Ernane Rosa Martins
(Organizador)

FUNDAMENTOS DA CIÊNCIA DA COMPUTAÇÃO

Atena Editora
Ano 2019

Ernane Rosa Martins
(Organizador)

Fundamentos da Ciência da Computação

Atena Editora
2019

2019 *by Atena Editora*
Copyright © da Atena Editora
Editora Chefe: Profª Drª Antonella Carvalho de Oliveira
Diagramação e Edição de Arte: Lorena Prestes e Geraldo Alves
Revisão: Os autores

Dados Internacionais de Catalogação na Publicação (CIP)
(eDOC BRASIL, Belo Horizonte/MG)

F981 Fundamentos da ciência da computação / Organizador Ernane Rosa Martins. – Ponta Grossa (PR): Atena Editora, 2019.

Inclui bibliografia
ISBN 978-85-7247-157-2
DOI 10.22533/at.ed.572190703

1. Computação. I. Martins, Ernane Rosa.

CDD 004

Elaborado por Maurício Amormino Júnior – CRB6/2422

APRESENTAÇÃO

A Ciência da Computação estuda as técnicas, metodologias e instrumentos computacionais, visando automatizar os processos e desenvolver soluções com o uso de processamento de dados. Este livro, possibilita conhecer os elementos básicos desta ciência por meio do contato com alguns dos conceitos fundamentais desta área, apresentados nos resultados relevantes dos trabalhos presentes nesta obra, realizados por autores das mais diversas instituições do Brasil.

Assim, são abordando neste livro assuntos importantes, tais como: desenvolvimento de sistema mobile utilizando as plataformas iOS e Android; desenvolvimento de protótipo que trabalha em cenário real de sala de aula e na comparação de algoritmos usados no reconhecimento facial; criação do jogo que explora a criptografia em um ambiente de computação desplugada; construção de simulador que mostra especificamente o comportamento do escalonador First-in First; apresentação de abordagem para orquestração do conhecimento curricular em Ciência da Computação baseado nas matérias do currículo referência para a Ciência da Computação e em estruturas curriculares de cursos de graduação.

Espero que este livro seja útil tanto para os alunos dos cursos superiores de Ciência da Computação quanto para profissionais que atuam nesta importante área do conhecimento. O principal objetivo deste livro é ajudar na fascinante empreitada de compreender a computação perante os mais diferentes desafios do século XXI. Desejo a todos uma excelente leitura e que está obra contribua fortemente com o seu aprendizado.

Ernane Rosa Martins

SUMÁRIO

CAPÍTULO 2

AGILE PROJECT-BASED LEARNING TO COPE WITH THE COMPUTER PROGRAMMING EDUCATION AT BRAZILIAN HIGHER EDUCATION: A RESEARCH PROPOSAL

Alexandre Grotta
Universidade de São Paulo
São Paulo, SP, Brasil

Edmir Parada Vasques Prado
Universidade de São Paulo
São Paulo, SP, Brasil

RESUMO: A educação em programação de computadores (ED-PROG) é fundamental para o curso de Sistemas de Informação e áreas afins. No entanto, ensinar programação por meio de métodos tradicionais tem se tornado muito desafiante. Há mudanças na maneira de aprender das novas gerações e há novas máquinas computacionais para se programar. Neste contexto, a Aprendizagem Baseada em Projeto (PjBL) possui potencial para beneficiar o ED-PROG, principalmente a Aprendizagem Baseada em Projeto Ágil (APjBL). Por outro lado, foram encontrados poucos estudos relevantes relatando a utilização de PjBL no contexto nacional e latino-americano para a ED-PROG. Assim, esta pesquisa propõe analisar os benefícios de um método APjBL com relação ao método tradicional de ensino. Como método APjBL, se propõe uma versão adaptada do AMoPCE (*Agile Model for Projects in Computing Education*). Como critérios de comparação, propõe-se medir o rendimento escolar, a motivação para aprender, a comunicação e o aspecto profissional dos estudantes.

PALAVRAS-CHAVE: Programação de Computadores. Método de Ensino. Aprendizagem baseada em projeto. Aprendizagem baseada em projeto ágil.

ABSTRACT: Computer programming education (ED-PROG) is a fundamental subject to System Analysis Bachelor and related graduation courses. In general, teaching programming using traditional methods has become much more challenging due to many reasons, such as changes in the manner new generations are prone to learn and the arising of new programmable devices like robots and intelligent ambient. In this context, Project-Based Learning may offer potential benefits to ED-PROG, mainly Agile Project-Based Learning (APjBL). However, there are a few relevant studies relating PjBL and ED-PROG in Brazilian. Therefore, we propose to analyze the benefits of the APjBL when compared to the traditional Brazilian teaching method. We also propose the Agile Model for Projects in Computing Education (AMoPCE) as the APjBL teaching method, which was originated from previous researches and that we adapted to this context. As the comparison criteria, we propose to evaluate the benefits to students' grades, motivation to learn, communication, and profession.

KEYWORDS: Computer Programming.

Teaching Methods. Project-based Learning. Agile Project-based Learning.

1 I INTRODUCTION

Recent studies have reported challenges at Information Systems (IS) higher education and related courses at both developed and underdevelopment countries. Challenges such as the high evasion or falling rates and the lack of interest by new entrants. Part of these challenges is related to computer programming education (ED-PROG). Within this context, in order to enhance the ED-PROG, there are at least three relevant aspects: (i) the teaching methods, (ii) the students' grade and (iii) the student's motivation to learn. Improvements on the teaching methods are known to be related with improvements in students' performance. Thus, Project-Based Learning (PjBL) might be used as an alternative teaching method, given its effectiveness when compared to the traditional teaching methods. Among different PjBL approaches, the Agile Project-Based Learning (APjBL) tends to be more effective given its simplicity, adaptability and its origins related to the software development (SILVA FILHO et al., 2007; MONETT, 2013; VEGA; JIMÉNEZ; VILLALOBOS, 2013; SHANNON; WARD, 2014; GANNOD et al., 2015; SEMESP, 2015; LISTON; FRAWLEY; PATTERSON, 2017).

Although APjBL may help students to improve the ED-PROG, including but not limited to, student's grades and motivation, this research identified via a systematic literature review (SLR) that a few relevant reports came from Latin America or Brazilian context. Therefore, this research proposes the following leading objective: to analyze the main benefits of the APjBL teaching method when compared to a traditional teaching method, mainly the students' academic performance, motivation to learn, verbal communication and vocational inquiry aspects. As a comparison criterion, we propose to evaluate the students' academic performance, motivation to learn, verbal communication and vocational inquiry aspects. We also propose the Agile Model for Projects in Computing Education (AMoPCE) as the APjBL teaching method, which was originated from previous researches and that was adapted to this context. This research will adopt an experimental approach via a quasi-experiment at the System Development and Analysis higher education course, during the first semester of 2018.

The remaining of the research proposal is as follows. Section 2 describes the research problem. Section 3 presents the proposed solution. Section 4 addresses the solution evaluation. Section 5 reports the partial results. Section 6 presents the research conclusion.

2 I PROBLEM DESCRIPTION

ED-PROG is still considered very challenging for both students and educators.

Students might experience difficulties to learn computer programming due to many reasons, given it is considered a very complex and mentally demanding process. It requires a long learning curve. All these challenges might result in high evasion rate, such as those found at introductory programming courses (ABDOOL; POORANSINGH, 2014; AUTHORITY, 2017; GIRAFFA; MORAES; UDEN, 2014; ISKANDER, 2008; QUEIRÓS, 2014; VEGA; JIMÉNEZ; VILLALOBOS, 2013).

PjBL classes are bounded by real-world challenges and also by collective knowledge. Besides, PjBL might help students to deal with a second foreign language, such as the context found in Latin America IS courses. There were also reports that PjBL enhances students' grades and motivation in computer programming contexts (GOULDING, 2013; QUEIRÓS, 2014; THOMAS, 2017; ZOUGANELI et al., 2014).

However, applying PjBL to the ED-PROG may not be a standard or straightforward process. Therefore, we propose to join three different aspects, as follows: #1, the education aspect; #2, the project management aspect and #3 the PjBL outcomes and benefits. Thus, the original study (GROTTA; PRADO, 2018a) was adapted to this book chapter, and merged with another study (GROTTA; PRADO, 2018b), including the adaptation of Figure 1 as follows:

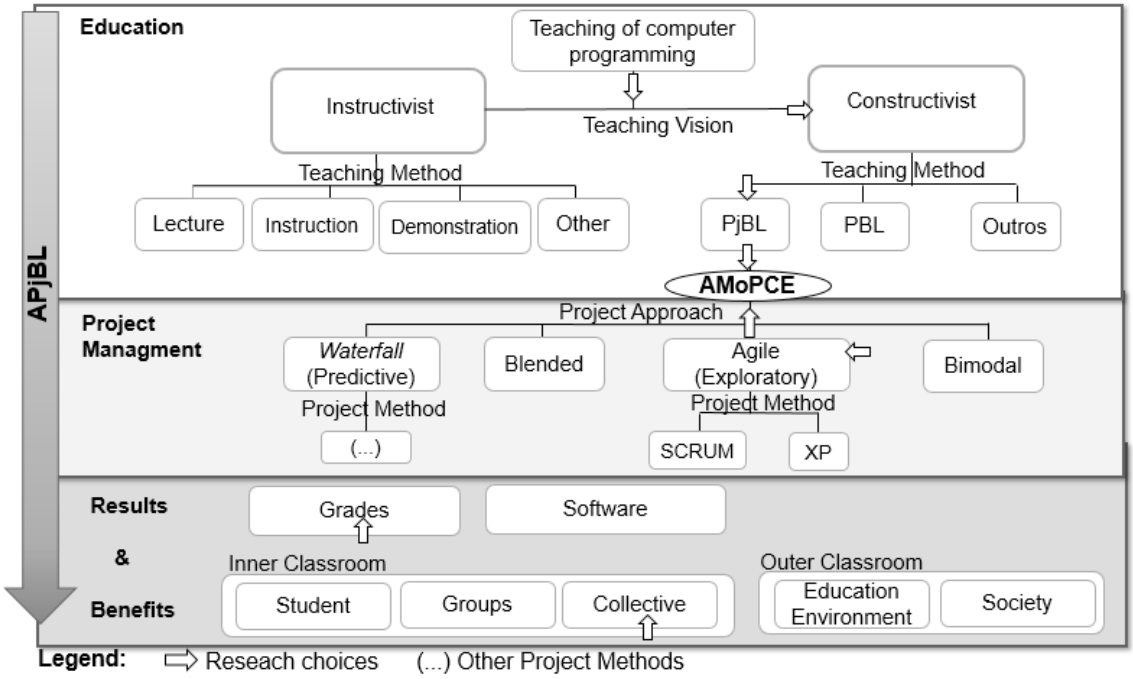

Figure 1. Research base concepts

Source: Adapted from GROTTA and PRADO (2018a, 2018b)

In figure 1, the first lane is education. In the need of defining traditional and non-traditional education, we chose to classify teaching methods under two distinct education visions: the instructivist and the constructivist visions. Instructivist vision is also known as a professor-centric approach, in which knowledge is mainly passed via instructions to the students, such as lectures. The constructivist vision states that students construct their own knowledge, such as PjBL or problem-based learning (PBL)

methods. Anyhow, the education processes are usually a gradient set into middle points of this *continuum* (PAYNE, 2009; BIGGS; TANG, 2011; PORCARO, 2011; GUZMAN-RAMIREZ; GARCIA, 2013; BELL C., 2016).

The second aspect relates to the project management, in which there are both project methods and project approach. Many of them were created asides the education environment such as project approaches (Agile, Waterfall or Blended) and its related project methods. Thus, choosing APjBL as teaching education method implies the need to bind the process of project management and education (TARNE, 2007; PMI, 2017a; AXELOS, 2018).

The third aspect relates to outcomes & benefits, come from both education and business projects lanes. Regarding education projects, students' grades are the most common outcomes from any course. Other additional students' outcome might relate to non-grades measures, such as motivation (GROTTA; PRADO, 2018b).

3 I PROPOSED SOLUTION

This work adopts the causal research with quali-quantitative analysis (also known as mixed analysis). This choice was based on the interest of understanding the phenomenon - PjBL - and its relations with the benefits variables, such as students' grades and motivation. This approach is relevant to multidisciplinary contexts, where qualitative and quantitative data give each other mutual support. Thus, this research adopts the educational quasi-experimental to be executed at a real university and a real semester (BELL, 2005; SAMPIERI; COLLADO; LUCIO, 2006; CRESWELL, 2009) J.W. (2014.

The main objective of this research was split into four specific objectives. Specific objective 1**:** Identify and describe the project methods and project approaches that are related to the ED-PROG, including the most suitable method to the Brazilian context. Specific objective 2**:** Identify the impact on students' grades and motivation after the use of PjBL as an alternative programming teaching method. Specific objective 3**:** Identify the students' benefits of PjBL. Specific objective 4**:** Compare the APjBL teaching method to the traditional programming teaching method in Brazilian Information System higher education, by analyzing the benefits to students' grades, motivation to learn, verbal communication and vocational inquiry aspects.

Based on findings produced by an SLR (Systematic Literature Review) (KITCH-ENHAM; CHARTERS, 2007) conducted by this research, AMoPCE (ROMEIKE; GÖT-TEL, 2012; KASTL; KIESMÜLLER; ROMEIKE, 2016) was selected as the most suit-able APjBL method to this research. AMoPCE is a teaching method that simplified Agile most relevant principles and applied them to computer education, thus resulting in a supportive teaching method. All principles were adapted from the original studies are described in figure 2:

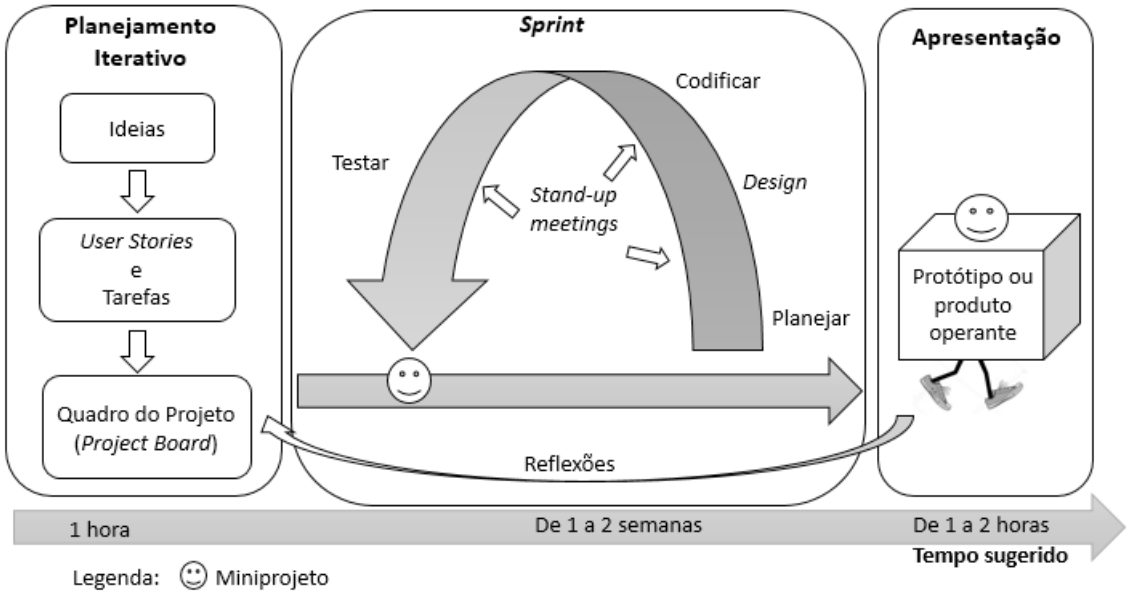

Figure 2. Adapted version of AMoPCE

Source: Adapted from ROMEIKE and GÖTTEL (2012) and KASTL, KIESMÜLLER, and ROMEIKE (2016)

At this research, professors will be able to adapt the most suitable principles of agile project-based learning to their programming courses to cope with the computer programming education. In order to make principles easier to be understood and applied by the professors, the original 14 principles (ROMEIKE; GÖTTEL, 2012; KASTL; KIESMÜLLER; ROMEIKE, 2016) were consolidated into seven Agile principles as follows:

(1) **Collaborative planning**: lane that includes the planning activities of AMoPCE: generation of ideas, planning of the user stories and their related tasks. Tracking tasks and deliverable by a project board.

(2) **Iteration**: The iteration is considered a core value from AMoPCE. This is a small chunk of time, usually between one and two weeks, in which it occurs the development of the planned software. The activities follow the plan, design, code, and test sequence.

(3) **Standup meeting:** this Agile principle is a short 10 to 15 minutes meeting, in which all members stand up to report what they did, what they plan to do today, and what are the issues and difficulties;

(4) **Pair programming:** Agile principle the two people join together to solve a programming task or challenge. One person leads the computer programming task, while the other one gives directions and suggestions. After a certain point, they change position.

(5) **Keep it simple:** Principle of doing the simplest solution to achieve the objective, such as learning from the simplest topics first as much as possible.

(6) **Planning poker:** a quick collective game in which all participants give their best estimate to a challenge, usually the estimation of tasks during the planning phase.

(7) **Presentation**: mini-project should be reviewed collaboratively whenever as possible. Additionally, based on Agile principles, it is encouraged the inclusion of non-punitive assessments named as reflections.

The SLR also indicated that the main benefits of the PjBL to students are grades, motivation, communication and the professional aspect.

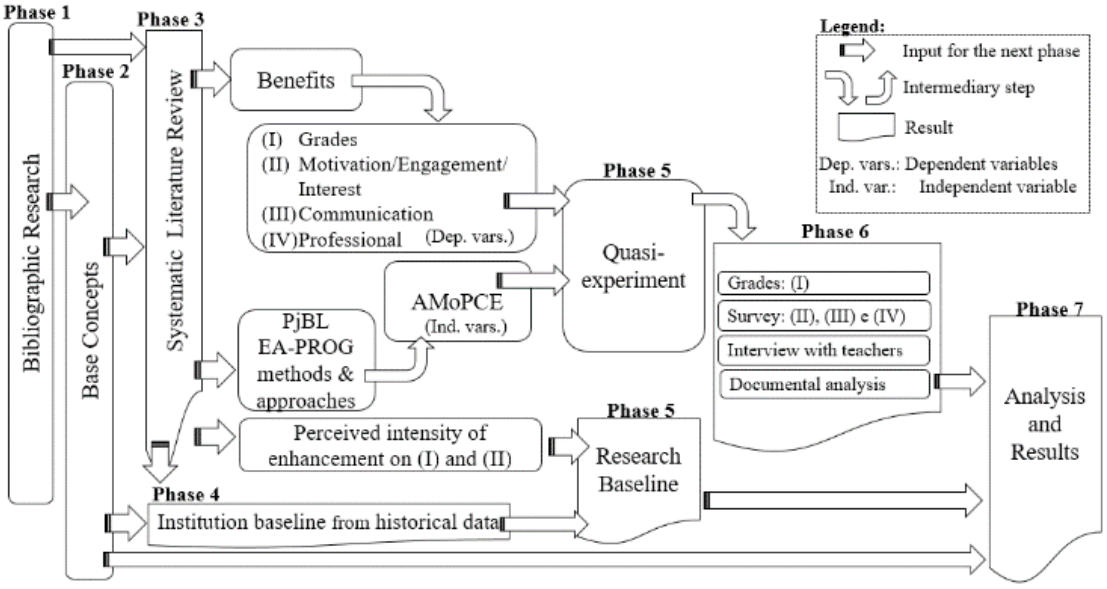

Figure 3. Research phases diagram.

Source: Adapted from GROTTA and PRADO (2018a)

Given the base concepts, this study narrowed down these benefits into four leading hypotheses, and their respective research variables, as follows. **H1:** AMoPCE benefits students' grades. **H2:** AMoPCE benefits students' motivation to learn. **H3:** AMoPCE benefits students' verbal communication and **H4:** AMoPCE benefits students' vocational exploration, according to figure 3:

Phase 4 will provide historical data collected from past courses to support the research analysis. On phase 5, there will be two groups participating to the quasi-experiment: first, the experimental group will be subjected to APjBL principles; second, the comparison group will learn computer programming according to the Institution traditional ED-PROG. On phase 6, it will be collected students, professors, and historical data. On phase 7, it will occur the analysis and the result reporting of this research.

4 I SOLUTION EVALUATION

The researched Institution is located at San Paulo state, Brazil. Given the resources and time constraints that are naturally applied to a Master Thesis, the scope of this proposal is limited to a single site only. The scope might be extended to the Brazilian and Latin America contexts in a near future during a Doctoral phase. Additionally, the Researched Institution has other *campi* across San Paulo state, which may support

possible future researches.

The programming courses are part of a higher education program named Information Systems Analyses and Development. In order to evaluate these impacts, AMoPCE will be applied to programming courses by professors who may voluntary give their contribution to this research. Given the time and resources constraints, a suggested by (KASTL; KIESMÜLLER; ROMEIKE, 2016), collective and individual workshops will be conducted with the professors, in addition to the research documentation. And each professor will be supported constantly by the researcher during the entire research.

On phase 6, data will be collected from the students, from the professors and from historical data. Students' data will be collected via an electronic survey, as close as possible to the end of each course. The data will be acquired from both the experimental and comparison groups. Surveys will be adapted from the following studies: motivation to learn (BORUCHOVITCH, 2008); verbal communication (MORIMOTO, 2016)diversity has been becoming a big trend among Japanese companies. As a result, a high level of communication skills is required of employees. The mainstream information technology (IT; vocational exploration (TEIXEIRA; BARDAGI; HUTZ, 2007), been one of the intended contributions of this work. Students' data will result in quantitative measures. On the other hand, professors' perspectives, including their observations about the three non-grading measures, will be collected via a semi-structured interview, thus resulting in qualitative data.

Phase 7 will have descriptive and inferential results based on phase 6 data. The evaluation will occur in four steps. First, the quantitative data will subject to descriptive statistic; content analysis will address the qualitative data. Second, it will be used Analysis of Variance (ANOVA). Third, the qualitative data professor interview will be analyzed via context analysis. Fourth, the final results will be consolidated and published.

5 I COMPLETED ACTIVITIES

Phases 1 and 2 were mainly developed in 2017 as part of the Master Thesis, and are the research base concepts. Phase 3 was an SLR (KITCHENHAM; CHARTERS, 2007), in which the specific objectives were achieved. Phases 4 and 5 are planned to start in Mar 2018 and the research is planned to end in July 2019. Based on preliminary studies on phase 4, for procedural classes (ANDERSON et al., 2001), it was found a relation between constructivist teaching method and students' grades enhancement but it was not found impact on students' frequency.

6 I CONCLUSION

IS higher education has been challenged by new generations towards innovative

and flexible teaching methods, as well as by the arising of new programmable devices, such as smartphones, robots, and intelligent ambient. Within this context, APjBL may offer potential benefits to the students. This research proposes to investigate the benefits of AMoPCE, an APjBL teaching method, mainly the students' academic performance, motivation to learn, verbal communication and vocational inquiry aspects, at the Brazilian Information System higher education, when compared to the traditional computer teaching method. In finding benefits to students, AMoPCE might be applied in similar contexts and benefit other students. But even if the research points to similar benefits, AMoPCE might be considered an alternative computer programming teaching method which brings the Agile approach closer to the academic routines. Future researches might investigate the impact of APjBL in developing countries on other particular settings. After all, the revolutionary Agile methods were created to better support software programming.

REFERENCES

ABDOOL, A.; POORANSINGH, A. An Industry-Mentored Undergraduate Software Engineering Project. In: IEEE FRONTIERS IN EDUCATION CONFERENCE (FIE), 44., 2014, Madri. **Proceedings**… Madri: IEEE, 2014. Disponível em: <https://www.computer.org/csdl/proceedings/fie/2014/3922/00/07044180-abs.html>. Acesso em: 2-set-2017.

ANDERSON, L. W. *et al.* **A Taxonomy for Learning, Teaching, and Assessing:** A Revision of Bloom's Taxonomy of Educational Objectives. Pennsylvania: Longman, 2001.

AUTHORITY, H. E. **A Study of Progression in Irish Higher Education**. Dublin: [s.n.]. Disponível em: <http://hea.ie/assets/uploads/2017/06/A-Study-Of-Progression-in-Irish-Higher-Education-201213-201314.pdf>. Acesso em: 22-ago-2017.

AXELOS. **What Is PRINCE2? The Definition, History & Benefits**. Disponível em: <https://www.prince2.com/usa/what-is-prince2>. Acesso em: 29 jan. 2018.

BELL, J. Abordagens de Pesquisa. *In*:_____. **Projeto de Pesquisa:** guia para pesquisadores iniciantes em educação, saúde e ciências sociais**.** 4. ed. São Paulo: Artmed Editora, 2008. p. 21–22, 135-148.

BIGGS, J. B.; TANG, C. S. Effective teaching and learning for today's universities. *In*:_____. **Teaching for quality learning at university**. New York, USA: McGraw-Hill Education, 2011. p. 1–16. (SRHE and Open University Press Imprint, 4).

BORUCHOVITCH, E. Escala de Motivação Para Aprender de Universitários: Propriedades Psicométricas. **Avaliação psicológica**, v. 7, n. 2, p. 127–134, 2008.

CHAN MOW, I. T. Issues and difficulties in teaching novice computer programming. *In*: ISKANDER, M. (Ed.). **Innovative Techniques in Instruction Technology, E-Learning, E-Assessment, and Education**. Dordrecht: Springer Netherlands, 2008. p. 199–204.

CRESWELL, J. W. Mixed Methods Procedures. *In*:_____. **Research Design:** Qualitative, Quantitative, and Mixed Methods Approaches. 3. ed. Thousand Oaks: SAGE Publications, 2009. p. 203–226.

GANNOD, G. et al. Agile Way of Educating. In: FRONTIERS IN EDUCATION CONFERENCE, 2015, New York: IEEE, 2015. p. 10–12.

GARTNER [*website*]. Implementing Bimodal IT - Delivering on the Promise. Disponível em: <https://www.gartner.com//it/content/3123400/3123418/october_21_implementing_biomodal_smingay.pdf?userId=94941060>. Acesso em: 16-maio-2017.

GIRAFFA, L. M. M.; MORAES, M. C.; UDEN, L. Teaching Object-Oriented Programming in First-Year Undergraduate Courses Supported By Virtual Classrooms. **Springer Proceedings in Complexity**, p. 15–26, 2014.

GOULDING, T. A first semester freshman project: The enigma encryption system in C. **ACM Inroads**, v. 4, n. 1, p. 43–46, 2013.

GROTTA, A.; PRADO, E. Principles of agile project-based learning to cope with the computer programming education at Brazilian Information System higher education. In: WORKSHOP DE TESES E DISSERTAÇÕES EM SISTEMAS DE INFORMAÇÃO, 11., 2018, Caxias do Sul. **Anais**...Caxias do Sul - RS: jun. 2018a. Disponível em: <http://natal.uern.br/eventos/csbc2018/anais/Anais%20WEI%202018.pdf>. Acesso em: 01-out-2018.

_____. Um ensaio sobre a experiência educacional na programação de computadores: a abordagem tradicional versus a aprendizagem baseada em projetos. In: WORKSHOP SOBRE EDUCAÇÃO EM COMPUTAÇÃO (WEI), 26., 2018, Natal - RN. **Anais**...Natal, RN: ago. 2018b. Disponível em: <http://portaldeconteudo.sbc.org.br/index.php/wei/article/view/3496>. Acesso em: 01-out-2018.

HERNANDEZ-BARRERA, A. Teaching introduction to robotics: Using a blend of problem- and project-based learning approaches. In: IEEE SOUTHEASTCON, 2014, Lexington. **Proceeding**... Lexington: IEEE, 2014. Disponível em: < https://ieeexplore.ieee.org/document/6950686 >. Acesso em: 02-set-2017.

KASTL, P.; KIESMÜLLER, U.; ROMEIKE, R. Starting out with projects - Experiences with agile software development in high schools. In: WORKSHOP IN PRIMARY AND SECONDARY COMPUTING EDUCATION, 11., 2016, Münster. **Proceedings**... New York: Association for Computing Machinery, 2016. Disponível em: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994322700&doi=10.1145%2F2978249.2978257&partnerID=40&md5=fcbaa46e95d7d0cdbfaf1b0fc3b78c3f>. Acesso em: 02-set-2017.

KITCHENHAM, B.; CHARTERS, S. **Guidelines for performing Systematic Literature Reviews in Software Engineering**. Keele, UK: [s.n.].

LANG, G. Agile Learning: Sprinting through the Semester. **Information Systems Education Journal**, v. 15, n. 3, p. 14–21, maio 2017.

MONETT, D. Agile Project-Based Teaching and Learning. In: INTERNATIONAL CONFERENCE ON SOFTWARE ENGINEERING RESEARCH AND PRACTICE, 13., 2013, Las Vegas. **Proceedings**... Las Vegas: 2013 Disponível em: <https://search.proquest.com/docview/1629366456?accountid=14643>. Acesso em: 02-set-2017.

MORIMOTO, C. Improvement of IT Students' Communication Skills using Project Based Learning. In: INTERNATIONAL CONFERENCE ON COMPUTER SUPPORTED EDUCATION, 8., 2016, Rome. **Proceedings**... Rome: SciTePress, 2016

PAYNE, C. R. Constructivism and Progressive Higher Education in the World of Information Technology. In: _____. **Information Technology and Constructivism in Higher Education:** Progressive Learning Frameworks. Hershey, PA: IGI Global, 2009. p. 1–29.

PMI - PROJECT MANAGEMENT INSTITUTE. **A guide to the project management body of knowledge (PMBOK ® guide)**. 5th. ed. Newtown Square: Project Management Institute, Inc., 2013.

PORCARO, D. Applying constructivism in instructivist learning cultures. **Multicultural Education & Technology Journal**, v. 5, n. 1, p. 39–54, 2011.

QUEIRÓS, R. **Innovative Teaching Strategies and New Learning Paradigms in Computer Programming**. Hershey, PA: IGI Global, 2014.

ROMEIKE, R.; GÖTTEL, T. Agile projects in high school computing education - Emphasizing a learners' perspective. In: WORKSHOP IN PRIMARY AND SECONDARY COMPUTING EDUCATION, 7., 2012, Hamburg. **Proceedings**... New York: Association for Computer Machenary, 2012. Disponível em: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-84878432904&doi=10.1145%2F2481449.2481461&partnerID=40&md5=e6aed2496246addcec0589ef1a04f111>. Acesso em: 02-set-2017.

SAMPIERI, R. H.; COLLADO, C. F.; LUCIO, P. B. Modelos de Pesquisa. *In*:_____. **Metodologia de pesquisa**. 3a. ed. São Paulo: McGraw-Hill, 2006. p. 152–223.

SCHWABER, K. **About I Scrum.org**. Disponível em: <https://www.scrum.org/about>. Acesso em: 16 maio. 2017.

SILVA FILHO, R. L. L. E *et al.* A evasão no ensino superior brasileiro. **Cadernos de Pesquisa**, v. 37, n. 132, p. 641–659, 2007.

TARNE, B. **Combine Agile and Traditional Project Management Approaches**. Disponível em: <https://www.pmi.org/learning/library/combine-agile-traditional-project-management-approaches-7304>. Acesso em: 16 maio. 2017.

TEIXEIRA, M. A. P.; BARDAGI, M. P.; HUTZ, C. S. Escalas de exploração vocacional (EEV) para universitários. **Psicologia em Estudo**, v. 12, n. 1, p. 195–202, 2007.

THOMAS, M. Project-Based Language Learning with Technology: Learner Collaboration in an EFL Classroom in Japan. New York: Taylor & Francis, 2017. p. 43–47. (Routledge Studies in Applied Linguistics)

VEGA, C.; JIMÉNEZ, C.; VILLALOBOS, J. A scalable and incremental project-based learning approach for CS1/CS2 courses. **Education and Information Technologies**, v. 18, n. 2, p. 309–329, 2013.

ZOUGANELI, E. *et al.* Project-based learning in programming classes – the effect of open project scope on student motivation and learning outcome. **IFAC Proceedings Volumes**, v. 47, n. 3, p. 12232–12236.

SOBRE O ORGANIZADOR

Ernane Rosa Martins - Doutorado em andamento em Ciência da Informação com ênfase em Sistemas, Tecnologias e Gestão da Informação, na Universidade Fernando Pessoa, em Porto/Portugal. Mestre em Engenharia de Produção e Sistemas pela PUC-Goiás, possui Pós-Graduação em Tecnologia em Gestão da Informação pela Anhanguera, Graduação em Ciência da Computação pela Anhanguera e Graduação em Sistemas de Informação pela Uni Evangélica. Atualmente é Professor de Informática do Instituto Federal de Educação, Ciência e Tecnologia de Goiás - IFG (Câmpus Luziânia), ministrando disciplinas nas áreas de Engenharia de Software, Desenvolvimento de Sistemas, Linguagens de Programação, Banco de Dados e Gestão em Tecnologia da Informação. Pesquisador do Núcleo de Inovação, Tecnologia e Educação (NITE).

Agência Brasileira do ISBN
ISBN 978-85-7247-157-2