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An Analysis of Middle School Teacher Practices in Robotics as Synthesis of
STEM in Middle School Curriculum

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CHAPTER III

METHOD

As introduced in Chapter I the purpose of this paper is to determine the extent to which robotics education addresses Common Core Content Standards, thus facilitating the role that leadership in technology education plays of identifying appropriate teacher training and determining the most productive teaching tools. The study will focus on how Common Core Content Standards are used in the development of student achievement in their ability to obtain knowledge, apply creative problem-solving skills to develop solutions, gather and process data to measure the success of their solutions, and communicate to share their results. This data will allow leadership in technology education to identify proper professional development for teachers and become aware of which materials are most effective in teaching robotics. The quantitative method will be

used because of the type of data that will be developed during this study. Teachers of middle school students will be asked to complete a survey and participate in discussions on their views of the topic.

Research Method

To fully understand the broad scope of the application of curriculum to fulfill the Common Core Content Standards, a quantitative research model had been selected.

The questions will be in the form of a survey to teachers that will examine their knowledge of and the extent to which they use the Common Core Content Standards. This is important because it will establish how familiar the participants are with the Standards. The survey will then move on to find the types of activities the teacher uses in their robotics class. Methods of teaching will establish the range in which the standards are addressed. A face-to-face and online round table discussion with middle school robotics teachers will also be included to support and motivate teachers with completing the survey.

The study will address the following research questions:

1. To what extent are teachers using mathematics skills when providing robotics instruction? The range of depth in mathematics application to robotics will be measured.
2. To what extent are teachers using literacy skills when providing robotics instruction? The range of depth in literacy application to robotics will be measured.
3. To what degree does robotic education provide open-ended challenges and projects that emphasize in-depth study of mechanical engineering concepts and application?
4. To what degree does the integration of CAD afford robotic curriculum engagements the opportunity to experience real-world authentic learning?

5. To what degree does robotic education emphasize programming and sensor use?

Documents Used in the Study

The original documents used in the study are listed in the Appendix. Appendix A is an IRB approval for the proposal. Next is a request to the Executive Director of The New Jersey Technology and Engineering Educators Association (see appendix B). This letter will ask permission to contact the members so they can participate in the study. A similar letter to Dr. Amy Eguchi of Bloomfield College, Bloomfield, NJ is included (see appendix B). Dr. Eguchi was chosen due to her experience in developing robotics curriculum for students and her involvement with teacher training. An explanation of the purpose of the study is then given. This letter is designed to motivate the respondent in completing the survey because he or she will understand that the research will benefit all robotics teachers by demonstrating how valuable robotics may be in satisfying the Common Core Standards. Motivation is important as Gay, Mills, and Airasian (2012) state. A survey “must be of sufficient significance both to motivate potential respondents and justify the research effort in the first place” (Gay, Mills, & Airasian, 2012). The introductory letter will inform the participants that the goal of the research is to demonstrate that robotics is an effective means of meeting Common Core Content Standards.

Instructions on how to complete and submit the survey is then specified in the cover letter. A copy of the survey questions is then provided.

Resources

Technical and human resources used in this study are comprised of; a panel of experts to validate the survey, a group of middle school robotics teachers that are members of NJTEEA, research tools obtained from the New Jersey City University Frank J. Guarini Library, Survey Monkey, and internet sites.

The panel of experts will be comprised of highly qualified technology education experts.

The group of middle school robotics teachers will include Colonel Edward Peterson and Shahram Dabiri and Anne Vitale. Colonel Peterson and Mr. Dabiri are both leaders in education and have developed numerous curricula at Picatinny Arsenal which is a United States Army base. Anne Vitale is STEM supervisor at Randolph Middle School. They will assist in the development of questions that will be provided to the respondents of the survey and participants in the robotics round table discussion.

Research materials in the form of scholarly, peer-reviewed documents and articles for this research will be acquired from New Jersey City University's Frank J. Guarini Library,

Survey Monkey will be used to collect data. Analytical software will be used to prepare documents, record data, create charts, and analyze data.

Internet sites used in the study include;

<http://eecs.oregonstate.edu/education/about/publications/usinganintegrated.pdf>,

<http://dl.acm.org/citation.cfm?id=950595>, and

<http://www.sciencedirect.com/science/article/pii/S0360131510001831>.

Participants

Participants will be fifty certified middle school robotics teachers that are members of NJTEEA. The grades will range from sixth to eighth grades. The teachers need not be solely robotics teachers because it would be difficult to find teachers that only instruct robotics however, they must spend over two hours a week on their robotics curriculum in their class.

Data Collection

Data collection will begin with obtaining approval from the independent review board to conduct the study.

The data collection is designed to determine the extent to which robotics education addresses Common Core Content Standards, hence enabling leadership in technology education to identify proper teacher preparation and expose superior teaching practices. The questions will determine the application of Common Core Content Standards to the development of student achievement in their ability to obtain knowledge, apply creative problem-solving skills to develop solutions, gather and process data to measure the success of their solution, and communicate to share their results.

A list of the Core Content Standards can be found at the following location online <http://www.corestandards.org/>. © Copyright 2010 National Governors Association Center for Best Practices and Council of Chief State School Officers. The use of the standards for this study follows the guidelines of the National Governors Association and the Council of Chief State School Officers. Development of Common Core Content Standards started in November 2007 as state education chiefs met to discuss developing common standards during The Council of Chief State School Officer's Annual Policy

Forum in Columbus, Ohio in an attempt to align state curricula. As of June 2014, forty three states, the Department of Defense Education Activity, Washington D.C., Guam, the Northern Mariana Islands and the U.S. Virgin Islands have adopted the Common Core Standards in English Language Arts/literacy and math. They are now in the process of implementing the standards locally (nea.org, 2015).

Middle school robotics teachers will be solicited to participate in the study by use of contacts gained from networking, email distribution lists, announcements in peer publications and video conferences (see appendix C). They will be asked to complete a survey placed on the Survey Monkey website and to participate in online and face-to-face forums to help complete the survey should they have any questions. The participants will have four weeks to complete the survey while several online and face to face round table discussions will take place.

Several steps will be taken to insure data quality. First, the researcher will verify that each respondent teaches robotics at least two hours a week. Second, the questions will have multiple statements for the subjects to be studied. Finally, two separate groups will be established and administered the questionnaire. The scores will be compared to each other to insure reliability.

Data Analysis

According to Gay, Mills, and Airasian (2012) after data collection responses are converted into a numeric system or categorical organization using a spreadsheet. Data is organized systematically using subgroups if necessary. The next step is to review the figures using descriptive statistics. Excel will be used to calculate the frequency of each response. A bar graph representing this information will be included.

Gay, Mills, & Airasian, state that interpretation of data leads to finding meaning from the collected data (Gay, Mills, & Airasian, 2009). The researcher will use the processed qualitative data to interpret the information on how teachers apply the Common Core Content Standards to robotics education. This will be accomplished by first identifying themes or patterns that emerge from reviewing the data.

The researcher intends to establish a conceptual model that depicts the relationship between the various factors contributing to the ways middle school robotics teachers use Common Core Content Standards to support their curriculum.

Summary

Chapter III discusses the research method, documents, resources participants, data collection, and data analysis of a quantitative study to determine how middle school science teacher use the Common Core Content Standards in their robotics curriculum. Conclusions will address the research questions and also identify alternative methods of meeting Common Core Content Standards using state of the art technology that is interesting and motivating for students.

CHAPTER IV: FINDINGS

Data Categorization

Data Discussion

Summary

CHAPTER V: DISCUSSION

Heading Related to RQ1

Heading Related to RQ2

Heading Related to RQ3

Heading Related to RQ4

Summary

CHAPTER VI: SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND REFLECTION

Summary

Conclusions

Recommendations

Reflections

BIBLIOGRAPHY

Chang, C., Lee, J., Wang, C., Chen, G. *Improving the authentic learning experience by integrating robots into the mixed-reality environment*. Retrieved on February 15, 2015 from <http://www.sciencedirect.com/science/article/pii/S0360131510001831>

Gee, J. (2003). *What video games have to teach us about learning and literacy*. Retrieved on February 15, 2015, from <http://dl.acm.org/citation.cfm?id=950595>

Gay, L. R., Mills, G. E., & Airasian, P. (2012). *Educational Research: Competencies for Analysis and Applications* (10th ed.). Upper Saddle River, NJ: Merrill.

Traylor, R., Heer, D. Fiez, S. (2003) *Using an Integrated Platform for Learning™ to Reinvent Engineering Education*. IEEE Transactions on education, vol. 46, no. 4, November 2003 409. Retrieved on February 15, 2015 from <http://eecs.oregonstate.edu/education/about/publications/usinganintegrated.pdf>,

APPENDICES

Appendix A: Request for IRB Approval Letter

IRB PROPOSAL: An Analysis of Educational Robotics as Synthesis of STEM in Middle School Curriculum

This study will evaluate the level to which common core content areas of mathematics and literacy are used in robotics education. A survey will be provided to middle school robotics teachers to measure the extent of cross disciplinary teaching practices that are provided. The question to be addressed is to what extent does teacher training need to be provided. Middle school teachers will be given survey monkey URL that will measure different a variety of skills by students.

Potential benefits to the students include:

- this data will allow leadership in technology education to identify proper professional development for teachers and become aware of which materials are most effective in teaching robotics;
- funds can be allocated accordingly to the needs of teachers;
- teachers will be able to view the study to assess where their skills and knowledge base stand compared to their peers.

Since the survey is anonymous and takes place on a secure website, there is only minimal risk associated with individual participation. Participation is voluntary.

This study will survey a group of 50 middle school robotics in the greater New Jersey area. The subjects for this study will be recruited from their membership in the New Jersey Technology and Engineering Educators Association, graduates from Bloomfield College and other teachers engaged by the researcher. They were identified and recruited by the researcher specifically because they most likely teach robotics. A letter of consent will not be necessary because the participants are adults.

This survey will be introduced to the members of the New Jersey Technology and Engineering Educators Association, graduates from Bloomfield College and other teachers in form of an Informative Letter with the survey being made available on Survey Monkey. There is an Information Sheet available at the beginning of the on line survey, to inform participants of the purpose of the survey, that the survey is voluntary and that the survey is anonymous. The survey is intended to be available on line for a period of four weeks. The records of this study will be kept confidential.

Appendix B: Request for Permission from Kelly Hart, Executive Director New Jersey Technology and Engineering Educators Association

Appendix C: Request for Permission from Dr. Amy Eguchi, Bloomfield College, Bloomfield, NJ

Appendix D: Survey Questions

1. What mathematics skills do you use with your robots? Enter the number that applies most closely to you.

1 never 3 seldom 5 frequently 7 mostly 9 all the time

I have students measure the distance their robot travels using rulers.

I have students calculate the distance the robot travels using the circumference of the wheel.

I have students calculate the speed of the robot.

I have the students use Pythagorean theorem to calculate the distance traveled by the robot.

I use more advanced math.

I use no math.

2. What literacy skills do you use with your robots? Enter the number that applies most closely to you.

1 never 3 seldom 5 frequently 7 mostly 9 all the time

I have the students write blog.

I have the students write a journal.

I have the students keep a design log that includes all steps of the design process.

3. What other tools do you use?

I have students create a model using CAD software.

I have students design modifications to their design using CAD.

I have students design parts for their robot using a 3D printer.

I have the students market their robot using presentation software or video.

I have students write a description of what the robots functions are.

LIST OF TABLES

