The Future of Engagement in Information Technology

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Scientia

THE FUTURE OF ENGAGEMENT IN INFORMATION TECHNOLOGY

As many industries, government agencies and community organisations incorporate Information Technology solutions into their business process, the need for skilled diverse talent continues to grow. A dedicated team at the University of Cincinnati is addressing this with a program of Design Based Information Technology Learning Experiences (DITLE) to design diverse experiences to promote and study high school students' engagement in information technology.

Indispensable Information Technology Throughout Society

Over the past few decades, a wide variety of scientific and technological advances have been transforming society and professional settings. The Information Technology (IT) field is in constant growth, leading to a greater need for technology professionals to cover what are now among the most highly paid roles in many countries worldwide.

Currently, 51% of Science, Technology, Engineering and Maths (STEM) related positions are those that require advanced knowledge of computers and software. These include roles such as Information Security Analysts, Software Developers, Computer Network Administrators, Database Administrators and many more.

STEM education has become more important than ever, to ensure that the workforce of the future is well-equipped to face the challenges of modern society and that those who wish to pursue a career in technology have been provided with the necessary tools early in their academic path.

While most IT jobs require post-secondary education, students' preparation in technology should ideally begin before college. An early acquisition of basic IT related skills can considerably improve young people's chances of succeeding in relevant higher education courses, while also broadening job possibilities for high school graduates who are not in a position to immediately move on to college.

The University of Cincinnati, Ohio, has therefore developed Design Based Information Technology Learning Experiences – DITLE, an academic program that introduces high school students and teachers to basic IT skills. Through a variety of learning experiences, the DITLE project tries to increase secondary students' interest in and awareness of IT related topics, while improving their preparation and broadening their prospects for the future.

The DITLE Program

The DITLE program was developed by an interdisciplinary team from the University of Cincinnati School of Information Technology and the School of Education including Dr Chengcheng Li, Dr Helen Meyer, Dr Hazem Said, and Dr Marcus Johnson. The project was managed by Rebekah Michael, who is an experienced professional with 14 years in developing and managing software projects. They explain that, 'through a variety of hands-on learning experiences, the DITLE project tries to increase secondary students' engagement in IT related topics, improving their preparation and broadening their prospects for the future.'

The program was introduced in 2015 with 38 students participating in a summer camp and many more participating in IT clubs throughout the year. The number taking part in the summer camp has been increasing, with 49 students in 2016 and 52 in 2017. The 4-year project, funded by the National Science Foundation (NSF), involves

a collaboration between teachers, students, faculty members, industry partners of the University of Cincinnati, and businesses in the Cincinnati area.

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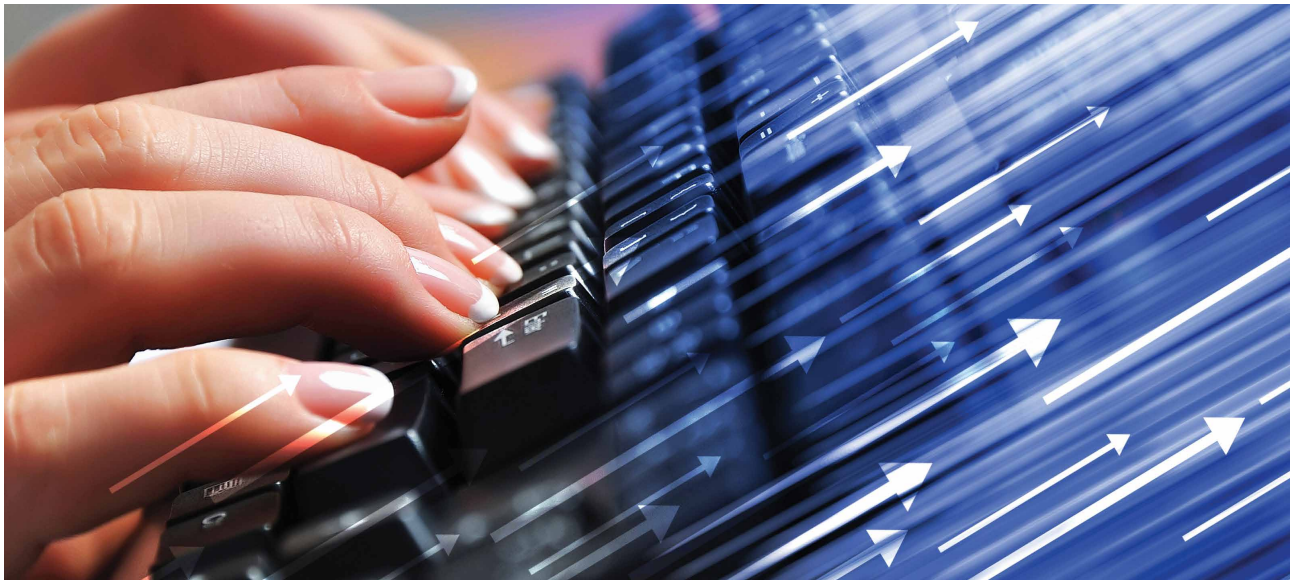

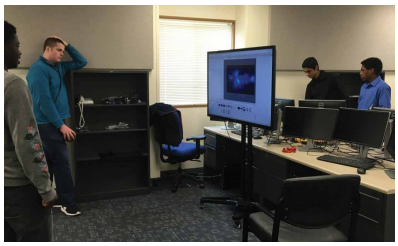

A number of local high schools are participating in the program including Aiken High School, Hughes STEM High School, Oak Hills High School, Shroder Paideia High School, Taft Information Technology High School, Walnut Hills High School, and Withrow University High School. The program offers high school students an intensive summer camp, an opportunity to network with other students interested in IT, and the chance to start applying their skills in community projects and paid internships within the IT sector.

The course material is based on specific background literature for teaching Information and Communications Technology (ICT) and STEM related topics. The model consists in training students to solve problems with Design-Based approaches, a subtype of Problem Based Learning methods. Design-Based methods foster students’ creative thinking and communication, developing their interest in ICT while strengthening their ability to grasp relevant mathematic processes.

These learning strategies ask students to apply their skills in ways that are authentic and related to real-world problem solving, in contrast with more traditional teaching methods that provide knowledge without testing its practical applications. Students on the program gain access to experts in the field and are provided with the opportunity to learn from experienced college professors and IT business leaders.

A Variety of Learning Experiences

The DITLE program offers high school students the possibility to participate in a variety of interesting learning experiences. At the University of Cincinnati Information Technology Day Camp, students fully immerse themselves in learning activities related to app development, cyber-security, building computer networks and much more.

The University of Cincinnati Information Technology Expo is a chance for them to develop their own mobile games, apps, robots, or work on other IT-related projects, with the option of presenting these in a competition. The Expo includes presentations by guest speakers and undergraduates in the university’s IT program. It is a great opportunity for DITLE participants to network with experienced IT professionals and older students pursuing degrees in STEM subjects.

The ICT Summer camp consists of a series of courses that allows the students to explore ICT related topics further. Students benefit from keynote speakers who are experts in their field talking about diverse topics including, ‘For the Love of Programming’ by Butch Wesley who is a Senior Developer at General Electric, ‘Playing Games is Research’ with Dr Guo Freeman from the University of Cincinnati and ‘One Woman’s Journey in IT,’ with Jen Martin PR Representative of Girl Develop IT.

The students at the summer camp are guided in a series of learning activities and projects by college students. A diverse range of activities include an ‘Agile Principles Learned Through Lego Group Activity,’ a ‘Create a College Budget’ activity and also how to, ‘Create Art by programming in Java.’

Groups of four-five students work together to create an IT solution or research project of their choosing guided by a college student as a mentor. Projects include designing an Android app that will find your location and will give a list of available radio stations for a genre of music, a home security system for under $100 using a Raspberry Pi, and an on demand greeting card printer to replace the greeting card areas of stores.

The college students stay with the high school students throughout the day, taking them on tours of the campus and leading some of the lessons. This allows them to gain valuable experience and learning credits for taking part in the program.

Beyond the summer camp the DITLE program also includes mentoring and job shadowing from Cincinnati business leaders, through internship opportunities offered at the Information Technology Solutions Center.

The DITLE program also organises community events at participating high schools, bringing together students and parents from the local community to share ideas. Students organise family and community IT events at their local high schools and in community centres to teach others the information technology skills they have learned, such as Microsoft Excel and programming.

At specially organised community nights, students share their learning and skills with others in their community and at coding nights students can take a turn at teaching community adults about coding. Finally, the After-School IT Club provides a space in which the students can work on their own IT projects that they can later show to their families, friends and other community members during specifically tailored Family Nights.

Measuring Engagement

Research associated with the program is looking into new mechanisms for expanding student engagement and participation in the various program activities and how that relates to the different abilities of the students' and their different demographic backgrounds. The team are working to understand the experiences that support student success in ICT careers and they are aiming as a result of their analysis to find new ways to broaden the demographics of students pursuing ICT careers.

The team are also gathering information that could be useful to devise future program strategies. They are collecting both quantitative and qualitative data from high school students who had been part of the program, through individual interviews, observations, and the administration of relevant questionnaires.

Focus groups that took place during the school year served as a chance to observe any changes in the students' knowledge, attitudes and interest in IT. Observations were made during the program and semi-structured interviews were carried out with up to six high school students for every year of the program and ten students from the 2017 cohort to further assess the program's impact.

The program has increased in popularity over the years, with more students joining after 2015 through referrals from family, friends, and school. It was found to have high attendance rates, with 87.9% of students being present on any given day in 2017. Those participating in the program were consistently pleased with the new relationships they formed, their group projects, and the completed activities were generally perceived as useful and valuable, improving their confidence in ICT related areas.

Students often reported that hands-on activities were the most engaging and useful, while assessments of their growth suggested an improvement after attending courses and events. Overall, the program appeared to increase the students' confidence in themselves and in their acquired skills, with many suggesting that they felt more competent and empowered.

The process of measuring student engagement is helping to shed light on areas of the program that could be improved, for instance suggesting the potential benefits of a greater focus on the hands-on projects that were particularly popular among students.

Building the Workforce of the Future

The fields of technology and science are developing at an increasingly fast pace, placing responsibility on education to ensure that the workforce of the future is equipped with all the skills necessary to meet the needs of modern society.

As society's reliance on technology increases, introducing students to the basics of information and computing technologies before they decide whether to pursue higher education is of growing importance. In-depth IT courses for high school students are still considerably rare, but projects such as the DITLE program could play a central part in preparing younger generations for a career in IT.

The DITLE program is an important initiative that has already opened great possibilities for many high school students in Cincinnati who are interested in IT, increasing awareness of IT in a number of local high schools and presenting opportunities for students to take their first steps into the field.

The project has revealed that project-based active learning is more effective in engaging diverse students and that female and minority students are more likely to engage in IT through hands-on learning activities. It also supports the use of credentialed active learning activities to play a role in increasing the scale and diversity of the IT talent pipeline.

The University of Cincinnati will be continuing with the summer camp in the coming year and local teachers will also have the opportunity to attend, to learn more about the fundamentals of IT. They can then develop new ways to incorporate what they have learned into their science or maths classes. The teachers will also be given the opportunity to work with or lead IT clubs at a partner school.

There is a national and global risk of facing a shortage of skilled technology workers in the years to come, so projects such as the one developed by the University of Cincinnati could be a substantially enabling resource for local communities. Such projects can act to increase the numbers and diversity of students engaging in information technology and pursuing successful careers in this field.

Meet the researchers

Dr Chengcheng Li
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Dr Chengcheng Li is an associate professor and assistant director for graduate studies at the School of Information Technology at the University of Cincinnati. He has over ten years of experience with teaching information technology in higher academic environments. He has carried out multiple research projects and has been part of two Review Panels for the National Science Foundation (NSF). He is the director of the UC Center for Academic Excellence in Cyber Defence.

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Dr Helen Meyer is an associate professor at the University of Cincinnati and the Secondary Science Education Coordinator. She has worked in many different academic settings, teaching students in secondary school, college and university and has carried out extensive research in the field of education. She also serves as the director of the University of Cincinnati Fusion STEM Education Center, which works to improve teaching in the fields of science and mathematics.

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Dr Hazem Said
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Dr Hazem Said is a Professor and Head of the School of Information Technology at the University of Cincinnati. In March 2012, he founded the Information Technology Solutions Center where he consulted with government, public and private organisations on a variety of information technology solutions. He is a recipient of more than 120 grants and contracts totaling over $5.1 million. He authored 23 articles on different topics related to information technology education. Dr Said received the 2015 Southwest Ohio IT Leadership Award and is a two-time recipient of the Golden Apple excellence in teaching award.

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Dr Marcus Johnson is an associate professor and core faculty member of the Developmental and Learning Sciences at the University of Cincinnati. As a developmental and educational psychologist with expertise in 'motivation in education,' he has experience teaching in secondary and postsecondary environments, and presently teaches graduate courses in human development and educational psychology. He has carried out research into the motivational, developmental, and cognitive changes that occur across the human lifespan.

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Rebekah Michael is an assistant director of special projects in the School of Information Technology at the University of Cincinnati. She spent over 14 years building applications for the aerospace and defence manufacturing and healthcare industries in roles as a software developer, business analyst, and product manager. She works as the director of multiple grants to educate and promote Information Technology to students of all ages and improve diversity in the Information Technology industry.

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