RELATION BETWEEN STRUGGLE AND LEARNING PERSONALITY IN PROGRAMMING EXERCISES

Alina Deriyeva, Jesper Dannath, and Benjamin Paaßen

Struggle Indicators

We define task struggle as a continued failure to progress at a task and use struggle indicators as a more fine-grained version of a correctness measure for programming tasks. In particular, we aim to enrich learner modelling thourgh incorporating different measures of struggle. We chose 2 struggle measures: time-based and progress-based from [1].

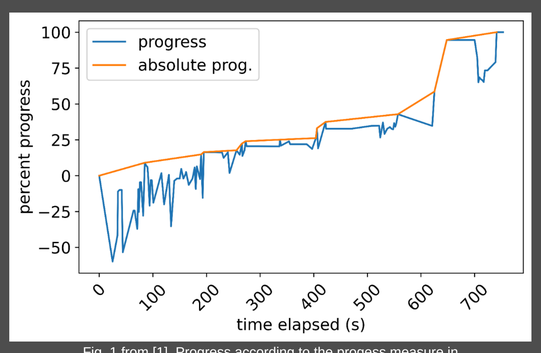


Fig. 1 from [1]. Progress according to the progess measure in comparison to the absolute progress (Levenstein distance based)

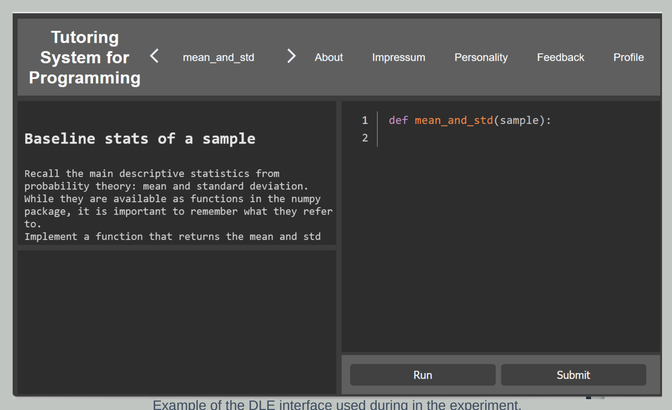
[task description]

Given the above programming task, consider this partial solution to the task:
[code snippet]

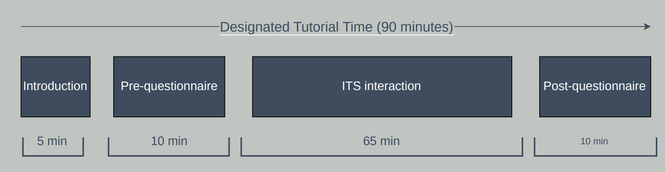
The current progression-state of this solution can be described in one word as: *[output]*

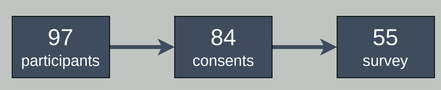
Prompt

Experimental Setup



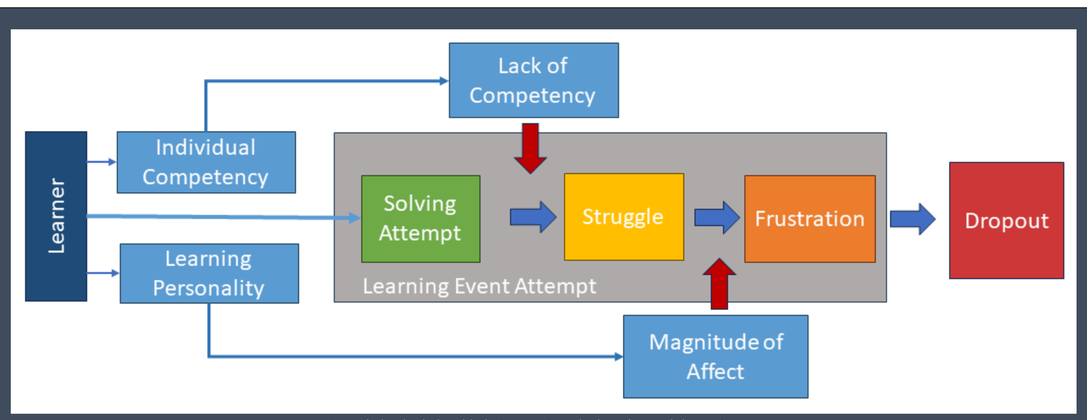
Example of the DLE interface used during in the experiment.





Limitations:

- non-representative sample (single EU University, all major Computer Science)
- class imbalance (**83%** prevalence: almost all tasks solved correctly, eventually)



Hypothsized relationship between struggle, learning and dropout.

Struggle, frustration, dropout

"I get easily frustrated, if I have to attempt solving a problem several times before success."

-0.44 → # tasks
-0.36 → # submissions
-0.41 → # attempts

Struggle sensitivity can be an indicator for dropout and pedagogical decision-making

We hypothesize that the competency affects struggling rates while solving tasks, and the learning personality correlates with the susceptibility to frustration in case of struggle. Further, we assume that frustration can consequently lead to lower learning gains and potential dropout.

Results

Correlation betwen self-reported learning personality assessment and struggle-based ability estimation.

- Big 5 personality traits had no significant correlation.
- chatbot use correlates with struggle, consistent with prior work on proficiency correlating negatively with help-seeking [2].
- time-based struggle mostly related to learning preferences, progress-based struggle also to problem solving strategies.

Problem Solving	time-based	progress-based
Using Chatbots	-0.18	-0.28*
Sub-problem decomposition	0.05	0.07
Using a visual debugger	0.15	0.22
Trial and Error	0.25	0.36**
Revisiting learning material	-0.16	-0.22
Revisiting online resources	0.03	0.01
Conceptualizing solutions through visualization	-0.1	-0.03
Learning Preferences	**time-based**	**progress-based**
Acquiring only the minimum skill	-0.31*	-0.22
I like solving bonus tasks	0.28*	0.33*
Challenging tasks increase my interest	0.29*	0.33*
I get easily frustrated	-0.41**	-0.28*
I tend to quit the course if it becomes too complicated	-0.33*	-0.17

(*) - $p < 0.05$; (**) - $p < 0.01$

Future directions

- How do the introduced struggle measures correspond with the subjective experience?
- What struggle measures are the most efficient for online implementation?
- In what way learning can personality modeling inform and benefit pedagogical decisions (particularly in DLEs)?

Learning Personality: How to define it?

Personality traits: more or less constant over the time.

Learning preferences: can undergo changes, but very slowly.

Problem solving strategies: can be learnt within the course of several months, and sometimes can be treated as meta-skills.

[1] Dannath, J.; Deriyeva, A.; Paaßen, B.: Evaluating Task-Level Struggle Detection Methods in Intelligent Tutoring Systems for Programming. In Proceedings of the 22th FachtagungBildungstechnologien (DELFI), 2024.

[2] Aleven, V.; Roll, I.; McLaren, B. M.; Koedinger, K. R.: Help Helps, But Only So Much:Research on Help Seeking with Intelligent Tutoring Systems. en, International Journal ofArtificial Intelligence in Education 26 (1), S. 205–223, 2016,issn: 1560-4292, 1560-4306,doi:10.1007/s40593-015-0089-1.

[3] PytlikZillig, L.; Hemenover, S.; Dienstbier, R.: What Do We Assess When We Assess aBig 5 Trait? : A Content Analysis of the Affective, Behavioral, and Cognitive ProcessesRepresented in Big 5 Personality Inventories. Personality and Social Psychology Bulletin28, S. 847–858, 2002,doi:10.1177/0146167202289013.

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