Motivating Characteristics of Robotics within an Intermediate School Level Classroom

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Chapter 1: Introduction

Introduction

Over the years, technology in education has taken on many façades. With today's vision in education focusing on the 21st learner, the robot is the "machinery" to motivate children and sustain a love learning in a classroom. Robots have been dispersed in classrooms as educational tools locally and globally, ranging from Pre-K to higher level education (Datteri, Zecca, Laudisa, & Castiglioni, 2013). A robot is a fascinating piece of technology with its circuits, wires, and mechanisms all wrapped up in a user-friendly unit. This unit is a great addition to a teacher's toolbox. One such robot produced by LEGO, creates a strong motivational vehicle when infused within the technology and science activities (Norton & McRobbie, 2015).

With the momentum stretching across the science, technology, engineering, and mathematics (STEM) fields, robots have the potential to interlock all these fields with engaging hands-on activities which provide and foster motivation in keeping with stimuli of innovation (Alimisis, 2013). In this day and age of technological advancements, in the education sector, classroom educators are seeking new technologies to include in their repertoire and LEGO robots and its' programs has the flexibility to be scaled down and customized to fit into any classroom. With that said, now is the time to move in the direction to include educational robotics programs, referred to as "all-in-one technological learning tool" and intermix the motivation aspect of the "friendly robot" including the hands-on applications that drive the focus back to the student with engaging and enlightening activities which stem the entire curriculum (Eguchi, 2014, p. 34).

Statement of the Problem

This study will seek out the underlying motivational qualities of a robotics curriculum that inspire student learning in a classroom. Research indicates that students' motivation and engagement in classroom activities diminish when they are not actively involved in the actual "hands-on" piece of a lesson (Smith, 2013). The education system is on the move to keep up with the STEM directives, but the application of robots is still lagging behind within the classroom curriculum (Li, Huang, Jiang, & Ting-Wen, 2016). Classroom directives in the area of robotics and STEM need to foster students learning initiatives in order to stay be current and motivated at while fostering a set of 21st century skills (Freeman, Adams, Becker, Cummins, Davis, & Hall-Giesinger, 2017). The field of robotics lends itself to the necessary components that can increase and sustain engagement and motivation for learning in the classroom.

How does one define "motivation"? According to Dictionary.com "motivation" is "the act or an instance of motivating or providing with a reason to act in a certain way" (Motivation. n.d.). Understanding the concept of motivation is important because the inspiration behind the use of a robot by students is the driving force for students when engaged in any activity. Motivational beliefs can be fostered, adjusted, and nurtured to seek out more thought-provoking and difficult challenges which allow additional risk-taking activities, in turn, motivate them to advance to higher levels of achievement in the safe classroom environment (Smith, 2014). Motivation is more than just doing an activity, is about having a vision and a strong desire to achieve that vision or goal. It is that extra push or inner drive to accomplish something. Just like motivation, learning is more than just completing worksheets and taking tests, it's about creativity, engagement and accomplishment.

Purpose

The purpose of this qualitative study is to explore the primary reasons that inspire student motivation when working with the robot in the classroom. In order to fully understand the underlying motivation of students in a classroom, the use of LEGO robotics education kits will be employed as part of the hands-on designer activities. The participants in this study are a heterogeneous six grade homeroom with a population of 23 students, nine females and 14 males will be observed in their regularly scheduled computer class. In searching for what motivates students, especially in the area STEM, researchers have to understand the complexity of motivation (intrinsic/extrinsic), what brings this about and sustain that aura among students in the classroom. Motivation is important cognitive skill, it drives actions in the classroom, and without out it, the classroom is lifeless.

There is a certain vivacity and familiarity with classroom robotics. Students' recall playing with LEGOs from early childhood years. These fond memories symbolize playful and fun times and did not realize that they were involved in learning. This image from early childhood could be the entrance or spark needed in the classroom to motivate students. Robots, especially LEGO robots, a familiar item to many children is a perfect counterpart especially in the areas of science, where the push is full-speed ahead to incorporate STEM activities in the classroom. According to Li, Huang, Jiang, & Ting-Wen (2016), Lego bricks, known as "the toys" serve as tools to enrich and foster students' cognitive skills, thus laying the ground work for successful connections in STEM fields. This specific phenomenon lends itself to higher level thinking including learning by doing, one of the best practices for multi-intelligence which crisscrosses into other cognitive skills.

Research Questions

The research questions for this qualitative study are:

- **RQ 1:** What is the role of a robot on student motivation in a classroom?
- **RQ2:** How do students interact with the robot when engaged in a classroom activity?

- **RQ3:** What features of the robot-based learning lesson motivates student to complete the activity?
- **RQ4:** How does the interaction with the robot affect student motivation?

With these questions, the researcher wants to identify and characterize the students' motivation factors or reasons by coding the relationships and experience in categories by the way of relevant and strong data connections.

Limitation, Delimitation, and Assumptions

Limitation. According to Creswell (2014), using grounded theory approach limitations lends itself to ethical issues. Since this study is based on data analysis of participant viewpoints, there is a possibility of bias and "power of voice" leading to the intense scrutiny of the data. (p. 438). The interview process, if not properly instituted by means of permissions accompanied by documented observational notes and memo writings, could lead to be potential issues. The issue of replication can be minimized with extreme caution in gathering and categorizing the data into a form that can be viewed and understood by other researchers. Furthermore, since the researcher is the prime recipient of the data from the observations, the researcher has to be extremely careful not to prejudice or bias the observed data (Creswell, 2014). With this research there are some other possible limitations. Since research takes place in a regular setting, the exact uniformity is very unlikely within this specific context. Unfamiliarity with the LEGO Robotics kits, robot, and the technological instruments can possibly limit some of the hands-on activities in the classroom. In following with the technology piece, the instructor's familiarity or unfamiliarity with the content in the lessons can influence the participants outcome(s). Another potential limit is the structure and time of the physical class, along with participant attendance.

Delimitation. A few of the boundaries in this research consist of: (a) LEGO kit geared toward educational institutions; (b) pre-set lessons; (c) equipment that the participants use for writing and running the program; and (d) classroom setting. These four specific areas create the restrictions of the research study. The limitations are set by the specific kit that the district has mandated to use in the classroom. Each kit provides teacher will all the necessary tools and pre-set lessons. In order to program, run and control the robot, the equipment is up to date and has sufficient capabilities to carry out the instructions. The physical layout of the classroom denotes the perimeters of the lesson activities.

Assumptions. The researcher assumes that all students will participate in the building, programming and executing the problem set forth by the teacher in the lesson. Teacher has created groups and assigned a specific role to each student. Students will cooperate, be respectful and follow the directions to the lesson. The task of solving the problem will be completed in an honest and forthright manner by the students.

Chapter 2: Literature Review

Introduction

Reviewing the literature, motivation and hands-on learning emerges as the key constituents within STEM initiatives and robotics curriculum. Learning methodologies pointed out in the majority of the literature covers constructivism and constructionism, active learning, hands-on learning, and problem-solving including motivation and cognitive skills. Hands-on learning promotes motivation and critical thinking skills by creating an alliance filled with engaging activities and children at a very young age can understand the concepts (Ortiz, Bos, & Smith, 2015). Some of the literature combined motivation with problem-solving and vis-versa. Motivation is a complex key element that guides and strengthens student learning in an engaging learning setting (McGill, 2012). Additional research is needed to thoroughly examine the key factors which are the driving forces of this phenomenon (Alimisis, 2013; Hyun, 2014; Norton, McRobbie, & Ginns, 2007; Castledine & Chalmers, 2011; Altin & Pedaste, 2013, & Holmquist, 2014). With all the artifacts and digital devices collecting dust in the teacher's classroom, the one all-encompassing technology, the robot, the key to motivating, engaging and sustaining the interest of students, not just another expensive technology item used as a doorstopper.

Classroom Climate

Creating a nurturing climate where students and teachers are energized and full of excitement, is robotics curriculum infused in a classroom. The robot, an engaging tool, can be the instrument of choice to help increase student motivation in STEM fields (Altin & Pedaste, 2013). According to Hyun (2014), robotics curriculum can support classroom teachers, with innovative lessons which can be combined with other academic subjects. Hyun noted that these robotic lessons are filled with 21st century skills being reinforced by engaging and robust activities which are conducive to motivate students in thinking logically and critically about solving real life situation or problems. Robotics education also allows creativity, exploration, and collaboration within the confines of nurturing, active, non-threatening classroom environment.

Elevating and sparking the 21st century learner to acquire as much knowledge as possible is a huge job for any teacher, novice or experienced. In the today's world where students are on some sort of device such as cell phones, iPads, laptops, Xbox, Wii, etc. their fingers and hands are in constant motion. Why not make good use of this common hands-on activity and infuse it in a safe and cultivating school setting. Robotics education utilizes hands-on learning, initiates and sustains student motivation and engagement (Smith, 2013). Students are ready and in tune with solving problems and using brain power to think about and resolve an issue if the robot does not perform correctly. involving hands-on levels of activities absorb and maintain positive motivation attitudes thus pursue additional challenges and increase higher levels of learning and overcome and difficulties that arise.

In addition, Smith (2013) indicates that her study found students are more far more likely to be fully engaged and motivated when discovering and figuring out, by trial and error, what makes the robot work. All parts of motivation, the intrigue and curiosity are inviting to students in which the robot task provides an end to the means, exploring a difficult but captivating path. Other motivational observations in Smith's study provide evidence of students working together, not individually, courage is raised by having to interact and speak up to defend solutions to the problem.

Robots and Motion

Specifically, in the education field, curriculum needs to be expanded to encompass more STEM initiatives turning the vision beyond the horizon and re-establish a more diversified and motivating comprehensive robotics education to serve our future global population. Motivation works in many mysterious ways and is purely the action which is unpredictable but also invigorating in the classroom. That unpredictability is also part of what excites students when working with robots; the unknown, what if, and how about directives in building confidence to seek out solutions by means of telling a story. Alimisis (2013) relates this to student motivation moving away from the traditional approaches of working with robotics to the nontraditional, where students let the imagination run freely and become part of the story. Students push a button or the touch on the iPad, off goes the robot, on its mission, creating an aura of excitement and mystery, wherever it is programmed to go. Echoes of engaged student voices, motivated by the shear fun and movement of a mechanical device, the robot fill the classroom. These vocalizations indicate students are actively involved and want to expand their horizon with more of these hands-on activities.

Constructionism

According to Cummings (2017) students learn through doing, hands-on activities, solving real world problems which are the fundamental criteria displayed within the educational robotics curriculum. With the emphasis on ‘hands-on” activities, Eguchi (2014) stated: “Robotics in education is one of the best technological and educational tools to integrate all of the movements previously described (hands on activities). Using robotics introduces students to emerging and innovative technological creations, as well as encouraging their participation in the act of making, which, in turn, nurtures them to become active creators rather than consumers of technological products in the future” (p. 29).

Referenced throughout the literature, are Seymour Papert and Jean Piaget, both worked together in 1960's, concurred that students learn best by constructing, not been taught. This plays right into back into the robotics curriculum. Learn by doing or referred to as hands-on designer learning is the core of robotics curriculum. Noted by Alimisis (2013) and Castledine & Chalmers (2012) educational robots (unit and accessories) in the classroom present the tools for the active learner to construct and create a unique product utilizing metacognitive and motivation skills. Likewise, Smith (2013) along with Li, Huang, Jiang, & Ting-Wen, (2016) described Papert's constructionism in relation to engineering and hands-on applications while actively addressing any situations that occur when utilizing the robot. Specifically, Smith (2013) related the building of LEGO pieces into a customized robot, then programming and running the program in which students identified with the robot due to the actual physical/material unit.

Summary

In conclusion, the inter-connectivity between student motivation and robotics curriculum is evident throughout this literature review. From wires to bricks, motors to sensors, this technology rich companion has direct impact by engaging and motivating the 21st century learner in diverse learning activities. According to Altin & Pedaste (2013) there is still a need for more research if robotics curriculum is to be mandated as part of the direct curriculum not as an aide to the teacher in the classroom. Motivation is part of the STEM curriculum by enticing students to solve real world problems through a tool such as a robot because the robot is interesting and inspiring for the students. Now is the time to move in the direction to include educational robotics programs, referred to as "all-in-one technological learning tool" and fuse the motivation aspect of the "friendly robot" including the hands-on applications that drive the focus back to the student with engaging and enlightening activities which address the entire educational curriculum (Eguchi, 2014, p. 34).

Lastly, Smith (2013), summed up the relationship between motivation and robotics in these words: “Perhaps the greatest contribution of the robotics program is exposing youth to the possibilities of what could be. It is hard to be motivated to do something, to be something, if you have never seen it for yourself” (p. 193). Today’s students are tomorrow’s future, in order to facilitate and create the future, we as educators must understand what motivates students.

Chapter 3: Methodology

Introduction

As categorized by Creswell (2015), there are three qualitative designs: ethnography, grounded theory and narrative (p. 12). In the field of educational technology, researching the underlying factors that drive students to be engaged and motivated in the classroom by using robots and robotic education is a paradigm for grounded theory. A qualitative approach with the grounded theory methodology allows for an understanding of a concept based on gathered data. This allows for gathering of data by observing the participants in their natural setting to determine the underlying characteristics that support motivation of students when engaged in hands on activities using robots in the classroom. Charmaz's (2006) vision of ground theory comprises of principles, practices, flexibility, social interactions, viewpoints and understanding of meaning (pp. 9-10). Focus is contingent on views, actions, relations, intentions, feeling connected to society and human nature. Ground theory approach, according to Charmaz (2015), identifies active learning and hands-on applications in the classroom, as an instrument in leading the outcome of motivation, voices and allows for the student to be heard, detailed by mounds of collected data (Charmaz, 2015).

The hands-on designer tactic is a very important piece in this type of research in that the activity creates an environment that is conducive to wanting to learn and in addition allowing for a classroom climate which challenges student knowledge in order to reach higher levels of learning. The constructivist approach developed by Papert is rich in concepts of constructing and building which echoes the importance of allowing students to create and modify using a hands-on designing approach for the activities including using robots in the classroom. (Norton, McRobbie, & Ginns, 2007). Cummings (2017) noted: "The constructivist approach to educational robotics encompasses all of the 21st century skills in its design" (p. 20). Constructivism is widely accepted as the best approach to understand the essential 21st century skills that students should master before graduating from the education system (Smith, 2013).

Research Design

This study is designed as a qualitative research study using the grounded theory method. This method is the foundation for qualitative research, basically focusing on a single concept, idea or process that is part of human nature whereas trying to find out the "inner workings" of individuals. As Creswell (2015) states: "…the researcher seeks a deep understanding of the views of one group or single individuals" (p. 128). The central phenomenon of this study is motivation factors of students with robotics as the catalyst in a classroom. Seeking out an understanding of how key puzzle pieces (motivation factors) align and come together to form an illustration in which the researcher can then create a picture/theory/concept.

For this study, grounded theory allows for observation of students, to gain insight and extract student beliefs, understandings and personal experiences in what motives the student in a natural environment. Strauss and Corbin (1990) identified three levels of analysis: (1) data represents the participants views, without bias; (2) memo writing, field notes, and researcher views are part of the narrative; and (3) theory construction should be clear and concise (pp. 31-32). These levels are the keys to this study on motivation because this phenomenon is based primarily as a societal issue.

Population & Sample

The researcher will specifically select participants and a site to conduct the research in order to understand the phenomenon of motivation and engagement of students when using robots in classroom. The district is the largest in Somerset County and one of the largest in New Jersey, serving 8,800 students. For this research study, the population is a heterogeneous sixth grade homeroom with a population of 23 students, nine females and 14 males will be observed in their regularly scheduled computer class. The classroom makeup is comprised of five AI, two special needs, 16 general education students. The students that are general education are grade level appropriate in learning capacity, AI students are one grade level above and the special needs have IEP's and come to class with an aide. According to Creswell (2015), purposeful sampling is necessary when a researcher wants to study a certain phenomenon or experience. Using a purposeful sampling method, the researcher will obtain an understanding of the factors which influence the motivation and engagement of students within the specific robotic STEM unit. The method of "concept sampling" allows for data to be collected on a certain idea (Creswell, 2015, p. 207). In this study the concept is student motivation. This research study will last for six months of the school year. Each individual computer class is 35 minutes in length.

Researcher's Position

The researcher will observe and collect data in the natural classroom setting. Using the constructivist approach to grounded theory in qualitative research, Creswell (2015) states that this method is conducive and appropriate to measure the feelings and emotions that students have during an activity. Both Creswell (2015) and Charmaz (2006) emphasizes the gathering of the emotional aspects, the adhere to human functions and not the facts. When the researcher is observing the students, data is collected and during the collection researcher develops the specific categories that the data will be placed in.

As stated by Charmaz (2006): "With grounded theory methods, you shape and reshape your data collection and, therefore, refine your collected data" (p. 15). An important notation because the researcher is the observer or instrument of data collection. The researcher is the "eyes" and must make sure that the data is shaped and categorized in the specific themes on target with the realm of the actual observations. The researcher brings to the class personal assumptions, knowledge, ideals and concerns which assist in the allocation and distribution among the formed categories (Charmaz, 2006). These perspectives help in the collection and process of observational data, but with caution of biases. The researcher will construct a narrative which can be written in a story telling method full of details and supported with lots of scientific data.

Procedures

In this grounded theory approach to the qualitative design method, the researcher will be seeking out an understanding and then create a theory. The research structure will follow these steps: (1) identify a process; (2) seek permissions and approvals; (3) sample individuals who have experienced the process; (4) code data into categories or concepts; (4) additional observations if warranted; (5) create a theory from the categories; and (6) validation of the theory (Creswell, 2015).

In this study the researcher will seek out and understand the process of the underlying factors that generate student motivation in the classroom. By seeking the factors, the researcher will note the following: (1) robotics curriculum is used as a backdrop; (2) hands-on activities; and (3) natural classroom environment for the researcher to observe the students. The researcher will obtain the following approvals: institutional review board, district superintendent, school principal, classroom teacher, and parent/guardians of the students in the targeted class. Once all the approvals have been verified the classroom observations, can being.

Observations. Observations are an essential part of the process because the students are working and engaging in hands-on activities in which robots are used as the best vehicle in exploring an activity in a STEM related field in their natural classroom environment. The researcher will observe students engaging in a science lesson using LEGO robots as the instrument to demonstrate a solution to a problem that the teacher has assigned The classroom structure is set up that is conducive to group work utilizing hands-on activities with basic long tables and student size chairs, bins full of extra pieces, iPads in storage cart, LEGO kits on shelves each number accordingly to student group number. The room is spacious enough to store all the equipment and also provides open space to run the robots. The equipment including kits, extra pieces and the devices are readily accessible for the students.

Data Collection and Coding. Using the constant comparison process, the overall process the researcher carries out is collecting data from the classroom observations, sort(code) the data into specific categorizes based on definitions of the labels that the researcher has established, revisit the specific classroom, collect additional data, code it and reorganize data into adaptable categories (Creswell, 2015). This is a slow and time-consuming method in which will either support or not support the purpose of this qualitative research study based in the grounded theory design. This methodology allows for manipulation of data into new and previously defined categories. The ground theory design allows for constant comparison of data with the possibility of changes in the theory because of the nature of the data collected, coded, analyzed and formed a “data heavy” theory. In other words, the categories the researcher developed is “grounded” in data from the observations to create the “grounded” theory.

Memo writing, note-taking by the researcher during the observations carries a huge impact on theory construction. Making notes, keeping a record of the student attitudes, conversations, questions, process of creating robot, the programming and the act of carrying out the program are vital data linked to the creation of the theory. This type of journaling takes place by the researcher during the course of data collection and examination (Charmaz, 2006). As part of the activity by the researcher, categories are created and defined to justify the specific label that category was assigned the evidence gather during the observations and memos/notes from observational and memo writing evidence. These memos can be anything from words, pictures, symbols, diagrams, concrete or abstract, referencing earlier memos, short or long phrases, but each and every memo has to contain a date, heading and data section (Charmaz, 2006). The evidence gathered at the observations and memo writing contributes to the justification of the assigned label name including any sort of inter-connections and relationships along the hierarchy of the categories. Memos can also spark a new lead or direction the researcher needs to address which calls for additional observations. The cycle begins again, observations, memo writing coding data, placing data in categories or even aligning and reshuffling of data into a different section, adding new categories and then reworking the theory. This activity continues on until the researcher feels that all avenues have been thoroughly completed and exhausted and conclusively the theory is fully developed. This the best method of research for this study because the researcher is trying to find the underlying factors of motivation.

From the book, *Constructing Grounded Theory, A Practical Guide through Qualitative Analysis*, authored by Charmaz (2006), she details helpful tips when writing memos for instance, keeping in mind when writing to develop your own voice with a rhythm; watch for gaps in the data; open to new categories no matter where you are in the observations, and just take a few steps back and really think about the data, where it might lead to, what it is trying to say to you, and the connections. These tips are applicable in the grounded theory research in so far as understanding of what is going on in the students' mind while working on a project. The observations by the researcher needs to detail the interactions, moods, verbally exchanges, non-verbal interactions, progress of the lesson, teacher's attitudes, students' attitudes, room climate, equipment functioning, monitor use of the robot, reactions by the student if robot does or does not perform correctly, independent or co-dependent, group, individual, seating arrangements, intrinsic or extrinsic, collaboration, gestures, and other actions in the classroom.

Open Coding. Next step for the research is the process of coding the data. This is constructed by open coding which allows for shuffling and reshuffling of all data collected on numerous student observations in the class. The data is collected and placed in categorizes. From the categories emerges more categories and leaving the researcher in need of some additional data. The researcher goes back into the classroom, observes the newly created themes, records the evidence and then codes. The process repeats until the researcher feels that there no more data, completely exhausted all areas. This begins axial coding and development of the coding paradigm (Creswell, 2015, p. 444). The researcher creates or selects a core category from previous established one, in this research is could be "motivation" and revisits for more data for the additional categories, approaches and results (Creswell, 2015, pp. 444-445).

Develop, Validate and Write the Grounded Theory Project. The researcher will use "selective coding", to move forward in creating a theory. The researcher will write a narrative on the process of how the data and categories are interlinked and that constitutes the either confirmation or denial of the uncovering of the underlying characteristics/factors involved in student motivation in relation the use of robots in the classroom. After the researcher has established a theory, it has to be validated through other literature resources. This is a comparison of other literature processes in the scholarly world. The researcher will generate a report, usually in third party point of view to include the problem, what methods were used in this project, written narrative and discussions, results and the theory.

Checklist of Items in Observations

- Students working independently or a as a group
- Understanding of the mission (direction of robot)
- Fully engaged or off track, not focused
- Classroom conditions
- Cogitative skills applied
- Project finished or give up
- Each student involvement in use and contributions
- Room lends itself for hands-on activities
- Problems with equipment, network, programming, if so, how was it handled
- Teacher’s role, active, passive, authoritative, facilitator vs. dictator
- Smiles on faces, interactive and collaboration with everyone, not only group
- Open to change
- Hands-on activity of building, programming and running, success or struggling

Questions for the researcher to think about

- ✓ What did student learn from this hands-on activity?
- ✓ What did the student like or dislike with this activity?
- ✓ What kept the student’s attention?
- ✓ What did the student find fun about this activity?
- ✓ How did the student feel about using the robot?
- ✓ What motivated the student to finish or not finish the activity?
- ✓ What is the role of the teacher?

- ✓ How does the students converse with each other or the teacher?

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