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**CREU 2016-2017 Final Report: Investigation of Academic Performance,
Motivation, and Personality Traits in an Introductory Computer Programming
Course**

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I) Goals and Purpose

Please describe the goal(s) and purpose of this project. What open research problem or question does the project address?

The use of robotics in the undergraduate curriculum has proven to be instrumental in meaningfully engaging students and motivating them to achieve. In this project we investigate the motivation levels, engagement, academic performance, and personality traits of students enrolled in an introductory programming course.

Question 1: Is there any significant difference between the achievement of students enrolled in the robotics lab and the traditional introductory computer programming laboratory sessions?

Question 2: Is there any significance difference between the personality types of students enrolled in the robotics lab and the traditional introductory computer programming laboratory sessions?

Question 3: Is there any significance difference between the motivation of students enrolled in the robotics lab and the traditional introductory computer programming laboratory sessions?

II) Related Work

Include a scholarly review of related prior work. Include citations to the relevant literature.

The seriousness of attrition in computer science programs across the United States has been described in several studies. More than half of the students who initially declare their major as computer science change their majors prior to graduation (Division of Research, Evaluation, and Communication, Directorate for Education and Human Resources). Research suggests that major factors contributing to attrition include lack of experience with computers prior to entering college (Hagan & Markam, 2000) and poor mathematics preparation. Research investigations (Davy, Audin, Barkham & Joyner, 2000; Hagan & Markham, 2000; Morrison & Newsome, 2001) have found that students with no prior programming experience are at a disadvantage in successfully completing a computer science degree. One important development in addressing the above problem has been the use of



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robotics as both a motivating and a “hands on” approach toward computer science education and to teach students algorithmic thinking . These approaches have their origins in the turtle graphics of Logo whose aim was to teach algorithmic thinking by moving a turtle around and not concentrating on the specifics of the language.

McGill used Keller’s Instructional Materials Motivation Survey to measure four components of motivation: attention, relevance, confidence, and satisfaction. The results of this study indicate that the use of robots had a positive influence on participants’ attitudes towards learning to program in a CS0 course, but little or no effect on relevance, confidence, or satisfaction and gender, technical self-perception, and interest in software development have no bearing on the overall motivational levels of students.

There are several research studies that used combinations of the students’ personality traits, cognitive skills and previous academic performance to build models that would predict CS1 performance. Hostetler successfully classified 61 of 79 students (77.2%) into low and high aptitude groups using a multiple regression equation developed from 5 predictors. The study examined to what extent certain cognitive skills, personality variables and past academic achievement were predictive of CS1 success. The study randomly selected 120 of the 600 students enrolled in the CS1 course. Because of missing data, the final sample size was reduced to 79 students. The dependent variable used was the final exam numerical score earned by the students in the CS1 course. The five independent variables found to have a significant correlation to CS1 success included Diagramming and Reasoning from the Computer Programmer Aptitude Battery Test, college GPA, math background and the personality trait variable PF05. A high score on personality trait PF05 represented a “Sober/Happy-go-lucky” personality type. This proved to be a very good prediction model for the time with a multiple correlation value of 0.653. Hostetler concluded that changing educational trends and the introduction of the personal computer into the home prompted for a new model to be developed.

Furnham’s study has shown that among an elite, highly selected student body, personality traits (but not cognitive ability) are definitely related to academic success such as final examinations, written essays, and continuous assessment. This study has suggested that between a fifth and a third of the variance in marks can be accounted for by personality traits and two in particular, namely, Conscientiousness and Extraversion. The results from the study suggest that both conscientious and introverted (and to a lesser extent stable and female) students are likely to do. The results suggest that once suitable levels of intelligence are met, personality variables play an increasing role in educational outcomes, which mitigates in favor of psychometric tests for university screening.



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Furnham, A., Chamorro-Premuzic, T., & Moutafi, J. (2003). Personality and intelligence: Gender, the Big Five, psychometric and self-estimated intelligence.

Hostetler, Terry R. "Predicting Student Success in an Introductory Programming Course." ACM SIGCSE Bulletin (): 40-49.

Monica M. McGill, Learning to Program with Personal Robots: Influences on Student Motivation, ACM Transactions on Computing Education (TOCE), v.12 n.1, p.1-32, March 2012

Morrison, M. and Newman, T. (2001) A study of the impact of background and preparedness on outcomes in cs1. Proceedings of the 32nd SIGCSE Technical Symposium on Computer Science Education, Charlotte, NC, 179-183.

III) Process

Please describe your approach and/or strategy in solving the problem.

The participants for this study includes students enrolled in CSC 1311– Computer Programming II Spring Semester 2017. Intact groups were used for the control and experimental (robotics) groups.

- There are 36 participants: 17% females and 83% males, self-identified themselves as 32 African Americans, 1 White American, 1 Hispanic, and 1 Indian, and 1 Native American. The robotics group consisted of 1 female and 15 males. The control group consisted of 5 females and 14 males.
- We administered a pre-course assessment.
- We also administered the Myers-Briggs Personality Type Inventory and Keller's Instructional Materials Motivation Survey at the beginning of the semester to determine personality traits and motivation.
- We developed instructional modules using the Finch robot as the vehicle to enhance and improve programming skills during the Fall Semester 2016.
- The instructional modules covered the following programming concepts: Classes & Objects, Sorting & Searching, and Inheritance & Polymorphism
- We incorporated the modules during the weekly closed laboratory sessions.
- We administered pre/post assessments and surveys for the instructional modules to assess and evaluate the effectiveness of the modules.
- We are currently analyzing the data. We will use SPSS to analyze some of data.



IV) Results and Discussion

Please list or describe the conclusions of the work and the results achieved. Provide empirical and/or theoretical justification of the results. Include any limitations of the results. Feel free to include any screen shots or diagrams in this section.

The control group in our study performed better than the robotics group on the sorting and searching quiz and Test 1. One major factor attributing to this result may be the issue that the robotics group had with the robots, experiencing connectivity issues. Four of the students in the robotics group decided to leave the group after learning that a personality the explanation of the study. The final examination (proficiency examination) was administered this week and is in the process of being scored. Our research is not complete but we are still gathering the data and analyzing our findings. Due to our summer extension we will be able to continuously work on analyzing our results.

Table 2. Results of Meyers Briggs Personality Inventory

Type	Control Group	Robotics Group
Defender	1	1
Mediator	0	1
Adventurer	0	1
Executive	0	2
Logician	1	1
Advocate	2	2
Campaigner	3	1
Consul	2	4
Entertainer	0	2
Commander	1	0
Protagonist	4	0
Logistician	2	0
Total	16	15
Missing Data	1	4

Table 3. Academic Performance on Searching Lab

Group	Pre-test (Average)	Posttest (Average)
Control	76	82
Robotics	74	78

```

while( index < array.length)
{
  if(array[index] >= 75)
  {
    element = index;
    r.saySomething(s[index] + " You passed!");
    r.sleep(2000);
    r.setLED(0, 225, 0);
    r.setWheelVelocities(225, 225, 1000);
  }
}

```

Figure 1: Solution to Robotics Search Lab



Figure 2: Finch Robot



Listed are the results of the survey regarding learning with the finch report after the first module on sorting and searching.

Survey Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
❖ The Finch Robot is enjoyable to use.	7%	13%	40%	27%	13%
❖ The Finch interface was easy to understand.	0%	33%	47%	13%	7%
❖ The Finch Robot programming improved my motivation to learn programming.	7%	33%	33%	20%	7%
❖ The difficulty of the Finch Robot was appropriate for my skill level	13%	13%	54%	13%	7%
❖ Practicing with Finch Robot improved my confidence in my programming ability	13%	53%	27%	7%	0
❖ I would program with Finch robot again	53%	27%	0%	13%	7%
❖ Visualizing the code execution with the Finch Robot helped me understand the concepts	53%	33%	0%	1%	1%
❖ I would recommend this learning module to other programming students	67%	20%	0%	0	13%

What learning style do you personally find most effective?

- Auditory (7%)
- Hands On (73%)
- Visual (20%)

```

while( index < array.length)
{
  if(array[index] >= 75)
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    element = index;
    r.saySomething(s[index] + " You passed!");
    r.sleep(2000);
    r.setLED(0, 225, 0);
    r.setWheelVelocities(225, 225, 1000);
  }
}

```

Figure 1: Solution to Robotics Search Lab



Figure 2: Finch Robot

V) Future Work



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Please list or

describe your plans for future work on this project or new questions that have resulted from the progress you have made on the research problem.

In the future we plan to repeat this study with the network working properly and compare the results to what we obtained in this study. This study has sparked our interest in investigating the profiles (personality traits, academic performance in STEM course, and intrinsic motivation) of females from underrepresented groups who successfully complete introductory computer programming courses and pursue majors in Computer Science/Information Technology.

VI) **Web Links**

Please provide links to your project web pages. If there is more than one, please list each link on a separate line.

www.wssurobotics.wix.com/wssurobotics

VII) **Presentations and Publications**

Please list the titles and venues of any presentations or publications resulting from this project. Please list each on a separate line.

University Scholars Day
Winston-Salem State University, Winston Salem, NC
April 6, 2017

2017 ADMI Symposium: The Internet of Things
Virginia Beach, Virginia
March 23-26, 2017

Emerging Researchers National (ERN) Conference in STEM,
Washington, D.C.
March 2-4, 2017

StemPosium hosted by SciTech Institute "Intro to Finch Robots"
Wake Forest BioTech Place, Winston Salem, NC
November 11, 2016