Jupyter Notebooks allow the presentation of programming code, text, figures and other multimedia content in an interactive way which, in principle, makes them an ideal tool for education. Not surprisingly, the number of publications dealing with Jupyter Notebooks and teaching have increased rapidly during recent years. Inspired by the Open Software philosophy, most of this Notebooks are intended as open educational resources. However, very few of the educational Jupyter Notebooks available take into consideration basic teaching and learning principles, a problem that potentially results in poorly designed content and/or little reuse by other educators.

This poster is a call for attention on the need for implementing well-established educational principles into Jupyter Notebooks for creating content of superior educational value. Given the magnitude of the task, the poster paper only deals with Jupyter Notebooks in the context of inquiry based learning (IBL) education.

**Background and Objectives**

**Good Practices for Notebooks in IBL**

**Findings**

Notebooks are excellent tools for explaining different concepts in class, not only in STEM, but also in Humanities and Social Sciences [1]. Notebooks can be used for translating the students from a passive to an active, hands-on, position in which the students are allowed to experiment, explore, evaluate and play with the possible solutions to a problem, i.e., promote student-centred learning.

Notebooks can be naturally integrated in inquire-based learning methods, promoting investigative and innovative skills, increasing engagement and motivation, leading to reflection and deep learning [7].

All of these concepts are at the heart of education reform efforts promoting student-centred learning, as proposed by e.g. the European Student Union [8]. Notebooks can easily result in poorly-designed teaching activities; as J. Grus put it, “pressing shift-enter over and over again, until you get at the bottom of the tutorial, is not learning” [5].

According to Hanč et al. [6], most of the Notebooks created with educational purposes discussed are empirical approaches and classroom notes with a strong focus on the contents and little reflection on how the teaching and learning activity proposed is linked to the psychological principles of learning and/or what other educators are supposed to do with the material.

**Missed Opportunities: Suspected Causes**

The teacher is experimenting with an unfamiliar educational strategy.

Early stage teachers—who are much more likely to incorporate Notebooks in their teaching and learning activities than in-service teachers [6]—tend to focus mostly on the subject content of the course, and consider students as receptive rather than active.

**What is Inquire-Based Learning (IBL)**

IBL comprises several pedagogical approaches with common features: all of them are based on active learning, link theory and practice, have a direct connection with the real practise of the discipline and are driven by the students (often involving teamwork) [4]. IBL starts by posing a question or a series of challenging questions, problems or scenarios that the students can solve interacting with course material, which in this case are the resources included in the Notebook provided by the teacher.

Although IBL activities must be driven by the students, the teacher has to be present in order to provide guidance and supervision, as well as for assessing how the activity has helped the students in reaching the intended learning outcomes [7, 3].

**Resources**

The students need to address the questions posed at the beginning of the IBL activity using the available resources, which in our case are contained in the Notebook.

Plan according to students skills and curriculum boundaries. Among other things, this implies that the student-Notebook interaction has to be planned in a way that no coding skills are needed, unless programming is an intended learning outcome and/or the students have previous computational skills. Minimising undesired student-code interaction is a strategy to reduce the cognitive load and hence facilitate learning.

Use widgets! Ensure access to your Notebooks through internet browsers without local installation.

Attend to diversity. Be prepared to meet students with different levels of computational literacy. Plan the notebook in a way that allows interactions at different complexity levels.

**Guidance, Supervision and Assessment:**

The presence of the teacher is essential. However, there is a debate in the literature on how much guidance should be included in inquire-based methods [7]. Choose the option involving more active learning and less supervision. This approach allows the students to follow their own learning process and, when correctly implemented, prevents the “shift-enter” trap.

For decreasing the teacher’s working load, the notebook can incorporate technology-enhanced formative assessment (TEFA) tools. For example, Barba et al. [1] proposes the creation of a exit ticket in the notebook, i.e., batch of short questions that the students need to answer at the end of the activity. The exit ticket must not be limited to subject-specific questions, but also metacognitive questions encouraging the students to reflect on their own learning process. Tips on how to use this type of audience response systems and TEFA tools can be found elsewhere [2]

**The Educational Statement File:**

In contrast to traditional copyrighted educational resources, most of the time Notebooks are not accompanied with a document explaining the educational context. This is the main source of distrust in Open Educational Resources (OER).

Create an Educational Statement File (ESF). The ESF must contain: (i) Notebook title, authors with affiliations, (ii) type of activity (e.g. IBL, virtual lab, lecture, flipped classroom, etc.), (iii) programming skills needed? and if yes at which level and language, (iv) student requirements (e.g. basic knowledge of <x>, prior attendance to a course on <y>, etc.), (v) intended learning outcomes, (vi) assessment (are technology-enhanced assessment tools included? Y/N. Examples of questions for assessment, etc.), (vii) Notes and suggested tweedles, tweedles or frobs. Point out possible pitfalls and how to avoid them, etc.

**References**


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