Analysis of debugging strategies in MOOCs

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Rationale

Compared to traditional educational setups, Massive Open Online Courses (MOOCs) provide a new learning experience where immediate feedback (Hattie et al., 2007) plays a key role in exercise solving. They allow students to solve an exercise multiple times and provide many resources (lecture videos, notes, forum) helping students to learn for mastery. However, how students use these resources can greatly depend on their personal preferences, often referred to as learning styles (Kolb, 1985).

Previous research in this field dealt with examining these behavioral patterns over longer period of times in MOOCs (Wen and Penstein, 2014). This study puts this approach in a new context by examining whether different learning and debugging strategies can be observed during exercise solving on a finer scale by searching the answer for the following questions:

- What are the **different debugging strategies** used?
- Do people **stick to** one specific strategy or are they opportunistic?
- Is any strategy **more efficient** in terms of final grades than the others?
- Do people following the MOOC as part of a regular EPFL course **behave differently**?

Methodology

- Analyzing **clickstream data** between the first and last submission of a given problem for each user
  - Event types:
    - Problem submission (Single, Repeated)
    - Video (Load, Play, Pause, Seek)
    - Forum (Launch, Load, View, Post, Comment)
- Building **Markov chains** of events and constructing transition matrices
- Identifying different behavior patterns with **K-means clustering**

Dataset

Introduction to Object Oriented Programming in JAVA (Coursera, end of 2015)

- 7 weeks, 11 programming exercises
- 995 registered students
- 653 people solving exercises
- 30942 problem submissions , 58278 forum and 535951 video events
- Part of the regular EPFL course

References

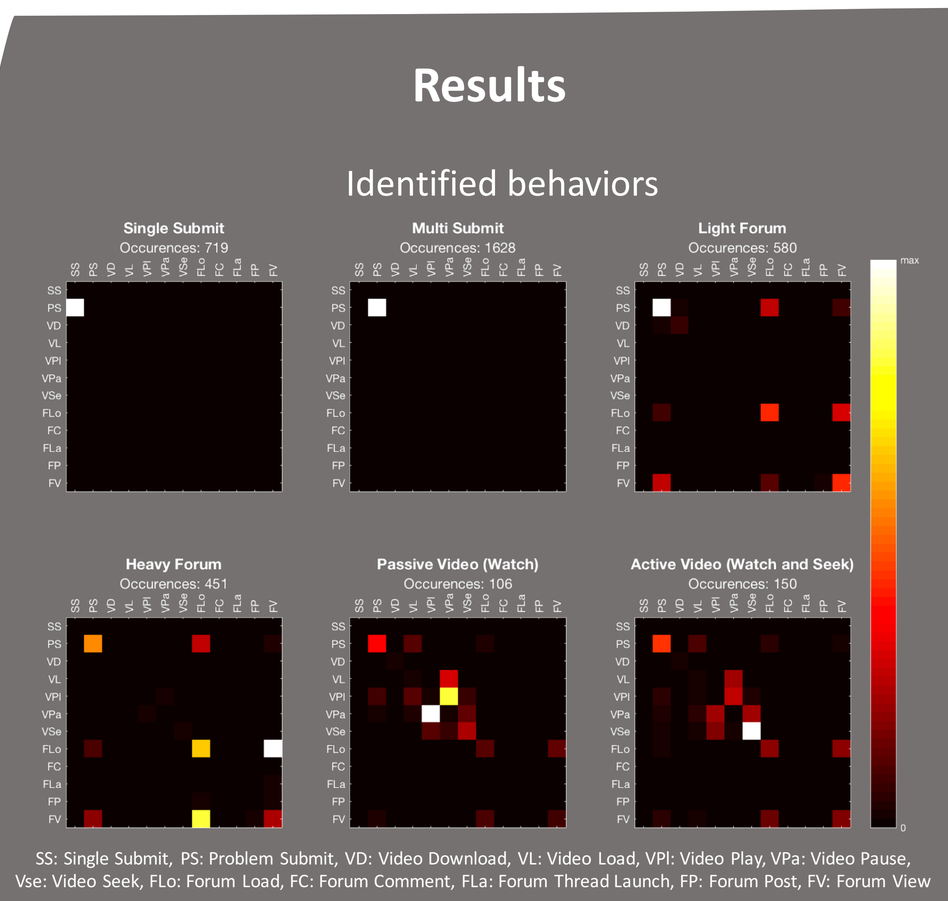
Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81-112.

Kolb, D. (1976). *Learning style inventory*. Boston: McBer and Company.

Wen, M. & Penstein Rosé, C. (2014). Identifying latent study habits by mining learner behavior patterns in massive open online courses. In: *Proceedings of the 23rd ACM International Conference on Conference on Information and Knowledge Management*. New York: ACM, pp. 1983-1986.

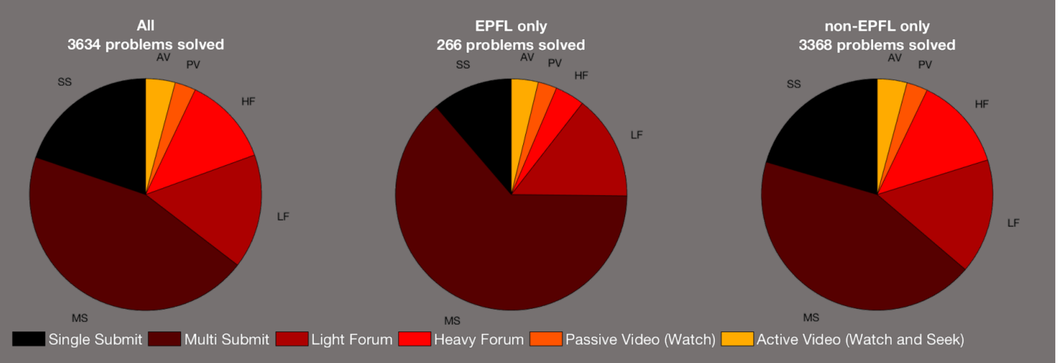
Results

Identified behaviors

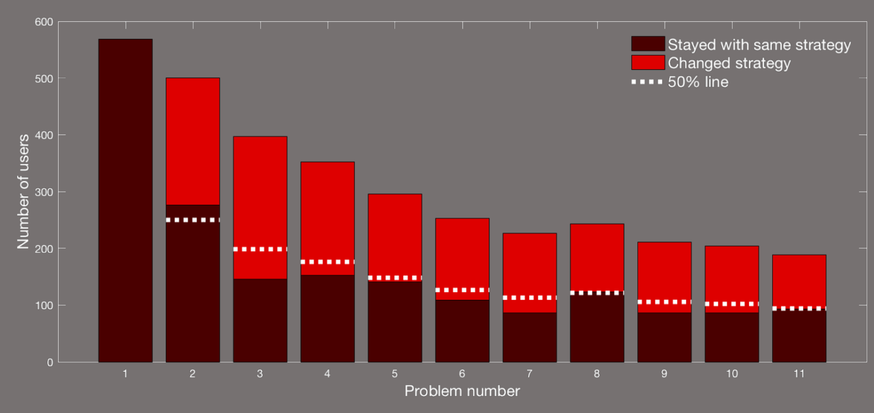


SS: Single Submit, PS: Problem Submit, VD: Video Download, VL: Video Load, VPl: Video Play, VPa: Video Pause, Vse: Video Seek, FLo: Forum Load, FC: Forum Comment, FLa: Forum Thread Launch, FP: Forum Post, FV: Forum View

Distribution of different strategies



Changes in strategies over time



Conclusions

- **Different strategies appear** from the clickstream data
- Students do **not stick** to a specific strategy during problem solving
- Two thirds of problems solved **without consulting the course material** after the first submission
- **No connection** identified between the used strategy and the grades obtained
- People in the regular EPFL course **behave differently** than people outside EPFL (chi^2 p-value: 1.12e-9).

More about this study

This study was carried out by M.Sc. Students at EPFL as part of the Social and Human Science course *How People Learn.*
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