the SSG worked without technical problems. This item was intended to measure the extent that the SSG was available and responsive, which is a possible issue in cloud based systems. During the development of the SSG, students mentioned that lack of technical problems was how they identified technical effectiveness. This item was not decomposed into

further items, such as response time, availability, sign-on, browser compatibility or device operation, as students were not comfortable identifying this granularity, or even the terms. The area of what students thought of as user friendly lacked some clarity, as students had a difficult time articulating this experience.

    - Students self-reported whether the SSG results were connected to the decisions made while playing the game. This could have been considered a part of the syllabus, but students did mention this as part of the user friendly experience, during the survey development. The concept that outcomes were connected to decisions in a game was naturally a part of a system working properly, in view of students.

- Curiosity Initiation – This item was intended to be a single item measure of the interest in the SSG. Students self-reported whether the SSG was interesting. This factor would later be related to the latent constructs of user friendliness and ease of use.
- Motivation Generation – This item was intended to be a single item measure of the motivation of the students to learn using the SSG. Students self-reported whether the SSG motivated them to learn the course subject.
- Learning Outcomes – This item was intended to be a single item measure of the extent that students felt that they learned the course material from the SSG. Students self-reported whether the SSG enhanced their learning of the course subject.

- Class Delivery Type – This variable was a demographic survey item to identify whether the student took the course on-premise or via distance learning.
- Student Type – This variable was a demographic survey item to identify whether a student had a sales concentration (major or minor), or whether they did not have this concentration. Students self-reported their class, college, major and minor. Whether they were a sales concentration was derived from these data.
- Additional Feedback – There were additional survey open ended questions intended to identify student impressions of the SSG. Students self-reported what they thought were the positives, negatives, possible improvements in the SSG and improvements how the SSG could be used in the course. These questions provided a small scale student focus group every semester, in order to provide context to the survey instrument data.
- At the end of each semester, there were student reports and presentations. These provided additional context to the survey results in that semester. The information from these report outs were synthesized with the open ended questions from the survey to provide qualitative context to the empirical analysis.

4.4 Instrument Design

The instrument design was developed in parallel with the SSG itself. The design was accomplished using items from the literature as previously noted, then evaluated during the SSG development and finally validated with the assistance of faculty before it was launched in an actual class. The survey used closed end questions with a 5 point Likert scale, a neutral point and an increasing scale. The assumption was that the responses were of equal distance allowing an ordinal interval continuous variable treatment during the analysis, if demonstrated by normality tests. In addition to the closed end questions, there were open ended questions to provide added context to responses.

SSG Development and Class Launch

The SSG was developed and tested during the 2015-16 academic year. It was then play tested using a beta approach in the sales leadership course (PSLS 4710) during the 2016-17 academic year. During the beta test, the new SSG was run in parallel to the former simulation game being used in that course. This provided a frame of reference, and whether the students felt the new SSG was an improved component of their class experience. The new SSG was then launched for use in the 2017-18 academic year, and repeated in the 2018-19 academic year and the fall semester 2019. The simulation was used after the students completed the core course material. This made the SSG an example of applied project based learning, where the students apply skills already taught, which solidifies the class material. The survey instrument was used at the end of every semester, right after the students complete their SSG play.

Survey Instrument of Student Experience

A student survey was created, in order to evaluate the student experience with the SSG. This survey was created from literature items, as well as observations, and evaluated for reliability by test-retesting along with faculty evaluation. The survey measured the student's impression of their experience with this SSG. Using a survey was not a direct test of the SSG's efficacy as a learning modality, but rather a proxy based on the student's self-evaluation. Obviously, the only way to demonstrate learning efficacy directly would be a RCT experimental design, which is not possible in an actual academic course. Instead this survey was intended to measure the students' perception of this SSG in the context of the PSLS 4710 course.

Survey Instrument Item Construction

The items in the survey were derived from the literature, as well as observation by this researcher. The literature has shown that researchers have used survey instruments with self-reported items that measure perception of the aforementioned variables. Sometimes these researchers have developed latent factors from their items, but also used single item measurements as a proxy for the variables. For example, a number have used self-reported learning as an outcome variable. This is similar to the commonplace where exercise science uses self-reported single items to represent fatigue as an outcome. The following identifies what literature provided support for each survey item.

Academic usefulness was defined as a latent construct, which was built based on the alignment to the course syllabus and learning objectives. Several researchers have used course alignment as a survey variable (Abodor, 2006; Cook, 2006; VanLankfeld, 2017). The objectives in PSLS 4710 were specific to that course, and only partially matched prior research, in terms of the specific detail. This was particularly around the syllabus, which was specific to PSLS 4710 as a sales leadership course. Any course would have had a very specific syllabus, so it would never line up with very specific items found in the literature. The key point was to determine whether students self-reported that the SSG supported their course content and syllabus. The following items, along with prior research were used to define academic usefulness:

- "I felt that the simulation game followed the content of the syllabus" was the first item in the survey, and a number of researchers have used self-reported items asking how well a simulation game was aligned to the course (Cook, 2006; Connolly, 2012; Cronan, 2012). The following items were part of the PSLS 4710 syllabus, which were pedagogical content sub-items in the survey:
    - Coaching (this was defined but no literature used this item)
    - Training (this item was defined but no literature used this item)
    - Compensation (this item was defined but no literature used this item)
    - Quota assignment (this item was defined but no literature used this item)
    - Motivation (Abodor, 2006 used this item)
    - Account assignment (this item was defined but no literature used this item).
- "I felt that the simulation game enhanced my understanding of decisions that sales managers make" (Abodor, 2006; Cook, 2006; Cronan, 2012).
- "I felt that the simulation game involved team skills" (Abodo6, 2005; Cook, 2006).
- The items that were not specifically defined by literature, were the specific syllabus items, which were considered to be under the broader literature supporting alignment of the course content.

User friendliness was defined as a latent construct, which was built on items intended to directly measure this factor. The user friendliness of a simulation game has been analogized by game researchers to use the TAM structures that address how user friendly a technology is to use (Abodor, 2006). The following items, along with prior research were used to define user friendliness:

- "I felt that the simulation game was user friendly" (Abodor, 2006; Venkatchet, 2003). As noted, this was the hardest item to reconcile with student experiences.
- "I felt that the simulation game worked without technical problems" (Abodor, 2006).
- "I felt that the simulation game results were connected to my decisions" (Cook, 2006). Additional research has used this linkage between results and simulation decisions for both usefulness and ease of use (Wellington, 2017).

A single item was identified to measure curiosity initiation, which is analogous to interest. Several researchers use a single item to measure the interest in the simulation game they were studying (Cook, 2006; Kenny, 2011; Girard, 2013). This was further confirmed in later research on simulation game application in the classroom (Wellington, 2017; Lamb, 2018, Imlig-Iten, 2018). The item in this survey that was used to measure curiosity was:

- "I felt that the simulation game was interesting" (Cook, 2006).

A single item was identified to measure motivation generation. Researchers have typically used this item to be motivation to learn. Meta studies have found motivation to be frequently studied in the learning process around simulation games (Girard, 2013). The item in this survey that was used to measure motivation generation was:

- "I felt that the simulation game motivated my learning experience during this class" (Connolly, 2012; Girard, 2013).

A single item was identified to measure learning outcomes, which was found to be commonplace with a number of researchers (Abodor, 2006; Cook, 2006; Cronan, 2012). Additional researchers found this as a commonly used item in their meta-analysis (Girard, 2012). More recent research has also used this item as a measurement scale (Lamb, 2018; Imlig-Iten, 2018). The item in this survey that was used to measure learning outcomes was:

- "I felt that the simulation game enhanced my learning in this course" (Abodor, 2006; Cook, 2006).

The contextual factors, which made up the moderating variables were often cited by researchers as possible predictors of learning in simulation games. Abodor (2006) and VanLankveld (2017) both identified student level and experience as possible confounding factors in explain learning outcomes. Both Connolly (2012) and Girard (2013) in their meta-analysis found that how courses were delivered could influence the or be a predictor of learning. Lamb (2018) in his later work found that delivery method could be a significant factor explaining immersion, which could influence the motivation in learning.

The open ended questions at the end of the survey were not based on specific prior research, and were meant to provide additional context to the survey responses. Four questions were constructed to address positive/negative aspects of the simulation game, as well as how the game could be improved and how the simulation game could be used in the course might be improved. The feedback from the open ended responses provided compliments to the closed end questions in the survey. The open ended and closed end survey responses were used along with report outs and panel discussions at the end of each class.

Survey Instrument Confirmation

The survey instrument reliability was evaluated via a test-retest process during the beta test in the 2016-17 academic year. The SSG was being played in parallel with the old simulation game in this academic year, so there were multiple times to pilot the survey. The results showed that testing and re-test results were highly repeatable and consistent in both the fall and spring semesters of that academic year. Using a t-test, the instrument reliability for all the items was significant at the .01 level (Table 31). During the survey testing, all the students in the pilot in each semester, completed the survey twice with three weeks separation. Each item (closed end) in the survey were compared using the test/re-test results. The t-test was then run on each item over the respondents.

The survey face validity was evaluated using faculty input. Key faculty were asked to evaluate the survey instrument, and provided adjustments to the specific wording of selected items. They also provided additions to the open ended questions, with the idea of providing additional data that would be similar to what would be collected in a focus group. As previously noted, the fact that the original items had come from literature also added validity to the instrument.

Appendix B show the actual survey questions, and reliability test results.

4.5 Data Collection and Sampling Frame

The unit of analysis was all students in the PSLS 4710 Sales Leadership course. The sampling frame covered the period from fall 2017 to fall 2019. Using the Banner system, it was determined that there were 274 total students during the five semesters from fall 2017 to fall semester 2019. A total of 166 (60.5% response rate) students completed the survey as they finished their respective semesters. As was shown, the survey collected the student demographic data, the delivery method of the course, the students' self-reported elements of the SSG and open ended responses about the SSG. In addition to this data, there was a report out by student teams as the end of each semester. The teams were made up of four students, who provided presentations about their experience and results using the SSG in the PSLS 4710 course. Notes were taken at each student presentation, in order to provide additional insight and context around the survey results each semester.

There were a number of variables that were controlled over the five semesters of the course. The class was given in the same classroom by the same faculty member.

This faculty member already had extensive experience using a simulation game in the syllabus of the course. The biographical variables collected from the survey also provided data to compare the population in each semester to insure that they were representative of the overall population. In order to confirm that each of the five semester populations were made up of students with similar academic performance, data were collected from the Banner system to measure their cumulative grade point average ("GPA") and their actual grade in the PSLS 4710 course. This was done for all five semesters of the PSLS 4710 course.

The final aspect of the data collection came from the faculty focus group meetings during the SSG development. The faculty were all from the COBI Schmidt School of Professional Sales, and had domain knowledge and experience seeing a simulation game used within their program. The notes and interviews from these meetings were synthesized and organized into a focus panel format. Included in these meetings was a review of the existing simulation game being used in PSLS 4710 at that time. Additional information around how this SSG would fit within a total "Sales World" platform was reviewed. This retrospective qualitative information was to build context beyond the quantitative survey data. This provided the specific objectives and results from the SSG, which the faculty team expected. Along with the student focus panel results, this was to provide added context to the student surveys. The purpose was that this information should provide additional qualitative support for the quantitative analysis of the survey data.

4.6 Analysis Methods and Tools

The initial step in the analysis was to determine if there were significant differences between the student population over the five semesters, in terms of academic capability. This involved gathering Banner data on the students' course grade and cumulative GPA. This test used a single factor ANOVA for each variable respectively.

The next step in the analysis was to determine the strength of using parametric methods to analyze the closed end survey item data. This consisted of evaluating the mean, median, mode, standard deviation, skewness and kurtosis and doing a normality test of each variable over the total five semester population. If the population was reasonably close to normal distributions, then it would suggest that parametric inferential methods were reasonable tools. If this were not the case, it would suggest that non-parametric statistical methods would be more appropriate. The relative strength of each was evaluated with the above normality tests.

The dependent variable was the self-reported learning outcomes, which was treated as ordinal-interval on 1-5 scale. The independent variables included self-reported motivation generation (ordinal-interval 1-5); self-reported curiosity initiation (ordinal-interval 1-5); self-reported user friendliness (formative latent construct ordinal-interval 1-5); self-reported academic usefulness (formative latent construct ordinal-interval 1-5); student type (sales concentration or not) – dichotomous variable and delivery type (distance learning or on-premise) – dichotomous variable.

Parametric inferential statistics were used to evaluate the hypotheses, including hierarchical multi-stage multiple regression and ANOVA.

Chapter Five

DATA COLLECTION AND HYPOTHESIS TESTING

5.1 Data Collection Process

The data for each of the five classes was collected at the end of the respective semesters, as well as a sixth semester completed during the COVID-19 pandemic shutdown where the students all were remote. The data collected for each semester included several components:

- The Banner data were collected via a SQL report against the Oracle Operational Data Store (“ODS”). and included grade in the PSLS 4710 course, as well as their cumulative GPA for each student. Student names were not collected, so this data were anonymous, and therefore only reflected the student population as a whole in each semester. This data were meant to be used to assess whether there was any difference in the student populations over the five semesters. There were 274 students reflected in this file.
- The students completed a Qualtrics survey at the end of each semester. Their response to this survey included both the closed end and open ended questions (see Appendix B). There were 166 responses to the survey (60.5%).
- The students completed end of semester presentations, and the notes from the students’ presentations were organized and categorized by key points. Notes from these presentations were part of the data collected, and were related to the open ended survey data to build context to the data analysis.

- Student panel discussions that occurred after the end of semester presentations were also included in the data collection process. These were open ended discussions that address the experience of this sales leadership SSG. Notes were taken from these panel discussions, and organized by key points.

Information from these presentations were not connected to the survey data, as student identity in the surveys was confidential. This meant that a given student's survey data could not be connected to their presentation, which was done as a team (four students were a team). The same applied to the panel discussions, which were not recorded with any student identity. This meant all the data collected was confidential, and could not be identified to the individual students by name.

In order to validate that the class make up was similar, there was an analysis of the student academic performance profile by class. This data were also collected in a confidential manner, such that the student identities were not exposed. From the Banner system, the student cumulative GPA, and grade in the PSLS 4710 class were evaluated statistically. This allowed the five semesters to be compared, and confirm if they were in fact statistically the same student profile.

The final piece of data collected was the assimilation of the focus groups representing both the students and Schmidt School of Professional Sales faculty. The student focus group data were assembled by integrating the open ended questions with the data collected from the student presentations and the report out panel discussions. Together this information provided a type of synthetic qualitative information and data that would be similar to focus group panels. For the faculty, the information collected during the SSG development represented a retrospective focus panel. This information, while used for the SSG development, provides a type of focus group lens through the eyes of the faculty. Together this student and faculty qualitative information was synthesized to be used to provide context for the empirical analysis of the survey data.

Several variables remained constant throughout the data collection, so required no special data collection. The course location and faculty member, who was experienced at teaching the course, were both constant. The faculty member has always used a simulation game in this class, so the new one did not represent a change in syllabus. The course syllabus and flow remained the same during the five semesters. The sixth semester (spring 2020) represented a somewhat different structure due to the COVID-19 shutdown, where students were entirely remote and lacked access to the same experience as the students in the other semesters.

5.2 Data Coding

Once the data were collected in the Qualtrics survey instrument, it was converted to an Excel spreadsheet. Each record in the database represented one student, but without any personal identifiers. The record number was the key to the file, and the student demographics and responses followed. The number of records for each semester were then equal to the number of students who completed the survey for that semester. The responses (i.e. "strongly agree") were converted to their respective numbers (i.e. "5"). This was repeated for each semester, and then all five semesters were combined. This meant that one large file had all the students, and then five smaller files had the respective semesters.

The demographic data from the survey consisted of class, college, major and minor. This data were additionally coded as sales concentration or not sales concentration, so a categorical or dichotomous variable. The sales concentration code meant that the student was either a sales major or minor. For ease of analysis, the coding was binary to reflect it was a sales concentration or not, and converted to a 1 or 0.

The students open ended responses were recorded in text boxes as the last fields of information. In this way, one could see the student's responses to the closed end questions that display quantitative results along with their subjective open ended responses. The comments provided context to the student survey responses. Finally, these responses were standardized, so as to provide a more comparative qualitative view of the open ended responses. This qualitative view was turned into a rank order score, which could be related to the average closed end response across all items. This allowed the closed end questions to be checked against the open ended responses. We would expect the closed end results to be further validated by the open ended responses.

Finally, for each semester there was data coded that was for the entire class, and could not be attached to any single student record. First, this included standardized responses to the student presentations in the form of notes. There was no link between the student surveys and the presentations, as the surveys were anonymous. Since only the top teams presented at the report out sessions, it was only one of the components. In addition to these notes, there were the student panel discussions with all the students, which were done after the presentations. This information was also coded as notes, and could not be linked to student surveys, since there was no way to link individual anonymous student responses to group discussions.

The last piece of student data collected and coded was the GPA (x hours) and cumulative GPA of each class, but was anonymized so student identities were masked. This data were collected and coded for all students by semester, and was gathered from Banner ODS records. This data were collected and coded in order to confirm whether there was a potential bias in any particular semester, or whether it was reflective of the overall student population. It was important to be able to demonstrate that the academic performance of the student population in each semester were equal.

The final data collected and coded was the open ended panel discussions with the faculty. This was coded so as to compare to the student views of the SSG. The discussions were collected in terms of themes and categories of discussion, so as to provide context. These faculty meetings occurred during the SSG development and beta testing, so were intended to guide that process. The nature of this activity leant itself to standardizing, organizing and categorizing the thinking of the faculty, as the goal was product development.

In summary, the coded data then consisted of: student survey closed ended question responses along with the respective student demographic data (166 records); student survey open ended questions with thematic categorization around the four questions; thematic categorization of the student presentations, report outs and discussion which were at the semester level; and the categorization of the faculty views during the SSG development process. This provided coded data to complete the hypotheses testing using empirical analysis, as well as the student and faculty panel information that could provide context around the data analysis.

5.3 Results and Hypothesis Testing

Testing for the Homogeneity of the Five Semesters

The first analysis was to compare the student populations between the five semesters, in order to insure that the populations were homogenous between the respective semesters. The cumulative GPA and their respective grades in the PSLS 4710 course were collected from Banner, coded and analyzed using ANOVA. The null hypothesis was that the students in each semester were equal, and the alternative hypothesis would be that they were not the same statistically. If the student populations were in fact different, it would imply the need to incorporate that factor into the research model. This was tested using a single factor ANOVA with unequal group sizes. The results show that the students' academic performance in the five semesters were the same at the .01 level, so we accept the null hypothesis for both cumulative GPA and the course grade. Table 4 and Table 5 show the results of this analysis.

Table 4 – ANOVA of Class Cumulative GPA

ANOVA: Single Factor							
GPA Cum							
SUMMARY							
Groups	*Count*	*Sum*	*Average*	*Variance*			
Fall2017	38	121.633	3.201	0.217			
Spring2018	65	206.753	3.181	0.209			
Fall2018	84	272.746	3.247	0.300			
Spring2019	52	166.995	3.211	0.234			
Fall2019	36	114.634	3.184	0.190			
ANOVA							
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	
Between Groups	0.197269	4	0.049317	0.205	0.935	2.405	
Within Groups	64.84954	270	0.240183				
Total	65.04681	274					

Table 5 – ANOVA of Class Grades in PSLS 4710

ANOVA: Single Factor						
Grades x Hours						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Fall2017	38	396.06	10.423	2.202		
Spring2018	65	645.09	9.924	3.547		
Fall2018	84	822.09	9.787	4.508		
Spring2019	52	516.09	9.925	6.001		
Fall2019	36	345	9.583	4.088		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	15.12485	4	3.781212	0.902	0.463	2.405
Within Groups	1131.752	270	4.191674			
Total	1146.877	274				

<u>Testing for the Normality of the Survey Data</u>

The next test was to evaluate the normality of the data from the survey, specifically the closed end questions. Each item needed to be evaluated to determine if the data were normally distributed, such that parametric methods could be utilized to test the hypotheses in this research. Table 6 shows the data for each survey item, which are identified as Quest-1, Quest-2, Quest-3…Quest-14. For each item, the mean, median, mode, standard deviation, distribution by number, distribution by %, skewness, kurtosis and respective z values are shown. The z-skewness and z-kurtosis are used to test normality. The normality results were significant at the .01 and .05 levels.

Table 6 – Normality Tests

	Quest-1	Quest-2	Quest-3	Quest-4	Quest-5	Quest-6	Quest-7	Quest-8	Quest-9	Quest-10	Quest-11	Quest-12	Quest-13	Quest-14
Mean	4.02	3.91	3.93	3.90	3.85	3.84	3.81	3.86	3.93	4.10	4.00	3.71	3.60	3.93
Median	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	4.00	4.00
Std Dev	1.08	1.02	1.09	1.09	1.11	1.15	1.13	1.09	1.00	1.11	1.11	1.23	1.16	1.05
# 5	65	51	58	57	54	57	53	55	52	78	72	57	41	57
# 4	64	72	66	65	62	59	62	60	71	51	48	47	56	62
# 3	19	25	22	20	25	22	24	30	29	20	24	27	41	31
# 2	11	13	13	19	18	22	21	15	8	9	18	27	17	10
# 1	7	5	7	5	6	6	6	6	6	8	4	8	11	6
% # 5	39.2%	30.7%	34.9%	34.3%	32.5%	34.3%	31.9%	33.1%	31.3%	47.0%	43.4%	34.3%	24.7%	34.3%
% # 4	38.6%	43.4%	39.8%	39.2%	37.3%	35.5%	37.3%	36.1%	42.8%	30.7%	28.9%	28.3%	33.7%	37.3%
% # 3	11.4%	15.1%	13.3%	12.0%	15.1%	13.3%	14.5%	18.1%	17.5%	12.0%	14.5%	16.3%	24.7%	18.7%
% # 2	6.6%	7.8%	7.8%	11.4%	10.8%	13.3%	12.7%	9.0%	4.8%	5.4%	10.8%	16.3%	10.2%	6.0%
% # 1	4.2%	3.0%	4.2%	3.0%	3.6%	3.6%	3.6%	3.6%	3.6%	4.8%	2.4%	4.8%	6.6%	3.6%
Total	100.0%	100.0%	100.0%	100.0%	99.4%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Skewness	-0.91	-0.09	-0.06	-0.09	-0.14	-0.14	-0.17	-0.13	-0.07	-0.81	-0.90	-1.05	-0.35	-0.07
Kurtosis	0.91	0.55	0.54	0.05	-0.06	-0.30	-0.25	0.03	0.94	1.00	-0.14	-0.79	-0.36	0.48
Z-Skewness	-3.16	-0.31	-0.21	-0.30	-0.47	-0.48	-0.56	-0.44	-0.24	-2.76	-3.06	-3.39	-1.16	-0.24
Z-Kurtosis	3.14	1.95	1.85	0.17	-0.20	-1.02	-0.83	0.10	3.37	3.39	-0.49	-2.56	-1.20	1.67
Normality														
Skewness(.05)	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES	YES
Kurtosis(.05)	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES	NO	YES	YES
Skewness(.01)	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	YES
Kurtosis(.01)	NO	NO	NO	YES	YES	YES	YES	YES	NO	NO	YES	NO	NO	NO

The results show that the majority of the items were normally distributed and significant at the .05 level, and many even at the .01 level. This confirmed that parametric statistics would be acceptable to use for the hypotheses testing.

Factor Analysis

The factor analysis provided support for the two latent constructs, academic usefulness and user friendliness. The two factors explain 76% of the variance in the components, which are shown in Table 7, along with Table 8 which shows the coefficient matrix that creates the Z scores for each factors in each record. The Scree plot in Figure 4 shows the relative strength of the two factors, both with eigenvalues >1. Finally, the rotated factors are shown on the component plot in Figure 5, which demonstrates how cleanly the elements are loaded on each factor. Table 9 shows the KMO (.903), which is significant at the p < .01 level. The overall factor analysis validates the two latent variables that were used as the measurement model for the regression analysis.

Table 7 – Factor Analysis Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.779	64.212	64.212	5.779	64.212	64.212	5.549
2	1.081	12.014	76.226	1.081	12.014	76.226	3.400
3	.565	6.274	82.500				
4	.451	5.015	87.515				
5	.398	4.420	91.936				
6	.268	2.977	94.913				
7	.218	2.419	97.332				
8	.132	1.464	98.796				
9	.108	1.204	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 8 – Factor Analysis Component Score Coefficient Matrix

Component Score Coefficient Matrix

	Component	
	1	2
Syllabus - Coaching	.196	-.072
Syllabus - Training	.206	-.072
Syllabus - Compensation	.180	.015
Syllabus - Quota	.170	.032
Syllabus - Motivate	.183	.003
Syllabus - Account Assign	.174	.017
User Friendly	.032	.354
Technical Problems	-.054	.507
Results Connect to Decisions	.017	.399

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Figure 4 – Factor Analysis Scree Plot

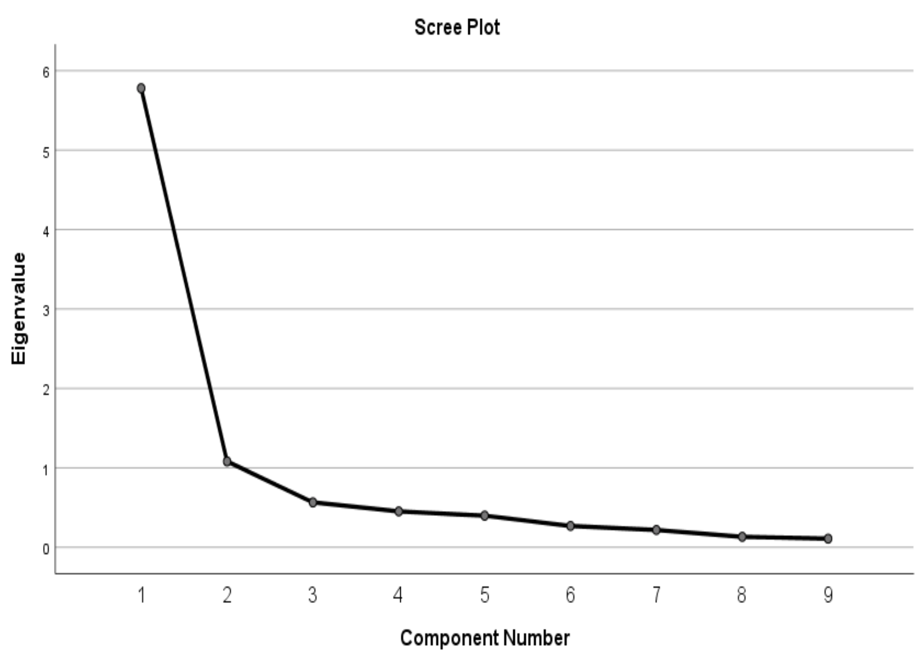


Figure 5 – Factor Analysis Component Matrix

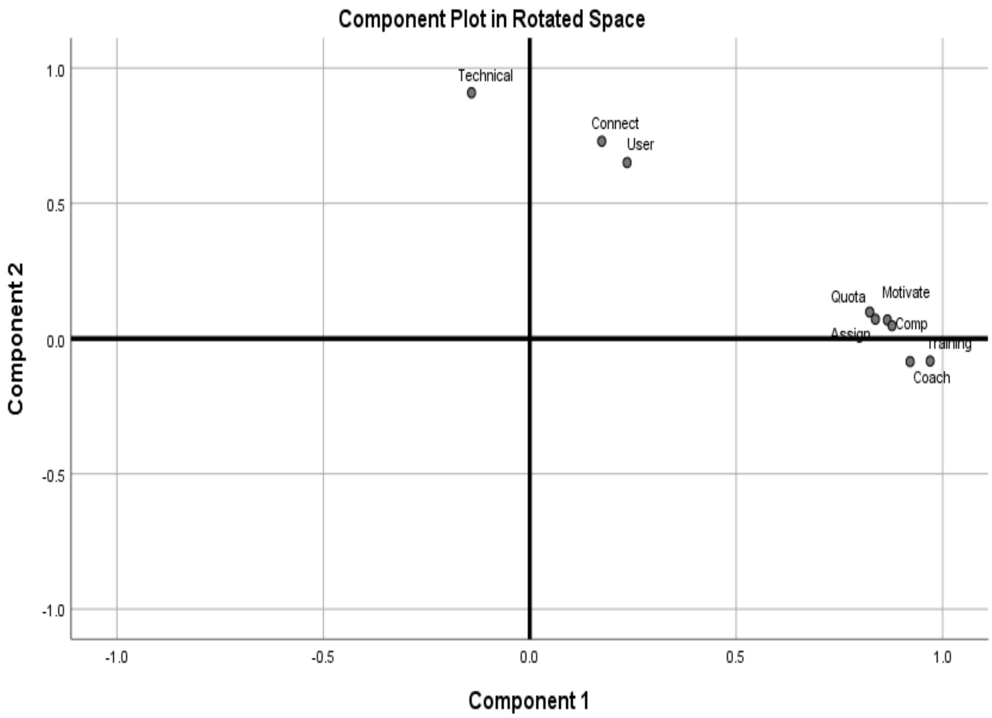


Table 9 – Factor Analysis KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.903
Bartlett's Test of Sphericity	Approx. Chi-Square	1216.344
	df	36
	Sig.	.000

Hypothesis #1 and Hypothesis #2

The scores for the two latent factors (academic usefulness and user friendliness) were computed for all the records and inserted into the database. Then multiple regression was used to evaluate the relationship between curiosity initiation (dependent variable) and these two latent variables. This analysis supported the positive relationship between the two latent factors (academic usefulness and user friendliness) and curiosity initiation. The relationship of both factors and the overall model $F(2,163) = 95.115$ were significant at the $p < .01$ level, which supports both H1 and H2. Table 12 shows the coefficients, which showed no collinearity with a VIF of 1.539.

Table 10 – Hypotheses #1 and #2 – Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.734[a]	.539	.533	.735	.539	95.115	2	163	.000	1.933

a. Predictors: (Constant), User Friendliness, Academic Usefulness

b. Dependent Variable: Curiosity Initiation

Table 11 – Hypotheses #1 and #2 - ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	102.833	2	51.416	95.115	.000[b]
	Residual	88.113	163	.541		
	Total	190.946	165			

a. Dependent Variable: Curiosity Initiation

b. Predictors: (Constant), User Friendliness, Academic Usefulness

Table 12 – Hypotheses #1 and #2 – Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.566	.257		2.204	.029	.059	1.074					
	Academic Usefulness	.401	.072	.369	5.587	.000	.259	.542	.637	.401	.297	.650	1.539
	User Friendliness	.507	.074	.453	6.858	.000	.361	.653	.671	.473	.365	.650	1.539

a. Dependent Variable: Curiosity Initiation

Hypothesis #3

Linear regression was used to evaluate the relationship between motivation generation and curiosity initiation. The relationship was found to be significant with F(1,164) = 276.818 at p < .01 level. Curiosity initiation, the independent variable, showed significance at the p < .01 level with t = 16.638, which supports H3. Table 13 shows the overall model, Table 14 show the analysis of variance and Table 15 shows the coefficients.

Table 13 – Hypothesis #3 Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.792[a]	.628	.626	.614	.628	276.818	1	164	.000	1.870

a. Predictors: (Constant), Curiosity Initiation

b. Dependent Variable: Motivation Generation

Table 14 – Hypothesis #3 ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	104.412	1	104.412	276.818	.000[b]
	Residual	61.859	164	.377		
	Total	166.271	165			

a. Dependent Variable: Motivation Generation

b. Predictors: (Constant), Curiosity Initiation

Table 15 – Hypothesis #3 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.962	.185		5.207	.000					
	Curiosity Initiation	.739	.044	.792	16.638	.000	.792	.792	.792	1.000	1.000

a. Dependent Variable: Motivation Generation

Hypothesis #4

Linear regression was used to evaluate the relationship between motivation generation (IV) and learning outcomes (DV). The relationship was found to be significant with $F(1,164) = 349.993$ at the $p < .01$ level. Motivation generation, the independent variable, showed significance at $p < .01$ level with $t = 18.708$, which supports H4. Table 16 shows the overall model, Table 17 the analysis of variance and Table 18 the coefficients.

Table 16 – Hypothesis #4 Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.825[a]	.681	.679	.594	.681	349.993	1	164	.000	1.738

a. Predictors: (Constant), Motivation Generation

b. Dependent Variable: Learning Outcomes

Table 17 – Hypothesis #4 ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	123.338	1	123.338	349.993	.000[b]
	Residual	57.794	164	.352		
	Total	181.133	165			

a. Dependent Variable: Learning Outcomes

b. Predictors: (Constant), Motivation Generation

Table 18 – Hypothesis #4 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.540	.187		2.888	.004	.171	.909					
	Motivation Generation	.861	.046	.825	18.708	.000	.770	.952	.825	.825	.825	1.000	1.000

a. Dependent Variable: Learning Outcomes

Hypothesis #5

The mediation relationship was evaluated using a multi-stage multiple regression analysis, along with a Sobel test. The first two conditions required for the mediation were met with the linear regression models evaluated in H3 and H4, which were both positive. The next step was to use linear regression to evaluate the direct relationship between curiosity initiation and learning outcomes. The model in Table 19 was significant at $p < .01$ with an $F(1,164) = 209.043$. Table 20 shows the coefficients, which are used to compute the strength of the mediation. Learning outcomes (dependent variable) was then regressed against curiosity initiation and motivation generation, the independent variables. Table 21 shows the multiple regression model to be significant at $p < .01$, with an $F(2,163) = 194.789$, and both independent variables showing significance with $t = 8.940$ and 3.649 respectively. Table 22 shows the coefficients, which are used in the mediation evaluation are significant, and VIF at 2.6 showing no collinearity.

Table 19 – Hypothesis #5 Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.749[a]	.560	.558	.697	.560	209.043	1	164	.000	1.939

a. Predictors: (Constant), Curiosity Initiation

b. Dependent Variable: Learning Outcomes

Table 20 – Hypothesis #5 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.998	.210		4.760	.000	.584	1.412					
	Curiosity Initiation	.729	.050	.749	14.458	.000	.630	.829	.749	.749	.749	1.000	1.000

a. Dependent Variable: Learning Outcomes

Figure 21 – Hypothesis #5 Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.840[a]	.705	.701	.573	.705	194.789	2	163	.000	1.806

a. Predictors: (Constant), Curiosity Initiation, Motivation Generation

b. Dependent Variable: Learning Outcomes

Table 22 – Hypothesis #5 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.372	.186		1.999	.047	.004	.739					
	Motivation Generation	.651	.073	.624	8.940	.000	.507	.795	.825	.574	.380	.372	2.688
	Curiosity Initiation	.248	.068	.254	3.649	.000	.114	.382	.749	.275	.155	.372	2.688

a. Dependent Variable: Learning Outcomes

Given that the four regressions showed significant relationships, the strength of the mediation can be evaluated. The strength of the mediation is evaluated using the path coefficient ratio, which is calculated from the standardized betas. The computation is the beta for (beta H3 * beta H4)/(beta for direct curiosity initiation <> learning outcomes), which examines the three paths in the mediation. The result shows a % mediation ratio of 87.2% (.792*.825/.749), which is significant. Table 23 shows the Sobel t-test, which confirms the mediation is significant at t = 12.7 p < .01, and supports H5.

Table 23 – Hypothesis #5 – Sobel t-Test

To conduct the Sobel test

Details can be found in Baron and Kenny (1986), Sobel (1982), Goodman (1960), and MacKinnon, Warsi, and Dwyer (1995). Insert the *a*, *b*, s_a, and s_b into the cells below and this program will calculate the critical ratio as a test of whether the indirect effect of the IV on the DV via the mediator is significantly different from zero.

Input:			Test statistic:	Std. Error:	*p*-value:
a	.792	Sobel test:	12.70480146	0.05142938	0
b	.825	Aroian test:	12.6949742	0.05146919	0
s_a	.044	Goodman test:	12.71465157	0.05138953	0
s_b	.046	Reset all	Calculate		

Hypothesis #6 and Hypothesis #7

Testing these two moderations involved multiple steps. The first step was to perform a standardization of the curiosity initiation variable. The Z-curiosity initiation was the independent variable in the analysis. The next step was to create two interactive variables by multiplying the Z-curiosity initiation by the respective moderating variables, sales concentration (sales concentration or not) and class delivery type (distance learning or on-premise). Then these two interactive variables (INT-SC and INT-DEL) were checked for collinearity with Z-curiosity initiation and learning outcomes (DV). Three multiple regressions were then run:

1. Model #1 – Learning Outcomes (DV) against Z-Curiosity Initiation (IV).
2. Model #2 – Learning Outcomes (DV) against Z-Curiosity Initiation (IV) and the moderator (sales concentration or delivery type - IV). This constituted one regression for each moderator variable.
3. Model #3 – Learning Outcomes (DV) against Z-Curiosity Initiation, the respective moderator (sales concentration or delivery method) and the respective interaction (INT-SC or INT-DEL). This constituted one regression for each moderator.

The moderation test requires that model #1 and model #2 are both significant, and that model #3 is more significant than models #1 and #2. The final moderation test is that model #3 should show the interactive variable (INT-SC or INT-DEL), is more significant while Z-curiosity initiation and the respective moderator (sales concentration or delivery method) become less significant.

The three models that were done to evaluate Hypothesis #6 are in Table 24 (model summary), Table 25 (analysis of variance) and Table 26 (coefficients). All three models showed F values (F(1,164) = 209.04; F(2,163) = 105.113; F(3,162) = 69.678) that were significant at p < .01 level, so the first test for moderation was demonstrated. The second test showed that there was no significant change between the three models, in terms of the variance or F values. In the final test shown in Table 26, the interaction variable (INT-SC) was less significant than, Z-curiosity initiation and the moderator (sales concentration). Collinearity was marginal, with a VIF around 10.1. Therefore, sales concentration was not a significant moderator, and Hypothesis #6 was not supported.

Table 24 – Hypothesis #6 Model Summary

Model Summary[d]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.749[a]	.560	.558	.697	.560	209.043	1	164	.000	
2	.751[b]	.563	.558	.697	.003	1.080	1	163	.300	
3	.751[c]	.563	.555	.699	.000	.043	1	162	.837	1.976

a. Predictors: (Constant), Zscore: Curiosity Initiation

b. Predictors: (Constant), Zscore: Curiosity Initiation, Sales Concentration

c. Predictors: (Constant), Zscore: Curiosity Initiation, Sales Concentration, Sales Conc Interaction

d. Dependent Variable: Learning Outcomes

Table 25 – Hypothesis #6 ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	101.502	1	101.502	209.043	.000[b]
	Residual	79.631	164	.486		
	Total	181.133	165			
2	Regression	102.026	2	51.013	105.113	.000[c]
	Residual	79.106	163	.485		
	Total	181.133	165			
3	Regression	102.047	3	34.016	69.678	.000[d]
	Residual	79.086	162	.488		
	Total	181.133	165			

a. Dependent Variable: Learning Outcomes

b. Predictors: (Constant), Zscore: Curiosity Initiation

c. Predictors: (Constant), Zscore: Curiosity Initiation, Sales Concentration

d. Predictors: (Constant), Zscore: Curiosity Initiation, Sales Concentration, Sales Conc Interaction

Table 26 – Hypothesis #6 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	3.928	.054		72.623	.000	3.821	4.035					
	Zscore: Curiosity Initiation	.784	.054	.749	14.458	.000	.677	.891	.749	.749	.749	1.000	1.000
2	(Constant)	3.751	.179		20.992	.000	3.398	4.104					
	Zscore: Curiosity Initiation	.774	.055	.738	14.021	.000	.665	.883	.749	.739	.726	.966	1.035
	Sales Concentration	.115	.110	.055	1.039	.300	-.103	.333	.191	.081	.054	.966	1.035
3	(Constant)	3.748	.180		20.868	.000	3.394	4.103					
	Zscore: Curiosity Initiation	.740	.174	.706	4.251	.000	.396	1.083	.749	.317	.221	.098	10.234
	Sales Concentration	.115	.111	.055	1.039	.300	-.104	.334	.191	.081	.054	.966	1.035
	Sales Conc Interaction	.023	.111	.034	.207	.837	-.196	.241	.714	.016	.011	.098	10.185

a. Dependent Variable: Learning Outcomes

The three models that were done to evaluate Hypothesis #7 are in Table 27 (model summary), Figure 28 (analysis of variance) and Table 29 (coefficients). All three models showed F values ($F(1,164) = 209.043$; $F(2,163) = 105.885$; $F(3,162) = 35.305$) that were significant at $p < .01$ level, so the first test for moderation was demonstrated. The second test showed that there was significant change between the three models, in terms of the R-squared and F value changes. In the final test shown in Table 29, the interaction variable (INT-DEL was more significant than, Z-curiosity initiation and the moderator (delivery method). Model #3 did show collinearity between Z-curiosity initiation and the interaction variable, with a VIF > 10. This could present some overstatement in the conclusion; however, the results were significant well below p < .01, which helps remediate the risk of a Type I error. Therefore, delivery method represented at least a partial moderator effect on the relationship, and Hypothesis #7 was supported.

Table 27 – Hypothesis #7 Model Summary

Model Summary[d]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.749[a]	.560	.558	.697	.560	209.043	1	164	.000	
2	.749[b]	.560	.555	.699	.000	.001	1	163	.977	
3	.765[c]	.585	.577	.681	.024	9.507	1	162	.002	1.974

a. Predictors: (Constant), Zscore: Curiosity Initiation

b. Predictors: (Constant), Zscore: Curiosity Initiation, DL-Classroom

c. Predictors: (Constant), Zscore: Curiosity Initiation, DL-Classroom, Delivery Interaction

d. Dependent Variable: Learning Outcomes

Table 28 – Hypothesis #7 ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	101.502	1	101.502	209.043	.000[b]
	Residual	79.631	164	.486		
	Total	181.133	165			
2	Regression	101.502	2	50.751	103.885	.000[c]
	Residual	79.630	163	.489		
	Total	181.133	165			
3	Regression	105.916	3	35.305	76.041	.000[d]
	Residual	75.216	162	.464		
	Total	181.133	165			

a. Dependent Variable: Learning Outcomes

b. Predictors: (Constant), Zscore: Curiosity Initiation

c. Predictors: (Constant), Zscore: Curiosity Initiation, DL-Classroom

d. Predictors: (Constant), Zscore: Curiosity Initiation, DL-Classroom, Delivery Interaction

Table 29 – Hypothesis #7 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	3.928	.054		72.623	.000	3.821	4.035					
	Zscore: Curiosity Initiation	.784	.054	.749	14.458	.000	.677	.891	.749	.749	.749	1.000	1.000
2	(Constant)	3.918	.326		12.013	.000	3.274	4.563					
	Zscore: Curiosity Initiation	.784	.057	.748	13.693	.000	.671	.897	.749	.731	.711	.904	1.107
	DL-Classroom	.005	.172	.002	.029	.977	-.334	.344	.234	.002	.001	.904	1.107
3	(Constant)	3.369	.364		9.244	.000	2.650	4.089					
	Zscore: Curiosity Initiation	.010	.257	.010	.040	.968	-.497	.518	.749	.003	.002	.043	23.477
	DL-Classroom	.274	.189	.087	1.453	.148	-.098	.647	.234	.113	.074	.710	1.409
	Delivery Interaction	.430	.139	.733	3.083	.002	.155	.705	.760	.235	.156	.045	22.058

a. Dependent Variable: Learning Outcomes

Table 30 – Hypotheses Summary

Hypothesis	Support
H1 – Positive relationship between academic usefulness and curiosity initiation	Supported at $p < .01$
H2 – Positive relationship between user friendliness and curiosity initiation	Supported at $p < .01$
H3 – Positive relationship between curiosity initiation and motivation generation	Supported at $p < .01$
H4 – Positive relationship between motivation generation and learning outcomes	Supported at $p < .01$
H5 – Motivation generation acts as mediator between curiosity initiation and learning outcomes	Supported at $p < .01$
H6 – Student type moderation of relationship between curiosity initiation and learning outcomes	Not Supported
H7 – Class delivery type moderation of relationship between curiosity initiation and learning outcomes	Supported at $p < .01$

Focus Panels – Students and Faculty

In order to provide some further context to the quantitative research, a quasi-focus panel approach was used. This involved both students and faculty, and utilized their feedback to supplement, and provide insight into the conclusions drawn from the quantitative analysis. While neither of these qualitative investigations used a formal focus panel methodology, they still provided many of the same results one would expect from a formal focus panel. The purpose was to provide some qualitative evidence to confirm and add context to the conclusions from the quantitative research.

Student Focus Panel

The student focus panel was developed from a synthetic analysis of the open ended survey questions and the student report outs, which occurred at the end of each semester. The report outs were done on the last day of each semester, and consisted of presentations by the top three (3) teams of four-five (4-5) students. After the student presentations, there was a general discussion about the SSG with the entire class. The students completed the survey on their own, after the report out sessions. For this reason, the response rate for the survey was not 100%, as the students responded on their own after the course ended. The notes from the student report outs also included the post report outs discussion period. These notes were combined with the open ended questions in the survey to identify categories and themes about the SSG through the lens of the students.

There were fifteen (15) student report outs over the five (5) semesters, which produced several themes. Notes from the report outs, and the follow-on discussions were reviewed using qualitative analysis similar to how focus panels are evaluated. Going through the notes from these report outs, several themes emerged. The most commonly mentioned items were pulled out of the notes from the report outs and discussions:

1) The most commonly mentioned item during the presentations was that students felt that they lacked an understanding of the SSG behavior. Their concerns were that they could not connect their decisions to the game results, and often referred to this as a component of the system being user friendly. This theme was present in all five semester report outs, and mentioned by most of the presenters. Further, during the post report out discussions, this was a commonly mentioned point. They felt that understanding how the SSG would connect decisions was important, although they also acknowledged in the real world, that they probably would not be able to perfectly connect decisions to results.
2) Closely related to the first theme, was the students desired more documentation around the SSG. They had been provided basic documentation on how to use the game functionally, but this was strictly technical, and did not address the business function or logic. The reasoning from the faculty member was that he wanted the learning to include how to analyze problems through the business view, which is always uncertain. No business leader gets to make decisions with all the facts.
3) Along a similar theme, the students identified the realism in the SSG, especially how it mirrored the real world decisions by sales managers. Several presentations pointed to realistic decisions around sales team motivation and management styles, which were specific to the individual sales team. That allowed for a realistic experience in direct management of sale teams.

4) Another element of realism showed around account management decisions. Many of the team report outs pointed to the fact that as the sales leader they needed to make decisions around which salesperson to assign to each account, and this was a critical decision. Many teams reported this to be very challenging, and most noted that it was a decision that was crucial to game success, which is similar to the real world.
5) Another theme that showed in some of the presentations was the way the game was scored, as the students did not have access to how the faculty member weighted certain outcomes (i.e. profit versus growth versus market share, etc). This was actually a theme during the discussions that some students indicated that they felt it was very hard to make decisions without fully understanding the impact on the scoring. Again, this was intentional by the faculty member, who wanted to let students feel the real world of decisions under uncertainty.
6) Finally, some of the teams indicated that they wished the SSG were setup so they could make more decisions rather than have the game determining this for them. Examples cited included changing prices, hiring and firing of sales-people and even changing the number of staff in their district. The faculty intentionally did not want to expose the students to this large array of decisions.
7) During these report outs, the presenting students were the only ones speaking during presentation, but the post-presentation period discussion was broad based and most students in the class participated.

Similarly, the open ended survey responses by the students were also qualitatively analyzed. The survey was taken after the report outs and post presentation discussion groups. Referring to the survey in Appendix B, there were four open ended questions. The first one asked what students saw as the positives in the SSG, and the second one asked they saw as the negative points. The third and fourth questions addressed what the students saw as possible improvements in the SSG, as well as how it might be better positioned in the syllabus. The most common themes developed from the open ended question were as follows:

1) One of the most common themes was how the SSG emphasized working within a team. This was interesting, as this was not necessarily a goal of the SSG, and the factor analysis did not show teamwork as an important item in either factor.
2) Closely related to teamwork, another common theme was working alone instead of within teams. That is, some of the students indicated the desire to work alone, rather than within a team. Working individually also seemed to be associated with students who felt that they strongly agreed with the learning outcomes from the SSG. These students indicated a desire for competition and the winners to rise to the top, and translate to grades. There was a difference between students who were more individual and the ones that preferred more team based results.
3) Realism was mentioned in several forms. For example, experiencing the real world of the sales manager in terms of what types of decisions they need to make, the constraints and associated risks of these decisions. They also pointed out the need to motivate and train their sales teams was clearly in the SSG, and it reinforced the pedagogical side of their course.

4) Closely connected to the realism of the SSG was how it was interesting, and that interest came from the fact the SSG matched what the students were learning. Examples cited were the motivation of sales teams, setting quotas, setting targets, assigning accounts and managing costs. Several commented that the syllabus being aligned, and the system working technically were a key part of keeping them interested and motivated.

5) Distance learning was mentioned to be a negative experience with the SSG, as the students often mentioned how much better they learned, especially with teams, if they were on-site. Remote students found working with other team members who were virtual, to be very challenging.

6) Game scoring was mentioned frequently as a element of confusion in the SSG. The students generally felt that they were not sure how to score more points in the weighted instrument. The students did not have access to this weighting, and this was very similar to the comments seen in the report outs.

7) Learning from the SSG was often mentioned, and attributed to how well the SSG worked. Words mentioned included technically sound, user friendly, easy to understand, intuitive, alignment with course content, reinforced learning, competition made SSG interesting,

8) Finally, there was a theme around the experiential learning derived from the SSG, due to its realism and comprehensive nature. As such these comments also included a desire to use more realistic elements, such as setting prices and selecting and firing salespersons, all of which are possible in this SSG.

Faculty Focus Panel

The faculty focus panel utilized the meetings from during the SSG development, so they represented a retrospective view. The focus panel is the Schmidt School of Professional Sales faculty, who represented a very diverse set of academic backgrounds. They were a mixture of research faculty with terminal degrees along with many who had industry experience and lacked the full credentials of their research peers. Similar to the student focus panels, the purpose of this qualitative analysis was to again help provide context to the empirical work and hypotheses previously discussed. This involved reviewing the notes and documents built with these faculty as the SSG was being conceived and developed. Included in this was the review of the Dana simulation by this faculty team.

The primary objective of building this SSG was not only to improve the learning in the sales leadership class itself, but also develop a platform that would allow the main sales curriculum to have an SSG for each course (six in total). In this way the desire was to have a continuously reinforced pedagogical modality that would apply in all the sales curriculum. The faculty fundamentally believed that SSG's would be interesting and motivational toe the students, which would contribute their learning. As such, considerable time was put on areas like having the user interface very user friendly, and technology that was sound and reliable. They also felt that the SSG would need to somehow transmit the appropriate academic content naturally in the game play, and that each SSG would need a way to address the specific content. Finally, there was a belief that the SSG needed to be configurable, in order to allow for many scenarios and maximize the unique experiences that could take on real world learning.

While not as many thematic categories of the students, there were many important incites that came from these meetings. The themes that evolved from the faculty meetings represented their design vision, and were as follows:

1) The SSG needed to be simple and easy to use, and not requite extensive training. An intuitive interface was considered critical as there would not be extensive time for training students in any course.
2) The SSG needed to contain the course academic content, as they felt the SSG was to reinforce the learning from the class. The faculty all felt strongly about this factor, as they felt the SSG reinforced the learning, as opposed to create the learning. This was in contrast to some SSG's that were meant to teach content by actually playing the game, and learning like in real life, in the absence of any content knowledge.
3) There was a continuing theme of making the SSG captivating and interesting. Included in this idea was to build a platform that had SSG's for every sales course, and allow the students to emulate a "Second Life" experience where they build a sales career across all six sales courses. The feeling of faculty was that interest would lead to learning via some mechanism.
4) There was also a strong view that the SSG needed to be configurable in order to cover many scenarios from the course. This also implied a flexible architecture, so it could be delivered remote synchronously (or asynchronously) or on premise in class. A flexible configuration would allow the SSG to be played in teams or as individuals, and play in a zero sum game, or against the computer.

COVID-19 Semester – Spring 2020

The spring semester 2020 turned out to be an unusual experience, as it started out in normal fashion, and then pivoted to a completely remote situation. Therefore, this class became entirely on-line amidst all the other issues that the students were having. Many of these students were set to graduate, and would have normally had a commencement ceremony, all of which disappeared on them. So, while the mix and academic capability of the spring 2020 class was similar to the other five semesters, they presented a completely new view of the SSG.

The end of semester survey in the spring 2020 class showed remarkedly different responses, and for that reason was not combined in the empirical analysis of the hypotheses. Only 29% of the students in this section responded to the survey, versus 60.5% in the previous five semesters. They were more frustrated in general, and offered many more negative comments around the SSG, including many who felt that it should never be used again. While there were some positive statements about the user friendly interface, intuitive flow and the strong connection to the course material, the negative feedback around remote learning was extensive among respondents. The common theme in the spring 2020 class was that distance learning as a method of delivery was unworkable, and inhibited learning.

While this section had many confounding factors, their comments around remote delivery were interesting, and do line up with the empirical work that showed on-premise delivery is preferred over on-line, even when it is a normal semester.

5.4 Discussion of Results

This research started with the objective of building a strong case for the efficacy of an SSG as a tool to increase learning outcomes for sales leadership students, which was accomplished. The study started with a review of simulation games that use a strong pedagogical focus, and noted the wide range of vocabulary surrounding these tools. To bring some clarity to this research space, I then defined a new taxonomy called serious simulation games ("SSG's"), and further demonstrated where SSG's fit. Further, a reference example of a very sophisticated SSG built for Dana Corporation was highlighted as it became the seminal event leading to the development of the Sales Leadership SSG, which was the central artifact in this research. A combination of this researcher's extensive background in the field, along with a comprehensive literature review built a research model, which was analogous to the TAM structures, but applied in the modern context of an SSG. This research model consisted of seven (7) distinct hypotheses, some of which had been tested individually by other investigators, however nobody had ever conceived a complete model. In order to test this research model, a new SSG was developed using evolutionary software structures with a configurable database, which allowed for a virtually infinite number of scenarios. This was delivered via the web using a cloud architecture, which made it browser and device agnostic. Thus, this SSG could be deployed easily for on-premise as well as distance learning students, and deliver synchronously or asynchronously. As part of the development of the SSG, a survey instrument was also developed and validated (Appendix B), in order to assess student self-reported responses to the key elements of the research model. The SSG was deployed in a sales leadership course (PSLS 4710), which had a faculty who had used simulation before. This kept the faculty and the SSG a constant in the research. The SSG was used with the same configuration with the same faculty for five consecutive semesters, over three academic years. The survey results collected from 166 students (60.5% response), and a hierarchical stepwise multiple regression was used to test the research model.

The key elements of the analysis included a check for the normality of the data, which confirmed that parametric methods would be acceptable (Table 6). Then the five classes were checked for similarity, to insure that there was no bias in the population groups. Data (cum GPA and PSLS 4710 course grade for all students) were pulled from the Banner student system tables via SQL statements, which allowed anonymous evaluation of all the students in the five classes (274). This data were evaluated by two single factor ANOVA evaluations. Both showed that the five classes were academically similar (Tables 4 and 5).

Then the survey data from the five semesters, which covered 166 students, were entered into SPSS for analysis. All the variables including demographic, closed end questions and open ended items were entered. Additional transformations to this data were made for the analysis, including standardization, z-transforms, interactions transforms and recoded variables to create numerical values. This was the core data that was analyzed.

A factor analysis provided two excellent latent variables for the model. Academic usefulness which was described by course content items, and user friendliness which was based on technical items were the two factors. These two items explained 76% of the variance (Table 7), and showed strong KMO (.903) significant at a $p < .01$ level. The

Scree plot (Figure 4) showed two components with eigenvalues over 1.0 threshold, and the component matrix (Figure 5) providing clean loading of the logical items that fit the theory. The Z-scores were computed using the component score coefficients, and the data were loaded in SPSS for further analysis, specifically the first stage multiple regression. There was one Z-score variable for each of the two factors, so two new variables were inserted in the database.

The first two hypotheses were based on the theory that academic content and SSG user friendliness would predict interest (curiosity initiation). This is analogous to the theory behind the TAM measurement model. These factors were checked jointly, via multiple regression, and both H1 and H2 were supported (Table 12) at the $p < .01$ level with virtually no collinearity (VIF = 1.539). This is analogous to the measurement model stage of the TAM structure, so makes theoretical sense. We can conclude then that academic usefulness and user friendliness predict increased self-reported curiosity initiation by students. This was the first critical step, as without the measurement model, and this relationship, the research model would be hard to validate.

The third hypothesis was evaluated by a regression of motivation generation (DV) on the curiosity initiation (IV), which was supported (Table 15) at the $p < .01$ level with a $t = 16.638$. This was the relationship that was most studied in the literature, so it was expected to be demonstrated. Curiosity initiation represents interest, which has been identified as an antecedent to motivation, and action. The concept that interest is a predictor to motivation was again validated.

The fourth hypothesis was evaluated by a regression of learning outcome (DV) on the motivation generation (IV), which was supported (Table 18) at the $p < .01$ level with a t = 18.708. This relationship was also expected, as motivation is considered to be an antecedent to some action, which in this case leads to learning outcomes. Again, these were self-reported learning outcomes, as opposed to measured learning, which would require a quasi-experimental design. In any case the theory of motivation predicting a learning action was validated in this hypothesis.

The fifth hypothesis was aimed at determining whether motivation generation would act as a mediator in the relationship between curiosity initiation and learning outcomes. This mediating relationship was the least established by any prior research, even though the three variables were independently studied by several researchers. Even the work of Cook (2006) never provided this linkage, even though he did show the three elements to be associated. In fact, he actually considered this as a future item that might be studied. This research evaluated the relationship using the hierarchical multi-stage multiple regression, along with a Sobel test. The first two mediating conditions were established with H3 and H4, which were both positive. With these two conditions established, a direct relationship was then established between curiosity initiation and learning outcomes, using linear regression. This relationship was shown to be significant at the $p < .001$ level (Table 19). Multiple linear regression was then used to evaluate learning outcomes (DV) against curiosity initiation and motivation generation. This relationship was found to be significant at the $p < .01$ level, and both independent variables demonstrated this level with t values of 8.940 and 3.640 respectively. Table 22 shows the coefficients and the fact that there was virtually no collinearity, with a VIF value of 2.688. With the four regressions showing significant relationships, the mediation could be evaluated. The strength of the mediation was measured utilizing the standardized path ratio analysis, which showed an 87.2%, which is significant. Then a Sobel t-test was run, which showed the mediation was significant at the $p < .001$ level (Table 23). This demonstrated H5, which had not been done by any other research. This suggests that curiosity initiation predicts learning outcomes through a mediation by motivation generation. Essentially, analogizing to TAM structures, we have interest as the antecedent to learning outcomes flowing throw motivation, which provides the intent to action.

The moderation hypotheses both suggested that there would be variables that would modify the curiosity initiation to learning outcomes relationship. Both moderators were logical extensions of the literature as well as observations by this researcher. In H6, the moderator was the type of student, which in this research was the academic concentration of the student. The theory that was demonstrated by the prior research, suggested that a student that has a certain academic focus would have modified (increased) interest in the SSG, which has already been shown to predict learning outcomes. The moderation was evaluated in multiples steps that were covered in the results section. The evaluation did not show support for this hypothesis (H6), so the concept that student type (sales concentration) as a moderator was not supported. Even though this hypothesis was not supported, the results suggest that students no matter what their major or area of concentration, there was still a significant relationship between curiosity initiation and learning outcomes relationship. One might suggest this is actually a positive, as this means that all students can find an SSG interesting, even if they have a different major or minor. For a faculty using an SSG, this would be good news, as the non-majors in their class could interested in the SSG, even though it was not their field.

The same process to test H6 was used to test H7, which considered class type as a moderator. The theory developed through the literature posited that the class delivery modality should moderate the curiosity initiation to learning outcomes relationship. The class type was described as on-premise or on-line. The theory was that on-premise classes were more satisfying and should positively moderate the curiosity initiation to learning outcomes relationship. The theory was also based on the fact that a remote learning experience makes participating in a class SSG more difficult on student psyche. The multi-stage regression completed in the last section showed that there was some moderating affect. While there was some collinearity in this final model, the significance was very high with a $p < .01$, which can help reduce the risks of a Type I errors caused by the VIF over 10. Moderation at least partly was significant and H7 supported. Many faculty would suggest that when using specialized pedagogical tools, such as n SSG, being on-premise for the class will be an improved experience for students.

The summary of the findings is illustrated in Table 30, which shows six of the seven hypotheses supported. This provides the first time a comprehensive model has been built and demonstrated through empirical analysis. This provides a model which can provide significant guidance for both academics and practitioners in the use of SSG's. These findings become more compelling when compared to the findings in the qualitative analysis. Looking at the student and faculty findings, there are very specific items that help further validate the model hypotheses.

The student open ended responses were tightly aligned to several parts of the model. The user friendliness in the factor analysis identified three key elements. First, the factor analysis showed that user friendliness had three items; user friendly, technical performance and decision-outcome connections. Students reported in the open ended question and report outs that all three of these items were important. Particularly, they needed to understand the SSG behavior in terms of decisions to outcomes. The other key factor was academic usefulness, which was built on alignment to the elements in the syllabus. This was mentioned in the student open ended survey responses, and further confirmed in the report outs. There were numerous responses by students that the SSG should align to the content in the curriculum, in order to reinforce their learning. The students also pointed out that aspects of the SSG, particularly around realism, created engagement and interest in the results, which directly aligns to H1 and H2. Students also identified in the survey open ended questions that the SSG as a modality to increase learning, and this was repeated in the report outs, which aligned with H3, H4 and H5. The sales concentration moderator was not mentioned in the open ended questions or report outs, which aligned to the fact that this moderator was also not supported in H6. On the other hand, there were comments regarding distance and remote learning by students who felt this was a negative experience. So, the student open ended survey responses and report outs aligned to the finding that supported H7, the class type moderator. The findings from the COVID-19 spring 2020 semester added further support for this conclusion. Overall, the student open ended survey responses and report outs were in alignment with the empirical findings, thus providing positive context the findings.

The faculty panel qualitative analysis provided similarly positive context to the empirical findings. The faculty identified ease of use as a key factor during the development, which was determined to be a significant factor for the SSG in H2. The faculty also identified alignment to academic content as key, which was also a factor in H1. The faculty also identified interesting and motivating for learning, which was part of the core model. Finally, the faculty identified the need for a system to be deliverable flexibly to remote students, who they suggested might be less motivated (H7). The faculty added positive context to the empirical findings, and they did this before there was an SSG built or a survey constructed, so their thinking was completely independent from the survey analysis.

The confirmations of the research model and the associated hypotheses, along with the positive context from the qualitative analysis derived from the student and faculty panels provides a strong case for a sales leadership SSG as a tool to enhance skills of students in this field. In addition to confirming the theory and hypotheses in this study, this model has the capability of providing considerable guidance and predictive capabilities for both academics and practitioners. This is particularly true for those in the field of sales leadership training and development, who are seeking to build and utilize learning tools, especially SSG's.

Chapter Six

CONTRIBUTIONS, LIMITATIONS AND FUTURE RESEARCH

6.1 Academic and Theoretical Contributions

This research has provided significant new teaching and theoretical contributions to the academic community. This is especially true for those investigating the efficacy of simulation game structures as a pedagogical tool. This study will provide another solid building block for the continued research on this topic, which will become important as the use of SSG's grows in this field. As technology advances, we might expect that the use of these tools will increase, so that building an understanding around how to optimize their design and use, can only help their effectiveness as a pedagogical modality.

The first significant contribution was the creation of a new taxonomy to define serious simulation games ("SSG's"). This is very useful, as prior research has considered several modalities of simulations, games and other interactive tools, but none had addressed the concept of SSG's. By providing a clear definition of the modality, research can be more clearly focused, and prevent confounding factors associated with essentially different pedagogical artifacts. This was an issue that had occurred in some prior research, where the investigators mistakenly studied multiple pedagogies in one study, which limited their findings.

The second significant contribution was the development of a theoretical model from the prior research. To this point, research had explored efficacy questions, however none had integrated this into a single explanatory model. This model was built as an analogy to the TAM models, and then extended which for the first time provides an integrated view of the key predictors to learning outcomes associated with SSG's. Not only does this integrated model provide explanation, but also provides a platform to extend research on this topic. For example, the moderator factor was the dichotomous variable of on-premise versus on-line delivery. This could be extended to cover degrees of on-line versus on-premise, including hybrid courses. This could also pursue items like technology type, such as virtual reality and 3D deployments. This research model provides the basis and building block to extend the research in multiple areas.

A further contribution of this theoretical model is that it could be further decomposed into sub-models that would enable parts to be studied individually. The front end measurement model where two latent constructs (academic usefulness and user friendliness) are predictors of curiosity initiation represents a platform by itself. This model could be studied in very specific manners. Similarly, the backend of the model including curiosity initiation predicting learning outcomes and mediated by motivation generation presents many research opportunities. While there are many correlational studies that have evaluated the relationship between learning, motivation and interest, none have put this into a contiguous model, especially with moderating factors.

As part of this research, a new benchmark survey instrument was developed using literature, guidance from experts and survey validation methods. Most of the items in the survey were directly or implicitly derived from items and scales developed by other investigators. This provides a strong basis for the items, which were further validated by faculty experts in the field. Reliability was further demonstrated by testing and re-testing, as well as internal reliability measures. This provides an instrument that could be utilized by other researchers wishing to explore SSG’s, and even extended with additional items.

This research utilized a unique hybrid integrated approach covering theoretical model development, survey instruments, qualitative methods and multiple empirical methods. As was mentioned, a unique theoretical model was developed along with a benchmark survey instrument that was used to evaluate the model. The methodology of using an hierarchical stepwise multiple regression with formative constructs was an innovation, which was used to test the hypotheses. This was a useful way to evaluate the results incrementally, and collectively. Re-compiling the individual multiple regressions into an integrated model, and showing validity also provides a roadmap to evaluate not just this model, but extensions of the model. This also provided the basis for extending research on a single component in the model. For example, research could be done just on the curiosity intuition and the predictive latent constructs as a single model. By providing decomposed models with stepwise analysis, it leaves the researcher with a platform to extend the research.

The development of the sales leadership SSG, provides a vehicle for extended research around sales leadership pedagogy with this tool. As was mentioned, this SSG is configurable, and runs from an evolutionary software platform, which implies an almost infinite number of scenarios that could be studied. For example, the sales team avatars can be configured with a large number of attributes, which will determine how they might evolve uniquely in a given environment. This would allow a study of the leadership challenges to manage a sales team made up of given set of attributes, and competing against certain competitors.

Finally, the use of the research model and the associated findings provides teaching on how to optimally deploy and utilize this SSG. For example, the results show that having the syllabus align closely with the SSG decisions will provide optimal curiosity initiation. Similarly, the simulation could be delivered in a way that is more user friendly, so as to further optimize the user friendliness.

6.2 Managerial and Practitioner Contributions

In a very similar way, this work has made significant managerial and practitioner contributions. As has been noted, SSG's and similar tools are making their way into the corporate training and development programs. Providing a model around how to design, deploy and utilize these tools optimally, will only help their effectiveness and growth in the corporate space. The use of an SSG could be expected in a corporate or professional sales leadership program as the next generation employees enter the business. This is especially true when the SSG is built with realism and configurable attributes that enables the experience to emulate reality, which is critical for many practitioners.

Additionally, this model provides teaching for the sales manager to consider how to develop and advance skills, such as account assignments, motivation and quota establishment through the use of an SSG. The vast number of decisions in this SSG, provides a platform for practitioners to develop these specialized sales leadership skills. The SSG platform also provides considerable learning around competitive account management, pricing and particularly optimally matching sales team members to accounts. Due to this advanced platform, it would also provide the opportunity for academic research to be extended in the practitioner setting. For example, academic research could be extended into a specific market or industry to further validate the results in alternative contexts.

6.3 Limitations of Current Research

A few limitations were identified in this study. First, the study was very specific around sales leadership, and may lack generalizability to other domains. There was considerable contextual support for the empirical results, so there may be some level to extend to results beyond simply sales leadership. While many of the elements were directed toward sales leadership, the structural relationships between the leader in the SSG and the avatars (in this case sales team members) could potentially be generalized to leadership. The concept of managing employee resutls versus managing behaviors is applicable not only to sales leaders, but useful for all leaders. The sales leadership SSG provides this training, which could extend to all leadership.

Second, this was a cross sectional study, so lacked the temporal analysis or a RCT required for causation. Longitudinal data with a consistent cohort would have been required for that type of study, although that type of study is very difficult to carryout in an academic program.

Third, there were single item measures, which while they had been used by other researchers, perhaps could be improved. The compact nature of the survey instrument helped the student response rate (60.5%), however it could be expanded with a few additional items to possibly provide better measurement.

Finally, while the game was highly configurable, it was not changed during this study, and therefore did not take advantage of rich aspects that may have provided new insights. The fact that this SSG configuration stayed consistent, did provide the consistent data for the analysis, so this limitation was actually an advantage.

6.4 Future Research

An initial research opportunity would be immediately available, which would be to do more research with the current data set. Blending the qualitative data with the quantitative survey data could have the potential to surface further relationships. For example, we may be able to see how a student reported learning outcomes compared to certain qualitative factors, such as positive/negative feelings toward the SSG.

The future research opportunities with this platform could allow ever more granular empirical investigations including RCT experimental designs. This SSG's configuration capability provides an almost infinite number of possible playing scenarios, which would allow for new more granular studies. This would allow investigations around the effect of different configuration factors (treatments) in a quasi-experimental design. The questions that could be explored are around the efficacy of micro effects on the players. Instruments could be designed to measure pre-post learning impacts in these cases. Research questions might include:

- Does a given configuration impact learning of a given sales leadership skill?
- Does a given configuration impact learning of a given sales leadership skill for a specific category of learner?
- Does learning of a given sales leadership skill lead to improved performance in the SSG results?
- Are certain skills within the sales leadership set more difficult to learn?
- If certain skills within sales leadership are more difficult to learn, is this relationship moderated by the SSG configuration?

- Are certain skills within sale leadership enhanced playing SSG's with more visual interaction (i.e. human to avatar conversation)?

This SSG platform enables a rich growth in research, and could be extended to the professional market, to answer similar questions around that population. This could also be in conjunction with an expanded qualitative study with the open ended responses, and focus panels. There would be an opportunity to integrate a non-parametric analysis of the focus panels with the empirical results from the survey instrument. This could lead to the discovery of new measures and scales.

This model and associated SSG could also be used to apply for research grants that are aimed at addressing questions around SSG's as a modality of training and development, including method of delivery. An area that is likely to get more attention in the near term would be to provide SSG's as part of remote and virtual learning in a way to overcome the limitations of distance learning. Identifying ways that the user friendliness of the SSG might drive higher interest, and overcome the negative moderation from distance learning could prove advantageous.

6.5 Extension of Current Serious Simulation Game Platform

This sales leadership SSG will provide the platform to extend over the other academic programs in the Schmidt School of Sales. This will provide an integrated "sales world" platform that serves all six (6) courses in the professional sales academic program. This integrated platform could enrich the Schmidt School's academic program, as students experience the world of sales through this SSG, which could provide a type of "second life resume" for students in this program. A natural extension of using the SSG for the academic program, would be to deliver this SSG in a more advanced configuration to outside professionals in the field of sales leadership. Professional students would also provide extension to the research model.

Other areas of SSG extension could include academic courses covering cybersecurity, project management over engineering and business, other business programs such as finance, strategy, product development, supply chain, entrepreneurship, venture capital and innovation. Essentially, any course where a virtual reality based SSG could lead to experiential learning, represents an opportunity to expand the use of this platform. The addition of more advanced visualization using 3D/VR animation and augmented reality would be natural extensions to the platform. This in combination with the SSG intelligence could add an ever more realistic experience for the students Essentially, the configurable nature of this SSG makes it a natural platform to extend across the University of Toledo enterprise. It could provide considerable integration between the College of Engineering and COBI. For example, one of the current protype SSG's was built to emulate the National Science Foundation's ICORPS program, which has historically used the senior design project from Bio-engineering in combination with the COBI entrepreneurship program.

Finally, the platform and research model could be extended to bring joint funded research projects to COBI and the College of Engineering. The new projects from the University of Toledo Sponsored Research Programs covering cybersecurity on the hybrid electrical grid network will take advantage of this platform in collaboration with the National Labs. This research will involve a serious simulation game covering cyber wars on the hybrid electrical.

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Appendix A

Sales Leadership SSG Development

This appendix covers the development, testing and launch of the sales leadership SSG.

Development Methodology

The development of a SSG requires several key steps (Fullerton, 2008). The initial phase is the simulation conceptualization, which is both a creative and analytical process that requires subject matter experts (“SME’s”). The conceptualization consists of ideation around the subject matter of the game, the use case in an academic setting and the storyline of the simulation. After the game conceptualization, the model is developed, which frequently entails reviewing literature for empirical relationships. Synthesis of empirical studies involves normalizing the data models over many research papers. Algorithms can be relatively simple, but frequently use very advanced modeling and artificial intelligence (Harris, 2006). The next step is the functional and technical design, where all the variables, data models and pseudo code is generated. Finally, the game is developed including decisions, input/output, results, scoring and assessment tools. Once the game is created, it is tested (unit and integrated) and play tested with typical users.

Algorithms and Artificial Intelligence Background

The development of SSG algorithms involves not only the models, but also may use forms of heuristics and artificial intelligence. In the development of SSG’s, the type of artificial intelligence varies depending on the type of SSG and how the AI needs to operate in the game context. Typical AI structures in SSG's include several common models:

- Rule based algorithms that operate on conditional trees, where there is a finite and deterministic route to the decision-outcome threads. The advantage of these algorithm sets is that they are less complex and easy to evaluate and test. This makes them applicable to the less complex SSG models.
- Rule based probabilistic algorithms that create random modifiers to the threads in a pure rule based system. The stochastic nature of these algorithms provides the richer SSG with the same parsimonious model that a pure rule based system provides.
- A close cousin to rule based algorithms are behavior trees that provide predetermined structures as all possible routes are clearly understood. Like rule based systems, these can provide simpler models, but their disadvantage is the outcome possibilities can be very constrained and overly simplistic.
- Machine learning algorithms for SSG's include neural networks and genetic algorithms. Both offer highly realistic, but complex structures for SSG's.

Genetic algorithms ("GA's") are derived from the field of biology and used by analogy in computational science. This concept has its origin in the works of John Holland, who used the principles of living organism reproduction to develop evolutionary programs (Holland, 1976). Holland noted that these evolutionary programs had the unique ability to find the near optimum in very complex systems more quickly than other techniques, as only the most “fit” solutions would “survive” after each iteration in a model. This concept uses the Darwinian principles that survival depends on the species breeding and creating ever more fit individuals that can survive in a given environment. This means that a GA is an iterative solution that works to breed the best offspring (as measured by some kind of fitness test), and therefore works with large populations to achieve this result. This kind of evolutionary program is only recently making its way into SSG’s, due to the large complex computing load and the difficulty of controlling its direction (Kirby, 2011). Even Holland noted, “computer programs that evolve in ways that resemble natural selection can solve complex problems and create results even their creators do not fully understand” (1976). In a large scale SSG, GA based models can be very difficult to test. Goldberg, who was one of Holland’s students, clearly explained the steps behind GA operators (1989):

1. First, the genome (set of chromosomes) must be identified and coded (binary). For example, a business may have a large set of characteristics that some define as the corporate DNA. A given actor-object (i.e. a sales person) could make up a genomic pattern, with several chromosomes (traits), so one of its “traits” might be ambition. This trait could begin in a natural state for the avatar, but evolve as the simulation proceeds. This may influence the sales results, and ultimate success of the firm, so the evolution during a simulation would be based on the ambition that leads to the optimum outcomes.

2. Second, a fitness function must be created (i.e. sales success). When using GA to find an optimum solution, this will be connected to the objective function. When GA's are used in an SSG, it is more about growing "intelligent agents" within the game. The purpose of the fitness function is to select out the most fit offspring to survive in the next round. This natural selection is used to evolve the traits of the actors within the SSG.
3. An initial population is chosen. In GA, this is usually very large, as the surviving population will shrink quickly after a few iterations, until the failure rate levels off. Typically, the failure rate of offspring will become asymptotic as iterations proceed.
4. A reproduction process is then executed by mating and reproducing offspring asexually. This is done by performance of a crossover (at the chromosome level), and then followed by a mutation. The crossover is typically performed by randomly splitting the chromosome at given point (i.e. digit 4), and performing this crossover on a certain number of the chromosomes. If the crossover rate is 1.0, then we perform crossovers on all the traits. This creates an intermediate population that is randomly mutated. The mutation rate defines the fraction of the chromosomes that are switched at a single point. This creates the offspring population, and at times reduces the fitness of a given offspring, as mutation does not guarantee improvement, only evolution.
5. The offspring are then selected for survival by filtration through a fitness function. A randomized process may be used with this also. The output of this

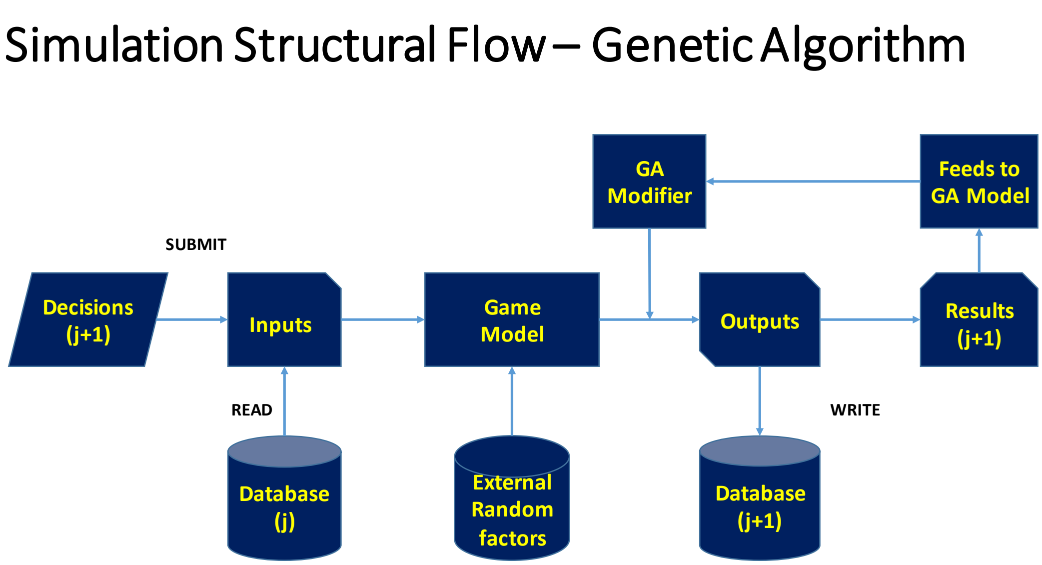
step then provides the surviving offspring that goes back into the pool for step #3. A certain portion of the offspring that were not selected are usually put back in the pool with the surviving offspring, so that the GA operator does not converge too quickly to an improper solution. In optimization problems, this is to avoid local optima being mistakenly found and thought to be the global optimum. In an SSG we are only concerned with evolving the traits of the actor-objects in the SSG.

6. The above steps are done iteratively until a solution (could be an optimum) is achieved. In the application of GA's to an SSG, the objective is to evolve the actors within the game circumstance, as opposed to find an optimum solution. As such, the process is set to terminate at a certain number of iterations from a programming standpoint.
7. The final solution of applying GA's to SSG's is then a given actor's traits have been evolved as a function of the game environment, such that the traits that will "survive" best will be retained by the actor.

GA's are being used in a large number of fields, and the concept itself is still evolving. While the high-level framework of how GA operators execute is well understood, independent researchers are deriving their own distinct GA operators that are tailored to their specific problems (Kusyk, 2011). Another reason for the recent evolution of GA applications is the growing computing power researchers can use. When Holland first conceived this idea, it was nearly impossible for a normal researcher to get enough computing power to run a solution, which made much of the initial work analytical. Now we see many more examples of computational work that empirically demonstrates a given GA modality (Tsafarakis, 2011). The goal is to create GA operators that can act as modifiers in a simulation model, such that intelligent agents (“robots”) make human like decisions in a way that insures their competitive survival as competitors or co-operators. Synthesizing multiple robots into a stable system is still not a science and the large simulation game studios require broad expertise in creating stable systems (Lengeyel, 2012). The concept of a GA modifier in a simulation game flow is depicted visually in Figure 6.

In the sales leadership SSG, GA’s were used to create trait evolution in selected areas. This created balanced equilibrium for negotiation processes, selective forces during successful sales transactions, genetic drift in various behaviors and reduced vitality of avatars as their stressors evolve.

Figure 6



Sales Leadership Simulation Game Development

Simulation game development covers the technical/functional overview, storyline, game components/objects, configuration, model development, decisions/outputs/game flow, and how users are scored/assessed (Fullerton, 2008).

Technical and Functional Overview

This SSG's intent is to be used as part of a Sales Leadership or Sales Management Class. This class is taught at many universities, typically dealing with topics related to managing a sales force at the first line, operational level, and including topics such as the fit of the sales function with the strategy of the firm, designing and organizing a sales force, account assignment, compensation, motivation, recruitment and selection, training, coaching, and evaluating salespeople. The use of a SSG provides a realistic practical experience, and enables operational experimentation in a safe environment.

The game audience (players) is intended to be students (individually or in teams) who are taking a sales leadership class (in the extant case at University of Toledo that is PSLS 4710), usually at the junior or senior level of an undergraduate sales or marketing program, although it could be played by MBA students as well. Students enter the simulation as sales managers supervising a sales force. The course instructor is able to utilize the game as part of an overall instructional design of the class. As such, the game could be included within the actual class setting, or setup so the people (teams) engaged in this training can play asynchronously outside of the classroom setting. In either case, the game's objective is to enhance their skills around the sales leadership topics and objectives from the class. In most cases, the SSG is used in conjunction with traditional pedagogies, so the SSG represents an application of project based learning or experiential learning of the class material.

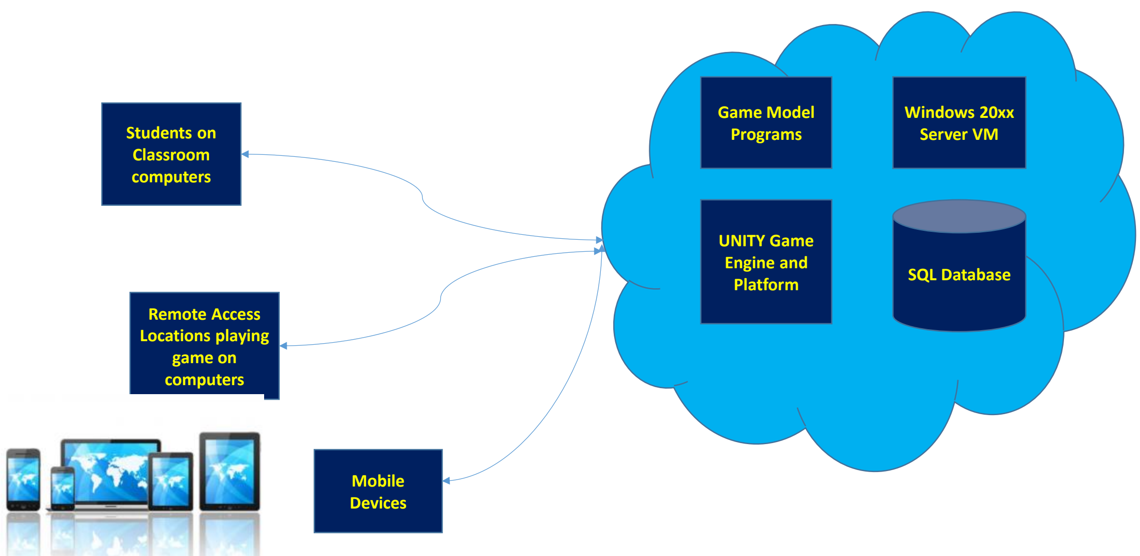
The students play this simulation as a player versus system ("PvS") game. This means that the players do not see the other students as their competitors, as would be the case in a zero sum game. They are playing against the intelligence within the simulation. The sales team, competitors and customers are all acting as intelligent avatars within this SSG. These avatars adapt depending on the decisions made by teams, as well as random exogenous factors that affect the ecosystem. This structure drives the SSG to evolve recursively after each round.

This SSG is a game with an educational purpose. It is a round based strategy game, and not real time, so there is no concept of time in the simulation (i.e. like real time video games). Since it is a round based strategy game, there is no game clock that is functioning inside the simulation to limit the time taken on decisions. In v1.0, the system was built on a closed model, meaning that all possible player decisions are pre-defined, and there are no open ideas, options or decisions. Even though the decision options are pre-defined, the results from playing of the game are not. Through a combination of heuristic algorithms and randomization, the results may be unique to each playing scenario. This allows a much faster entry of the game, and quick learning as to what will work best for players to learn sales leadership. This SSG is a personalized sales leadership learning experience, and every player situation can be unique.

The technical architecture of this simulation game is "cloud" based, which means no part of the system resides on the student computers, or any system in the classroom. The game user interface is accessed via any browser, and is client device independent (i.e. Apple, Windows computers, tablets, mobile devices like Android, etc). This architecture allows the simulation to be played asynchronously from any place at any time. This flexibility is essential for the desired sales leadership course syllabus functionality. Since the simulation is running in a cloud architecture, the elements of the game including servers, database/storage, security, identity management, game model, game engine, program execution and control are all functioning in the cloud hosting location. Currently, this SSG is running on the Microsoft Azure cloud service, but could run on any cloud service. Figure 7 displays the technical architecture and components of this SSG.

Figure 7

Simulation Game Cloud Technical Architecture



Storyline

In the above context, this SSG story covers an individual sales manager, as this person progresses through the sales management operational functions. There are several broad areas of the sales management game:

- Before the game even begins, the sales force structure has to be established and the organization put in place. This is part of the configuration by the faculty member, who determines the sales team members' attributes (i.e. genomic traits). Once the sales team is established, other parts of the game are configured, which includes competitors, customers and product configurations. Then it is ready for the students to play. The player makes strategic decisions regarding each sales team member including compensation, training plan, account assignments and management style.

- The game story provides a product (Software as a Service "SaaS"), a diverse number of key accounts, several unique competitors, resources (funding and time) and randomized exogenous variables. These game actors function autonomously in the simulation game utilizing various heuristic algorithms.

- Once the sales force and game structure are established, the operational management begins. This is where the game storyline fits. The players decide on: account assignments, compensation incentives, sales' representative development and management style decisions. Sales representatives' attributes include experience, skill level, motivation, career stage and personal variables (motivation, effort level, employee satisfaction and turnover intentions).

<u>Storyline – Opening Screens – Assessment Utilizing Dashboard</u>

The game storyline opens up in a setting where the manager (representing a team or individual player) evaluates the sales team members, accounts, product, competitors and the financial condition of the business. There is no actual animation, so images are computer graphics in 2D web user interface static format. This game is played and visualized entirely in a 3rd person POV. The reason for this construct is that each player's sales manager avatar has unique attributes, which are set as the actual attributes of their human counterpart (when there is a one to one match between player and sales manager). In this way, the simulated results approximate what might happen when the manager attempts to carry out the same process in the real world. In the opening screens, the manager has already have been presented with the situation established by the instructor during configuration (e.g., product; organizational factors including sales force organization, strategy and base compensation; general environmental issues like demand, seasonality and economic situation; as well as with the six salespeople who work for the sales manager). Additionally, any news flashes from corporate requiring management action are provided, such as price increase or decrease limits. All this information is made available to the manager (student players) before the start the game and each succeeding round via the results dashboard.

In the opening screens, the student players (who are playing the manager) are introduced to the past period performance statistics (via a dashboard) for each salesperson on the sales force. Each round starts with these dashboard screens. The manager uses the dashboard to assess results and plan decisions regarding managing sales force for the next period. The manager's dashboard shows the last three periods (training received, motivational tools employed, compensation, account prioritization, and outcomes including calls made and revenue/profit generated; both in report/graphic formats). After each round this assessment takes place.

Storyline – Second Screens Goal Setting Decisions based on Assessment

Once the manager (student players) make their assessment, they can enter any updates into their sales team includes targeted number of calls and revenue by account. These targets are for each sales person for the upcoming round, with some also set by account. Each round this goal setting takes place. An option is always be to leave all decisions from the prior round the same (i.e. make no changes and move to next set of screens – sometimes known as the "do nothing" decision).

Storyline – Third Screen Operational Decisions based on Assessment and Goal Setting

In the next screens, the manager (student players) now enters decisions covering compensation, incentives, training/development and management style to be used with each sales person. The manager (student players) see the results of each salesperson before they make the final decision on each variable. The manager (student players) submit the goal setting and operational decisions. All outcomes are based on the decisions made and the programmatic game model.

After each round there are outcomes based on the sales manager decisions. These include sales results at each account, sales results by sales team member, motivation levels of team members and financial results of the district.

Game Components – Actors, Objects, Resources and Variables

There are five significant actors (game objects) in this simulation game. They include the sales manager, sales team members, customers (aka "accounts"), product and competitors. These game components with their attributes are as follows:

- Game Actor Attributes – Manager (1 Manager per sales team = the player's avatar)
  - Six (6) attributes represent the Manager – all are fixed at configuration and do not vary during the simulation
    - Social Type (1-4 integer)
    - Sales Manager Experience (1-100 integer)
    - Selling Orientation (1-3 integer)
    - Ambition (3N.N)
    - Power Orientation (3N.N)
    - Target Accountability Factor – (3N.N)

    - The attributes are representative of the avatar for the student player(s) and have nothing to do with any player (i.e. be a fictional character within the simulation representing the student team).

- Game Actor Attributes – Salesperson (6 sales people assigned for each sales team) – the name and social type are fixed at configuration and do not vary during the simulation. All the other attributes are initialized at configuration but vary during the simulation game
    - Name (short text)
    - Social Type (1-4 integer)
    - Sales Experience (1-100 integer)
    - Total Experience (1-100 integer)
    - Time with company (1-100 integer)
    - Industry Experience (1-100 integer)
    - Historical Performance (3N.N)
    - Product Knowledge (3N.N)
    - Industry/Competitor Knowledge (3N.N)
    - Legal/Regulatory Knowledge (3N.N)
    - Company Knowledge (3N.N)
    - Skills (time management) – (3N.N),
    - Skills (technology) – (3N.N)
    - Skills (selling) – (3N.N)
    - Skills (communication) – (3N.N)
    - Skills (proposal writing) – (3N.N)
    - Ethics Level (3N.N)
    - Sales person performance based variables (some internal to model)
        - Performance Record (3N.N)
        - Internal Motivation Level (3N.N)
        - Motivation Level (3N.N)
        - Effort Level (3N.N)
        - Turnover Intention Level (3N.N)
        - Salesperson Index (3N.N)
        - Employee Satisfaction (3N.N)

- Game Actor Attributes – Customers (18 in total game) – the name, type and loyalty attributes are fixed at configuration, and do not vary. All the other attributes are initialized at configuration and vary during the simulation.
    - Name (short text)
    - Type (A,B,C)
    - Loyalty Trait (3N.N)
    - Volume Potential (units) – (1 – 1,000,000) – initial configuration and update per round
    - Revenue Potential ($ currency) – initial configuration and update per round
    - Revenue Actual ($ currency) initial configuration and update per round

- Product Price ($ currency) – initial configuration and update per round
- Probability will Consider Meeting (0-1 continuous variable - number 3,2)
- Probability will Consider Purchase (0-1 continuous variable – number 3,2)
- Probability will Make a Purchase (0-1 continuous variable – number 3,2)
- Customer Satisfaction (3N.N)
- Geographic Location (3N.N)
- Support Requirements (3N.N)
- Security Requirements (3N.N)
- Customer Problem Requirements (3N.N)
    - Costs
    - Supply Chain
    - Market Timing
- Price Sensitivity (3N.N)
- Early Adopter Tendency (3N.N)
- Technical Capability (3N.N)
- Affinity for Cloud SaaS Products (3N.N)

- Game Actor Attributes - Product that is being sold – the product typology, customer support, technical security and customer problems solved are set at configuration, and do not vary during the simulation. The remaining attributes are initialized at configuration, but vary during the simulation.
    - Product Typology (this is a Software as a service "SaaS")
    - Customer Support (3N.N)
    - Technical Security (3N.N)
    - Solves Customer Problems (level) – (3N.N)
        - Cost problems
        - Supply Chain problems
        - Market timing problems
    - Product Maturity (3N.N)
    - Product price ($ currency)

- Game Actor Attributes – Competitors (4 in game and fixed during configuration) – all the competitor attributes are fixed at configuration, and do not vary during the simulation.
    - Name (short text)
    - Geographic Location (1-100 integer)
    - Aggressiveness (3N.N)
    - Product Focus (3N.N)
        - Costs
        - Supply Chain
        - Market timing
    - Customer Support (3N.N)

- Product Security (3N.N)

These attributes represent game variables and fall into three categories, which include variable, configured-variable and configured-fixed. Configured-fixed variables are associated with things that are core to the actor and do not change during the simulation (i.e. personality traits of a sales person). The configured variables are covered in the next section (Configuration). In addition to these actor-attribute variables, the simulation has some additional variables. The computed variables in the financial statement and financial ratios represent most of these variables. The only other variables in the simulation are the market growth and seasonality, with can be set-up during configuration.

<u>Configuration</u>

The simulation is custom configured by the faculty who utilize the game within their courses. Each configuration represents a unique experience, and will typically have its own identifier. This allows the faculty to set-up the simulation game experience to be more or less complex, according to what they want their students to experience. This allows each game (configuration) to be unique to each team within the class, if that is a desired objective. In this way, different challenges can be set-up unique for each team, if that was a useful modality. This also allows the course faculty to have each team play multiple game configurations (i.e. play the game two times, with one very difficult scenario and one easier one). The configuration options are as follows:

- Game Player set-up (some data may come from the Learning Management System integration)
    - Course #/Section # (LMS integration)

    - Game Name (short text)
    - Game configuration # (if more than one being played per team)
    - Names of students in specific class (LMS integration)
    - Names of Teams (short text)
    - Student Assignment to teams (members of the Team table from student list)
    - Multiple game configurations may be set-up per team

- Length of Play Option by Game
    - Set play to # of rounds in a game (game automatically ends after that # of rounds)
    - The game is self-paced, however the faculty can configure a date and time limit per round. This is a self-paced game until this date/time for each round. Each team plays the same number of rounds, and is subject to the same time deadline in each round.

In addition to this game configuration, there are attributes of the game “actors” that can be set-up variably. Game actors include the Manager, Salespeople, Customers, Products and Competitors. The attributes of each actor type appeared in the prior section. All of these actors’ attributes are defined during configuration, and some vary during game play, while others remain fixed. The market growth and seasonality level are also set-up during configuration. The growth rate increases (or decreases) the market each round by an economic index level. The seasonality accentuates the market by a cycle per round, and follows a Taylor series shape over the game cycles. The level of oscillation (wavelength and amplitude) in the function is fixed during configuration, and remains a constant.

<u>Simulation Model Development</u>

Once the concept and storyline of a game is created, the next step in the process is to create the game model (Fullerton, 2008). The model represents the game engine, and must virtually simulate reality, if the users are going to have an effective experience. Essentially, the model must build a mathematical resemblance of the reality the users will experience (Fishwick, 1995). In a perfect world, we would construct the entire simulation model from a comprehensive set of empirical research. However, in the real world, empirical research is very targeted and specific. However, SSG's invariably cover very large functional landscape, so by definition need many empirical research artifacts. This means that our model must be constructed from several areas of research, including some that are qualitative or semi-quantitative. This is a common problem, and other simulation game developers have created solutions to this problem (Zhang, 2012). While these do not resemble one large empirical model, they are reasonable for our purpose, as experienced subject matter experts can test the model for "reasonable reality" (Boinodiris, 2014). Each part of the model can be constructed with a combination of empirical research as well and qualitative inputs from subject matter experts (Kapp, 2014). In order to create this sales leadership model, subject matter experts (Dr. Michael Malin and Dr. Ellen Pullens) provided the holistic model assumptions, which included extending qualitative understanding to quantitative models. This is consistent with how the Mars model was developed in a previously used simulation game (Cook, 2006). Without going into the exhaustive detail of every model, the following theoretical models cover each section of this SSG. These models were synthesized into a single simulation game, which proved stable and resembled the reality of a sales leader.

The key core models include the following areas:

- Sales persons' index, performance, motivation, skills, knowledge and ethics.
- Product including attributes, customer value attributes and pricing evolution.
- Competitor behavior including price offers.
- Account award process including customer satisfaction

- The simulation objects including sales persons, product, accounts and competitors are all abstract avatars in the simulation. These avatars operate with intelligence within the simulation.

The sales team has a performance model, which consists of their past performance, motivation, skills, knowledge and ethics. This index evolves through the simulation game. The sales person's performance is based on revenue achievement/target, market share and customer satisfaction.

<u>Decisions, Outputs and Game Flows</u>

The key part of any simulation game consists of the decisions that the users make and the results or outcomes they obtain as the simulation model processes their decisions. This process, which appears in Figure 1, is what provides the engagement for the player. In traditional video games, this is what makes the product successful. The decisions in this simulation include the following, which represent with the sales leader will decide and are at the salesperson level:

- Setting targets for each salesperson
    - # of sales calls
    - Targeted revenue per account
- Assigning accounts for each salesperson
    - Each salesperson is assigned their own unique set of accounts
- Setting compensation including bonus and quotas
    - Base compensation
    - Incentive compensation – bonus, incentives and quota stretch
    - Sales contest prizes – set per salesperson based on targets achieved
- Recognition – tangible and intangible
- Providing training and development opportunities
    - Sales skills training – tech, time management, communication, selling and proposal writing
    - Knowledge – competitor, industry, product, regulatory and company
    - Ethics

- Determining the management style to be used with each salesperson
  - Outcome based – results oriented management style
  - Behavior based – coaching style typically for less experienced
  - Mix of styles is set per salesperson

The game outcomes (results) come from the model and game flow previously described. The key results of the simulation game include:

- Sales results by account by sales person
  - # calls
  - Unit volume
  - Revenue
- Sales team (and salesperson) condition – round and trends
  - Motivation level
  - Effort level
  - Employee satisfaction
  - Turnover intention
  - Salesperson Index (effectiveness instrument)
- Financial Income Statement – round and trends
  - Quota
  - Revenue
  - Variable costs
  - Fixed costs
  - Gross margin
  - Selling expenses
  - Net margin
  - G&A Overhead
  - Net Income
- Performance Ratios – round and trends
  - Gross margin/revenue %
  - Overhead/revenue %
  - Selling expense/revenue %
  - Net margin/revenue %
  - Total product cost/revenue %
  - Actual revenue/Target revenue %
  - Market share %
  - Average price

Scoring and Assessment

The faculty configures how a particular simulation game result is going to be measured. Assessment is a key component in any simulation game, and is a paramount consideration when applied to a pedagogical setting like this sales leadership product. The score is calculated by weighting key outcomes from the game results against targets. This forces the students to make key tradeoffs before they determine their decisions in the simulation. The key areas that are used to calculate the student leaderboard include; customer satisfaction, revenue, market share, financial profitability, employee satisfaction, sales team/member index and business growth.

Appendix B

Survey Instrument

Overview of the Survey

The survey used a five point Likert scale, and was given at each class section at the end of the semester:

1 Strongly Disagree

2 Disagree

3 Neutral

4 Agree

5 Strongly Agree

Survey Instrument

The survey questions were constructed to measure the variables in the theoretical model. Additionally, demographic data were collected on each student responding to the survey. The survey was delivered using Qualtrics as the tool, and the students completed the survey at the end of each semester.

https://utoledocon.co1.qualtrics.com/jfe/form/SV_eDQieWvYSPUAZi5

1. Student demographic data
    a. Student's class (fr, soph, jr, sr, grad)
    b. College
    c. Major
    d. Minor
    e. Class delivery (on-premise classroom or distance learning)

2. I felt that the simulation game was interesting ("Curiosity Initiation")
3. I felt that the simulation game enhanced my understanding of decisions that sales managers make. ("Academic Usefulness")
4. I felt that the simulation game followed the content in the course syllabus ("Academic Usefulness")
    a. Coaching
    b. Training
    c. Compensation
    d. Quota Assignment
    e. Motivation
    f. Account Assignment
5. I felt that the simulation game motivated my learning experience during this class ("Motivation Generation")
6. I felt that the simulation game involved team skills ("Academic Usefulness")
7. I felt that the simulation game is user friendly ("User Friendliness")
8. I felt that the simulation game worked without technical problems ("User Friendliness")
9. I felt that the simulation game results were connected to my decisions ("Academic usefulness")
10. I felt that the simulation game enhanced my learning in this course ("Learning Outcomes")
11. Please provide any additional feedback on this simulation game

a. What were the most positive aspects of this simulation game?

b. What were the most negative aspects of this simulation game?

c. What recommendations do you have to improve the simulation game itself?

d. What recommendations do you have on how the simulation game is used in this course?

Table 31 – Test and Re-Test

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Question 2 Test & Question 2 ReTest	35	.741	.000
Pair 2	Question 3 Test & Question 3 ReTest	35	.798	.000
Pair 3	Question 4a Test & Question 4a ReTest	35	.939	.000
Pair 4	Question 4b Test & Question 4b ReTest	35	.947	.000
Pair 5	Question 4c Test & Question 4c ReTest	35	.973	.000
Pair 6	Question 4d Test & Question 4d ReTest	35	.928	.000
Pair 7	Question 4e Test & Question 4e ReTest	35	.864	.000
Pair 8	Question 4f Test & Question 4f ReTest	35	.839	.000
Pair 9	Question 5 Test & Question 5 ReTest	35	.888	.000
Pair 10	Question 6 Test & Question 6 ReTest	35	.933	.000
Pair 11	Question 7 Test & Question 7 ReTest	35	.899	.000
Pair 12	Question 8 Test & Question 8 ReTest	35	.759	.000
Pair 13	Question 9 Test & Question 9 ReTest	35	.937	.000
Pair 14	Question 10 Test & Question 10 ReTest	35	.944	.000