Produção Científica e Experiências Exitosas na Educação Brasileira 4

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(Organizadores)

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APRESENTAÇÃO

Os e-books intitulados **"Produção Científica e Experiências Exitosas na Educação Brasileira"** apresentam 6 volumes baseados em trabalhos e pesquisas multidisciplinares de diversos estudiosos da educação. A produção científica corrobora para o conhecimento produzido e difundido, além de fazer um papel de diálogo entre os pesquisadores e o meio científico.

Estas pesquisas têm como base os estudos multidisciplinares, que apresentam desafios em seu mapeamento, pois envolvem pesquisadores com distintas áreas de atuação. Diante desse cenário, a Atena Editora aglutinou em seis volumes uma grande diversidade acadêmico cientifica com vistas a uma maior contribuição multidisciplinar.

No primeiro volume encontramos trabalhos relacionados as vivências, práticas pedagógicas, desafios profissionais, formação continuada, bem como propostas de novas técnicas diante do cotidiano dos pesquisadores.

No segundo volume nos deparamos com estudos realizados no âmbito da educação especial, bullying, educação inclusiva e direitos humanos, bem como com políticas educacionais. Neste capítulo, buscou-se apresentar pesquisas que demonstrem aos leitores as experiencias e estudos que os pesquisadores desenvolveram sobre os direitos e experiencias educacionais.

No terceiro volume temos como temas: as tecnologias e mídias digitais, recursos audiovisuais, formação de jovens e adultos, currículo escolar, avaliação da educação, mudança epistemológica e o pensamento complexo. Neste volume, é perceptível o envolvimento dos pesquisadores em mostrar as diferenças de se ensinar por meio da tecnologia, e, também, com visão não reducionista, ou seja, o ensinar recorrendo a uma rede de ações, interações e incertezas enfrentando a diversidade humana e cultural.

No quarto volume, encontra-se diferentes perspectivas e problematização em relação as políticas públicas, projetos educativos, projetos de investigação, o repensar da prática docente e o processo de ensino aprendizagem. Os artigos aqui reunidos exploram questões sobre a educação básica abordando elementos da formação na contemporaneidade.

No quinto volume, apresenta-se pesquisas baseadas em reflexões, métodos específicos, conceitos e novas técnicas educacionais visando demonstrar aos leitores contribuições para a formação dos professores e as rupturas paradigmáticas resultante das experiências dos autores.

Para finalizar, o sexto volume, traz relatos de experiências e análises de grupos específicos visando demonstrar aos leitores vários estudos realizados em diversas áreas do conhecimento, sendo que cada um representa as experiências dos autores diante de contextos cotidianos das práticas educacionais sob diferentes prospecções.

À todos os pesquisadores participantes, fica nossos agradecimentos pela

contribuição dos novos conhecimentos. E esperamos que estes e-books sirvam de leitura para promover novos questionamentos no núcleo central das organizações educacionais em prol de uma educação de qualidade.

Keyla Christina Almeida Portela
Alexandre José Schumacher

SUMÁRIO

CAPÍTULO 24

PROBLEM-BASED LEARNING: A EDUCATION RESEARCH OF TECHNOLOGY UNDERGRADUATE COURSE IN ENVIRONMENTAL MANAGEMENT AT THE FEDERAL INSTITUTE OF EDUCATION, SCIENCE AND TECHNOLOGY OF RIO GRANDE DO NORTE, BRAZIL

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ABSTRACT: Problem-based learning (PBL) is a learning method that has been used in diverse universities around the world since the end of last century, and is getting greater importance in different fields of knowledge. This study shows the results of a research performed at the Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Norte (IFRN) Brazil, at Technology Undergraduate course in Environmental Management. The research assessed the PBL students opinion about that method of learning in order to verify the teaching and learning effectiveness of it once applied to environment in Citizenship, Ethics, and Environment discipline (CEMA). We performed a quantitative and qualitative researches by a case study, and the date were collected through a semi-structured questionnaire applied to the participants. This research aim to demonstrate the PBL effectiveness as a learning method that can be incorporated into the curriculum and into teachers educational practice, due to its innovation and its importance in the learning results as well as its significance in the development of professional skills.

PALAVRAS-CHAVE: PBL; Learning; Innovative method; IFRN.

1 | INTRODUCTION

Currently, one of the greatest education challenges in Brazil is to promote an educational reform that, in fact, accompany the scientific, technological, social, cultural, economic and environmental fast development of an globalized world. Any reform process in education brings inevitably changes which, among others, lead to break with established structures and traditional teaching model, besides the investment in teacher training in order to provide skills development to recover the essential dimension of teaching and learning. It shall focus on a significant knowledge production to contribute to professional training of people who will work in the society by pioneering and ethically conducts. An innovative learning method often occurs from small individual experiences of success, developed by teachers who achieve good results in their teaching. The emphasis on practices that develop new student experiments

in the educational context is potentially destined to mobilize significant processes of change. For this reason, it needs to be disseminated in schools. Thus we consider the Problem-Based Learning (PBL) a revolutionary learning method as an alternative to the didactic teaching models based on traditional perspectives, where the teachers is the center of knowledge transmission process.

This paper aims to present the research results of Problem-Based Learning method on Citizenship, Ethics, and Environment discipline (CEMA), under the Environmental Technology undergraduate course of the Federal Institute of Education, Science, and Technology of Rio Grande do Norte (IFRN - Brazil), as well as to disclose an innovative learning method for professional education, which can be used in all levels of education, from basic education to Post-Graduation.

2 I PBL FEATURES

Problem-Based Learning is a method that, in the last few years, has gained space in diverse educational institutions of higher education (from graduation to post-graduation), and in diverse disciplines at primary and middle schools (Souza & Dourado, 2015). The reading of theoretical references on PBL presented us with a variety of definitions about this issue (Barrows & Tamblyn, 1980; Barrows, 1986; Delisle, 2000; Leite & Esteves, 2005). The emphasis, however, is in the fact that each of these descriptions provides important contributions to the understanding of PBL definition, therefore allowing us a good improvement of its application in diverse fields of knowledge and levels of education.

Barrows & Tamblyn (1980) and Barrows (1986) define the PBL as a learning method that prioritizes the use of problems for acquisition and integration of new knowledge. It's a type of student-centered learning, in groups, where teachers are facilitators of the knowledge production process, and the problems workout as are stimulus for learning and impetus for skills development to solve them (Souza & Dourado, 2015).

Delisle (2000, p. 5) states that PBL is "a teaching technique that educates students by presenting a situation that leads to a problem that must be resolved". Leite & Esteves (2005) outline PBL as a way that leads students' learning. Accordingly, the student try to solve problems relating to his area of expertise, focusing on learning to carry out an active role in the research process, analysis, and synthesis of knowledge studied.

In general, the authors use the PBL as a strategy for learning centered on the student, and mediated by the research, aimed at producing individual and group knowledge, cooperatively, using critical analysis techniques for understanding and problem-solving, significantly and in continuous interaction with the teacher (Souza & Dourado, 2015).

We found a consensus on its basic characteristics by analyzing the extensive literature about PBL, where copyright discourse states that it promotes knowledge acquisition, skills development, expertise, and attitudes throughout the learning process, extending its benefits to other contexts of student life (Barrows & Tamblyn, 1980; Barrows, 1986; Delisle, 2000; Lambros, 2004; Barell, 2007; O'Grady et al, 2012; Barrett & Moore, 2011). Therefore, it represents an educational model providing an integrated and contextualized learning. This kind of interaction that PBL establishes is critical to achieve success in its application, considering the fact that interaction is required in all senses, with theme and its context, among students and teacher, in an overview. This interactional basis builds PBL structure, since it is the key to the learning process (Souza & Dourado, 2015).

The mentioned above strengthen our belief that students during the PBL structure design develop skills and abilities for methodically and systematically investigations, and to learn to work together, cooperatively, as well as achieve the research results satisfactorily, complementing their individual learning.

3 I HISTORICAL ASPECTS

The pedagogical theory of John Dewey was the most significant inspiration for the Problem-Based Learning. Delisle (2000) and O'Grady et al, (2012) point Dewey as one of the PBL pioneers. They state that the author believed that to stimulate students' thinking, the teacher should give an informal subject, related to their everyday lives (Souza & Dourado, 2015).

Along this same lines of conception, other New School thinkers performed innovative educational experiences in order to change the education. Delisle (2000); Savin-Baden & Major (2004); Hillen et al, (2010); Hill & Smith (2005); O'Grady et al, (2012) are unanimous when confirm the origin and development of PBL at the current model, from a professors' group initiative at McMaster University in Canada, specifically in Medicine in 1969. Thus, at the end of the 1960s, PBL model has expanded for many medical schools worldwide. Howard Barrows is pointed as one of the main articulator of the professors team formed by Jim Anderson and John Evans, who thought the medicine program in 1966, established officially in 1969 (Hillen et al, 2010). This professors' team intended to promote the development of students' abilities to contextualize the theoretical knowledge acquired in college, by practice them in daily life competently and humanely. Barrows realized that to achieve this purpose, the physicians, besides the theoretical knowledge acquired during their training, needed to learn to contextualize it in practice in order to obtain good learning results (Delisle, 2000; O'Grady et al, 2012).

PBL was not restricted only to health care field when expanded around the world; but was adapted to diverse areas of knowledge, as engineering, mathematics, physics, biology, chemistry and biochemistry, law, psychology, geography, among

others, as well as diverse levels of education, from basic education to higher education, and post-graduate (Delisle, 2000; Hill & Smith, 2005; Lambros, 2002; 2004).

4 I METHODOLOGY DESCRIPTION OF RESEARCH

PBL was applied to the current effectiveness course period of Technological Degree in Environmental Management, in the Central Campus (CNAT) of IFRN in Natal. The choice was made because the researcher teacher has a class in CEMA. This discipline program is composed by Introduction to Complex Thought, Citizenship, Ethics, and Environment. Sub-themes compose each of these themes covering the content necessary to achieve 80 semiannual hours-classes.

Environment is the fourth and last unit of the program to be developed by PBL; it will be the time for students integrate all knowledge (introduction to complex thinking, citizenship, and ethics) acquired before Environment theme. They shall present the knowledge necessary to complete the course with a report based on a transdisciplinary vision.

The students were organized in five groups of five or six members, receiving a problematic setting about water, construction, noise pollution, health, and urban violence. They had to perform an introductory survey and set a real context allowing the research of each theme. Organized in groups, the students carried out statistical data, maps position, photographs, and information containing the main characteristics of the chosen locations. After this setting characterization, each group prepared a slide presentation for use in a multimedia projector, to show to the class the setting chosen with all data, and information collected. Then, they start to identify and develop the problem-issues. The students identified in each setting, a number of problems used to define the problem-issues considered crucial to reach the solutions.

The students answered a questionnaire to record their perceptions on PBL after its conclusion, the difficulties they found during the application steps, and to identify the positive and negative points of the method. The time used for learning about Environment corresponded to 20 hours- class divided in two classes per week of 90 minutes each.

4.1 Methodology: the type of research

We chose a case method for this research strategy through semi-structured questionnaire. This methodological tool was important to obtain the results for the research in question. This case study was the most appropriated due its short-time duration and consistent with the research process, where there is a specific interest by the Professor (Stake, 1995), whose performance was apply the questionnaire after provide content on Environment by PBL.

4.2 Population and sample

All students registered in CEMA discipline of the first period of Technological Degree in Environmental Management were the research population. The class consisted of 28 students between ages from 17 to 40, who participated in all PBL stages. The choice of 28 students was not random, because it was the only class of the first period of the course. In addition, it seems to be the most convenient for sampling because it was coordinated by researcher professor. According to McMillan and Schumacher (2001), it is common to do this kind of choice in educational research.

We wanted to evaluate the level of learning, the skills developing for problem solutions, and satisfaction with PBL as a learning method in CEMA discipline. In order to achieve our purpose, we justify the necessity to use students who had never got in contact with PBL.

Some ethical principles necessary for the proper progress of the research were observed. McMillan and Schumacher (2001) pointed the consent informed as a necessary principle to start a responsible research, since those involved (directly or indirectly) can decide about their participation. Thus, when the professor decided to carry out the research with students of the Environmental Management course, he informed to the educational coordinator that he would perform a research to assess the learning of these students in that discipline, by using the PBL application. They agreed to apply a questionnaire at the end of the research to obtain information about the method used with the students.

4.3 Description of data collection tools

According to the study purposes, the questionnaire was chosen as a data collection tool. This instrument is the most suitable to obtain the respondents impressions for analysis, interpretation and finding the results from PBL application.

We defined the data we intended to collect and the questions format, in order to obtain the expected results. We opted for a semi-structured questionnaire, with mixed questions (open and closed), and ask the respondent to justify their response to closed questions. Closed questions were characterized by a Likert scale, where affirmative alternatives are presented and the respondent chooses between a maximum degree of agreement and disagreement. These questions are easy to answer and enable a fast quantification and analysis (McMillan & Schumacher, 2001). We used this type of questionnaire because it better match the needs of our research. The questions were clearly worded to avoid ambiguities, addressed with only one aspect to prevent confusing and the presence of the professor for clarification was necessary for keeping the student free of pressure. We tried to be objective during questions' elaboration to avoid induced response (McMillan & Schumacher, 2001).

4.4 Data collection and analysis by the questionnaire

The students completed the questionnaire in written at the end of the last phase of the Environment study. A 90 minutes class was performed to help the filling of eight issues. The students answered the questions individually without changing information. Before start the filling, the professor repeated the importance of seriousness and sincerity without question unanswered. Then, the professor read the questionnaire to answer any doubts before the students begin with the responses phase.

The reading of the collected data was presented in a table, for quantitative analysis of closed questions, and in a descriptive approach for justification of closed and open questions, whose answers were free expression by calculating the frequency and percentage.

5 I RESEARCH RESULTS

The results obtained from the Problem-Based Learning were collected from students' opinions on PBL phases (the setting, the problem, and the problem solution), by assessing the content learning and the general opinion about the method.

5.1 PBL phases

Table 1 results shows that the analysis and understanding of the setting was easy for the students, assuming the method as suitable for environment study (57%), since there was no difficulty. It revealed that 32% had little difficulty and 7% had moderate difficult to analyze and understand the setting.

ISSUES	(n=28)											
	Very difficult		Difficult		Moderate difficult		Little difficult		No difficult		N/A	
	f	%	f	%	f	%	f	%	f	%	f	%
In your opinion, analysis and understanding was considered one phase on the education development guided by PBL	0	0	0	0	2	7	9	32	16	57	1	4
In your opinion, the problem formulation phase from the setting corresponded to one phase	2	7	3	11	11	39	7	25	4	14	1	4

Table 1. PBL Results on Setting and Problem

Legend: f – frequency; N/A – Did not answer.

Analyzing the students reasons, it was observed that 89% considered not difficult and little difficult, 14% answered that "the setting anticipate the vision of PBL process"; 51% answered that "the setting enabled the problems identification," and

24% answered that “the setting enabled anticipate the problems solution.” Those 7% who considered moderate difficult justified their answer by stating: “The group had little experience, but could understand the setting.” Only one student did not answer or justified the question, which represent 4% of all respondents. These results confirm the statement of Barell (2007) that the setting is constituted as the main PBL stage, since a good setting is an open space to achieve good results in the following phases.

The second issue of Table 1 intended to evaluate the difficulty or easiness to formulate the problem-issues from the setting. The result showed that 14% considered easy to elaborate the issues; 25% had little difficulty; 39% stated it was neither easy nor difficult; 11% said it was difficult; 7% found it very difficult, and 4% did not answer. In this issue, 39% considered not difficult and somehow difficult, 18% justified their answers with the following statements: “The problems were very clear; we just needed to elaborate the issues”; “there was a diversity of issues, which facilitated the development of the issues.” From 39% who said it was moderately difficult, 30% justified the response stating that: “It was neither easy nor difficult to elaborate the problems, since some problems are from our daily life”; “there were many problems and little time to formulate the questions.” 11% of those who considered difficult and very difficult justified their answer by stating: “There was some difficulty in defining what was the problem”; “The group did not have a good integration and it interfered in the problem-issues development.” The results and comments of students confirmed little difficulties related to the lack of experience with PBL, since the traditional education by lecture does not stimulate autonomy in the learning process, causing a teacher’s dependence, regarding the content transmission for memorizing and activities performance formatted to be answered. Unlike PBL, due the fact that it is a student-centered method, in research, team work aimed at problem solution.

Table 2 shows the results of research and discussion of groups to problems solutions phase.

ISSUES	(n=28)											
	Nothing		A little		Moderate		Enough		A lot		N/A	
	f	%	f	%	f	%	f	%	f	%	f	%
Learn to search for the information:	0	0	0	0	8	29	7	25	13	46	0	0
Learn to select the relevant information:	0	0	0	0	8	29	7	25	13	46	0	0
Learn to synthesize the information collected:	0	0	0	0	4	14	10	36	13	46	1	4
Learn to interpret the researched information:	0	0	0	0	4	14	10	36	13	46	1	4
Learn to critically analyze the found solution:	0	0	1	4	1	4	9	31	17	61	0	0
Learn how to plan the working group:	0	0	1	4	7	25	6	21	14	50	0	0
Learning to collaborate with the group:	0	0	1	4	7	25	6	21	14	50	0	0

Table 2. Learning in Discussion Phase and Problem Solution in the Group

Legend: f – frequency; N/A – Did not answer.

It was observed that 46% of students said they learned a lot researching information; 25% said they learned a lot; and 29% have learned moderately. Regarding the other learning, concerning selecting relevant information, 46% said they have learned a lot, 25% learned enough, and 29% learned moderately; to synthesize the information collected: 46% said they learned a lot, 36% learned enough, 14% learned moderately; to interpret the researched information: 46% said they learned a lot, 36% learned enough, 14% learned moderately; critically analyze the solutions: 61% said they learned a lot, 31% learned enough, 4% learned moderately, and 4% learned a little; planning group work: 50% said they learned a lot, 21% learned enough, 25% learned moderately, and 4% learned a little; to colaborate with the group work: 50% said they learned a lot, 21% learned enough, 25% learned moderately, and 4% learned a little. In a general analysis, the learning was effective in all matters, because the average between those that have learned a lot and enough ranged from 71% to 82% in learning. Those that have learned moderately and a little ranged from 8% to 29%, which confirms the PBL effectiveness as a learning method.

5.2 Contents learning through PBL

Table 3 shows the results about the learning progress through PBL in class.

ISSUES	Fully Agree		Agree		Agree Moderately		Disagree		Strongly Disagree	
	f	%	f	%	f	%	f	%	f	%
PBL teaching provided contextualized learning on environment related with real problems.	14	50	12	43	2	7	0	0	0	0
PBL provided the environmental content integration with citizenship, ethics, and complex thought.	27	96	1	4	0	0	0	0	0	0
PBL, in CEMA discipline, has enabled the preparation for analyze, investigate, and offer viable solutions to environmental problems.	9	32	16	57	3	11	0	0	0	0

Table 3. Contextual learning, Integration, and competence for Environmental Problem Solution.

Legend: f – frequency.

The first question showed that 50% of the students fully agreed that PBL have provided the contextualization of environment with real-life situations, 43% only agreed, 7% agreed moderately. The second question deal with the knowledge integration

of ethics, citizenship, and complex thinking with the environment knowledge. The results show that 96% fully agreed that there was integration, and 4% only agreed. The third question aimed to figure out if PBL enable the preparation for analyze, investigate, and provide solutions to environmental problems. In this issue, 32% fully agreed; 57% only agreed, and 11% agreed moderately.

The students justifications for the first question displays that 93% are fully satisfied, which can be seen in the speeches of A23: “As the problems are real, we got to know the true reasons and find solutions” or A4: “The PBL provided the problem identification from a real setting, as well as its investigation, and solution in a planned way.” Those 7% that agreed moderately gave their opinion more positively than negatively, as A2 statement: “I believe that the result would be better, if PBL were used in other semesters of the course.”

On the second question, 100% of the students fully agreed or only agreed that PBL has integrated the discipline contents, as justified in A7: “The integration of knowledge was naturally, since there is no way to investigate an environmental problem without integrating the individual in his way of think and act, as a citizen,” and A13: “The PBL, in general, increased knowledge not only in environment, but in ethics and citizenship content.”

The third question aimed to figure out if PBL, in CEMA discipline, enable the preparation for analyze, investigate, and provide solutions to environmental problems. The results show that 89% of those who fully agreed or only agreed are aware of the method benefits. That is what we found in other speeches such as A19: “I feel more prepared to collect information on a setting and investigate their problems to get them solve,” and A12: “I feel more prepared to analyze problems and find solutions.” Those 11% who agreed moderately gave positive reasons as A5: “Somehow, it made me look differently to the society problems.” Therefore, in the general analysis of Table 3, it is verified that the average of three questions that fully agreed or only agreed is only 94%. This result confirms the effectiveness and efficiency of PBL as a learning method, because it promoted context, knowledge integration, and skills necessary to solve environmental problems.

Table 4 presents the results of PBL assessment as a learning method for teaching Citizenship, Ethics, and Environment.

ISSUE	(n=28) I loved		I liked		I liked moderately		I did not like		I hated	
	f	%	f	%	f	%	f	%	f	%
Learning by PBL.	13	46	12	43	3	11	0	0	0	0

Table 4. PBL as a learning method.

Legend: f – frequency.

The results indicate that 46% of the students loved the PBL; 43% liked, and 11% liked moderately. Students who loved and those who liked totalize 89%. The method application encouraging has a positive tone, as described by A23: "It was very interesting to know this method of teaching so different from the common teaching standards. It is so spectacular to get involved in the problems solutions," and A6: "PBL is crucial for professional qualification and humanized citizens who are aware of the social function of each one." It was detected that 11% of those who said they liked moderately justified their answer positively, as shown in speech A12: "It was not bad, but could have been better, because the group's integration only improved at the end of the semester." It was observed, once more, the student satisfaction with PBL in teaching and learning process. In addition, the real experience was really important.

5.3 PBL general aspects

Table 5 shows the students opinions regarding the general aspects of PBL. The question "what do you most like in PBL class?" allowed the students to point diverse aspects that during learning process were more significant.

CATEGORIES	(n=28) **What do you most like in PBL class?**	
	f	%
PBL method	8	29
Group interaction	3	11
Final performances	6	21
The discipline content	4	14
Solutions gave to the problems	3	11
To learn from real problems	4	14

Table 5. Opinion on PBL General Aspects

Legend: f – frequency.

It was observed that 29% of students said that PBL method was the one they liked most; 11% liked group interaction; 21% liked the final performances; 14% liked more the discipline content; 11% liked the solutions given to problems, and 14% liked more to learn from real problems. Those results confirm all data obtained by the questionnaire.

Based on tables 1 to 5 analyzes, the students opinions on Problem-Based Learning, applied to CEMA discipline, showed excellent results regarding its applicability, considering that all students agreed that PBL has fulfilled its purpose to promote an integrated, contextualized and meaningful learning, and most of the students liked the PBL classes. Moreover, a small number of students opposition stating some difficulties with the method, shall be considered normal for a class that had it first contact with PBL. In addition, the students not only enjoyed working in-

group, but also search and propose solutions to problems from everyday issues. They recognized, above all, the importance of collaborative work, because they cannot understand everything alone. They said that, due to this experience, they feel much more motivated to learn, to discuss, and interact with each other.

It was settled from these results that teaching by PBL is indeed effective in the learning process. Although this method requires more commitment and dedication of everyone involved, it contributed to a greater responsibility of students with their own learning.

6 I CONCLUSION

Thus, this research results points PBL as an innovative learning method used in diverse educational institutions, and different levels, achieving important results in learning and development of professional skills. PBL is not a fixed and closed method; it can be adapted to different realities and needs.

Another important issue considered as practical and political implications of this research, is the need for institutional support in terms of stimulating, educational support and infrastructure for development of innovative teaching methods in education. The results obtained in this study are proof to this statement. PBL is an effective method, whose benefits show its ability to achieve larger educational goals, than those accomplished by the traditional teaching methodologies; i.e., besides the knowledge, skills, and attitudes development, the students can get important gains in their academic and professional careers.

PBL is a method that enhances the teachers' work, since it encourages him to monitor the research process developed by the students, and the way they reach the problems solution. In addition, it also contributes to the development of continuing education of teachers, because they are encouraged to think about how to improve their teaching on the new challenges of learning.

In this sense, PBL is an effective method for important learning results. Professors who use it in their classrooms as a teaching learning tool in college point out positive results achieved: students who do not do well in traditional education, show better results in their learning through PBL, because they are more active and engaged; the students have mastered the knowledge and present their results firmly, because it is the result of an research and reflection produced by themselves, and not simply by ready answers to questions given by the professor; the students exercise their ability to formulate problem-issues, and critical analysis of the setting for the problems understanding and solutions; the students develop inter-relations and cooperation in team work, because they look for information and evaluate its importance to the problems solution, and learn with autonomy; the students develop the self-evaluation capacity and performance evaluation of the group members.

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