CT/DF: An instrument to measure Critical Thinking in Discussion Forums

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Abstract- The CT/DF Instrument to measure Critical Thinking in Discussion Forums is the result of a post-doctoral research done in a public university in central Mexico. A method to analyze the content in Discussion Forums created under the methodology of Grounded Theory, considered the five states of Critical Thinking of Garrison and the guidelines implementing Discussion Forums of Kutugata. The CT/DF instrument offers 10 categories with 44 codes, representing different types of Critical Thinking. With the implementation of Socratic Questions in the 12 Discussion Forums designed and 496 messages posted, according to transcripts, examples of indicators of critical and noncritical thinking where detected. Once the messages have been categorized and coded, in order to calculate the ratios of Critical Thinking, the different types of Critical Thinking are acknowledged as an achievement of the Discussion Forums applied in an academic course of a master's program in Educational Technology, part of the National Quality of Postgraduate Programs.

Key Words- Critical Thinking; Discussion Forums; Research instrument

INTRODUCTION

In recent educational researches, the value and impact of integration, sense of belonging to a learning Community [1], levels of satisfaction and perception of their own learning achievements[2], [3]are now days been considered highlights of excellency and high quality success[4]in universities around the world.

Even more, the co-relation between the perception of learning from students with a sense of Community [5] and the links within their levels of satisfaction has been related to their level and quality of their own commitment towards their learning process in their formal educational experiences[6], [7], [8].

Pursuant toO´Leary & Quinlan [9], the levels of satisfaction in students are an outcome of their emotional perception of a product, service and/or process. This lack of satisfaction is related with a failure in feedback from tutors, limited and poor interactions with other peers, as well as, a low integration in students within a group [10],[11].

Therefore, strategies and didactic tools are being applied in academic courses in order to increase and level indicators of learning, satisfaction and sense of belonging to an academiccommunity. This actions could be accomplished with a collaborative learning didactic skills with activities designed to promote interactions between peers,to construct knowledge, considering the diversities in profiles, learning styles and time consumed in efforts between students involved in such courses [12], [13].

To design activities implementing new technologies with a collaborative learning and use of diverse references sources, such as Social Media, Videos, and Discussion Forums,a direct instruction with objectives and competences should be present[14].

The Discussion Forums are the ideal tool to use taking into consideration that students prefer asynchronic interactions with flexible time to reflect and analyze arguments posted and time on their own torespond at their own convenience [15]. Within the benefits of implementing Discussion Forums are the opportunity of developing profound arguments with foundation of diverse resources consulted, outcome of increasing Critical Thinking and developing a strong interaction between students through collaborative learning skills in the debates promoted.

LITERATURE REVIEW

One of the main priorities in formal education programs from universities is to teach students to think in an analytic critical way; as well as, to increase several mental processes such as attention, categorization, selection and the skill to judge problems and solutions within a real context [16].

In the last couple of years, researches have published more papers discussing Critical Thinking and it´s educational processes. However, there are no evidence of instruments that

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could measure and analyze Critical Thinking in Discussion Forums implementing Socratic Questions, so far.

Critical Thinking is definedwithin vast views according to the philosophical and pragmatic scenery, however in an educational context deNovelles& Reyes-Foster [15] define it as the skill to reflect with an objective propose to evaluate, analyze and applied acquired gain knowledge.

To develop Critical Thinking in the learning and teaching process, Kumar & James[17] believe that precise instructions given by tutors in collaborative activities were reflection and analysis are specked must be given.

Even more, feedback-offering suggestions to improve the quality of their performance are relevant to increase their level of reflection. As well as, assistance along debates in Discussion Forums pointing out and valuing outstanding participations.

The Critical Thinking is a rational mental process focus in a series of believes and decisions about an idea. Such process develops in five stages starting with an initialclassification of preconceive ideas, the foundation of such ideas giving a profound support, reaching to conclusions that would lead to declare new advanced classifications through a strategy and method [18].

The understanding of Critical Thinking has evolved considering the definition given by Socratesas a process to describe the truth, Plato's as the discovery of knowledge and Aristotle's as the introduction to the intellect growth [1].

Nowadays, the Critical Thinking is composed of five stages according to Atabaki, Keshtiaray&Yarmohammadian[18] which are: (1) the identification of a problem; (2) the definition of the problem; (3) the search of possible solutions; (4) the evaluation of functions; & (5) the integration of understanding within the available knowledge.

Considering such evolution, it is possible today to understand that the principals of connectivism allows a referential frame to the Socratic Dialectic [19], by implementing Socratic Questions in Discussion Forums.

The Socratic Method provides the structure and referential frame to debate assertions between peers, while the model of connectivism offers the means to reach and develop skills to understand as well as to connect with a diversity of information resources [20].

One of the most used tools implemented in law academic programs in the US is the Socratic Method in debates, Forums, Congress, and simulators of jurisdictional courts [21]. However, the use of the Socratic Method in other programs of higher education has the intention of provoke in students the ability of reasoning through arguments, questions and answers posted in conversations [22].

When the Socratic Dialectic is adequate implemented, students achieve a profound and wide understanding of a determined context, elevating their level of Critical Thinking [23]. Besides improving their communication skills within electronic media guided by rules of netiquette, students can expand their thinking in an efficient way [24].

However, when the Socratic Dialectic is force in a Discussion Forum without clear objectives and understanding of a procedure followed by students, the participation of students is poor in terms or quality and quantity having intermittent messages with superficial comments without arguments with a deep analysis of concepts or ideas [25].

Conducive to design activities with top quality in asynchronic interactions, as in the case of Discussion Forums, Guanwardena, Lowe & Anderson [26] propose designing activities following five stages. The first stage is Comparing and sharing information, in order to follow the second stage of Exploring and discovering consistencies and inconsistencies between ideas, concepts and/or arguments.

In third stage, negotiate the definition and construction of knowledge through settlements and analogic proposals. Fourth stage would be to modify and evaluate proposals contrasting arguments with points of view, cognitive schemas, participants 'personal experiences, hard data and literature review. Finally, the fifth stage to applied new meanings, definitions, and constructed knowledge for its reevaluation.

Furthermore, to design Discussion Forums that would increase the perception of learning and levels of Critical Thinking, the following seven strategies of Kutugata [27]are considered, implementing them within the design of such collaborative activities.

1. Implement the taxonomy of Socratic questions as a pedagogical tool to promote debates and intensity of arguments with tutor &peers.
2. Design the Discussion Forum in three stages. First stage interaction tutor-student, second stage with interaction between peers within teams of 3 to 5 members. Third and final stage, interaction between teams working on assignment product such asa Report, Table, Essay, Chart, etc. following rubrics given in advanced.
3. Tutor should follow guidelines of interaction according the Theory of Interaction & Communication of Börje Holmberg. In essence, tutors

must interact applying warm vocabulary maintaining a constant communication with student, redirect participations when needed and follow up with those participants who might be lost or distance within the timetable of the Discussion Forum´s stages.

4. Apply and promote the rules of Netiquette, and Ethical codes from the educational institution, assuring a cordial environment to all participants.
5. Keep constant supervision to all participants, especially when it comes to the performance of members from team groups. Detecting and redirecting behavior of participants who might delay or affect the quality of the work done by teams.
6. Give feedback to all participants, one on one or by teams, in time and form reinsuring the quality of arguments and analysis in all the posted messages. Promote the citing of references in all interaction, according to APA.
7. Do adjustments in stages of the Discussion Forums when needed, according to situations and/or eventualities within the development of the activity.

Cardak[28], proposed that to have effective Discussion Forums all students must assume and play specific roles, previously assigned. Even more, to assure a balance participation between students working in groups, the teams should be of three to five members, allowing the discussion and debate of ideas in a fluent and profound way.If a team has more than five members, the following of messages posted are difficult to follow, having a chaos between teams [23].

However, when the development of the Discussion Forums is right, the interactions between peers have cognitive competences in communication developed. These competences are: (1) an elemental communication through messages with an introduction and salutes; (2) messages with profound ideas and/or concepts; (3) inferences of elements and/or learned processes; (4) judgment of value towards contexts; and (5) applied strategies acquired or reinforced, per Henri [29].

On the other hand, as reported by Garrison, et al. [30] model of Community of Inquiry [CoI], the cognitive, social and teaching presences are stablished in the process of Critical Thinking composed of 5 faces. The faces applied in the development and design of the Discussion Forums used in this research are:

1. Identification of problem. Ability to clarify through a trigger event that stimulates interest and curiosity to the student.

In this research design, the implementation of the Discussion Forums in its first stage uses the Socratic dialect as a resource to trigger the debate of ideas and reflection in the replica and counter replica in interactions between tutor and student.

The Socratic Teaching, Foundation of Critical Thinking(cited by Kutugata) [23], establishes there are six types of Socratic questions. The first type are conceptual clarification questions that stimulate a reflective thinking. Second type are probing assumption questions that would allow students to think about the presuppositions and unquestioned beliefs on which they are founding their arguments. Third type are questions probing rationale, reasons and evidence that would promote reasoning rather than assuming it is given. The fourth type are questions that challenge viewpoints and perspectives, showing one's position validating other viewpoints. The fifth type of questions are those that probe implications and consequences reveling logical arguments that could forecast such allegations in further debates. The sixth type of Socratic questions are "questions about the questions". These questions rise reflexive analysis of the arguments presented by turning the question in on itself by using their attack against themselves.

2. Definition of the problem. Ability to clarify and limit a problem or context stated through acquired knowledge or expressed ideas of a third party.

Taking into consideration the above, the interaction between peers promotes a fluid interchange of replicas and contra replicas between participants' grounding their messages posted with references following outlines of the rules of Netiquette and Ethical Codes, when promoted in the design of the Discussion Forums.

In the second face of the Discussion Forums, the teams of students would work in the product assigned following the outlines of the rubrics shared. The product could be a commentary, essay, table o summary integrating the best outcome of each participants for its evaluation.

3. Exploring the problem. Stage where inference of new acquired knowledge is promoting linking arguments with knowledge previously understood.

During this stage, knowledge could be increase through research, selection and analysis of new academic resources as well as the development of skills to reflect and inferring holistic reasoning with the goal of developing the level of Critical Thinking. Such development can be measure by analyzing the arguments posted with the new resources cited.

4. Evaluating the problem. The skill toconcretize through judgment and evaluating alternative

solutions with the incorporation of new ideas within a context.

The skill of making decisions, arguments, appreciations, evaluations, and critic are observed in the incorporation of elements been integrated in the product assigned and develop in the second face of the Discussion Forum. With a free interaction between peers, the tutor could observe and evaluate the quality of the arguments posted for its future analysis and classification according to the outlines of categorization and coding of the instrument PC/FD.

5. Integration of the problem. Skill to build strategies with a propose coordinating actions applied to a solution and/or final decision towards a problem.

During this stage, the team group land and select the best arguments debated integrating these to the final product as ideas, reflections, and conclusion within the product for its evaluation. The content presented is a result of a process of integration and approval of all members of the team, sending the product for its evaluation as a collaborative activity developed in the third and final face of the Discussion Forum.

Considering the model of Critical Thinking of Garrison, et. al. [30], the outlines designing Discussion Forums of Kutugata [27], and the strategies of qualitative research of Creswell [31] and Hernández, Fernández &Baptista[32]the development of the Constructive Grounded Theory can be established. Even more, the formulated guidelines of Clarke[33] and Charmaz[34] set the base to develop an instrument to measure identify and measure types of Critical and Non-Critical Thinking in arguments posted in Discussion Forums.

The research process of Ground Theory allows an outcome that would explain a general theory towards a phenomenon, process, action, or interaction gestated in a specific context [32]. However, the Constructive Grounded Theory integrates data obtained by all participants considering experiences, ideas and information gathered in the categorization and open and axial codification [33, 34].

METODOLOGY

With a sample composed of 12 Discussion Forums with a design in three stages,in consonance with the guidelines of Kutugata[27], such Discussion Forums implemented in the academic course *Methodology of Research* of the master´s program *Innovation in Virtual Teaching-Learning Environments*from a public university of the center of Mexico. This master´s program is subscribed in the National Quality Postgraduate Program of the National Council for Science and Technology [CONACYT]

The samples´ profile constitutes as follows:

A. Nine participants in 12 Discussions Forums, where four females and five male professors have a range of teaching experience between 3 to 15 years. The levels of teaching groups are elementary, junior, and high school through university level. All the participants have a Career and are part of a master´s program in Innovation in Virtual Teaching-Learning Environments to obtain the degree.

B. In the design, implement and active participation in the 12 Discussion Forums, one tutor with a teaching experience of more than 3 decades in levels of elementary, junior, high school as well as university and postgraduate groups. With a doctorate degree in Education with an accentuation in Communications and Educational Technology, the tutor is doing a post-doctored stay at a public university in central Mexico within the program denominated *Strengthening of the National Postgraduate* from the National Council for Science and Technology [CONACYT] starting august 2015 to august 2016.

With a total of nine Individual (Student-Tutor) Discussion Forums and three team (group team of 3 Students-Tutor) Discussion Forums, 496 posted messages were gathered in transcripts with a range of 90 to 650 words per message. Such interactions were replicas and contra replicas to questions, arguments and comments between peers and tutor in the 12 Discussion Forums created, analyzed, and categorized by the researcher.

Applying the methodology of the Constructive Ground Theory [33, 34], the model of Critical Thinking [30] and the design of Discussion Forums in 3 Stages [27], the Socratic Questions are used in stages 1 & 2 in the Discussion Forums. The use of Socratic Questions increases the quality of debate and reflection to increase the level of Critical Thinking [23]. Extracts of Socratic Questions posted appear in Table.1 Socratic Questions used in the 12 Discussion Forums.

How could you define the autonomy of participants and the intentionality as researcher?
Could you mention some ethical issues that might arise in educational research?
Is there a single code of ethics or can each researcher create his own code of ethics?
What does autonomy as participants mean?
Should such situation be considered an unethical act?
Can you be ethical and plagiarize "for ignorance" of a citation manual?
When should one assume ethical responsibility in an educational researcher, during his / her training, at the end of his / her studies or when he / she receives his degree (title) that credits him / her as an expert in his area?
How serious is it to commit plagiarism, to the credibility of an investigator?
What do you think is your ethics as a researcher in training?
Do not you think that there are guidelines that allow establishing ethical behavior in a researcher in training?
What harm do you think society does when we use false data in educational research?
Do you think that values are the indicator to know if our principles are positive or negative?
Could you argue a little more about these "bad decisions"? How did these decisions help you improve your personal and professional behavior?
Do you consider the process of "success and error" similar in a researcher in training?
When an investigator commits methodological "errors" due to ignorance, is it an unethical act?
What is the purpose of asking this question?
Why do you think I asked this question?
Does technology facilitate or hinder ethical application in an educational researcher?
What measures should we take in these cases to avoid deformation in young people?
However, do you think it´s a mistake to proceed that way?
What solution would you give to this problem?

Table 1. Socratic Questions used in the 12 Discussion Forums.

Note: Extracts of Socratic questions selected from transcripts of the 12 Discussion Forums. Table elaborated by authors (2016).

As a result of the research process, under pedagogical guidelines, the following list of 10 categories and 44 codes are created that express the different types of Critical and Non-Critical Thinking for their application in the content analysis of the interactions carried out in the 12 Forums Discussion. See. Table 2. Categories & Codes with Types of Critical and Non-Critical Thinking.

Table 2. Categories & Codes with Types of Critical and Non-Critical Thinking.

(HR) Holistic Reasoning
HR^+ = Considering several sources or areas to justify an analyzed situation (broad frame of reference).
HR^- = A fragmented holistic discussion limited to only considering one or two elements or areas, being able to consider other elements or other perspectives.
HRT^+ = The tutor offers reflections integrating diverse sources and / or resources that base a situation analyzed (broad frame of reference).
HRT^- = The tutor is limited to accepting a contribution without including diverse sources for its foundation (lacking reference frame).
(SI) Spinning ideas
SI^+ = Proposes new information and / or interpretation of a new concept.
SI^+ = Yarn data and ideas from a prior knowledge.
SI^- = Repeat information without spinning references and / or interpretation.
SI^- = Share ideas or opinions without contributing new reflections and / or data.
(J) Justification
JE^+ = Justification with evidence - example. Comment providing evidence and / or examples that support this contribution.
JS^+ = Justification with solutions and / or judgments Comment incorporating a solution and / or a valuation judgment.
JE^- = Comment irrelevant and / or limited without evidence or examples.
JS^- = Commentary with value judgments and / or solutions without explanation or justification.

(BK) Built-in knowledge
BK^+ = Incorporation of knowledge with references to scientific and / or etymological data that support an argument.
BK^+ = Incorporation of knowledge with reference to a context that allows to understand a reality.
BK^- = Contribution without sustenance nor incorporation of references to scientific, etymological or external data.
(R) Relevance
R^+ = Reflection that allows exposing causes and effects of previous actions and / or decisions within a specific context.
R^- = An irrelevant comment that merely exposes the obvious.
(DA) Devils´ Advocate
DA^+ = Answer a question with questions causing a debate of ideas.
DA^- = It responds with one to a question with another question as a form of evasion to respond clearly and accurately to a questioning, failed tactic.
DAT^+ = Within the feedback is presented a new question detonating to the reflection and analysis by the tutor.
DAT^- = Within the feedback, the introduction to a new triggering question is omitted, concluding a possible debate.
(N) Novelty
NI^+ = New Information. Contribution presenting new ideas and / or information from a reflection.
NI^- = Contribution that disqualifies and / or ignores new ideas and information.
NS^+ = New with solution. Argument presenting possible solutions to an approach.
NS^- = Contribution ignoring possible solutions, minimizing a problem.
ND^+ = Novelty Detonate. Argument presenting challenging ideas for possible discussion.
NDT^+ = Novelty Detonate Tutor. The tutor presents a challenging question for discussion.
NDT^- = The tutor accepts a limited contribution without posting a triggering question for possible discussion.
ND^- = Comment ignoring and / or disqualifying contributions from others.
NO^+ = New Opening. Evaluation to a contribution developing a new line of thought.
NO^- = Comment dismissing a reflection, inhibiting a new line of thought.
(CE) Critical Evaluation
CE^+ = Self-evaluation and / or others.
CE^- = Acceptance without a judgment of valuation and / or reasoning.
CET^+ = Tutor offers critical evaluation provoking reflection.
CET^- = Tutor accepts contribution without critical evaluation.
(RC) Request for Clarification
RC+ = The participant asks questions and / or relevant comments on procedures, formats and / or methodological aspects to carry out the activity in an efficient manner.
RC- = The participant does not ask irrelevant questions and / or comments about procedures, formats and / or methodological aspects that should already be dominated by the participant.
RCT+ = The tutor provides reasoned answers to the questions formulated by the participant facilitating the development of the activity.
RCT- = The tutor provides answers without substantiation putting at risk the quality of the development of the activity.
RL- = The participant mentions the need for organization without assuming the role of leader.
(C) Contribution
CL+ = Contribution with leadership initiative. The participant assumes a leadership role proposing working strategies.
CL- = Contribution without leadership initiative. The participant mentions the need for organization without assuming the role of leader.
CG+ = Contribution with guidelines. The participant introduces strategies, definitions and / or conceptualizations to develop the activity requested.
CG- = Contribution without guidelines. The participant only accepts offers from others without adding new information.

Note. Ten Categories in bold& 44 Codes with signs (+) and (-), where the sign (+) symbolizes a Critical Thinking while the sign (-) symbolizes a Non-Critical Thinking. Table elaborated by authors (2016).

With the 12 Discussion Forums concluded, transcripts with 496 messages of interactions between Student-Tutor (Individual Forums) and peers (Discussion Forums by Team with three members each) are analyze for its coding. It is relevant to establish that in one interaction (posted message) two or more Critical Thinking type codes could be detected and coded. In this sense, it is convenient to analyze such interactions with a flexible perspective to consider the established characteristics that integrate each code. See Table 3. Examples of messages coded.

Table 3. Examples of messages coded.

CODES	EXTRACTION OF INTERACTION
[R+]	... and this causes problems when it comes to interacting ...
[SI+]	As Shakespeare mentions: "Nothing is true, nothing is a lie, everything depends on the glass with which one looks."
[JS+]	... clarifying that institutions do not observe everything, ethics depends exclusively on the individual ...
[BK+]	Etymologically, the word "ethics" comes from the Greek word "ethos" meaning "character or form of being."
[HRT+]	Imagine a group of students, in a study on the use of the benefits of ...
[NDT+]	Can you be ethical and plagiarize "for ignorance" of a citation manual?
[JS+]	We are human beings and we can be wrong, it would be unethical if mistakes were constantly made because of ignorance.
[JE+][R+]	It would be important to ask whether it was done with conscience or unconsciousness. Raising an example ...
[CET+][HRT+]	... as long as whoever did the experiment did not have the consent of the parents ...
[DAT+]	... while other professionals warn of the danger of "cyberbullying" in social networks ...
[CG+]	I propose we could start by defining…
[CL+]	I suggest that the general objective is…
[CG-]	In what can we help you to deliver the activity as soon as possible ...
[CL+]	Again, I with the proposal of the collaborative work, transversal and fast as regards the ...
[CG-]	Just to confirm, I suppose I am with you, since it is the group that opens.
[RC+]	... then on this activity, delivery is postponed to April?
[RCT+]	I suggest you do this, so you could have free time in Easter and ...
[CE+]	... I make the following proposal, we share the points, we propose at least two principles of ethics for each point ...
[HR+]	Taking the point of ethical values, I found the following ...
[CL-]	I agree with your entries, I think they are very successful and I think we are covering ...
[CI+]	As a start of the activity, I ask you some questions with the intention of creating our code ...
[BK+]	It would be good to read it as it can locate us regarding what the code of ethics should contain ...
[RC+]	... the first link I already consulted this morning. I draw the following conclusions ...
[BK+][CE+]	However, Ethics concerns us all, as everyone is faced with situations ...
[HR+][CL+]	... here is the link that I propose to help elaborate our ethical code. You tell me what you think ...
[CE+][HR+]	From the link you sent, I selected the following points ...
[RC+]	These are the points that I think we can take into account, what do you think...?
[CET+]	The analysis of information is outstanding and with a good ...
[HRT+]	I share two arguments ...
[CL+]	Thanks for the information, I will be reading the documents for tomorrow to work
[RC+][CL+]	... I am making a document that complies with all that is asked of us. Could you start writing the objective of the code of ethics?

Note: Extracts of interactions obtained from the transcripts of the 12 Discussion Forums. Table elaborated by authors (2016).

RESULTS

Once all the messages have been coded and categorized, the Critical Thinking ratio is calculated by counting the positive and negative (-) indicators, and the ratio of each indicator is calculated by the following formula: x ratio = (X + - x-) / (x + + x-). The totals are converted on a scale of -1 = no critical value with superficiality to +1 = critical with depth. This procedure allows measuring the quality of the messages in relation to the type and degree of Critical Thinking rather than the number of participations.

Table 4. Calculation of ratio by codes

Category		(+) Code	(-) Code	Ratio = (x+ - x-) /(x+ + x-)
(N) Novelty				
N. Information	NI	13	0	1.00
N. Solution	NS	2	0	1.00
N. Detonate	ND	1	0	1.00
N. Detonate in Tutor	NDT	43	0	1.00
N. Opening	NO	1	1	0.00
(CE) Critical Evaluation				
CE in Participant	CE	41	0	1.00
CE in Tutor	CET	15	1	0.88
(RC) Request for Clarification				
RC in Participant	RC	20	0	1.00
RC in Tutor	RCT	4	0	1.00
(C) Contribution				
C. with Leadership	CL	11	0	1.00
C. with Guidelines	CG	67	6	0.84
(HR) Holistic Reasoning	HR	27	1	0.93
	HRT	12	0	1.00
(SI) Spinning ideas	SI	57	0	1.00
(J) Justification				
J. Evidence	JE	46	4	0.84
J. Solutions	JS	55	5	0.83
(BK) Built-in-Knowledge	BK	2	0	1.00
(R) Relevance	R	16	4	0.60
(DA) Devils' Advocate				
DA in Participant	DA	1	1	0.00
DA in Tutor	DAT	7	1	0.75

Note. Table elaborated by Authors (2016).

Taking into consideration, the results of the ratios by codes (see. Table 4. Calculation of ratios by codes), it is possible to reach the following conclusions: The Holistic Reasoning of the participants is superior than the one obtained from the Tutor. This is reasonable considering that the participants are a group of teachers with a vast teaching experience taken a course of master´s degree of high performance.

The Spinning Ideas are outstanding as well as the Justification with evidence and solutions given in the analyzed interactions. However, the built-in-knowledge in terms of the ratio is positive; in number of input coded, but the outcome is not relevant.

Moreover, the messages with positive Relevance are higher than the messages with negative Relevance, being able to establish an evident domain within this type of interactions.

In the Devils' Advocate, the ratio in the Tutor is higher than the one in the participants. This result is comprehensible if we take into consideration the level of expertis in virtual courses, especially in Discussion Forums versus the level of experience of the participants.

The same explanation could be used within the results of the messages coded Novelty with information from the Tutors versus the participants. Reminding also that one of the tasks as a Tutor is to redirect the interactions in all the participants in the Discussion Forums, as well as to promote the debate and argumentation or ideas in all stages of the Discussion Forums as a goal to achieve during the whole course.

In the messages coded Critical Evaluation, the ratio is high considering the profile of the participants, being educators with experience in teaching and using social media and Discussion Forums previously. The same context can be mention regarding the Request for Clarification allowing them to argue and make profound remarks with the intention of having a deep level of interaction using resources as background elements in their messages posted.

Regarding the Contributions with Leadership and Guidelines, the value of ratio is significant high, giving a sense of validation in the design of the activity, especially in stage 3 where the teams should create a code of ethics through research and interactions along the Discussion Forum.

The use of several educational resources such as videos, digitalized texts, and free research of information on the Internet, gave them the freedom they valued, according to statements posted. Even more, the Contributions with Guidelines are significant higher in ratio and number or messages posted, revealing the active participation and motivation to do the product required by all members.

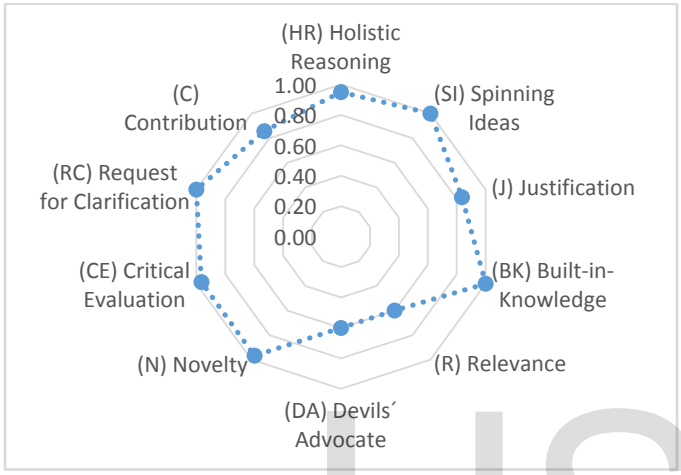
In general, the codes of ethic were send on time by all the teams for its evaluation with an outstanding level of quality regarding the number of areas analyzed and considered in the codes. Taking into consideration that the only space to discuss and gathered relevant information were the Discussion Forums, the implementation of them were considered extremely useful, according to comments posted.

Table 5. Calculation of ratio by categories

Categories	(+) Code	(-) Code	Ratio = (x+ - x-)/ (x+ + x-)
(HR) Holistic Reasoning	39	1	0.95
(SI) Spinning ideas	57	0	1.00
(J) Justification	101	9	0.84
(BK) Built-in-Knowledge	2	0	1.00
(R) Relevance	16	4	0.60
(DA) Devils' Advocate	8	2	0.60
(N) Novelty	60	1	0.97
(CE) Critical Evaluation	56	1	0.96
(RC) Request for Clarification	24	0	1.00
(C) Contribution	78	6	0.86

Note. Table elaborated by Authors (2016).

Figure 1. Ratios of the 10 Types of Critical Thinking.



In the results of the ratio by categories, (see Table 5. Calculation of ratio by categories& Figure 1. Ratios of the 10 Types of Critical Thinking.), the results obtained from the ratios of the codes, allows calculating the ratio of the 10 types of Critical Thinking by Categories. When considering the rank of the value 1 as the highest value to a type of Outstanding Critical Thinking, decreasing it´s value in relation to the decimal value obtained in consecutive calculations, as when the value of .6 or less it´s considered a poor value, demanding attention to increase its value.

The interactions categorized as Holistic Reasoning have a ratio of .95, showing a high percentage of arguments incorporating concepts, ideas and resources learned and transferred by participants. This type of Critical Thinking should be set to reach within the designs and implementation of Discussion Forums.

In order to achieve the transfer of knowledge and the formulation of arguments in high levels of reflection is the type of Critical Thinking expected to accomplish in a high-quality design of Discussion Forums in academic courses of postgraduate levels.

The Spinning of Ideas has a ratio of one, showing evidence of a high number of messages with the recollection and expressions of concepts mentioned in the interactions. However, regarding the Built-in-Knowledge ratios of one, with only two messages coded positive and no messages coded negative, shows an area to be concern in order to increase the level reflection and development of arguments with a deep thinking taking into consideration the profile of the participants.

The ratio of Justification is .84, being acceptable. However, if look closely regarding the number of messages posted and coded as Justification with evidence and solutions, vs. the number of messages coded as Built-in-Knowledge; strategies and new directions should be considered in the future to increase the level of argumentations in order to increase a real building of new knowledge. If an acceptable number of messages coded have arguments revealing solutions and evidences regarding guidelines, concepts and/or contextual resources analyzed, the substantial elements are gather to achieve a more profound level of thinking.

Therefore, more suitable Socratic Questions posted to challenge participants into arguments and skills with a deep level of reflection could be positive. Even more, within the replicas and contra replicas on stage one more Socratic Questions could trigger a more complex level of debate. Alternatively, keep such new strategies in stage 2, redirecting participants when leaving debates or resting their cases for unknown reasons. Furthermore, challenging others to participate and rainstorm possible new visions or interpretations of the context in case, creating a challenging and debatable atmosphere to increase in level of thinking the arguments posted by all.

With a ratio of .6 to both, Relevance and Devils' Advocate, a restructure of the Discussion Forums is advice. The participation of the Tutor in stage two is necessary in order to increase the number and quality of messages posted by the

students. Once a message of Relevance is being posted, with the feedback of the Tutor, the students can continue their debates posting more interactions trying to challenge others with the guidelines of the Tutor´s help. Therefore, the task of the Tutor should remain active in the second stage to assure a different outcome in the types of Critical Thinking master.

Even though some students could feel uncomfortable arguing with their Tutor, it is highly suggested that the communication should be maintain polite and friendly, without dismissing comments or arguments posted. Once their messages are analyzed, if needed, they should be challenge to reconsider other points of view to enrich their original statements. With this in mind, the development of the Discussion Forum would be efficient and effective allowing the students to fulfill their benefits in the collaborative activity learning to develop their skills in argumentations in a competitive way.

The ratio of Novelty and Critical Evaluation is .97 & .96 respectively. Such values represent a high acceptable level of achievement to all the participants sharing and debating with arguments with a novelty context and profound evaluation of themes to their interest.

In terms of interest and motivation, the selection of the product to do along the activity during the Discussion Forum should be of use to all the participants. In the actual Discussion Forum, a creation of an Ethical Code by teams was the task they should accomplished with a specific timetable. Being all the participants' active educators and students of a course to obtain a master's degree, the use and understanding of an Ethical Code would be useful along their academic formation, as comments posted at the time, regarding the product in question.

Regarding the ratio of 0ne, in the Request for Clarification, its value is high showing evidence of the profile of the participants with a teaching experience by adding data and arguments with references search by the teams. The comments and reflection posted a strong point of view towards the diverse contexts stated.

In terms of the messages categorized as Contribution, the ratio of .86 is acceptable giving space to improvement by developing skills of leadership to all participants. Even though some members are natural leaders, the responsibility should be given and taken by all, by assigning team captains to ensure the work done on time with the approval of all the team members, increasing the level and quality of the collaborative learning in the different stages of the Discussion Forums.

Even more, in the Contributions of guidelines, the number of interactions categorized is high assuming the capacity of teamwork done by all the participants. Such results show accuracy within the design and formulation of the activity in terms of the instructions offered to be full field.

CONCLUSIONS

The development of Critical Thinking is without a doubt one of the objectives that all Educational professional wishes to achieve through the planning and designing of academic activities offered in his/her courses. The implementation of Discussion Forums as a tool could be the perfect ideal vehicle to promote the debates of ideas and the development of multiple Critical Thinking types.

In order to design Discussion Forums with a high standard of efficiency, the guidelines of Kutugata [27] allows the proper implementation of such tool,in order to increase the interactions between student-tutor, peers and apprentices with the academic's resources selected to use and analyzed along the academic courses.

Even more, the use of Socratic Questions helps to increase the debates of ideas and arguments with the proper citing of references offered to consult, assuring the development of Critical Thinking. Such implementation suggested within a design of Discussion Forums in three stages, allows that in the first and second stages, the Socratic Questions would trigger the interactions with the Tutor in a one-to-one interaction and their peers in a team groups collaborative work developing the product requested within the activity (Kutugata, 2016).

To measure and detect Critical Thinking, it is suggested to consider all the contributions, interactions, replicas and counter replicas of all participants of the Discussion Forum in question. To take a "devil advocate" position, it will be easier to find first the tutor´s participation with the trainees in the first phase of the Forum, enabling the participants to assume and develop this ability among peers in the second and third phases of the Discussion Forum.

To be able to detect and identify the types of Critical Thinking, all the interactions such as comments, replies and contra replicas should be transcript and considered for further analysis. When promoting the replica and contra replicas of others, the idea of responding and questions others with the proper background of facts and references should be encourage.

By doing so, the doubt of one´s own reflections could be considered for further deep reconsiderations provoking a deeper analysis trying to refute or assure such arguments stated before. Eventually, such actions would gestate the process of developing Critical Thinking in all the participants.

At the time of coding and categorizing the posted messages, a one line of interpretation is in order to assure a pure

implementation of the analysis of contents within the interactions considered with a mythological approach. When assistance researches are available, they could help gathered, record and list the codes and categories enlisted, following the guidelines of the main researcher. By doing so, the quality of the whole research is guaranty.

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