Graphical Tasks for Practicing Loops in Python

Bachelor’s thesis · Comenius University Bratislava

Problem and aim

Loops are one of the topics where beginners struggle most (Eckert et al., 2022). Research on novice programmers finds that their mistakes rarely come from not knowing the commands – they know the syntax, but cannot turn a problem into an algorithm (Winslow, 1996; Kwon, 2017).

A worded assignment lets them skip that step: keywords map onto commands, and the loop itself never gets pictured.

The aim of the thesis was to

- design loop tasks whose assignment is **only a title and a picture**,
- try them out in real lessons at a secondary school,
- find out where students get stuck with them.

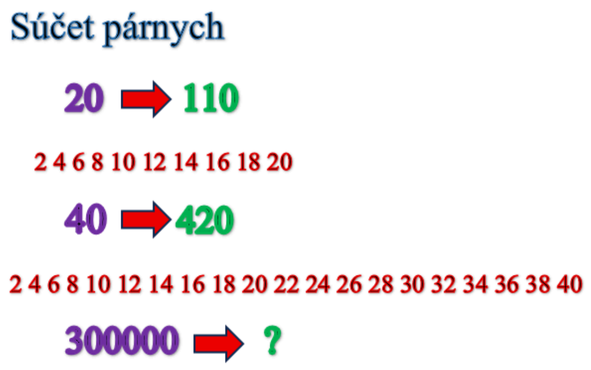
The assignment is a title and a picture

Students receive no verbal description and no hint about the procedure.

- The picture shows solved **input → output** pairs; the last row is the question.
- Students work out what the program should do themselves, and only then look for an algorithm.
- The tasks live on a web page – the next one unlocks only after the correct result is entered.
- At the end of the lesson students also hand in their code.

All assignments share the same visual style, so with every new task students can focus on the new problem alone.

A sample assignment



Súčet párnych (Sum of the even ones). This is the whole assignment a student gets: the program has to add up the even numbers from 2 up to the given number.

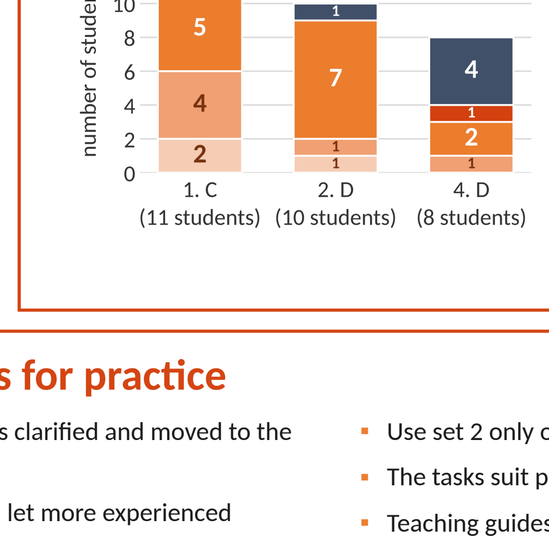
Two sets of four tasks

Set 1 – designing the algorithm

Four tasks with no graphical output, ordered by increasing difficulty. Each one puts the loop in a different context: a numeric range, a string, a nested loop, and finally several operations combined.

Students need a `for` loop with `range()`, iteration over a string, conditions, the modulo operator and conversions between `int` and `str`.

The set follows Bloom’s taxonomy, so difficulty grows gradually and students can work at their own pace.



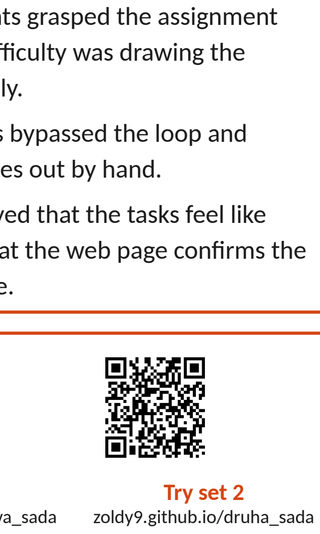
Kóduj pomocou pozície písmen
(Encode by letter position)

Set 2 – algorithm plus graphics

Finding the numeric result is not enough – the program must also draw it correctly using `tkinter`. That demands more precision and a better grasp of what happens in every step of the loop.

The four tasks work with line segments, squares, circles and finally a grid of cells generated by a nested loop.

The output is a picture in a tkinter window together with a number printed by `print()`. The drawing itself is checked by the teacher.



Obsah modrých
(Area of the blue ones)

Classroom trials

How the tasks were tried out

- 6 lessons at a secondary technical school in Bratislava
- each set in three classes – together spanning the first to the final year
- 29 and 30 students respectively; 45–60 minutes per set
- students worked on their own, without guidance; we stepped in only minimally
- we observed how they solved the tasks, typical mistakes and where they got stuck

Set 1: how far students got



Set 2: how far students got



* Class 1. D worked as a whole class, so the numbers do not reflect individual progress.

What we found

- The tasks told students apart well – the more experienced ones worked faster and got further.
- In set 1 the hardest part was understanding the assignment and designing a procedure.
- In set 2 students grasped the assignment quickly; the difficulty was drawing the output precisely.
- Some students bypassed the loop and wrote the values out by hand.
- Students enjoyed that the tasks feel like puzzles and that the web page confirms the answer at once.

Changes and recommendations for practice

- The hardest task, **Nadmorská výška** (Altitude), was clarified and moved to the end of set 1; set 2 needed no changes.
- With a weaker group, solve the first task together; let more experienced students work on their own.
- Use set 2 only once students have some experience with tkinter.
- The tasks suit practice and revision rather than a first encounter with the topic.
- Teaching guides for both sets are available.

Try set 1
zoldy9.github.io/prva_sada

Try set 2
zoldy9.github.io/druha_sada

FAKULTA MATEMATIKY, FYZIKY A INFORMATIKY
Univerzita Komenského v Bratislave

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