In search for the perfect syllabus: teaching introductory course in logic

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Abstract

This paper describes the syllabus of an introductory course in logic for cognitive science students at Adam Mickiewicz University in Poznań, Poland, and offers some reflections on effective practice in teaching logic.
Keywords: Teaching logic, cognitive science curriculum, student's activity

1 Introduction

Recently, we are witnessing a 'practical', or cognitive, turn in logic [2]. In a sense, it consists in a return to Aristotelian view on the role of logic as both ancillary to and indispensable in any scientific enterprise. Proponents of this turn claim that logic has much to say about actual reasoning processes and argumentation, and that high standards of logical inquiry that we owe to Peano, Frege, Skolem, Tarski and others offer a new quality in research on reasoning and argumentation.

A fundamental educational problem which arises in this context is that to make sense of the interplay of logic and actual reasoning one needs, among others, a substantial competence in logic. For a student this means going trough the foundations of set theory, model theory, classical and some non-classical systems and their metatheory before he or she will be able to grasp the idea of even the basic applications of logical analysis to reasoning processes. And this way may be seen as quite a trying one. Thus, in teaching logic, how to avoid Scylla of trivial narrative without proper formal basis and Charybdis of excessively hermetic formalism? How not to reduce logic neither to critical thinking exercises, nor to formal mindteasers, a kind of mind fitness for our students? How to teach logic as both formally and empirically grounded science of reasoning processes? How to design a cognitively oriented course in logic, which is a subject of secondary importance in a typical curriculum? This educational problem is one of the issues for cognitively oriented logic, probably the most practical and challenging one of all I mentioned in [4]. In the present paper I shall offer some reflections

on effective practice in teaching logic, based on experience in teaching an introductory course in logic for cognitive science students at Adam Mickiewicz University in Poznań, Poland.

2 The Syllabus

Cognitive Science curriculum at the Adam Mickiewicz University in Poznań has been the first such curriculum in Poland. It started in 2005 as a full five year MA programme (we do not offer BA degree). It consists of several blocks of subjects, reflecting the multidisciplinary nature of cognitive science itself. The logic block starts with Introduction to Logic (1st semester), followed by Formal Logic 1 and 2 (2nd and 3rd semesters), Logic in Cognitive Science (8th semester), Proof Methods and Automated Reasoning (9th semester) and Concept Creation and Reasoning (10th semester). Thus in this curriculum logic definitely is not of secondary importance. This obviously makes things easier when it comes to deciding the content of the syllabus for the introductory course. However, most of these courses deal with formal logic (with the exception of the first course and the last one).

2.1 Learning objectives

Main aims of Introduction to Logic are twofold. The first one is to introduce the students to the conceptual apparatus of these areas of logic (a) which they will not systematically study any further, but (b) which will be extensively used during all the rest of their study (categorial grammar, names and definitions, classification of reasoning, indirect justification procedures, fallacies). The second one is to make the students aware of the logical structure of different kinds of reasoning and to give them basic training in reasoning evaluation. There is also, as may be expected, a number of hidden agenda aims. Of these the most important are: to improve students' self-awareness as reasoners, to train them in reasoning within a given conceptual apparatus as well as in conscious adoption of Closed World Assumption and, finally, to convince them to appreciate the fact that words, though ambiguous way to often, do have their meaning which may be made unequivocal on purpose. All those aims are standard rather than surprising.

2.2 The structure of the course and topics covered

The course lasts 15 weeks. Each slot consists of two sessions each week: a lecture and a tutorial, usually scheduled for different days. Lectures (2 hours each, 30 hours in total) are led for a group of 70–80 participants and tutorials (again, 2 hours each, 30 hours in total) are led for three groups of 22–27 participants each. The participants are students of the first year of Cognitive Science curriculum at Adam Mickiewicz University in Poznań, Poland. The course is led in winter semester, from the beginning of October till the end of January, with an approximately one and a half week break at the end of December. Language of instruction is Polish.

The topics are divided into four groups:

1. Signs, languages and general grammar (categorial grammar and finite automata).
2. Names (including theory of definitions and the concept of classification).
3. Sentences (basics of classical logic, both propositional and first-order, and syllogistics, entailment).
4. Reasoning (classification, evaluation, applications, justification procedures, erotetic reasoning, pragmatic inferences, fallacies).

All the course materials (in Polish) are available at the website:
`http://logika.wikidot.com/wprowadzenie-do-logiki`.

2.3 Evaluation

There are two grades assigned: the first for tutorials, the second for the whole course.

Grades for tutorials are based on points earned for different kinds of assignments: three written in-class tests (15 points each, scheduled after completion of 2, 3 and 4 topic group), short in-class exercises and written homeworks (usually 4–5 in a semester, 13 points in total). Grades are assigned according to following scale:[1]

55 and above	5
51–54	4,5
47–50	4
43–46	3,5
36–42	3
35 and below	2

Points for tutorials contribute to the final grade, for which there are also two other assignments: four short essays (1–2 pages, 3 points each; topics are posted on the course website) and a final in-class exam (open-question, 40 points).

Final grades are assigned according to following scale:

101 and above	5
91–100	4,5
81–90	4
71–80	3,5
56–70	3
55 and below	2

A student has to get two positive grades in order to complete the course and to get 7 ECTS credits. However, only the final grade is counted against the overall result of the study, for calculating scholarships etc. None of the assignments is obligatory: the students should earn enough points to pass the course but it is at their discretion at which grade they aim.

[1] In the Polish system 5 is the highest grade (equivalent to A). The only failing grade is 2.

3 Practice

I do believe that the most effective learning is an outcome of, in that order: teaching others and doing things by oneself (on the condition that decent feedback is provided). That is, the most effective learning comes from individual activity of a student; the atmosphere of constructivism is around. But this is only one side of the problem of facilitating effective learning. The other is, as Weimer concisely puts it, that "you can lead a horse to water, but you can't make it drink" [5, p. 102]. Thus it is a teacher's responsibility to manage student's motivatation to learn. On the other hand, it's not just a matter of what a teacher should do, but of "the form of the interaction that must take place between teacher, student and subject matter" [3, p. 70].

In my experience there are two (quite evident, in fact) factors that enhance students motivation to learn. The first is interest in the topic, no matter where this interest comes from. The second is perceived practicality, or usefulness, of the topic. Both factors are highly subjective. They are also obviously interwined. The question is how to use these factors to facilitate more and better learning.

3.1 Instruction style

It is probably pointless to try to escape deductive teaching during logic classes, even if it is not the most effective of possible instruction styles. Direct instruction is indispensable, especially in the case of lectures. One problem is, that the students sometimes are too eager to accept this style of instruction. Our first-year students strive for unequivocality and truth (the-one-and-only). They are not that willing to encounter problems, gaps in knowledge and inconsistencies. They want useful competencies to be trained and applicable information to be delivered. They start to appreciate what they have learned during logic classes later on, when both knowledge and reasoning style become useful in solving quite practical problems during classes in programming or statistics. Thus it is indispensable to let them experience all these logical inconveniences by themselves. This is why tutorials usually cover less material than lectures do: tutorial activities consists mostly of students' own work and their pace is much slower.

3.2 In-class activities

As I observe, in-class activities usually evoke higher engagement than homework assignments. However, in the era of ubiquitous multiple choice testing in education one cannot assume that first-year students will exhibit a substantial competencies in higher-level skills in the cognitive domain (according to Bloom's taxonomy [1]). They can be left alone with a number of simple repetition tasks or assignments consisting in mastering certain computational techniques. They cannot be left alone when it comes to developing their reasoning abilities and fluency in argumentation.

Quite effective teaching practice is organizing small group activities. The students are divided into 3–5 person groups. Each group is assigned a task; the tasks are similar in form but different in content. After prescribed period of time (usually 5 to 10 minutes, depending on task's complexity) one member of a group presents the solution to

the whole class; sometimes, in the case of differing views or *votum separatum*, more than one solution is presented. The solution is evaluated by the rest of the class. The emphasis is not on the solution but on its justification. Even if the solution itself is not a satisfactory one it is appreciated if supporting argumentation is carried out in a reasonable way.

Even more effective is organizing kind of self-helping groups with best students as tutors. However, this technique works best when it is known what can be expected from the students, thus I use to apply it at later stages of the curriculum. And it should be noted that those who benefits the most are the tutors themselves.

3.3 Writing assignments and exams

Writing assignments evoke diversified engagement (recall, that they are not obligatory). On the average half of the students prepare essays (with a rather obvious exception of the first one, which is prepared by roughly 60–65%). The point is to make them notice that logic is something they encouter in their lives, both in everyday and in academic contexts. Thus the tasks are the ones like "find an argumentative statement which involves syllogistic reasoning; reconstruct this syllogism and evaluate it" or "in your cognitive psychology textbook find a description of an experiment and reconstruct its underlying reasoning in terms of canons of eliminative induction".

On the other hand, tasks like name classification aim at raising awareness of reasoning within the borders of certain conceptual apparatus. Switching between non-academic and academic (or scientific) use of language requires awareness of the differences between the two. One basic difference is that fluency in pragmatic factors of communication in everyday language is something that in an academic context may need to be supressed. Single words do matter and one-to-one assignments of meaning to words is something that must be trained on early stages of an academic career.

Exams are designed in such a way that an average student can pass the course relying on knowledge and comprehension. For better grades application and analysis are needed. On this introductory level synthesis and evaluation are addressed rather seldom. Ability to synthesize and evaluate at this stage of the study comes from earlier education and from individual differences and in my opinion they should not be a subject of evaluation within the introductory course.

4 Conclusion

If the practical turn in logic and the resulting renewed logical interest in actual human reasoning are taken seriously, they form a substantial challenge for logic teachers. This challenge is related to both the choice of topics covered in logic courses and techniques that we use in teaching. But this is not only the matter of which topic is more important and which is less important or which educational tricks are more efficient than others. Logic classes are the best place for loop-input learning of reasoning and argumentation. Interactions between teacher, student and subject matter which take advantage of this fact are the best way to make the thirsty aware of their needs.

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