OBEC

INSPIRING REVOLUTIONARY EDUCATIONAL CREDENTIALS

Module 10

One Block for Educational Credentials (OBEC)
2020-1-SE01-KA204-077803

Co-funded by the Erasmus+ Programme of the European Union

OBEC

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ABOUT THE PROJECT

OBEC (2020-1-SE01-KA204-077803) is a KA2 Strategic Partnership co-funded by the Erasmus+ of the European Union. Led by SwIdeas in Sweden, the project gathers partners in Croatia (Regional Develpment Agency of Sisak-Moslavina County - SIMORA), Italy (LAI-MOMO Società Cooperativa Sociale & Università degli studi di Urbino Carlo Bo), Belgium (EURADA - Association Europeenne Des Agences Developpement).

OBEC is an innovative project that aims to explore the potentials of Blockchain technology to promote competency development and recognition of skills and qualifications by creating an innovative system to issue and validate learning credentials on a trial basis. Through this effort, the project's goal is to encourage the professional and academic integration of migrants, exchange students, and individuals with informal and non-formal learning backgrounds.

By contributing to the educational and economic integration of these targeted groups, OBEC envisions to benefit individuals with migrant background, students, teachers, education institutions, and employers. Focusing on the key issue of lack of uniformity and transparency in systems of validation of credentials, it is expected that this effort will result in positive effects in the working context, promoting employability, empowerment, and accessibility to the labour market.

Lecture Notes Module 10

Slide 1: Introduction to the topic of formal logic and critical thinking. The teacher should emphasis the practical applications of knowing logic and how this can help in developing a more critical understanding of reasoning. Some references to proper arguments and fallacious ones should also be given, in order to exemplify the subject from the beginning. Some interesting statistics related to PIAAC and national reports on the lack of proper textual understanding from individuals could also be given to strenghten the point.

Slide 2: The teacher should refer to two distinct research agendas related to reasoning. On the one side there is a normative analysis of reasoning that tries to provide individuals with ideal reasoning models that should be followed in order to avoid mistakes (examples of such approaches are logic, probability theory and decision theory; the teacher could also explain why those subjects are normative in nature). On the other side, there is a descriptive approach which has the aim to describe how human beings do, in fact, reason in every day life (an example of such approach is psychology).

Slide 3: The general framework of the module is introduced, highlighting that the approach is going to be integrated between a normative and descriptive approach. Analyses from different disciplines will be taken into consideration to construct a general understanding of reasoning.

Slide 4: The first direction of the module's approach is to go from a descriptive reading of reasoning to a normative one. The idea is that to obtain an appropriate description of reasoning, a researcher must analyse and understand the reasoning mistakes committed by individuals. However, in order to identify those mistakes, it is necessary to identify, first, a normative definition of corretness, which is therefore the aim of a proper descriptive theory of reasoning.

Slide 5: The second direction of the module's approach is to go from a normative reading of reasoning to a descriptive one. For example, in artificial intelligence, a researcher is not interested in how human beings reason, but, instead, tries to build

ideal models of reasoning.
However, in order to obtain approapriate results, especially with higher order level abstractions,
some assumptions relating to human beings limitations must be made, which call for a descriptive analysis.
Another example of this inter-relationship could be seen in economics. One the one side, ideal human beings
are assumed in order to obtain economical models. However, in order to understand more complex phenomena, the
assumption of ideal human agents is abandoned and limited rationality is assumed (e.g., in behavioural economics).

Slide 6: The teacher should highlight how using formalizations could help to make those analysis simpler.

Slide 7: Examples of where inferences and reasoning are employed are given. Both general and specific cases should be
analysed. In the slide, some specific examples are presented. The teacher should present some form of reasoning that is
employed in each case.

Slide 8: Examples of everyday life are introduced to show that reasoning is not limited only to specific setting, but is
employed every day for simple tasks and to make simple decisions. The students are also invited to make some examples.
This is used to check whether the students already grasped some of the basic concepts of the material presented.

Slide 9: A clear cut example is presented. The students are asked whether they think that the example presents a correct
reasoning or not. The students that disagree should be invited to explain their point and an active discussion in the class
should be incentivized. (The example used should be a correct and valid reasoning, meaning both that the conclusion follows
from the premises and where the truth of the premises is sensible).

Slide 10: A secon clear cut example of reasoning is presented. As with the previous case, discussion is invited in cases of
disagreements. This second example should be chosen to be slightly different from the previous one. In particular, a valid
reasoning should be chosen, but such reasoning must contain premises and concusions that are non-sensical, if not blatantly
false. Differences between form of an argument and content of such argument should be hinted at. Further analyses will be
completed lated.

Slide 11: A third example is presented. In this case, the reasoning should contain an instance of induction, where a general
premise is derived from specific observations. The students are invited to concentrate on the different strenght that connects

the conclusion to the premises that could be found in the previous examples compared to the current example.

Slide 12: A fourth example is presented. In this case, the reasoning should contain an instance of a defeasible reasoning. Such class of reasonings, also known as hypothesis to the best explanation, are related to medical and legal reasonings. The aim is to provide a conclusion that sensibly follows from the premises, even though it might not be the correct conclusion. This is often employed when it is not possible to obtain a clear cut conclusion, but an answer is needed nonetheless.

Slide 13: A fifth and final example is presented. In this case, the reasoning should be an instance of a reasoning by default. Such examples of reasoning are employed to derive a conclusion from the characteristics that are commonly attributed to an objects. In the example,
bird are attributed, as a default feature, the ability to fly. Then, once it is claimed that Titti is a bird, it follows that it should be able to fly. Those are other forms of defeasible reasonings.

Slide 14: The teacher should now give a clear definition of reasoning to the students. In particular, a reasoning is a process that starts from a finite set of sentences (the premises) and justifiably derives a final statement (the conclusion).

Slide 15: A graphical representation of a reasoning is presented. All the elements in such graph are described and explained.

Slide 16: A proper definition of sentence (statement, proposition, etc.) is given. A sentence is a linguistic expression which can receive,
in principle, a truth value. Distinctions and descriptions for other types of linguistic acts are presented, e.g., questions ("What time is it?"
does not have a truth value; it makes no sense to say that it is true), orders, etc.
The principle of bivalence is introduced, claiming that sentences can only receive two truth values (true and false).

Slide 17: Some examples of sentences are presented. The sentences should be taken from various disciplines and real life situations. Both simple
and complex sentences should be used as examples.

Slide 18: Some further examples of non-sentences are presented. Students should be asked why each of those is not a statement.

Slide 19: Some finer grained distictions are made between sentences and propositions. A proposition is the content of a sentence and is

invariant
to different linguistic choices (e.g., the language chosen). "La neve è bianca" and "Snow is white" are technically speacking different sentences,
but they share the same content, i.e., they are the same proposition. An initial reference to ambiguity is made, i.e., it is explained that ambiguous sentences might contain two distinct propositions.

Slide 20: The teacher should show that even formal languages are languages nonetheless and that sentences in such artificial languages can be treated
in the exact same way as sentences in natural language are. Depending on the audience, the teacher should already start making an effort to discourage
"formalism panic", i.e., the situation in which the students have a natural rejection of formal theories.

Slide 21: The teacher should start using the five main examples previously introduced to show some characteristics of reasoning.
In particular, this will help to develop a normative theory of correctness, which will be extremely important later in the module.
The teacher should show that for examples 1 and 2, whenever the premises are true, the conclusion is necessarily true, while this might not hold
for the other three examples.

Slide 22: It is explained that the reasonings that follow a similar path to 1 and 2 are called deductive reasonings, also known as reasonings that are
logically correct.

Slide 23: It is explained why example 3 might fail the test of deductive correctness.

Slide 24: It is explained why example 4 might fail the test of deductive correctness.

Slide 25: It is explained why example 5 might fail the test of deductive correctness.

Slide 26: The teacher should remark that learning to properly assess reasoning is an extremely important tool to escape the prison of ignorance.
It should be pointed out that learning is not only gaining new concepts, but also the proper instruments to put those concepts together. The slide
contains an interesting story about a philosphy professor that claims that studying is necessary not to become good persons or to better grow inside out
societies, but it is necessary, primarily, to escape our own prison

that is ignorance.
This slide should also be used to convince the students that what they will be doing is important for them independently from the module or the course.

Slide 27: The art of reasoning is further explained, showing that reasoning is, in fact, a form of art. It should also be explained that reasoning properly
is a difficult task, which requires efforts and might create frustrations. To reason is similar to completing a jigsaw. It is difficult and the beginning, but
once finished, the satisfaction of seeing the complete picture is priceless. The teacher should try to convince the students that this beauty is indeed there.

Slide 28: The second part of the module starts. The teacher should show to the students how to properly deconstruct and reconstruct reasonings that they
might find in their ordinary lives. The contents of this second part of the module are introduced.

Slide 29: The teacher should explain to the students how to recognize that an argument is present. The first characteristic is that an argument is such if it
tries to convince the listener (or reader) that a specific fact is true. The objects employed for this convinction process must target the rational mind of the
listener (reader). Moreover, an argument has to have premises and conclusions (even though they are not always explicit).

Slide 30: Emphasis should be placed on how important the conclusions are. In particular, it should be highlighted that often people provide arguments for conclusions
that they are not even aware they are arguing for.

Slide 31: Other characteristics of arguments are presented. In particular, it is highlighted that in order to recognize an argument, the first step must be that of
identifying the conclusions of such argument. If there are no conclusions, then the text that is read (or the speech which is listened) is not an argument. Once it is
recognized that an argument is being made, the argument must be properly reconstructed and finally, it has to be evaluated. This concludes the evaluation process of an
argument.

Slide 32: One thing that might create confusion in the analysis of an argument is the fact that the sentences that are included in the argument might have meaning that
are distinct from their factual meanings. Cleaning all the sentences

in order to obtain their factual meaning is one of the most important things to do in order to
assess an argument correctly. Among the other aspects of the meanings of a sentence there are: i) its rethoric meaning; ii) its implicational meaning; iii) the use of
definitions.

Slide 33: Examples of rethorical meanings are presented. The rethorical meanings of a sentences must always be eliminated or transformed into factual meanings. If this is not
done, those rethorical meanings might create confusion when the argument is evaluated.

Slide 34: Examples of implicational meanings are presented. The implicational meanings of a sentences must always be substituted to their factual meanings if
the arguer had the implicational meaning in mind. Otherwise, they should be eliminated in favour of better sentences.

Slide 35: Examples of definitions are presented. It is necessary to check whether those definitions are a common ground between the two agents in an argument. In case they are
not, it should always be checked whether the argument is correct employing different definitions.

Slide 36: The next step in analysing an argument is presented. Such step is to present the argument in its standard form.

Slide 37: The strategy to present an argument in its standard form is the following:
1) Identifying the conclusion; 2) Identifying the premises; 3) Putting the premises in order and giving them numbers;
4) Put an inference line under the premises; 5) Putting the conclusion under the inference line and giving it its code.

Slide 38: To properly complete steps (1) and (2) of the reconstruction of an argument, various techinques are available.
It should be shown how in a formal setting identifying premises and conclusions is way easier. Moreover, it is shown that spurious elements
must be eliminated.

Slide 39: The linguistic elements that identify the conclusions of an arguments in natural languages are presented. This should be adapted to the linguistic context that is natural for the students (english, french, etc.).

Slide 40: The linguistic elements that identify the premises of an arguments in natural languages are presented. This should be adapted to the linguistic context that is natural for the students (english,

french, etc.).

Slide 41: The spurious elements of sentences are introduced and explained. Examples are shown to prove that those elements might be misleading and
should, therefore, be eliminated during the analysis of the argument.

Slide 42: Linguistic spurious elements are introduced. In particular, ambiguity, vagueness and difference between primary and secondary connotation
of a word are briefly explained.

Slide 43: Emphasis is placed on the concept of ambiguity. It is shown that there might be ambiguity both at the word level and at the sentence level.
Context might help in fixing word ambiguity, while punctuation can help in fixing sentence ambiguity.

Slide 44: Emphasis is placed on the concept of vagueness. Vagueness applied when a term does not refer to a specific object, e.g., being bold does not refer
to a specific amount of hair (someone with two hairs would still be bold). It is highlighted that ambiguity and vagueness are two distinct phenomena, the first
applies to terms with two clear meanings that are although distinct, while the latter applies to terms which have a specific application, but whose meaning is not
clear cut.

Slide 45: Emphasis is placed on the concept of primary and secondary connotation. Primary connotation refers to the fundamental properties of an object. Secondary
connotation refers to properties which are typical but not mandatory of an object. Understanding to which properties the arguer is referring to is extremely important
to properly analyse an argument.

Slide 46: Semantic spurious elements are introduced. In particular, the concept of rethoric is explained in details.

Slide 47: Various examples of rethoric use of language are presented. The first example is that of the use of novelty, beauty and/or popularity to convince someone
of the value of a specific object.

Slide 48: The second example is that of the use of compassion, piety, guilt and/or fear.

Slide 49: The third example is that of direct and repeated attack towards a person instead of an argument.

Slide 50: The fourth example is that of the use of scare quotes, misunderstandings and the factual use of implicational meanings.

Slide 51: General examples are presented. The students must explain which rethorical devices are employed and they must try to clear the statements from such rethorical
devices. Other examples can be employed if the students are still confused and need further emphasis on those points.

Slide 52: Further examples.

Slide 53: The final steps in the reconstruction of an argument. Students are presented some arguments and they have to put them into standard form.

Slide 54: Some general conclusions on the topic of argument identification and reconstruction are presented. It is explained that the students must refer to good
reasoners to implicitly strenghten their ability to properly reconstruct arguments.

Slide 55: Complete example that the students must reconstruct and assess.

Slide 56: Complete example 2.

Slide 57: The new part of the module is introduced. The students will be shown how to use formal techniques to properly assess deductive arguments.

Slide 58: The concept of logical consequence is explained again to refresh the concept in the students.

Slide 59: The distinction between form and content is refreshed. It is explained that a deductive argument is correct independently from the content of the sentences (once
the meaning of those sentences is fixed).

Slide 60: The examples presented previously in the module are shown again to the students and it is shown that example 2 is correct even though the premises are false.

Slide 61: The definition of correctness is highlighted: a logically correct argument is one in which the conclusions are true UNDER THE ASSUMPTION that the premises are true.

Slide 62: A logically correct argument can also be one with false premises and a true conclusion. Moreover, an argument can also have true premises, true conclusion, but still be

incorrect.

Slide 63: The teacher should highlight that logical correctness is not the only value of an argument. Examples of reasoning (3) – (5) should be used to highlight this point.

Slide 64: The teacher should shown why the examples (3)–(5) are usefull.

Slide 65: The specific characteristics of examples (3)–(5) are described.

Slide 66: Each class of reasonings is described and further examples are made.

Slide 67: Slide 66 contnd'.

Slide 68: It is explained why those classes are called non–deductive reasonings. It is highlighted that the focus of the module will be on deductive reasoning.

Slide 69: The module opens its final part. The teacher should introduce the concept of formal logic as the discipline that studies deductive reasonings.

Slide 70: Another example of deductive reasoning is shown.

Slide 71: It is shown how the example presented in slide 70 is equivalent to the example (1).

Slide 72: Another example of deductive reasoning is shown.

Slide 73: It is shown how the example presented is slide 72 is equivalent to the example (2).

Slide 74: It is explained that in order to properly assess an argument, there must be a transformation from natural language to artificial
language. It is also explained that the process of transforming a sentence from its natural language form to the artificial form is called "formalization".
The role of the remainder of the module is how to actually formalize the sentences of an argument.

Slide 75: The basic language of propositional logic is introduced.

Slide 76: A distinction between simple and complex sentences is introduced. Simple sentences are sentences which cannot be reduced to simpler sentences. Usually,
there is a verb for each simple sentence.

Slide 77: Some examples of simple sentences are made.

Slide 78: The symbols that will be employed to formalize the simple sentences are introduced.

Slide 79: Example (1) is reanalysed in order to use the formalization of simple sentences through the symbols previously introduced.

Slide 80: The formalization is carried out.

Slide 81: Emphasis is placed on the fact that the reasoning analysed actually contained complex sentences. This means that other symbols are required to
properly formalize the whole argument.

Slide 82: Examples of complex sentences are introduced.

Slide 83: Propositional connectives are highlighted, showing how those are the objects employed to construct complex sentences starting from simple ones.

Slide 84: Symbols for the whole sentences (either simple or complex) are introduced.

Slide 85: Symbols for the propositional connectives are introduced.

Slide 86: The names for those symbols are given.

Slide 87: The teacher should concentrate on every connective in turn, explaining the history of it and some characteristic.
Negation is the first to be analysed.

Slide 88: The properties of negation are introduced. To negate something is equivalent to change its truth value. True becomes false and
false becomes true.

Slide 89: Conjunction is the second to be analysed.

Slide 90: Disjunction is the third to be analysed.

Slide 91: It is explained that there is a formal way to provide a meaning to the connectives. Those formal tools are described as the truth tables.

Slide 92: A truth table fixes the meaning of a connective by indicating its effect on the simple sentences to which such connective is applied.

Slide 93: The truth tables of negation, conjunction and disjunction are introduced. The teacher should also explain to the students how to construct those
from scratch.

Slide 94: The fact that the connectives are all truth-functional is explained. Something is truth-functional when the meaning of a complex statement can be derived from the truth
of the simple sentences that compose such complex sentence.

Slide 95: Implication is the fourth connective to be analysed.

Slide 96: It is explained that the logical implication is not counter-factual. It is called material conditional and analyses situations in which the antecedent is false as always true.

Slide 97: The truth table of the implication is given.

Slide 98: Correct forms of reasoning are presented. It is explained that those forms of reasoning could be used to analyse whether an argument that is presented is indeed correct or not.

Slide 99: Other forms of correct reasoning are presented.

Slide 100: More forms of correct reasoning are presented.
All the previous forms of correct reasoning are exemplified using texts taken from the real world.

Slide 101: A more powerful language is introduced. That of predicate logic.
An example of a reasoning which cannot be properly analysed with propositional logic is shown.

Slide 102: It is explained why propositional logic fails to provide a proper analysis of the example made and why something
more profound is needed.

Slide 103: Elements of predicate logic are introduced. In particular, the teacher shall explain that there are properties, relations and that those are formalized through symbols.

Slide 104: Moreover, in predicate logic there are individuals, with their respective symbols. Properties/relations and individuals are tied together through their formalization.

Slide 105: The fact that connectives can also be imployed in predicate logic is explained and some examples are shown.

Slide 106: An example of a reasoning in predicate logic is shown and explained.

Slide 107: It is shown how this example can be used to properly formalize the reasoning of example (2).

Slide 108: The concept of quantification is introduced in order to explain how to put in relation variables and properties/relations.

Slide 109: The concept of function is introduced in order to explain how to formalize some expressions in natural language.

Slide 110: It is shown how more arguments are analysable through the lenses of predicate logic.
Some concluding general remarks are made about the ability of an individual to properly assess the correctness of a deductive argument.

Slide 111: Questions and doubts are answered.