Beliefs and Behaviors in Learning Critical Thinking Skills*

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Abstract

The paper will present the relation between students' beliefs and their behaviours observed in the process of learning critical thinking skills. In the first place some consideration concerning the fundamental epistemological concepts used in the research and about the particular critical thinking skills are to be sketched. Then the testing-learning procedure will be shortly summarized. Thirdly the evaluation of beliefs, their relations with knowledge and the associated behaviors are presented. The results of the periodic testing procedures that were taking place according to the established methodology are to be discussed. Finally, some general considerations concerning the relations between beliefs, behaviors and knowledge that have emerged in the process of learning are going to be presented.

Keywords: *belief, knowledge, justification, decision, critical thinking.*

Introduction

The present paper aims to answer to the following two questions: (1) "How is decision (behavior) supported by reasoning in a critical thinking learning context?", and (2) "What are the actual relations between belief, knowledge and behavior (decision) in such a context?" We think this is important for several reasons. First, it could help us see the progress of the process of applying reasoning procedures as it is reflected in the decision results. Second, it could give an empirical insight in what are the relations between the fundamental epistemological concepts – belief and knowledge – in the context of our

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investigation. And last but not least, it could evaluate the relation between the two types of knowledge distinguished by Ryle:[1] the *knowledge-that*, and the *knowledge-how*. This investigation was inspired by the works in experimental philosophy presented by Joshua Knobe and Shaun Nichols.[2] Before presenting our experiments' methodology and results, we will make some considerations regarding the concepts used and the context of the investigation.

The concepts of *belief* and *knowledge* as they are currently used in the philosophical literature are the fundamental for our investigation. Both "belief" and "knowledge" are defined as *propositional attitudes*,[3] and have a similar logical structure: "S *believes* that *p*" and "S *knows* that *p*". Both types of propositional attitudes possess content and intentionality, as long they are *about* something, in this case they are about p, where *p* is a proposition. S, in the above expression, stands for the cognitive subject that possesses the respective propositional attitude. As it is well known, they differ fundamentally in the attitudinal aspect. For instance, it is perfectly possible for John to *believe* that Peter is in Helsinki now, and that he doesn't *know that* Peter is in Helsinki now. The differences lay especially in what was called in the classical analysis of knowledge *the necessary and sufficient conditions* for a belief to be considered knowledge: the *truth* of the proposition believed in this case "Peter is in Helsinki now", and the *justification* the agent has for his belief. There were many discussions concerning what does it mean for a proposition *p* to be justified. We will shortly present them bellow.

There are many distinguishable types of knowledge:[4]

- *knowledge-that* something is the case – the propositional knowledge
- *adverbial knowledge*: knowing what, when, how, why, and so forth.
- *knowledge by acquaintance* with individuals or things
- *performatory (or "how-to") knowledge*

In the classical analysis of knowledge the focus is on the first type of knowledge, the *knowledge-that* or propositional knowledge. There are some essential features that are assumed in propositional type of knowledge.[5] We are going to refer only to a couple of them. First, there is the condition of *truth* for a

[1] Gilbert Ryle, *The Concept of Mind* (New York, London, Melbourne, Sydney, Cape Town: Hutchinson House, 1951).

[2] Joshua Knobe and Shaun Nichols (eds.), *Experimental Philosophy* (Oxford: Oxford University Press, 2008).

[3] Edward J. Lowe, *An Introduction to the Philosophy of Mind* (New York: Cambridge University Press, 2004), 39-101.

[4] Nicholas Rescher, *Epistemology. An Introduction to the Theory of Knowledge* (Albany: State University of New York Press, 2003), xiv-xv.

[5] Rescher, *Epistemology*, xvi.

proposition *p* in order to be considered a candidate for knowledge. We cannot say that someone *knows that p* is the case unless *p* is true. He may well believe that *p* is the case, but if *p* is false, we cannot say that he *knows that p*. Second, even if *p* is true, *p* must be also *justified* in order to say that the cognitive agent *knows that p*. These necessary and sufficient conditions could be summarized as follows:

(1) S believes *that p*
(2) p is true
(3) S is justified *in believing that p*
(4) iff (1), (2), and (3) are the case, then S knows *that p*

For this research we will accept the conditions (1), (2), and (3) to be necessary and sufficient for (4). There is still something more to say about what it means for a true belief to be justified in order to be considered knowledge. In the epistemological literature there are different answers to this issue, most of them generated by the famous Gettier problem.[6] As Ichikawa and Steup assert in their paper,[7] the answer to the relation between a true belief and knowledge resides in that which prevents the *epistemic luck*. However, the problem is still here, for it has to be clarified *what* will prevent the so-called *epistemic luck*. There have been proposed many different answers to this issue: evidentialism, reliabilism (Justification-Reliabilism, Knowledge-Reliabilism), internalist and externalist views on justification and so on. A few words on the justification issue is necessary in the context of our research as long as the key point in the learning process of critical thinking skills are part of the justification process. In his 1963 paper Gettier presents two counterexamples for the classical analysis of knowledge that shows that it is possible for S to be justified in believing p, yet *p* is not the case. How are the conditions for knowledge to be modified in order to answer Gettier's problem? Two general strategies seem to be available: strengthening the justification condition,[8] or searching for a suitable further condition that would escape the Gettier's counterexamples. If *evidentialism* endorses a conception of knowledge that augments the justified true belief view with a supplementary condition that prevents the epistemic luck, in the last decades the popular perspective about knowledge is reliabilism, the view that advocates the reliability

[6] L. Edmund Gettier, "Is Justified True Belief Knowledge?" *Analysis* 23, 6 (1963), 121-123.
[7] Jonathan Jenkins Ichikawa and Matthias Steup, "The Analysis of Knowledge", in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta (Spring 2014 Edition), accessed July 3, 2015, http://plato.stanford.edu/archives/spr2014/entries/knowledge-analysis/.
[8] M. Roderick Chisholm, *The Foundations of Knowing*, Second Edition (Minneapolis: University of Minnesota Press, 1983).

of the cognitive process that produces the belief. The two types of reliabilism: one that sees reliabilism as a theory of justification (*J-Reliabilism*) and the other that sees reliabilism as a theory of knowledge (*K-Reliabilism*) could be formally expressed as follows:[9]

J-Reliabilism:

- S knows that *p* iff S's belief that *p* is (a) true and (b) justified
- S is justified in believing that *p* iff S's belief that *p* was produced by a reliable cognitive process (in a way that blocks the epistemic luck)

K-Reliabilism:

- S knows that *p* iff S's belief that *p* (a) is true, and (b) was produced by a reliable cognitive process (in a way that blocks the epistemic luck)

As it was noticed by,[10] evidentialists reject both types of reliabilism. The J-Reliabilism is considered wrong because it sees justification as an internal process, and for evidentialists justification is external to the subject. Chisholm rejects externalism proposing an internal justification sketched as follows:[11]

> *If a person S is* internally justified *in believing a certain thing, then this may be something he can know just by reflecting upon his own state of mind. And if S is thus internally justified in believing a certain thing, can he also know, just by reflecting upon his state of mind, that he is justified in believing that thing? This, too, is possible – once he has acquired the concept of epistemic justification.*

The type of justification internalism Chisholm proposes, called *accessibility internalism*, sustain that justification is recognizable on reflection. The opposed view, the justification type of externalism says simple that justification is not directly recognizable.[12] More, as the cited authors observe, it can be derived that J-Reliabilism is an externalist theory, and the same applies for K-Reliabilism.

There is no space here to dwell into all the complications of the knowledge analysis.[13] Instead we are concerned to define beliefs and knowledge as operational concepts for an empirical investigation that will provide us with enough information to find some connections between such concepts and, hopefully, to clarify some aspects on the knowledge issue, as sketched above.

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[9] Ichikawa and Steup, "The Analysis of Knowledge".

[10] *Ibidem.*

[11] M. Roderick Chisholm, *Theory of Knowledge* (Third Edition, New Jersey: Prentice-Hall, Inc. 1989), 7.

[12] Ichikawa and Steup, "The Analysis of Knowledge".

[13] *see* Ichikawa and Steup, "The Analysis of Knowledge," for further details.

What we are going to explore are just the particular type of belief and, accordingly, the particular type of knowledge that are referred to as *propositional*, even though in the process of solving critical thinking problems, the type of knowledge named the *knowledge-how* takes an important part, as long as *doing* seems to play an important role in learning. However, the ability to answer correctly to the questions in a particular amount of time will suffice as an evidence for the *knowledge-how* type of knowledge,[14] as long as the *knowledge-that* type is in this context dependent on the knowledge-how process.

However, to make things simpler, we will try to propose a kind of investigation that will allow us at least to make some observations on the nature of knowledge, belief and decision, as these concepts are inherently connected in a rational decision process. What is going to be taken as *belief* in this research is *the individuals' belief about each of the propositions* that are proposed as answers to the critical thinking questions in the evaluation tests. We could therefore define for this context that *the cognitive agent believes that p*, the propositional attitude that causes the cognitive agent to choose the proposition *p* (the particular answer to one particular question in the test) as being the correct answer to that question. And correspondingly, we will define, according to the justification true belief conditions, that *the cognitive agent knows that p*, iff the proposition *p* is true, the agent believes that p, and the agent is justified in believing p. Thus, when an individual will choose one answer from five possible answers offered to each question, we will suppose that his behavior (his decision in the evaluation context) is based on his *belief that p*, which means that he believes that the chosen answer is true. Furthermore, when the same individual will be asked to say if he is absolutely sure (100%) about the truth of the proposition he has chosen, and subsequently, that he can provide a justification for truth of the proposition chosen as the correct answer to the particular question, and the answer he has chosen is the correct one for the particular question, we will consider that the individual *knows that p*.

In order to assess the decision support offered by reasoning and also to the assumed relations between beliefs, knowledge and the behavior of the respondents, we must say a few words about the context of the decision and its design. The importance of learning critical thinking skills is by now largely accepted. For our study here it is important that the critical thinking tests provides a framework for our rational decision study, for it offers the cognitive agent sufficient information

[14] Ryle, *The Concept of Mind*, 25-60.

to make a rational decision in the context. We are postulating that in this particular context, a rational decision is that one which is grounded in the knowledge of the one correct answer from the five possible alternatives given for each critical thinking question. The particularity of the context is such as that each correct (true) answer is perfectly justified in the critical thinking problem's context. We can thus investigate the cognitive and decisional conditions of the cognitive agents that are constraint to solve the critical thinking problems in a certain amount of time. The justification tools were taught in the class as it will be shown bellow. For the purpose of our investigation is also important to mention that if the justification of the correct answer is inherent in the critical thinking particular problems, the kind of justification we are asking from the cognitive agent for his *knowledge that p* is internal in the sense that we are expecting the agent to discover the pre-existing justification of the true proposition p, and thus to support his *belief that p*. For our purpose here, this process that aims to discover what is already there – the justification of the true answer –, the perfect access to it and the capacity to expose in detail the justification is an essential part of the meaning of the *knowledge that p.*

Methodology. Teaching and Evaluation

We have used LSAT tests for three type of critical thinking abilities: analytical reasoning (RA), logical reasoning (RL) and reading comprehension (RC). As a first difference from the classical LSAT tests, in our investigation the time constraint was loosen from less than two minutes to almost four minutes in the regular seminar evaluation and two minutes and a half in the final examination. We have started to teach and evaluate undergraduate students taking the course in Critical Thinking for a period of three years. There were two different teaching schedules that have been used:

- The 2 h course/week and 2 hours seminar *each week* on a 14 weeks program – Teaching Schedule 1 (TS1)
- The 2 h course/week and 2 hours seminar *each two weeks* on a 14 weeks program – Teaching Schedule 2 (TS2).

The seminar consists in guided critical thinking solving problems procedures, according with the LSAT critical thinking types of abilities mentioned above. The preparation time for each theme of the seminar was done according with the TS1 or TS2 schedule as in the table bellow (*Table 1*).

Each evaluation of the specific critical thinking ability (RA, RL, RC) during the semester had 7 questions and took 30 minutes, meaning that the student had approximatively 254 seconds for each question. The standard time applied for the final evaluation of the critical thinking abilities as it is applied for a typical LSAT test format is 35 minutes for 22-27 questions of one type of critical thinking evaluated ability, meaning that for each question there will be an average between 77.78 to 95.45 seconds to be solved.

	TS1 amount of time/theme (min)	TS2 amount of time/theme (min)
Introduction to Critical Thinking	120	60
Deduction Reasoning & Errors	240	120
Inductive Reasoning & Errors	240	120
Exercises (Deductive & Inductive Reasoning)	150	60
Analytical Reasoning (AR)	240	120
AR Test	30	30
Logical Reasoning (LR)	240	120
LR Test	30	30
Reading Comprehension	240	120
RC Test	30	30
Recapitulation	120	30

Table 1. The Teaching Schedules for Critical Thinking

We haven't done a special diagnostic test for any group involved in the exploratory investigation, yet there were several so called "diagnosis-exercises" in class for each type of ability that were used in similar conditions as the tests that were to be taken for the specific ability. The results of their decisions were not particularity registered, yet there were no significant differences from one group to another in their behavior in the context.

As a general conclusion for the initial contact of the different groups of students with the critical thinking problems, we can say that there were a great discrepancy between what they believe to be the true answer to a question, and what was actually the correct one. For exemplification, we are depicting an image of a table of results for a particular problem in *Table 2*.

Q/A	A	B	C	D	E	No. of AGS
1				**10**	4	**14**
2	4	2	**3**	1	3	**13**
3	5	**5**	1	1	1	**13**
4	1	5	**5**	2	1	**14**
5	**11**	1		1		**13**
6	1	5	4	**3**	1	**14**

Table 2. The distribution of answers for a first critical thinking exercise

The Q/A in the table are the questions and answers. As it can be observed, for each question there are five proposed answers: A, B, C, D, E. The correct answer is marked with bold characters in the table. The last column contains the total number of the answers given by the students in the class, as the sum of the distributed number of answers for each question. It can been noticed that for the questions 1, and 5 the majority of the answers are correctly given, yet for the questions 2, 3, 4 and 6 the correct answers were chosen by a minority of students. The things are even more complicated in the example given in the Table 3 bellow, built after several teaching classes, where the justification procedures for each type of critical thinking exercise were given. Here students are also asked if they are certain about their choice, and if they could provide an explicit justification of the sort they were taught in respect with their choice.

In the *Table 3* are depicted the answers of nine students that had been tested with a Reading Comprehension (RC) exercise in class. The answers are lined on the first column and the questions (represented by numbers) are distributed on the first row. The student's choices are represented with letters (A, B, C, D, E) on each column, corresponding to each question and for each student in a row. There are a couple of things to be noticed here: first, because the type of exercise proposed is a RC one, it was scheduled in the class towards the end of the semester, and therefore the students should have a clear understanding of the justification procedure in the context; second, there are cases where the student is sure about his choice (meaning that he believes that *p*, and he believes that he has a justification for his belief that *p* that lead him to his choice, and that he thinks that his choice is true), and yet his answer is not correct, and therefore he doesn't know that *p* (i.e. S1 question 2, S4 question 6, and so on); also, there are cases where the student choses the right answer (p is true, and the student believes that *p,* yet he is not sure about his choice, meaning that he cannot provide an account for his choice, or, if he has it, he is not able to produce it explicitly). These cases of choice "background" are extremely frequent in all the groups investigated.

S/Q	1	2	3	4	5	6	7	8	9
S1	C	D*	A*	E	D	C	B	B	D
S2	C	D	C	E	D*	E	B	A	E*
S3	C*	A	C	D	D	E	B	B	C*
S4	A	C	C	E	D	E*	B	A	C
S5	B	A	D*	C	A	E	D	C	C
S6	E	C	E	D	D	E	D	B	D
S7	D	D	C	D	D*	E	B	A	E
S8	C	C	C	D	B	E*	B*	D*	E*
S9	C	A	C	D	D	C	A	A	E

Table 3. The distribution of chosen answers to a RC problem corroborated with knowledge acknowledgment distribution.

After a teaching and learning period of 14 weeks, the final evaluation (the final exam) was designed to be of 90 minutes and was composed by 36 critical thinking questions distributed as follows: 25% of them are RA questions, 50% of them are RL questions, and 25% of them are RC questions. It follows that for each question the student has at his/her disposal about 150 seconds to solve it correctly. It is a stronger constraint than that from the typical class evaluation, yet it is still more permissive than that used in LSAT tests (with an average of 86 seconds/question).

The population involved in the experimental procedure is represented by groups of undergraduate students. The population in the first group (Group A) is ranging between 140 and 180 individuals for each group. The teaching and evaluation procedures were performed in different years for each group, as follows:

- Group A1: year 1 - 140 students
- Group A2: year 2 - 180 students
- Group A3: year 3 - 143 students

Different group types of students from different faculties were used as control groups ranging in each university year from 48 to 110 as follows:

- Groups B: these groups were exposed to a single problem solving procedure for analytical reasoning during a single class; all these groups were tested only for RA ability:
    - Group B1: year 1 - 110 students
    - Group B2: year 2 - 95 students
    - Group B3: year 3 - 75 students
- Group C: it was a single group of 48 students from different faculties which had not been exposed to any preliminary problem solving procedure for a critical thinking test in class; they were tested just for RC ability.

All the testing conditions were the same and also the difficulty of the problems given was in the same range as for the regular students.

Results

The results of the investigation could be summarized as follows:

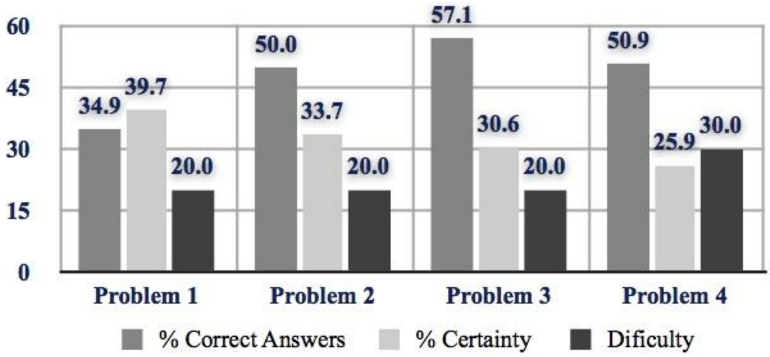
- The TS1 doesn’t seem to be better in terms of results than TS2, as expected: the tested group of regular students group A2 and group A3 which had been exposed to a TS2 teaching schedule did not appear to have significant lower results on all critical thinking tests than the group A1 which has been exposed to a TS1 schedule (see *Table 4* bellow).

Groups/Average tests results	RA	RL	RC	NS	RA-e	RL-e	RC-e	NE	NF
A1	6.62	5.57	5.74	**5.98**	5.08	4.98	4.39	**4.82**	**5.40**
A2	6.11	5.91	5.37	**5.80**	5.34	4.89	5.38	**5.20**	**5.50**
A3	6.44	5.37	5.87	**5.89**	5.44	5.16	4.85	**5.15**	**5.52**

Table 4. The average critical thinking tests results for the three groups A1, A2, A3

Legend: RA – test at seminar (average marks); RL – test at seminar (average marks); RC – test at 4seminar (average marks); RA-e – test at exam (average marks); RL-e – test at exam (average marks); RC-e – test at exam (average marks); NS – seminar final mark (average marks); NE – exam final mark (average marks); NF – average final mark (NS, NE).

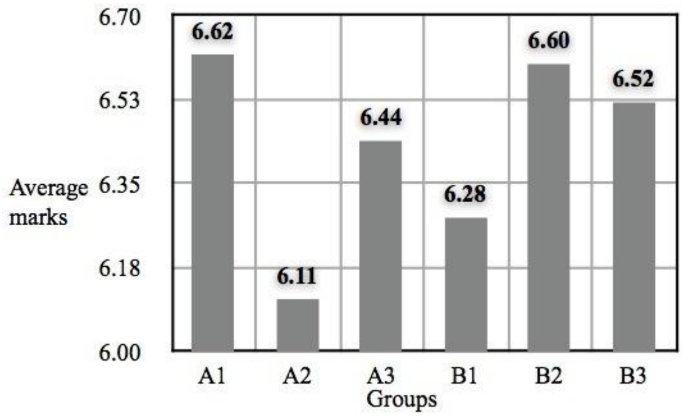
• Surprisingly, as the critical thinking skills improved as the more and complicated problems are solved in the class, and thus the students' ability to chose the correct answer is becoming more accurate, the students' feelings of certainty regarding their choices (or self awareness of their knowledge about the correct answer) appear to diminish (see the graphical representation for a series of RA ability tests bellow for the group A1 - *Graph 1*).



Graph 1. The correlation between the % of correct (true) answers given by the groups of students in the Group A1

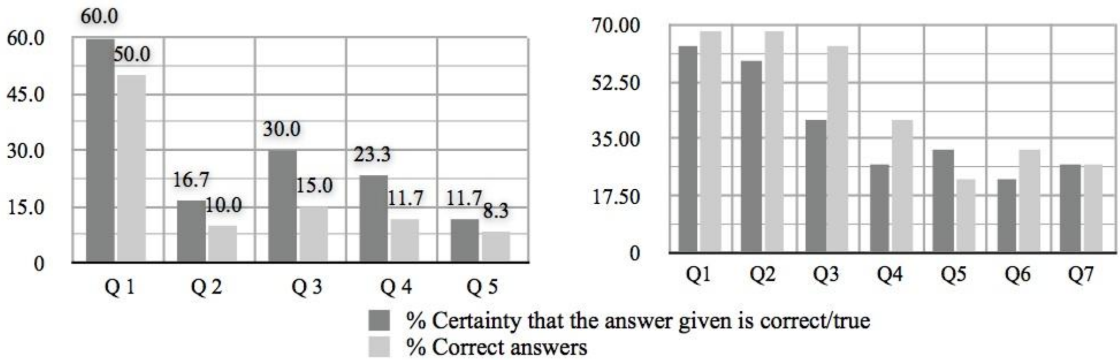
Because the three groups A1, A2, and A3 are similar in their general results, we could reasonably presume that this kind of attitude regarding their choice is also similar. This assumption was tested in class, yet not on a regular basis as in the group A1 case, due to the time limit in the TS2 teaching schedule.

• The series of groups in the category B (B1, B2, and B3) which were exposed only to a single problem solving situation had obtained results on a single RA test comparable with those of the groups involved in regular teaching schedules TS1 or TS2 (see *Graph 2*).



Graph 2. Average marks on RA tests on A and B type groups.

We have not investigated the possible explanations for this epistemic success of the B groups. However, to the group B2 the one RA exercise of five questions had a different distribution for percent of beliefs in the truth of the answer and percent of certainty that the given answer is true as those obtained on a part of A1 cases for a similar RA exercise (see *Graph 3* and *Graph 4*).

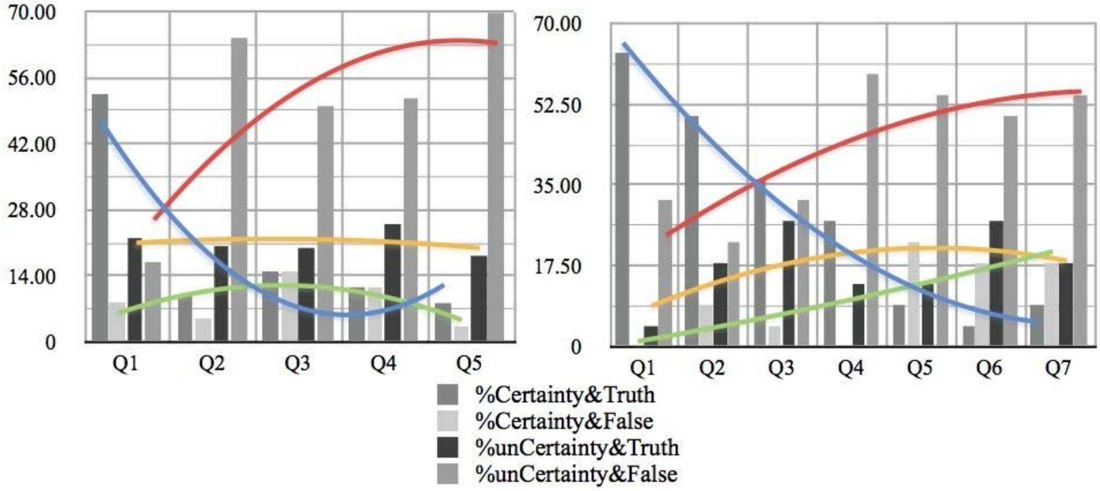


Graph 3. The relation between % of certainty that the given answer to a question is correct/true and the % of true answer given to the same question for group B2.

Graph 4. The relation between % of certainty that the given answer to a question is correct/true and the % of true answer given to the same question for group A1.

For representational convenience we are using just the data from a part of the group A1, all the other cases being similar for the entire group. It is perhaps significant that, despite the comparable results on the given topic of RA, the epistemic perspectives at least on a particular critical thinking situation are different. For it is noticeable that if on the *Graph 3* all the percentages of the "certainty" for given the true answer are greater than those for the real true answer in the B2 group, in the *Graph 4* the situation is reversed for a part of the group A1. A closer look into the dynamics of these macroscopic results will give us a better understanding of the development (see *Graph 5* and *Graph 6*).

The macroscopic differences seems to be produced by the a multitude of individual epistemic behaviors concerning the possibilities: a) that an answer is in fact true and is believed to be true and the person is certain to be true (has a clear justification in mind for its belief that the answer is true); b) an answer is in fact false, yet the person believes that it is true and is certain that it is true; c) an answer is believed to be true, it is in fact true, yet the person is uncertain about its truth; d) an answer believed to be true, yet it is in fact false and the person is uncertain about its truth. It can easily be noticed in the *Graph 6* that in the particular cases of the answers given to the questions 1 and 4 there is no cognitive agent that is certain about a false answer, yet this is not the case in *Graph 5*.



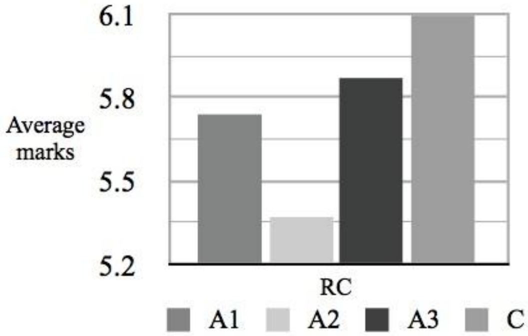
Graph 5. % of Certainty and the Truth of answers distributed per question for the group B2 on the same problem as in the *Graph 3*.

Graph 6. % of Certainty and the Truth of answers distributed per question for a part of the group A1 on the same problem as in the *Graph*

Moreover, there is a higher percent of “certainty and truth” for the first three-four answers in *Graph 6* than in *Graph 5*, and this tends to explain the overall “awareness” of the part of the group A1 of the epistemic situation compared with the “epistemic optimism” of the group B2. As it was shown in the *Graph 1*, the so-called “epistemic optimism” diminishes as the agent becomes more and more aware of the requests of the justification process.

- A particular interesting situation, not sufficiently explored in the course of investigation, was encountered comparing the groups A1, A2, A3 on RC results with the control group C, a group which had not been exposed to any critical thinking teaching class at all (see *Graph 7*).

- As it was expected, the greater the individual time spent in solving critical thinking problems, the greater was the final mark.



Graph 7. Comparison between A groups an C group on RC average marks

- It can be reasonably said that the investigation performed brings along with some expected answers to the questions (1) and (2) from above, a couple of other questions as well. For if it was expected that decision (behavior) will be better supported by learning the justification procedures in the context (knowledge-how), the actual relations between belief, knowledge and decision seem to be complex ones. For instance, the fact that the agents are certain about the truth of their choice and the answer chosen is really true does it count as the agent's knowledge that *p*? We have test also this on different cases asking the students to produce the clear justification for their choice, in the manner they were taught in seminars. There were just a couple of cases in which the correct justification was produced according to the rules. The majority of the productions were difficult to be counted as true justifications for their belief that *p*, even if this kind of inconsistency was not accidental. For, as the *Graph 1* shows, the majority of the choices were increasingly correct. Due to the constraints of the paper, we will restrain to just a final remark on the problem of justification. The cvasi-general lack of access to their own justification process in agents that are believing that *p*, as it appear to be supported by the data, seems to endorse an externalist position for justification. However, the issue needs to be explored more for a more clear position. For instance, we have not discussed here the position held by the virtue epistemology,[15] which seems to be a serious candidate to explain the behavior of the epistemic agents in the analyzed context.

[15] Duncan Prithcard, *What is this thing called knowledge?* (London and New York: Routledge, 2006), 69.

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