

Visualization Code Tools for Teaching and Learning Introductory Programming

Arik Kurniawati¹, Ari Kusumaningsih², Mochammad Kautsar Sophan³

Informatic Engineering

University of Trunojoyo Madura Bangkalan, Indonesia

{arik.kurniawati, ari.kusumaningsih, kautsar}@trunojoyo.ac.id

Abstract—This paper purposed tools for teaching and learning introductory programming for beginners. Trinket, online python tutor and flowgorithm are visualization tools for teaching and learning programming. Visualization tools facilitate the novice students more understanding of the execution line of code by guiding them through a series of animated techniques. Consequently teaching and learning to programme make easy and fun and then motivational the student to learn to programme will increase.

Keywords- teaching, learning, introductory programming, beginners, visualization tools

I. INTRODUCTION

Introductory programming courses are part of Computer Science; this is a basic course to develop competency in IT skills, one of them is Informatics Engineering. This course provides competencies on the basic concepts of Programming that will be the basis for the development and application of further programming subjects. This subject is according to the need of the industrial revolution 4.0 that focuses on mastering Information Technology, especially mastery of programming to support the Internet of Things or digitalization to be able to advance competitiveness in the 21st century.

However, teaching and learning programming is absolutely not easy and very challenging. Sometimes there are difficulties when learning or teaching programming in the early stages. As the programming language syntax, student motivation level, gap student knowledge background, teaching or learning method, the editor tool used, material complexity, etc [1-2].

There are tips will be useful to anyone teaching or learning to a programme at any level and any audience [3]:

- **Use live coding.** Live coding does not always begin from the blank screen; instructors should present to their students some starter code with the concepts they have already comprehended, and then they extend it or modify it with live coding. Highly recommended the students have reference material available after lectures, such as a textbook, hand out or anything else.
- **Have students make predictions,** the keyword when the presentation more effective is making students predict the result of the demonstration code before running it.
- **Remember that beginners are not experts,** Beginners program differently than experts and need different

approaches or tools. Beginners may need to spend time thinking; They may need to construct examples in guided steps.

- **Don't just code,** not only line of codes but be equipped explanation and how the code works.

Therefore, improvements are needed in teaching or learning to programme. If identified then the designs for teaching or learning to programme introductory programming courses can be categories be 4, • Curricula • Pedagogy • Language choice • Tools for teaching[4].

During the years several types of tools and approaches have been proposed to support programming teaching and learning. This paper purposed focus tools for teaching and learning introductory programming for beginners. These tools support Visualization learning and flowcharts.

- **Visualization tools,** the main purpose is to facilitate the novice students so that understanding the execution line of code by guiding them through a series of animated techniques [4-5]
- **Flowcharts** are regularly a great choice of a visualization tool because they can show the algorithm as a model that a novice student (with little or no prior knowledge before) can easily learn. By using this, the students will simply understand the program flow, and next, they can try coding independently. This flowchart is suitable for modeling of simple programming concepts, not for the complex problem [5].

II. TRINKET, THE KEY WAY TO OPEN TEACHING AND LEARNING

A. About Trinket

Trinket is an interpreter that runs and write code in any browser, on any device. Trinkets run directly, with no need to log in, download plugins, or install software. Simply share or embed the code like YouTube video with your changes when you're done [6]. Trinket just support Python language.

B. Advantages of Teaching and Learning using Trinket

For teaching : Presents that our code for the students real-time makes interesting things, inciting curiosity and motivating learning for the students.

For learning : With the trinket, the learner can share the code for collaborative learning with others because the screen look like their screen.

C. Getting Started with Trinket

First, go to <https://trinket.io/> and then write code in here and compile it. The result of this programme can be seen the side of it.

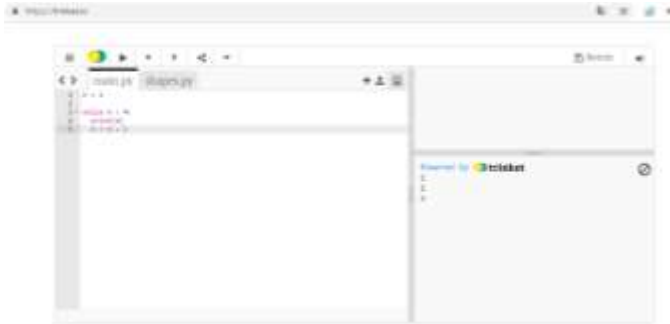

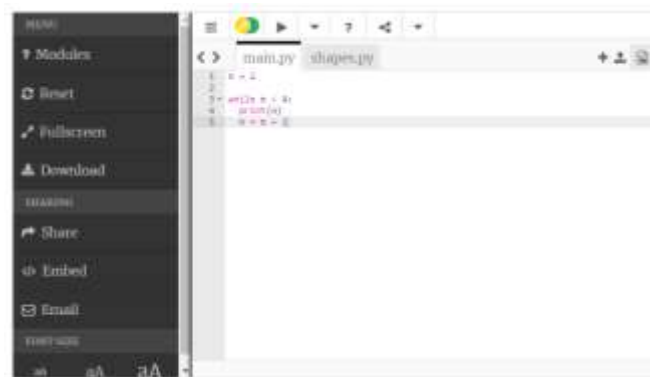


Figure 1. Running code in Trinket

For sharing code, through the menu  and then select sub menu Share. After that copy the link to share the code with others.



(a)



(b)

Figure 2. a. Menu b Sub Menu Share code

The last, for embed the code to the web can be done by clicking sub menu Embed. And then copy this code on your site



Figure 3. Sub Menu Embed code

III. ONLINE PYTHON TUTOR, VISUALIZATION PROGRAM

A. About Online Python Tutor

Online Python Tutor is a web-based program Visualization tool for any languages such as Python, Java, C, C++, JavaScript, and Ruby created by Philip Guo. The purposed of this tool is used to people overcome a fundamental barrier to learning programming so that understanding what happens as the computer runs each line of code. Through this tool, can write code programs directly in the web browser (without installing any plugins and share like Trinket [7-8].

B. Advantages of Teaching and Learning using Online Python Tutor

- Visualized step by step each line of code.
For teaching: make teaching more clearly for explanation concept of programming.
For learning: this visualization can be repeated anytime so that makes the students can repeat the material.
- Embeddable in web-based make the students can read lessons and interact with code visualizations with the same display on their web.
- Get live help from volunteers real time make the students learn independently

C. Getting Started with Online Python Tutor

Writing Code, first visit <http://www.pythontutor.com/visualize.html#mode=edit> and then write code in here.



(a)



(b)



(c)

Figure 4. a. Writing code b. Executed code c. Embedded code

The code display shows how to the program that is being visualized.

- A red arrow: points to the next line to be executed
- A light green arrow: points to the line that has just executed
- A slider bar and text indicate the current execution point being visualized. The user can click on or drag the mouse the slider bar to jump to a particular point or use navigation buttons to step forwards and backward executed lines
- The frames pane shows global variables
- The objects pane shows visual representations of objects
- The program output shows the cumulative output.

IV. FLOWGORITHM, INTRODUCTORY PROGRAMMING BASED ON FLOWCHARTS

A. About Flowgorithm

Flowgorithm is simple graphical flowcharts for beginner's programming language. Typically, when a student was first learning to a programme and then they used text-based programming languages (any programming language) can either be easy or frustratingly difficult. By practicing flowcharts, the student can concentrate on programming logic rather than all typical programming language. In Flowgorithm, after arranging flowcharts correctly the next step can also run programs directly.

Flowgorithm can interactively convert your flowchart to over 18 languages. These include C#, C++, Java, JavaScript, Lua, Perl, Python, Ruby, Swift, Visual Basic .NET, and VBA (used in Office) [9-10].

B. Advantages of Teaching and Learning using Flowgorithm

Flowgorithm can be executed directly by the built-in interpreter allowing students to learn programming concepts before being confronted with language-specific syntax and semantics.

Flowgorithm provides an integrated learning path so the students can apply their knowledge to a real programming language.

C. Getting Started with Flowgorithm

To help the students to visualize how a shape relates to its generated source code, both shapes and source code are color-coded based on their functional category.

If the student is passed through the code, the current shape in the flowchart is highlighted as well as the corresponding source code. Each line of source code is directly linked to its parent shape - and will change colors based if the shape is selected.

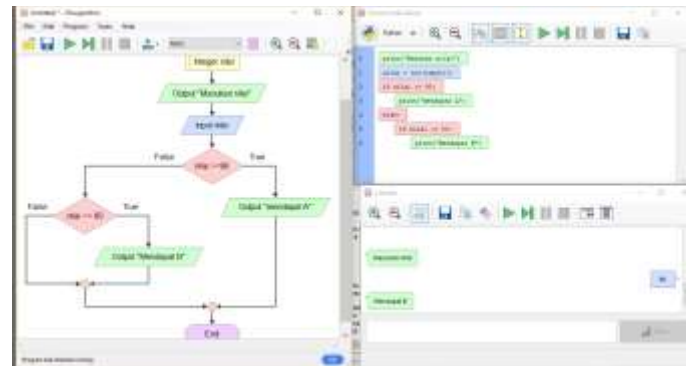


Figure 5. Writing code in flowgorithm

V. DISCUSSION

Based on this literature, the tools that purposed in this paper support for Visual Learning, where this visual learning is one of the keys to success in teaching and learning programming.

Student activity to try to be independent at a later time is very helpful in learning success. because those three tools will directly provide feedback if an error occurs in the programming syntax.

Using combination tools for teaching and learning to the programme will make learning more comprehensive. because each tool has advantages and disadvantages.

Through flogarhythm, students can write a simple program to exercise the ability to write code. Visualization how to work lines of code from Online Python Tutor makes the student can debug if the result not as expected. And Get help from this tool can encourage students to answer questions that may help her/him to reach a solution.

VI. CONCLUSION

Teaching and learning programming is challenging for both students and teachers. Therefore, there is a gap has been addressed to enhance the teaching and learning process of programming to students.

Writing code program using trinket, online python tutor and flowgorithm perform the teacher can explain clearly and detail so that the student can more understand about the program and increase student motivation.

REFERENCES

- [1] F. Alajmi, Enhanced Teaching Model (Etm) For Teaching Programming Languages, International Journal Of Computer Applications (0975 – 8887) Volume 121 – No.20, 2015
- [2] C. Areias, A. Mendes, A Tool To Help Students To Develop Programming Skills, Acm International Conference Proceeding Series. 285, 2007
- [3] N.C.C. Brown, G. Wilson, Ten Quick Tips For Teaching Programming, Plos Computational Biology, 14(4), 2018
- [4] A. Pears, S. Seidman, L. Malmi, L. Mannila, E. Adams, J. Bennedsen, M. Devlin, And J. Paterson., A Survey Of Literature On The Teaching Of Introductory Programming, Sigcse Bull. 39, 4 (December 2007), Pp 204-223. 2007.
- [5] D. Radošević, T. Orehova, A. Lovren, Verificator: Educational Tool For Learning Programming, Informatics In Education, , Vol. 8, No. 2, Pp 261–280, 2009
- [6] [Https://Trinket.io/](https://Trinket.io/)
- [7] <http://www.pythontutor.com/>
- [8] P.J. Guo, Online python tutor: embeddable web-based program visualization for cs education, Proceeding of the 44th ACM technical symposium on Computer science. In education (SIGCSE '13). pp 579-584. , 2013
- [9] <http://www.flowgorithm.org/>
- [10] D. D. Cook, Flowgorithm: Principles for Teaching Introductory Programming Using Flowcharts, Proceedings of the 2015 American Society for Engineering Education/Pacific South West Conference, 2015