

Conceptual framework of Google' s Online Learning Tools for Python Programming Activity on Challenge-Based Learning

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Abstract

The objective of this study was creation and assessment suitability of Conceptual framework of Google' s online learning tools for Python programming activity on challenge-based learning. From the study, Google Online learning tool for Python programming activity on challenge-based learning was composed of 1) Google Classroom, 2) Google Meet, 3) Google Jamboard, 4) Draw.io, 5) Google Colaboratory, 6) Google Site, 7) YouTube, 8) Google Doc, 9) Google Sheet, and 10) Google Slide. The Conceptual framework comes from procedure of arranging tools; in process of challenge-based learning; by using Google Classroom, environment. Moreover, appropriateness of the conceptual framework was strongly agree (Mean= 4.69, S.D. = 0.46), from 4 of Educational Technology experts and 3 of Computer Engineering experts.

Keywords: Online Learning tools, Python programming activity, Challenge-based learning

1. Introduction

The Organization for Economic Co-operation and Development (OECD) [1] has published the OECD Future of Education and Skills 2030 report, concluded that the world will need computer programming. Consequently, regard inspiring and encouraging students with computer programming should go along with Learning and Innovation (4Cs) skills which built 21st Century Skills [2]. Therefore, at present, the Ministry of Education of Thailand [3] has set the computational science subject in national core curriculum for developing programming skills, computational thinking skills, analytical thinking skills and systematic problem-solving skills. And Python has been determined as a basic computer programming language which every student in secondary level could coding program. Thus, every secondary school in Thailand need to put Python computer programming in learning activities of each school. Moreover, normal classroom learning activities have been paused by the world Covid-19 situation [4], online-learning tools are rapidly widespread because every school must change their learning activities in to online-learning to finished the syllabuses in a time.

From TPACK Framework [5] as a good designing of online learning activity should recognize 3 compositions of Part1) Content Knowledge (CK) – This describes instructors' own knowledge of the subject matter. In this study CK refer to Python programming and intention to form 21st Century student skills. Part2) Pedagogical Knowledge (PK) – This describes instructors' knowledge of the practices, processes, and methods utilized in teaching and learning. In this study PK refer to Challenge Based Learning (CBL) [6] which is process to improve student critical thinking, by child-center experimental learning strategy which is cooperated project with Apple Inc., 2011 and intend to create appropriate environment for well active and participate learning activities. CBL will facilitate learning, understanding, and increasing skills ability of student. And Part 3) Technological Knowledge (TK) – This describes instructors' knowledge and ability to use various technologies, technological tools, and associated resources. The researcher found that Google application is appropriate for

online-classroom management such as Google classroom [7]; the combination of Google Docs, Google Drive and Gmail via Cloud computing; can create Quizzes, Assignment, and Discussion. Besides, the researcher studied qualification of Google Colaboratory which is Python Coding and testing on browser for coding exercises and support synchronous time coding [8].

On another hand, Google Jamboard and Draw.io are supporting tools through drawing and writing on files then share to all members together in real time [9], while accessing Google Meet to get the best efficient communicate via media and sound [10].

The information above brought to a synthesis of “Conceptual framework of Google’ s online learning tools for Python programing activity on challenge-based learning”, this conceptual framework could be used as Python online-learning activity guidelines that stimulate student skills and thinking processes as critical thinking and problem-solving skill, creative thinking, collaboration and communication skills.

2. Research Objective

To create and assess suitability of Conceptual framework of Google’ s online learning tools for Python programing activity on challenge-based learning approach.

3. Background And Related Works

The researcher found that the Conceptual framework of google’ s online learning tools for Python programming activity on challenge-based learning are composed of 3 parts via TPACK Model, as follows.

1. Content Knowledge (CK); this study set CK scope about Python coding. From the standard learning from core curriculum of the Ministry of Education of Thailand, student should understand definition and characteristic of the computer program, as well as coding program in condition, loop function, variable and value operation.

2. Pedagogical Knowledge (PK); this study determined PK rely on Challenge-based learning (CBL) which comes from combination of teamwork, self-learning, and critical thinking for real solutions [11]. CBL is child-center strategy originated in Apple, Inc.’s project to get an up-to-date education in 21st century. Student should be got active learning program, improved ability of understanding each subject, and enhanced creative problem-solving skill [6]. Other research mentioned the utility of challenge-based learning that will extend interaction among student-student and student-instructors [12-15]. So, student will work as team, improve many soft skills, and integrate all knowledge for specific solutions.

In addition, many academic researches define that the challenge-based learning promote 21st Century Skills

[16-20]. From the study about challenge-based learning the researcher synthesizes the learning process from challenge-base learning as shown in Table 1

Table 1. Process of Challenge based-learning

Process of Challenge Based Learning	Apple Inc. [21]	Cheung et al. [22]	S. Yoosomboon and P. Wannapiroon [23]	Edu Trends [24]	Nichols, Cator, & Torres [25]	Yang, et al. [17]	Anson, C.Y. Tang and Meyrick, C.M. Chow
Stage 1 Engage Students are required to work in groups to identify topics (challenges), drawn from a global issue (big idea), that are relevant to the community.	✓	✓	✓	✓	✓	✓	✓

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Stage 2 Investigate Students analyze the challenge, brainstorm strategies and identify appropriate resources to tackle it. A solution is eventually conceived after a series of information searches and consultation with relevant experts in the community.	✓	✓	✓	✓	✓	✓	✓
Stage 3 Act Students must test effectiveness of the solution by implementing it in the community and evaluating its outcomes.	✓	✓	✓	✓	✓	✓	✓

3. Technological Knowledge (TK); this study chose TK for online-learning activity tools from internet connected programs/applications and increase supporting data accessibility of student and instructor. The researcher found that suitable Google Application for Python coding program learning activity via Challenge based learning are as follows.

3.1) Google Classroom [7] is a service that integrates Docs, Sheets, Slides, Gmail, and Calendar together for online-classroom activities as Quizzes, Assignment, and Discussion, by the way all of these are in Google Drive system.

3.2) Google Meet [10] is a service for video and chat communication for browser online-meeting which can share every image, sound, or documents from the screen.

3.3) Google Jamboard [9] is responding whiteboard system for creative tasks or online group working.

3.4) Draw.io [9] is software which G-mail users can create diagram online together in the same time. The Draw.io always used by engineering student for flowchart writing.

3.5) Google Colaboratory [8] (or Colab) is Online Integrated Development Environment (IDE) for Python coding examination, it can run and show the result under chosen condition. Colab has more advantage than normal IDE because the G-mail users can edit code and run program in the same condition together.

3.6) Google Sites [26] is an application for website creation which authorized users to real-time create and edit their online files together.

3.7) YouTube [27] is tools for video recording and sharing.

3.8) Google Doc [28] is a word processor program on Google Drive base, and has more advantage because the G-mail users can edit their document together in the same time.

3.9) Google Sheet [28] is a spreadsheet program processing on Google Drive base, and has more advantage because the G-mail users can edit their sheets together in the same time.

3.10) Google Slide [28] is a presentation program on Google Drive base, and has more advantage because the G-mail users can edit their presentations together in the same time.

4. Research Methodology

This study has 2 steps as follow.

1. Completing a review of related literatures on the challenge-based learning process and the Google online learning tools to create the conceptual framework of Google’s online learning tools for Python programing activity on challenge-based learning.

2. Evaluating the suitability of the conceptual framework of google’ s online learning tools for Python programing activity on challenge-based learning as follows:

2.1) Create a tool for evaluating the suitability of the conceptual framework of Google’s online learning tools for Python programing activity on challenge-based learning.

2.2) Propose the conceptual framework of Google’s online learning tools for Python programing activity on challenge-based learning to 7 experts who hold doctoral degrees, work as instructors at universities and have at least 10 years’ a relevant. These experts would consist of 4 experts in educational technology and 3 experts in computer engineering, who would consider and evaluate the suitability of the conceptual framework.

2.3) Analyze the results of the evaluation of the conceptual framework of google’ s online learning tools for Python programing activity on challenge-based learning. by using the mean and standard deviation (S.D.). The five-point Likert [29] scale would be used to determine the weight of assessing the appropriateness of the conceptual framework.

5. Result And Discussion

The challenge-based learning process and the Google’s online learning tools were synthesized to conceptual framework of google’ s online learning tools for Python programing activity on challenge-based learning. According to Fig.1, the challenge-based learning is composed of 3 stage: 1) Engage 2) Investigate and 3) Act, the researcher will explain Google’s online learning tools detail as follows.

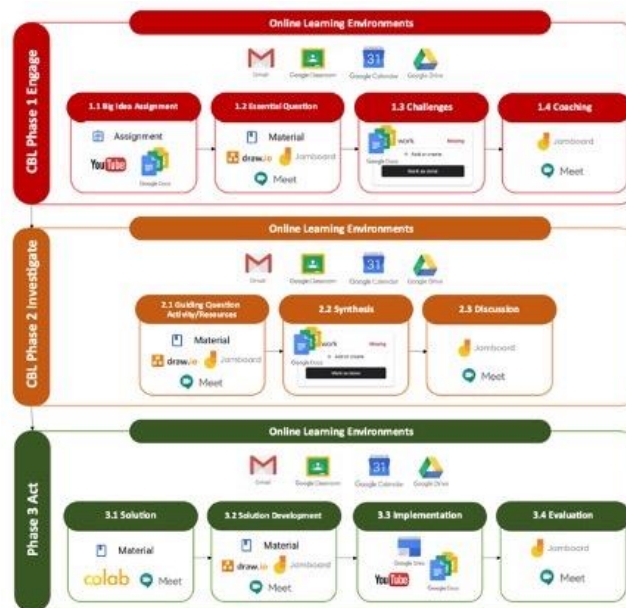


Figure 1: Conceptual framework of Google’s online learning tools for Python programing activity on challenge-based learning

1. In engage state, student team access Google classroom to get a specific problem: a clip video via YouTube link.

After that student will exchange ideas from the problem to find the main point (the project objective) and define their assigned project by using Material Section tools; Google Meet, Google Jamboard or Draw.io. Then student will send team project flowchart to Google Class room system and get a presentation appointment via Google Calendar. Instructor and student will use Google Meet, Google Jamboard or Draw.io to finish the project with challenge as much as possible in time limit.

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2. After getting the challenge project objective, student will be brought to investigate state. They will synthesize a project plan by using Google Meet, Google Jamboard, or Draw.io to categorize and order all learning contents, tasks, and necessary resources to finish the project, and send their plan to Google Class room. When the appointments date (as set in the Google Calendar) instructor and student will edit and improve the plan via Google Meet, Google Jamboard, or Draw.io.

3. Act Stage happens after plan improving, student will study (follow through their plan) and start a program coding. Student will get Python program coding work instruction from Material Section, and use the Google Colaboratory and Google Meet for coding and brain storming. When their finished the step or times up, student will create website to present learning results via Google sites that will show project information in text form (Google Doc), table (Google Sheet), Presentation slide (Google slide), and presentation video (embedded YouTube link). When the appointments date

(as set in the Google Calendar) instructor and student will assess and determine learning points together via Google Meet, Google Jamboard, or Draw.io.

4. The assessments (form 7 experts) of Conceptual framework of google' s online learning tools for Python programing activity on challenge-based learning are shown in Table 3.

Table 3. The assessment of Conceptual framework of Google' s online learning tools for Python programing activity on challenge-based learning

Assessment	Suitability		
	Mean	S.D	Meaning
1. The classification of the steps following the CBL process is appropriately classified.	4.86	0.38	Strongly agree
2. The learning Tools are properly classified.	4.43	0.53	Agree
3. The learning tools in each step are properly organized.	4.86	0.38	Strongly agree
4. The Conceptual framework facilitate to improve the Python programming skills for students.	4.57	0.53	Strongly agree
5. The Conceptual framework facilitate to improve the 21st Century skills for students.	4.71	0.49	Strongly agree
Summary of evaluation	4.69	0.46	Strongly agree

From Table 3, suitability of this study is strongly agree (Mean= 4.69, S.D. = 0.46), it will be caused by TPACK Framework principle. K. Papanikolaou, K. Makri, and

P. Roussos [30], A. Anderson and N. Barham [31] and L.Lu, L. Johnson, L. Tolley, T. Gilliard-Cook and Jing Lei, [32] who explained that TPACK Framework was appropriate for online learning activity design. Moreover, Using Google application as a tools in Conceptual framework of google' s online learning tools for Python programing activity on challenge-based learning is conformed to E. K. Park and J. K. Suh [33], O. Suwantarathip and S. Wichdee [34] and S. Iftakhar [35] who explained about Google Application qualification: Google Classroom, Doc, Sheet, or Slide: as tools for supporting online Collaborative Learning especially Google meet and Jamboard which are good brain storming and idea sharing area [36-38]. And the Google Colab is appropriate in online collaborative coding. Conformed to M. Borowski, J. et al. [39], L. Silva, A. J. Mendes and A. Gomes [40] and L. Baptista [41] who explained that Colab is suitability tools for Python program coding and running synchronous time coding with browser supporting. So Colab appropriates to use as Blended Learning or Distance Learning tools.

6. Suggestions

The scope of this study is just Google's tools. If more tools are studied from other sources, the conceptual framework may be improved. In addition, In the case of constructivism learning theory that is popular in

education systems dealing with such as problem-based learning (PBL) and project-based learning (PjBL) are developing higher order thinking skills according to challenge-based learning (CBL).

Therefore, the researcher suggests that the conceptual framework in this study could be used in the design of learning processes in modern education.

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References

- [1] OECD, “Future shocks and shifts: challenges for the global workforce and skills development,” in OECD Education 2030. First informal working group webinar/meeting. Oxford Martin School, University of Oxford, [online document], 2015. Available: <https://www.oecd.org/education/2030-project/about/documents/Future-Shocks-and-Shifts-Challenges-for-the-Global-Workforce-and-Skills-Development.pdf>. [Accessed: January 5, 2020].
- [2] Partner for 21st Century Skills, “Framework for 21st Century Learning”, [online document], 2009. Available: https://www.teacherrambo.com/file.php/1/21st_century_skills.pdf [Accessed: January 10, 2020].
- [3] Institute for the Promotion of teaching Science and Technology (IPST), “Summary of curriculum and indicators Information Technology and Communication Curriculum 2008 and Technology (Computational Science) Curriculum Improvement 2018, [online document], 2018. Available: <http://oho.ipst.ac.th/download/mediaBook/cs-ict.pdf>. [Accessed: February 10, 2020].
- [4] Cathy Li & Farah Lalani, "The COVID-19 pandemic has changed education forever", 2020. [Online]. Available: <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/>. [Accessed: January 10, 2021].
- [5] Kyparisia. P, Katerina. M & Petros. R, “Learning design as a vehicle for developing TPACK in blended teacher training on technology enhanced learning,” *International Journal of Educational Technology in Higher Education*, vol. 14 no. 34, pp. 1-14, 2017. <https://doi.org/10.1186/s41239-017-0072-z>
- [6] Cator, K. & Nichols, M. (2008) . Challenge Based Learning, [Online]. Available: https://www.challengebasedlearning.org/wp-content/uploads/2019/03/CBL_Paper_2008.pdf . [Accessed: January 12, 2021].
- [7] Mohd. S, Izwan. N and Jamil. J, Mohamad. R & Sarah .S, “The application of Google Classroom as a tool for teaching and learning.” *Journal of Telecommunication, Electronic and Computer Engineering*, vol. 8 no. 10, pp. 5-8, 2016
- [8] B. Marcel, J. Zagermann, K. N. Clemens, H. Reiterer and R. Rädle, “Exploring the Benefits and Barriers of Using Computational Notebooks for Collaborative Programming Assignments,” in *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, Portland, USA, 2020, pp. 468–474. <https://doi.org/10.1145/3328778.3366887>
- [9] J. Llerena-Izquierdo, O. Barcia-Ayala and R. Ayala-Carabajo, "Faculty Training through Crowdlearning for Emerging Online Education," 2020 IEEE ANDESCON, Quito, Ecuador, 2020, pp. 1-7, <https://doi.org/10.1109/ANDESCON50619.2020.9272103>
- [10] R. Al-Marouf, S. A. Salloum, A. E. Hassanien and K. Shaalan, "Fear from COVID-19 and technology adoption: the impact of Google Meet during Coronavirus pandemic", *Interactive Learning Environments*, 2020, pp. 1-16 <https://doi.org/10.1080/10494820.2020.1830121>
- [11] L. F. Johnson, S. R. Smith, J. T.Smythe and R. K. Varon,2009, *Challenge-Based Learning: An Approach for Our Time*. The New Media Consortium. Austin, Texas.
- [12] O'Mahony, et al. “A Comparison of Lecture-Based and Challenge-Based Learning in a Workplace Setting: Course Designs, Patterns of Interactivity, and Learning Outcomes”, *Journal of the Learning Sciences*, 2012, vol.21, no.1, pp. 182-206, <https://doi.org/10.1080/10508406.2011.611775>
- [13] R. S. Cheung; J .P. Cohen, Lo, Z. Henry and E. Fabio, *Challenge Based Learning in Cybersecurity Education*, *Proceedings of The 2011 World Congress in Computer Science, Computer Engineering, and*

Conceptual framework of Google' s Online Learning Tools for Python Programming Activity on Challenge-Based Learning

- Applied Computing, Las Vegas, Nevada, 2011, July 21, pp.1-6, <http://worldcomp-proceedings.com/proc/p2011/SAM5063.pdf>
- [14] S.E. Gabriel, "A modified challenge-based learning approach in a capstone course to improve student satisfaction and engagement", *Journal of Microbiology & Biology Education*, 2014, vol. 15, no.2, pp.316-318, <http://doi.org/10.1128/jmbe.v15i2.742>
- [15] L. D. Fernández, S. P. Salgado, J. Fernández, I. Tinao and V. Lapuerta, "Challenge-Based Learning in Aerospace Engineering Education: The ESA Concurrent Engineering Challenge at the Technical University of Madrid", *Acta Astronautica*, 2020, vol.171, no.1, pp.369-377, <https://doi.org/10.1016/j.actaastro.2020.03.027>
- [16] O. Mahony, et al, "A Comparison of Lecture-Based and Challenge- Based Learning in a Workplace Setting: Course Designs, Patterns of Interactivity, and Learning Outcomes", *Journal of the Learning Sciences*, 2011, vol.21, no. 1, pp.182-206, <https://doi.org/10.1080/10508406.2011.611775>
- [17] Z. Yang, et al, "Challenge Based Learning nurtures creative thinking: An evaluative study," *Nurse Education Today*, vol.171, no. 11, pp. 40-47, 2018. <https://doi.org/10.1016/j.nedt.2018.09.004>
- [18] I. E. Eraña-Rojas, M. V. L. Cabrera, E. R. Barrientos and J. Membrillo-Hernández, "A challenge based learning experience in forensic medicine," *Journal of Forensic and Legal Medicine*, vol. 68, no. 11, pp. 1-5, 2019. <https://doi.org/10.1016/j.jflm.2019.101873>
- [19] Anson.C.Y.Tang and Meyrick.C.M.Chow, "To evaluate the effect of challenge-based learning on the approaches to learning of Chinese nursing students: A quasi-experimental study," *Nurse Educ Today*, pp. 1-7, 2020.
- [20] L. Johnson and S. Brown, *Challenge Based Learning: The Report From the Implementation Project*, Retrieved November 23, 2020, Austin, Texas.: The New Media Consortium, 2011.
- [21] Apple Inc., "Challenge Based Learning: A Classroom Guide.," January 2011. [Online]. Available: https://images.apple.com/education/docs/CBL_Classroom_Guide_Jan_2011.pdf. [Accessed October 2020].
- [22] R. S. Cheung, J. P. Cohen, H. Z. Lo and F. Elia, "Challenge Based Learning in Cybersecurity Education," *Proceedings of The 2011 World Congress in Computer Science, Computer Engineering, and Applied Computing.*, pp. 1-6, 21 July 2011.
- [23] Sathaporn Yoosomboon and Panita Wannapiroon, "Development of a challenge based learning model via cloud technology and social media for enhancing information management skills," *Procedia - Social and Behavioral Sciences*, vol. 174, no. 1, pp. 2102-2107, 2015.
- [24] Edu Trends, "Challenge Based Learning," *Observatory of Educational Innovation*, Tecnológico de Monterrey, Nuevo Leon, Mexico , 2015.
- [25] M. Nichols, K. Cator and M. Torres, *Challenge Based Learner User Guide*, Redwood City: CA: Digital Promise, 2016, pp. 14-16.
- [26] F. Lardinois, "Google's redesigned Google Sites goes live", November 2016. [Online]. Available: <https://techcrunch.com/2016/11/22/googles-redesigned-google-sites-goes-live> [Accessed 10 January 2021].
- [27] G. Schlie, "YouTube in schools: A digital revolution in the classroom", June 2019, [Online]. Available: <https://www.dw.com/en/youtube-in-schools-a-digital-revolution-in-the-classroom/a-49049423> [Accessed 12 January 2021].
- [28] B. Levee, "New mobile apps for Docs, Sheets and Slides—work offline and on the go", April 2014, [Online]. Available: <https://blog.google/products/docs/new-mobile-apps-for-docs-sheets-and> [Accessed 13 January 2021].
- [29] L. Liedke, "Likert Scale Definition (+How to Use It and Examples)", December 2020, [Online]. Available: <https://wpforms.com/beginners-guide-what-is-a-likert-scale-and-how-to-use-it> [Accessed 20 January 2021].
- [30] K. Papanikolaou, K. Makri, and P. Roussos, "Learning design as a vehicle for developing TPACK in blended teacher training on technology enhanced learning ," *International Journal of Educational Technology in Higher Education*, vol. 14, no. 34, pp. 1–14, 2017. <http://doi.org/10.1186/s41239-017-0072-z>

- [31] A. Anderson and N. Barham, "Using the TPACK framework to unite disciplines in online learning", *Australasian Journal of Educational Technology*, vol. 29, no. 4, pp. 549-565, 2013. Available: <https://ajet.org.au/index.php/AJET/article/view/24/610> [Accessed 1 March 2021].
- [32] L.Lu, L. Johnson, L. Tolley, T. Gilliard-Cook and Jing Lei, "Learning by Design: TPACK in Action", in *Society for Information Technology & Teacher Education International Conference*, Nashville, Tennessee, USA, 2011. <https://www.learntechlib.org/p/37022/>
- [33] E. K. Park and J. K. Suh, "Active Learning Using Google Suites for Education to Promote 21st-Century Skills", November 2018, [Online]. Available: <https://facultyresourcenetwork.org/publications/transforming-teaching-through-active-learning/active-learning-using-google-suites-for-education-to-promote-21st-century-skills> [Accessed 1 March 2021].
- [34] O. Suwantarathip and S. Wichdee, "The effects of collaborative writing activity using google docs on students' writing abilities," *The Turkish Online Journal of Educational Technology*, vol. 13, no. 2, pp. 148–156, 2014. Available: <https://files.eric.ed.gov/fulltext/EJ1022935.pdf> [Accessed 1 March 2021].
- [35] S. Iftakhar, "Google classroom: what works and how?," *Journal of Education and Social Sciences*, vol. 3, no. 1, pp. 12-18, 2016. Available: <https://files.eric.ed.gov/fulltext/EJ1022935.pdf> [Accessed 2 March 2021].
- [36] S. Moriarty, "Investigating the Implementation of Enterprise 2.0 into AEC Companies", November 2017, [Online]. Available: http://media.matevzdolenc.com/itc-euromaster/cmc-2017/project-final-reports/samuel_moriarty-final-project-report.pdf [Accessed 3 March 2021].
- [37] N. Dahal et al., "Emerging ICT Tools, Techniques and Methodologies for Online Collaborative Teaching and Learning Mathematics", *Mathematics Education Forum Chitwan*, September 2020, <http://doi.org/10.13140/RG.2.2.16143.00164>
- [38] L. Chen, "Utilizing Online Collaboration to Enhance Learners' Social Emotional Competencies" in *EdMedia + Innovate Learning*, Jun 24, 2019 in *Proceedings of EdMedia + Innovate Learning Amsterdam*, Netherlands, June 24, 2019. pp. 28-31. <https://www.learntechlib.org/primary/p/209986>
- [39] M. Borowski, J. Zagermann, C. N. Klokmose, H. Reiterer and R. Rädle. "Exploring the Benefits and Barriers of Using Computational Notebooks for Collaborative Programming Assignments", In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education (SIGCSE '20)*. Association for Computing Machinery, February 2020 , New York, NY, USA, pp. 468–474. <https://doi.org/10.1145/3328778.3366887>
- [40] L. Silva, A. J. Mendes and A. Gomes, "Computer-supported Collaborative Learning in Programming Education: A Systematic Literature Review," 2020 IEEE Global Engineering Education Conference (EDUCON), Porto, Portugal, 2020, pp. 1086-1095. <http://doi.org/10.1109/EDUCON45650.2020.9125237>
- [41] L. Baptista, "Using Python and Google Colab to Teach Physical Chemistry During Pandemic". *ChemRxiv*, February 2021. <http://doi.org/10.26434/chemrxiv.13656665.v1>

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