Research Proposal

Improving K-12 CS Education in Utah: A Research Review

Arthur Judd

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ENG 316

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Dear Ben,

Thank you for taking the time to coach me and my classmates in this technical writing course. I'm sending this packet to you as a proposal for my term project: a literature review in the field of computer science. I would like to determine if there is sufficient literature to conduct a study regarding computer science in education for students in grades K-12 in the state of Utah. I have included the sources I intend to review and my plans for conducting the research. Please consider this proposal. With your approval I will continue my research.

Thank you in advance.

With regards,

Arthur Judd

IMPROVING K-12 CS EDUCATION IN UTAH

Introduction

Information technology and computer science are among the fastest-growing industries in the world economy today. However, their rapid growth has not allowed enough time for our school systems to develop standardized effective methods to teach children basic computational- and programming-oriented skills.

I would like to study the recent literature about computer science in K-12 education to address the following question:

Should Utah K-12 schools implement game-based curriculums to teach young students basic programming skills?

In preparation for that study, I propose a formal review of the available literature to determine there is enough evidence to answer the question above. A satisfactory pool of literature will discuss the cost and potential value of various methods that have been implemented in similar to Utah.

The Current Situation

Over the last decade the entire world has experienced a dramatic shift in the way it depends on computer technologies. Without any doubt, most local and international economies rely entirely on software of one form or another to conduct transactions, communicate over long distances, mobilize assets and much more. Even beyond economic matters, individuals around the world use electronic devices for personal communication, education, productivity and entertainment.

The technology industry now stands beside ancient columns of civilization like carpentry, mathematics, agriculture, metallurgy and others. However, because it is so young compared to its predecessors, our educational systems have not yet evolved to adequately prepare children and adolescents for careers in that field.

A few decades ago, there was a movement to teach programming languages like BASIC and Perl to school students. However, those programs were often very rigid in their approach which resulted in indignation and backlash from most students before they were discontinued.

In recent years, many new strategies have emerged that utilize new software and games to teach children programming skills without the rigor of an advanced language. But these efforts are far from standardized and have yet to reach a consensus regarding exactly what material should be taught to students of any certain age.

The focus of my research will be to determine whether or not there is adequate literature to determine which approach would be most effective for preparing high school students in Utah to excel in college courses and careers in the field of computer science.

If our schools continue without a standardized, effective approach to solve this problem, graduated students will not have the skills to pursue technical careers. As a result, Utah tech industries will need to look elsewhere to find skilled employees. This could have undesirable impacts on the state's economy

Methodology

To conduct this literature review I plan to evaluate ten credible sources thematically and score them based on the following criteria:

- (2 points) The authors have credible experience in CS education.
- (2 points) The case study in the source took place in a setting similar to K-12 education in Utah.
- (1 point) The source provides in-depth discussion of the challenges of K-12 CS education.
- (1 point) The source explores a unique approach.
- (1 point) The source provides a unique point of view regarding an approach that is also mentioned in another source.

An acceptable source should earn at least 3 points on this scale. These criteria are formulated to guarantee that a source with at least three points meets at least one of the first two plus any other. This is effective because the first two criteria are particularly important to my research question.

Because I expect all ten sources to have an average of three points each, I expect to achieve an overall score of at least thirty. That will indicate to me that the literature is reliable enough to continue my research.

Selected Literature

I have selected the following ten sources from available literature as the most potentially useful for my research. By reading their abstracts I determined they are likely to meet the aforementioned criteria and propose to analyze their full inform my final decision.

1. Kanaki, K., & Kalogiannakis, M. (2018). Introducing fundamental object-oriented programming concepts in preschool education within the context of physical science courses. Education and Information Technologies, 23(6), 2673-2698. doi:http://dx.doi.org.erl.lib.byu.edu/10.1007/s10639-018-9736-0

Reasoning: This is a recent study that shows promise using physical concepts that children are already familiar with. It could be a low-cost solution that could easily integrate with existing curricula.

2. Blakemore, L. (2017). Does teaching computer programming within key stage 1 of the primary curriculum enhance children's problem solving skills?(Order No. 10764458). Retrieved from https://lib-byu-edu.erl.lib.byu.edu/remoteauth/?url=https://search-proquest-com.erl.lib.byu.edu/docview/2001099459?accountid=4488

   Reasoning: This is a general analysis of how effective it is to even begin teaching computer science in the earliest of years. It could prove helpful in determining at what ages children should begin learning.

3. Pellas, N., & Vosinakis, S. (2018). The effect of simulation games on learning computer programming: A comparative study on high school students' learning performance by assessing computational problem-solving strategies. Education and Information Technologies, 23(6), 2423-2452. doi:http://dx.doi.org.erl.lib.byu.edu/10.1007/s10639-018-9724-4

   Reasoning: This recent study reports on the efficiency of computer games used to teach programming to high school students.

4. Christiane Gresse, V. W., Giselle Araújo E Silva,De Medeiros, Filho, R. M., Petri, G., Pinheiro, F. D. C., Ferreira, M. N., & Hauck, J. C. R. (2019). SplashCode - A board game for learning an understanding of algorithms in middle school. Informatics in Education, 18(2), 259-280. doi:http://dx.doi.org.erl.lib.byu.edu/10.15388/infedu.2019.12

   Reasoning: This is an intriguing study that uses a board game to teach programming concepts as an alternative to the popular computer simulations.

5. Ortiz-Rojas, M., Chiluiza, K., & Valcke, M. (2017). Gamification in computer programming: Effects on learning, engagement, self-efficacy and intrinsic motivation. Reading: Academic Conferences International Limited. Retrieved from https://lib-byu-edu.erl.lib.byu.edu/remoteauth/?url=https://search-proquest-com.erl.lib.byu.edu/docview/1967749155?accountid=4488

   Reasoning: This will provide a second opinion on the efficiency of computer games for teaching programming skills.

6. Tanya Estes, James Finocchiaro, Jean Blair, Johnathan Robison, Justin Dalme, Michael Emana, Luke Jenkins, and Edward Sobiesk. 2016. A Capstone Design Project for Teaching Cybersecurity to Non-technical Users. In Proceedings of the 17th Annual Conference on Information Technology Education (SIGITE '16). Association for Computing Machinery, New York, NY, USA, 142–147. DOI:https://doi.org/10.1145/2978192.2978216

   Reasoning: This study was directed at teaching programming skills to non-technical students, which may provide insight to providing a broad awareness of these skills.

7. Joseph DeLuca and David A. Joiner. 2006. Incorporating computational science activities in high school algebra. In Proceedings of the 6th ACM/IEEE-CS joint conference on Digital libraries (JCDL '06). Association for Computing Machinery, New York, NY, USA, 356. DOI:https://doi.org/10.1145/1141753.1141851

Reasoning: This study makes use of pre-existing algebra courses to introduce computational concepts, which could prove effective and easy to implement.

8. Ron Tenison, Janice Levenhagen-Seeley, Shereen Khoja, and Pamela Harrison. 2013. It takes a village, but together we can make a difference. J. Comput. Sci. Coll. 29, 1 (October 2013), 130–132.

Reasoning: This is a report from a school district in Oregon that had very positive results. If their situation is comparable to that of Utah, it will be a valuable study for my research.

9. Plauska, I., Lukas, R., & Damasevicius, R. (2014). Reflections on Using Robots and Visual Programming Environments for Project-Based Teaching. Electronics & Electrical Engineering, 20(1), 71–74. https://doi-org.erl.lib.byu.edu/10.5755/j01.eee.20.1.6169

Reasoning: This study presents a unique approach and thoroughly analyzes its advantages and challenges.

10. Sapounidis, T., Demetriadis, S., & Stamelos, I. (2015). Evaluating children performance with graphical and tangible robot programming tools. Personal & Ubiquitous Computing, 19(1), 225–237. https://doi-org.erl.lib.byu.edu/10.1007/s00779-014-0774-3

Reasoning: This study analyzes the PROTEAS approach for children over a range of ages and presents a thorough discussion of the results.

Management Plan

Timeline

I intend to complete this literature review by August 12, 2020, which leaves approximately 30 days from the from the time of this proposal. Because of that reduced timeframe I will employ a strict schedule to complete the research in the given amount of time. A gantt chart is given below detailing how I intend to divide my use of that time.

Materials and Costs

Because I have selected sources that are readily available online, I expect to only require my personal laptop to complete my research. Some of the sources may require a subscription or fee, which I will provide out of my own funds.

ITEM/ Date	7/14	/15	/16	/17	/18	/19	/20	/21	/22	/23	/24	/25	/26	/27	/28	/29	/30	/31	8/1	/2	/3	/4	/5	/6	/7	/8	/9	/10	/11	/12
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