Innovative Classroom Practices

Simulation and Role Playing with LEGO® Blocks

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ABSTRACT

Simulations, role-playing scenarios, and other forms of active learning are meant to enhance the learning process by providing alternate methods to convey knowledge to students. LEGO® blocks have been around for decades and most children play with them or some similar toy. Incorporating LEGO® blocks into the classroom creates a fun and enjoyable experience, and when used appropriately, an educational one as well. Two such exercises using LEGO® blocks are described here – a simulation and a role-play. Both are described in detail and then discussed in terms of faculty experiences and student feedback.

Keywords: Simulation, Role-Playing, Active Learning, LEGO® Blocks

1. INTRODUCTION

As educators, we attempt to create the best learning environment for our students. We use current textbooks and other material, relevant examples, case studies, guest speakers, and real-world projects, among others. Simulations, games, and role-playing can also be effective learning techniques (Hertel and Mills 2002).

When students are interested in the topic or material, they are more likely to remember the lessons and key points (McKeachie 1994). Two methods for increasing student interest are to make the material fun and hands-on (Davis 1993). LEGO® blocks provide both of these – students enjoy them, and they are hands-on. The incorporation of LEGO® blocks into the classroom can result in enhanced student learning. This paper describes two such hands-on exercises involving LEGO® blocks. The first is a simulation of the systems development process. The second is a role-play of systems acquisition within a simulated organization.

Following a discussion of the pedagogical support for such learning techniques, the simulation and role-play are described in detail. These descriptions, along with the accompanying appendices, provide the necessary information to incorporate either of these exercises into an existing curriculum. A discussion of their effectiveness, benefits, lessons learned by the instructor, and student feedback follows. The paper ends with some concluding remarks.

2. PEDAGOGICAL SUPPORT

Davis (1993), McKeachie (1994, 1999), and Taylor & Walford (1972) all agree that providing students the opportunity to apply what they are learning is a key component to their learning success. Studies have shown active learning techniques such as simulations and role-play to be stronger than traditional methods of instruction in terms of knowledge retention, knowledge application, and motivational outcomes (Dekkers & Donatti 1981; McKeachie 1999), primarily as a result of experiential learning (Bernstein, Scheerhorn & Ritter 2002; Byerly 2001; Parente 1995).

Simulations and role-play can be particularly effective teaching techniques by providing a concrete basis for discussion, by arousing interest, by illustrating the major principles from the course, and, in some cases, by allowing the students to practice what they have already learned (McKeachie 1994; Mitchell 1998). Students enjoy a fun learning atmosphere, and they are active participants in the classroom as opposed to passive observers (King 1993; McKeachie 1999).

3. SIMULATION

3.1 Introduction

The simulation has been used effectively in both the

undergraduate and graduate Systems Analysis & Design (SAD) courses. It is best used at the beginning of the course (first or second class session), as its purpose is to provide an introduction to some of the major concepts and issues that will be discussed throughout the course. By having the students experience these issues first-hand and in a hands-on manner, the takeaways are more likely to have meaning and context. The "Lessons Learned" at the end of the simulation provides the necessary connection between the simulation and the course. The simulation consists of four rounds of activity, with three student volunteers in each round. It lasts for approximately 45 minutes. A large box of LEGO® blocks – at least 500 pieces – is recommended in order to provide variety and options. The simulation is described in detail below, and the individual rounds are summarized in Appendix 1.

3.2 Round One

The simulation begins by asking for the first set of three student volunteers. These three students are asked to come to the front of the classroom and gather around a small table. At this time, the LEGO® blocks are brought out and put on the table. These three students are told that they are to use whatever LEGO® blocks they feel necessary in order to build a vehicle. They are given approximately seven minutes to build their individual vehicles.

During the time while these three students are creating their vehicles, the rest of the class should be watching the construction efforts. When the construction is almost complete, the rest of the class should discuss what the word "vehicle" means. This discussion will naturally bring out many possibilities for the word "vehicle," including but not limited to: car, boat, truck, bicycle, airplane, and rocket. Additional varieties will also come forth depending on geographical location – e.g., skis and/or snowmobiles in the northern states.

Once the three students have completed their vehicles, each is shown to the rest of the class and described by the respective builder. As the students were able to use any of the available pieces, and there was no limit on the number of pieces, these vehicles tend to be intuitive and easily recognizable. Any additional questions or comments regarding the word "vehicle" are addressed and the three students are asked to take their seats.

3.3 Round Two

When the second set of student volunteers is requested, there are usually many raised hands as most students enjoy playing with LEGO® blocks. This is helpful as the next few rounds get progressively more difficult.

The second set of students is told that they are to each select one of the three vehicles from Round One. They are then told that they are to each take that vehicle and build a boat, and they are allowed to select up to 10 additional pieces if desired. They are given approximately seven minutes to build their boats.

At this point, the three students will likely say something about the task being unfair, except of course if one of the original vehicles happened to have been a boat. The students are gently reminded that they can dismantle the original vehicle and start over if necessary. This usually calms them down.

Again, the rest of the class should be watching the three students build their boats. There is usually a lot to watch as the three students struggle to come up with a suitable design with the limited pieces. Once the boats are completed, each one is shown to the class and described by the respective builder, often accompanied by grins and laughter from the class. These boats tend to be less recognizable, in general, than the vehicles from Round One, but given a brief explanation, they are definitely boats. These volunteers then return to their seats.

3.4 Round Three

The students are now beginning to catch on that there may be more to this than just playing with LEGO® blocks. When the third set of student volunteers reaches the front of the room, they are told that they are to take the three boats from Round Two and, working as a team, create one car. They are only able to use the pieces already in the three boats, and they must use all of these pieces in their car. They are given approximately seven minutes to build their car.

If there was a little bickering during Round Two, it will increase at this point. Again, the students are reminded that they may dismantle the three boats and start over if they choose. Still, the students quickly realize the difficulty of the task, and after only a few minutes, they begin to realize that the car will be quite large due to all of the pieces.

As with Round Two, the rest of the class has a lot to watch. Depending on the progression of the three volunteers, the rest of the class is sometimes asked to offer design advice, whether desired or not. Eventually, the car is completed and is shown and described to the class. Unfortunately, the car often resembles a real car only in the abstract. While the students are keen on describing their car to the class, the class often does not "see" the car in their LEGO® creation. These volunteers then return to their seats and the final round begins.

3.5 Round Four

It is sometimes difficult to find volunteers for this last round, but after some coaxing if necessary, the round begins. The three students are given the car from Round Three and told to rebuild the three boats from Round Two. They may only use the pieces in the car (as they are the exact pieces from the original boats). As this task is more difficult, they are given

approximately ten minutes to rebuild the boats.
The rest of the class is glad they volunteered earlier or never volunteered at all. They watch with smirks on their faces as the volunteers desperately try to remember what the boats looked like in form and shape, let alone how they were constructed with the actual LEGO® blocks.

As with Round Three, after some time, the three volunteers can be given hints from the class, though not from the three students who actually built the boats in Round Two. After about ten minutes, at least one of the boats is ready, though rarely are all three. The boats are then shown to the class and an informal vote is taken as to whether or not these boats accurately depict the original boats. These volunteers then return to their seats and the discussion begins.

3.6 Lessons Learned
As this simulation is conducted in one of the first few class sessions of the Systems Analysis & Design (SAD) course, the students have limited knowledge of SAD principles; therefore, they are eager to see the bigger picture and the lessons learned from this simulation.

In Round One, the students were given very few instructions and the requirements were very general and vague – i.e., a vehicle as opposed to a specific type of vehicle. The lesson here is that limited requirements knowledge is a huge constraint on developing accurate systems. It should be pointed out that no one knew what kind of vehicle was required and therefore it was likely that none of the three vehicles would actually meet the requirements.

In Round Two, the students were given more specific requirements to help them match the needs. However, these additional requirements were given too late. In other words, asking for a boat was definitely more specific than just asking for a vehicle, but the requirement to use the pieces already used plus up to ten more limited their ability to build an accurate boat. Additionally, it should be noted that when requirements are changed late in the development project, it is often very difficult to accurately incorporate the new requirements without completely starting over.

In Round Three, the three boats were to be incorporated into a single car. This was fairly difficult, as the students in the two previous rounds had not necessarily built anything that resembled a car. Forcing the students in this round to organize, compile, and create a single object from three disparate ones created many problems. The lesson here is that if the final system design is unknown and unplanned, it will be nearly impossible to create out of smaller subsystems and components.

Finally, in Round Four, the students were asked to retrace their steps. They had a lot of difficulties. The lesson here, which is very clear, is that without proper documentation, going backwards is nearly impossible. The importance of proper documentation throughout systems development should be emphasized.

The simulation concludes with a brief discussion of the simulation being representative of systems development, especially since the analyst often gets blamed for poor or ineffective systems that do not match the requirements. Whether the analyst is actually at fault is a separate issue and one that leads directly into the importance for accurate analysis and design, the content of the course.

4. ROLE-PLAY

4.1 Introduction
The role-play has been used effectively in an undergraduate End-User Computing (EUC) course, though it is appropriate for any undergraduate or graduate course covering systems development, systems acquisition, or IT strategy. It is best used near the midpoint of the course as a reinforcement of the concepts and issues that have been discussed to date. Of course, this will depend on when the concepts are discussed initially. The "Discussion" at the end of the simulation provides the necessary connections between the role-play and the course. The role-play consists of four main rounds of activity, with the class divided into eight equally sized groups. It lasts for approximately 60 minutes. A large box of LEGO® blocks – at least 1000 pieces – is recommended in order to provide the necessary pieces. The role-play is described in detail below with supporting information and tables in Appendix 2.

4.2 Instructor Preparation and Background
The role-play covers the four primary methods for acquiring information systems: purchasing off the shelf, outsourcing/external consulting, internal IS department development, and end-user computing (EUC). Each of these options should have been covered in the course and/or in the readings prior to the role-play. For any given system, each one of these options requires a certain amount of resources, namely money, time, and/or knowledge. In return, a successfully developed system will result in gains in time, knowledge, and/or success.

The role-play takes place within a hotel. The context of a hotel works well for the following reasons: hotels are familiar to students, they are complex organizations, there is only a small chance of any experience bias as it is unlikely that any one of the students works in a hotel, and there are many well-defined departments to use for teams. The purpose of the role-play is for the students to experience the decision-making and strategizing processes required for systems acquisition, and the hotel context provides an appropriate real-world aspect. There are six teams representing six departments within

the hotel (Banquets, Housekeeping, Business Center, Food Service, Concierge, and Reservations) and two teams representing two management groups (IS and Hotel).

It is crucial to have a large number of available LEGO® blocks as these are used to indicate both the resources and the resulting system gains. More specifically, five different colors of LEGO® blocks are needed to indicate money, time, knowledge, system success, and system failure – see "LEGO® Categories" in Appendix 2. To make things easier to plan and explain, each peg on the top of a LEGO® block represents one unit of that particular item, thereby making the physical size of the LEGO® blocks less important. (In other words, many small blocks are equal to a few large blocks so long as the total number of pegs is the same in both sets.)

Once the five different colored LEGO® blocks are divided into piles of the same color, allocations need to be made for the eight groups (see "Department Resource Allocation" in Appendix 2) and put into bags labeled with the department name. The amounts of each resource are varied across the departments to help illustrate the real-world differences between departments in the same organization. In other words, some departments will have more money in their budgets than others, and some departments will have a stronger skill-set than others.

These initial amounts provide the six competing departments enough resources to acquire some or all of the systems (see "Systems to Acquire" in Appendix 2) without any interaction with the two management groups. However, in order to acquire the most successful systems, every group will need to come up with a strategy for obtaining additional resources. The two management groups have these additional resources to manage and distribute. The remaining blocks remain in the "bank" with the instructor. This preparation should be completed before the beginning of the class.

System success is determined by the "System Costs and Benefits" table in Appendix 2. For each combination of system (4 options) and acquisition method (4 options), a cost is listed in terms of the necessary resources. For example, to outsource the CustMgmt system, a team will have to turn in 150 units of Money and 10 units of Time. In return, they will receive 44 Success units and 6 Failure units. The success and failure amounts vary according to acquisition method and the overall matching of business needs by systems acquired through that option. Note that when systems are bought off the shelf, the team also receives additional Time units as a result of the time savings. Likewise, additional Knowledge units are received after EUC development as a result of the knowledge gained from the actual development efforts.

At this point, the role-play is ready to begin.

4.3 Class Instructions

A 10-minute introduction is helpful to start the class session. The class needs to be divided into eight equally sized groups of students. They should move around the room and sit with their team. The teams are told that the role-play takes place within a large hotel in a major city. Each of the teams will represent part of the hotel, and each of the eight departments is explained. They are to assume that they are managerial (i.e., department heads and managers), especially the IS and Hotel Management teams.

The teams are told that they should use real-world experiences for discussion and decisions and that they should take this seriously, but have fun as well. The categories of the LEGO® blocks are put on the chalkboard with the respective color. Each of the eight teams is given one of the labeled bags. The teams are told to review their particular LEGO® block allotment and determine the relative level of each resource. During the role-play, the instructor is both an advisor and the "bank."

4.4 Round One

Each of the six hotel departments (not the IS or Hotel Management) is responsible for obtaining each of the four systems. Each of the four systems is given a brief explanation. Using the available resources (money, time, and knowledge), each team is to determine which systems to purchase, outsource, develop internally, or develop by EUC. The systems can be acquired in any order, but must be acquired one at a time – i.e., one per round. The "System Costs and Benefits" table is given to each team as a reference and explained as necessary. The teams are told that the object of the role-play is to acquire all four systems while maximizing the success and minimizing the failure of the systems.

The six departments will have to work with the IS and Hotel Management teams to obtain additional resources as necessary. This can be done through barter or through gifting. It is up to these two Management teams to decide how to approach the acquisition of systems and which teams will get which resources and why. The six departments are not allowed to bargain, trade, or exchange LEGO® blocks with any of the other five departments.

Round One lasts for approximately 15 minutes to give the teams plenty of time to come up with an acquisition plan and obtain the necessary resources for the first system. During the role-play, someone in each group should act as a recorder to keep track of all transactions, decisions, and other issues that arise.

At the end of Round One, as each team acquires their first system, the appropriate "cost" resources are turned in to the "bank" and the appropriate "benefits" are given in return.

4.5 Rounds Two – Four
Rounds Two through Four are identical to each other and identical to Round One except that each of these rounds is only five minutes in length. At the end of each five-minute period, teams must turn in the resources for their next system acquisition.

Depending on the strategy of the teams, there may be a team during various rounds that does not make a system acquisition. This is allowed, though that particular team will suffer in terms of overall success.

At the end of Round Four, each of the six departments should add up their success and failure units, as well as any remaining resources (money, time, and knowledge). These totals are put on the board. The overall winner is the team with all four systems AND the most success and least failure.

4.6 Discussion
Once the winner is identified, the next 20 minutes are spent discussing the role-play, the decisions, and the results.

There are often several departments that were able to acquire all four systems, though not through the same methods. At this point, the teams are unaware that each department began the role-play with varying amounts of resources. Once this is revealed to the students, a substantive discussion usually takes place regarding the strategies of the successful teams. The other teams will try to "blame" their failure on a lack of resources, but it can always be pointed out that each team was given ample resources and means to complete the entire role-play successfully. It is strategy and decision-making that lead to success, regardless of resources.

Another meaningful discussion centers on the role of the IS and Hotel Management departments. Sometimes, these groups are very "loose" with their resources and are willing to give any department whatever they can. Other times, they are very "tight" with their resources and may only give out small amounts, and then only during the last couple of rounds when they are sure there will be enough for everyone. The varying strategies and the interplay between these two groups and the other six are very interesting and educational.

A final discussion topic concerns what the teams would do differently the next time. Depending on the overall success of the teams, this discussion varies in length. Still, knowing what they now know and having gone through the role-play, there are always ideas for improvement.

5. DISCUSSION

5.1 Instructor Experiences
After several variations and iterations, these two exercises have proven to be highly successful. They are fun to use as they provide a break from the regular classroom activities. Using the simulation early in the course is a great way to get the students interested in the course material from the very beginning. The role-play provides a valuable review and/or alternative exposure to information system acquisition, regardless of when it is used during the semester.

5.2 Student Feedback
There is rarely a student who does not enjoy playing with LEGO® blocks, and to do so in the classroom is even better. When they are told in class, or when they see on the course syllabus, that there will be an exercise involving LEGO® blocks, they are very enthusiastic and keen to know more. This anticipation is exciting to see as a professor, and it also boosts attendance and participation.

Students who have gone through these exercises have found them to be engaging, educational, a "nice break," and fun. Many students ask to do another role-play after completing this one, or ask to try this one again to do a better job. Unfortunately, another one has not yet been developed. At the end of the semester and in future semesters, students who have participated in these exercises have commented on how much they remember from playing with the LEGO® blocks and how the exercises have helped them put the course material into context.

5.3 Overall Benefits/Comments
The exercises in the formats discussed above and shown in the appendices have worked well, but they are by no means the only way to run them. With each of these exercises, variations and modifications can be made to fit one's personal teaching preferences or available class time. For instance, with the simulation, the level of detail necessary to convince the class of the appropriateness of one of the vehicles can vary. Also, a fun addition to the simulation is to require the boats from Round Two to actually float in a small tub of water. While this can get a little messy, it provides a good laugh and a little more realism. Similar adjustments can be made to the role-play in terms of the context of a hotel, the amount of given and/or available resources, the costs and benefits of the acquisition options, the ability to bargain and trade between the six departments, specific strategic instructions given to the IS and Hotel Management teams, etc.

A side benefit of these exercises with LEGO® blocks is that there is now a large box of LEGO® blocks on the floor in my office. Many students and other faculty notice this box and ask why it is there. When they are told that the LEGO® blocks are used in my courses, there is usually a quizzical look followed by one of curiosity. After explaining their purpose, nearly everyone wants to participate themselves.

6. CONCLUSION

Simulations and role-play scenarios are valuable and effective teaching techniques. When incorporated properly, students gain a much better understanding of the material with a focus on the real world. The above examples have enhanced the classroom learning and retention of the course material, and everyone has had fun in the process. These particular exercises can be used in many different courses, especially the role-play as it can be applied to courses covering systems development, IS strategy/policy, or specific courses on systems acquisition techniques.

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APPENDIX 1 – Summary of Simulation Rounds

Round	Volunteers	Item(s) to Build	Rules	Time	Lesson
One	3	Vehicle (3 individual)	Select any blocks necessary.	7 minutes	Limited requirements knowledge is a huge constraint.
Two	3	Boat (3 individual)	Must start from one of the vehicles from Round One. May select up to 10 additional blocks.	7 minutes	Additional requirements given too late are difficult to incorporate.
Three	3	Car (1)	One car as a group. Must use all blocks from the three boats from Round Two.	7 minutes	Without an overall system design, smaller subsystems are difficult to organize and compile.
Four	3	Boat (3 individual)	The three boats from Round Two using the blocks in the car from Round Three.	10 minutes	Without proper documentation, going backwards is nearly impossible.

APPENDIX 2 – Role-Play Details

LEGO® Categories
Money
Time
Knowledge
System Success
System Failure

Department Resource Allocation (# of pegs)

Department	Money	Time	Knowledge
Hotel Management	200	200	
IS Management			100
Banquets	90	30	30
Housekeeping	60	30	60
Business Center	60	30	90
Food Service	30	90	60
Concierge	30	60	90
Reservations	30	30	90

Systems to Acquire
ExpMgr – Personal expense report manager
Know – Knowledge sharing application for department (FAQ sheet and resource)
CustMgmt – Additional queries and reports in reservations/customer management database
WebEC – Electronic Commerce website with reservation capabilities and customer preferences

System Costs and Benefits

System	**Costs**	**Benefits**
ExpMgr	Buy – 10 Money; 2 Time OutS – 40 Money; 6 Time IntIS – 16 Time EUC – 12 Time; 6 Knowledge	Buy – 6 Time; 14 Success; 6 Failure OutS – 18 Success; 2 Failure IntIS – 18 Success; 2 Failure EUC – 16 Success; 4 Failure; 8 Knowledge
Know	Buy – 30 Money; 4 Time OutS – 100 Money; 10 Time IntIS – 24 Time EUC – 20 Time; 12 Knowledge	Buy – 10 Time; 30 Success; 10 Failure OutS – 34 Success; 6 Failure IntIS – 36 Success; 4 Failure EUC – 26 Success; 14 Failure; 16 Knowledge
CustMgmt	Buy – 40 Money; 4 Time OutS – 150 Money; 10 Time IntIS – 24 Time EUC – 20 Time; 14 Knowledge	Buy – 10 Time; 36 Success; 14 Failure OutS – 44 Success; 6 Failure IntIS – 46 Success; 4 Failure EUC – 36 Success; 14 Failure; 20 Knowledge
WebEC	Buy – 200 Money; 6 Time OutS – 900 Money; 20 Time IntIS – 36 Time EUC – 30 Time; 20 Knowledge	Buy – 8 Time; 48 Success; 18 Failure OutS – 56 Success; 10 Failure IntIS – 60 Success; 6 Failure EUC – 50 Success; 16 Failure; 26 Knowledge

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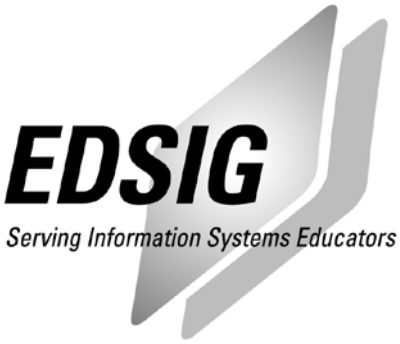

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