Analyses of the Flipped Classroom Application in Discussion Forum on LMS Moodle

Fabrícia Farias[1], Gilvandenys Sales[2], Alexandra Gonçalves[3(✉)], Adriano Machado[4], and Eliana Leite[4]

[1] Instituto Universidade Virtual - Universidade Federal do Ceará, Fortaleza, Brazil
fabriciamenezes@gmail.com
[2] Instituto Federal de Educação, Ciência e Tecnologia do Ceará, São Paulo, Brazil
denyssales@gmail.com
[3] Secretaria de Educação do Estado do Ceará, Fortaleza, Brazil
ajg.virtual@gmail.com
[4] Secretaria Municipal de Educação de Fortaleza, Fortaleza, Brazil
adrianomachado2007@gmail.com, elimoreiraead@gmail.com

Abstract. The research proposes an analysis of Flipped Classroom Active Learning Methodology and Inverted Mastery Learning, which aims to help the student to perceive him/her responsibility for the construction of their own knowledge, promoting their autonomy and mobilizing their cognitive abilities to transform them into knowledge connected with the reality in which it is inserted. This study addresses the use of Flipped Classroom as a pedagogical methodology in Distance Education, exclusively on LMS Moodle forums. The results allow recognizing the theoretical references of Flipped Classroom and Inverted Mastery Learning, as well as the principles that support them: Flexible Environment, Learning Culture, Intentional or Directed Content and Qualified Educator, especially if they were used in the Planning and Structuring of the discussion forum addressed in this research. The potentialities and difficulties in the use of these Active Learning Methodologies in the teaching-learning process in Distance Education were also highlighted.

Keywords: Active learning methodology · Distance education · Flipped classroom

1 Introduction

Active Learning Methodologies in the context of Distance Education (DE), especially in Virtual Learning Environments (VLE), has been used to use the available tools in order to seek an autonomous and innovative learning, where meaningful learning is the starting point of the whole planning of the teaching-learning process.

VLE provides interaction and collaboration of individuals in the construction of knowledge, forming a network of knowledge. For [1], "a VLE is a space that provides meaning where individuals and technical objects relate, enabling the construction of knowledge, and consequently learning."

Á. Rocha et al. (eds.), *Recent Advances in Information Systems and Technologies*,
Advances in Intelligent Systems and Computing 570, DOI 10.1007/978-3-319-56538-5_70

VLE supports the teaching-learning process as a platform that integrates technological tools (synchronous and asynchronous) which make learning possible. As synchronous tools, it is possible to highlight chat and videoconference, and as asynchronous tools there is the task, wiki, email, discussion forum, among others. In the differentiated dynamics for the construction of the knowledge to which one proposes the VLE, a proposal of insertion of the Flipped Classroom Active Learning Methodology, as a pedagogical methodology to be used in discussion forums, is approached in this study.

The insertion of the Flipped Classroom into DE makes it possible to use the benefits of a methodology already used in face-to-face teaching, such as arousing and stimulating the epistemological curiosity, autodidactic and pro-activity of the student, their autonomy and continuous learning. Recognizing the importance of Flipped Classroom for the construction of student's autonomy, it is understood that knowing and using properly its principles and theoretical references will potentiate the teaching-learning process in DE, in order to conceive favorable conditions for the student to take the leading role in the acquisition of their knowledge.

In the mentioned context, this study aims to answer the following questions: Why to insert the Active Learning Methodologies in DE? How does Active Flipped Classroom or Flipped Classroom Active Learning Methodology work in DE? What are the pillars of this methodology and the theoretical references? These pillars and theoretical references were followed in the construction of the discussion forum using the Inverted Classroom's principle?

The answers to these questions will be addressed in the following sections: Sect. 2 deals with Active Methodologies and Education in particular Flipped Classroom and its fundamentals; Sect. 3 addresses the methodological pathways and application data analysis of the Flipped Classroom Methodology in a discussion forum in the LMS Moodle, and finally brings the Final Considerations.

2 Active Learning Methodologies and Education

Experiments carried out over 30 years ago at MacMaster in Canada and in Maastricht in the Netherlands, in Medical Schools for countries in Africa, Asia and Latin America are successful examples of the use of Active Learning Methodologies in the training of health professionals, in particular the Problem Based Learning (PBL) methodology. In Brazil, experiences in the training of Nursing Assistants in Minas Gerais and Rio de Janeiro have been occurring for two decades [2]. The proposal of insertion of Active Learning Methodologies in education is to make the educational process more dynamic, attractive for the students and to enable new forms of development of the learning process, in which the student starts to act as protagonist of the training process itself, being confronted by real or simulated experiences that will require the mobilization of their cognitive potential to search for solutions.

The idea of Flipped Classroom is, as the nomenclature suggests, precisely reverse the traditional and expository practice of the classroom. Some common tools are used to provide the content to be studied previously and also to mediate the explanation and exposition of the contents by the teacher, modifying the student's way of learning, that

is, by flipping it. The proposal contributes to the search for knowledge in a more autonomous and active way, optimizing the time of meeting with the teacher and his/her peers, in order to promote more mature and complex discussions; As well as to carry out activities that refer to real situations, in which the student has the possibility to put into practice the knowledge previously acquired for the solution of real problems.

The adoption of Flipped Classroom also allows students to have more free time to rebuild their way of knowledge construction and recreate their own content studied in the classroom in tools such as blogs, videos, podcasts and learning objects, etc., demonstrating a more palpable knowledge acquired on various topics that reveal the acquisition of the learning objectives [3].

According to [4], in addition to simple video recording and visualization, Flipped Classroom promotes interaction between teachers and students; it promotes the autonomy of students, who become responsible for their own learning; it boosts constructivist learning and provides students with content that allows them to be accessed when and how often they feel the need. [5] points out that Flipped Classroom provides the student the prior study of the lesson and thus turn it a more active learning environment that can be used to delve into the proposed theme and solve practical activities, that are, required tasks with greater cognitive workload.

In the Inverted Mastery Learning, all elements of the Flipped Classroom are preserved and there is even a greater individualization of the educational process. In this, the student only advances to the next learning objective when there is acquisition of the previous one, respecting his/her own learning pace. In the new model, the burden of learning is entirely on the students. In order to be successful in the process, the student must take responsibility for his/her own learning [3]. There is no longer a rhythm imposed by a curriculum to be fulfilled in a given two-month period or the pace imposed by the teacher, which suggests the activity that the student must carry out to test whether the educational objectives have been achieved. The students sets their pace of learning

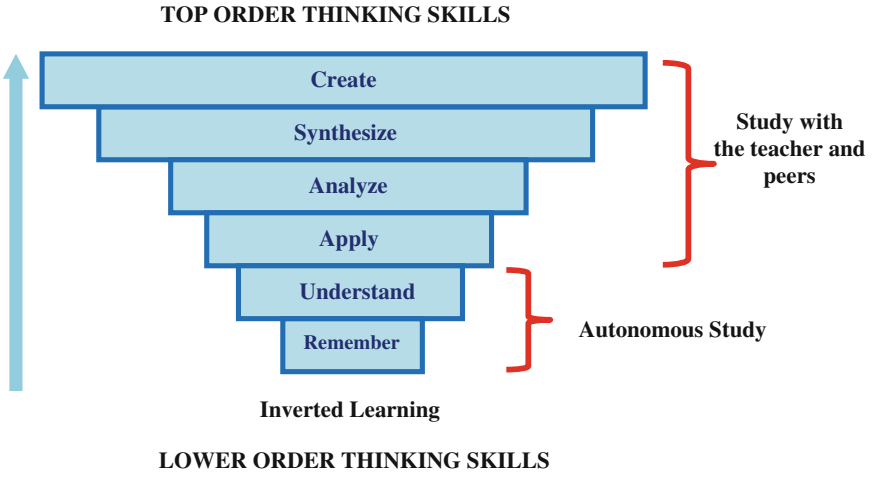

Fig. 1. Bloom's Taxonomy based on the Inverted Mastery Learning Model. Source: Prepared by the author based on [6].

and, when he/she feels empowered, he/she makes the assessments that attest to whether or not his/her apprehensions were meaningful and substantial. Only then will the student taken up to a new learning objective.

The proposal of the Inverted Mastery Learning of Bergmann and Sams is to reverse the sequence of thinking abilities proposed by Bloom in his taxonomy (Fig. 1). For this, initially, the educator would define the learning objectives clearly and using the taxonomy verbs, according to the cognitive domain to be acquired by the student. As in the Inverted Classroom, the student begins the construction of their knowledge and, consequently, the acquisition of the learning objectives in an autonomous way and at their own pace, through the materials made available by the teacher.

By proposing learning objectives using the Bloom Taxonomy verbs, the teacher enables the student to strive for and build in their knowledge from the simplest to the most complex learning objectives, thus ensuring a sequence of goals that take him/her (student) to the domain of higher order skills.

Suggested by Bergmann and Sams, and in accordance with the Flipped Learning Network for the development of Flipped Classroom Active Learning Methodologies and Inverted Mastery Learning Model, it is necessary for the educator to incorporate into his/her pedagogical practice four pillars: Flexible Environment; Learning Culture; Intentional Content - Intentional or Directed Content and Professional Educator - Qualified Educator. In order for the student to reach the learning objectives by the Inverted Mastery Learning or by the Inverted Classroom, it is necessary that the educator creates an environment conducive to learning. This is what concerns the diversification of pedagogical strategies and availability of the means used for individual or collaborative study in the case of group work or even in environments where students help themselves and seek to build knowledge in a collective and collaborative way. When referring to the implementation of the Flipped Classroom or the Inverted Mastery Learning in DE, whose methodologies are based on theoretical references and pedagogical principles, these issues must be respected, regardless of their use in face-to-face or distance education.

It is agreed with the authors that the learning objectives proposed by the educator in activities that use the VLE tools should lead the student to acquire - at his/her own pace and aim to achieve the objectives in a sequential and progressive way, from the simplest to the most complex - the higher order skills and not only the level of knowledge but its application and analysis. Many synchronous and asynchronous tools can be used to diversify the pedagogical strategies of the educator in an attempt to acquire the educational objectives by the student, individually or collaboratively. The educator can make a videotape available, an instructional handout, or any other way for the student's individual study and acquisition of the lower order skills, which are Remember and Understand.

It should be emphasized that the media chosen by the educator should be accessible to all students and at all times, further reinforcing the concept of Flexible Environment for the use of Flipped Classroom Methodologies and the Inverted Mastery Learning. From this perspective, it is interesting to promote the Learning Culture in Distance Education, the insertion of face-to-face moments, where students can interact and exchange knowledge more intensely with their peers and educators, using this moment to create links between the group of students and teacher.

The great differentiation between the traditional forum and the forum using Active Methodologies, in this case Flipped Classroom and Inverted Mastery Learning, starts with how the educator will structure it to provide the student with the acquisition of skills in a progressive way, Explores, through learning objectives, the cognitive domains, from the simplest to the most complex; Enabling the student to be an active and autonomous agent in the construction of their learning, favoring a Learning Culture.

Initially, the teacher can indicate a specific content and directed to the theoretical basis of the student, in order to answer the proposed questions. By using only questioning, which only requires the student to remember what has been studied to answer them; the teacher stimulates in the student the lower order skills. If the learning objective relates to the creation, synthesis, analysis or application of certain content, i.e. higher order skills, the teacher will propose a more complex activity in the forum (case study analysis, problem solving, game construction, object creation or artifact, among others), where the student has to mobilize the knowledge acquired in his individual studies to produce it, producing his own knowledge.

The educator, considering the activity proposed for the forum tool, can, according to the cognitive levels already dominated by the students, propose activities to be carried out individually, that bring more complex discussions to the group debate, advancing in the levels and acquisition of the cognitive abilities.

3 Methodological Route and Data Analysis

This is an exploratory descriptive study with quantitative-qualitative approach, with analysis of ICDT, especially the LMS Moodle discussion forum. According to [7], the descriptive research aims to characterize a particular set of individuals or phenomena or establish relationships between possible variables. Exploratory research, on the other hand, allows a greater knowledge of the object under study, in order to make it clear or to constitute hypotheses.

The study was developed with the 1st class of Specialization in Distance Education of the Federal University of Ceará, which started on August 28, 2014, being it in progress. This course, at the Lato Sensu (Specialization) postgraduate level in the semi-presential mode, consists of eleven compulsory subjects, with a course load of 448 h of class, 96 h of classroom instruction and 352 h of distance learning. The course is aimed at the teachers and administrative technicians of public educational institutions, tutors of governmental and non-governmental programs related to the Distance Education area linked to the Open Brazilian University (UNIVERSIDADE ABERTA DO BRASIL - UAB) and the ones who hold undergraduate degrees in any area of knowledge.

The course was divided into four classes: Lesson 1 - The process of Assessment of Learning in DE; Lesson 2 - Institutional evaluation of courses in DE; Lesson 3 - Current Assessment Concepts and Lesson 4 - The Evaluation of Educational Income and the Legal Aspects in DE.

The discussion forum using the Flipped Classroom analyzed in this study was carried out in Lesson 3. A full teacher, 10 tutors and 76 students enrolled in the platform participated in the course, which is larger than the number of students that the Public Note of the Selection Process reported.

As subjects of the research, we considered the participants in the Lesson 3 discussion forum who propose to use the methodology of the Inverted Classroom, those ones are: the full teacher of the subject, two tutors and the 76 students enrolled in the course.

The data were collected through the Educational Assessment in Distance Education in LMS Moodle (Fig. 2) [8], especially the information of the discussion forum of lesson 3, and the observation and participation of the author as a student of the referred subject.

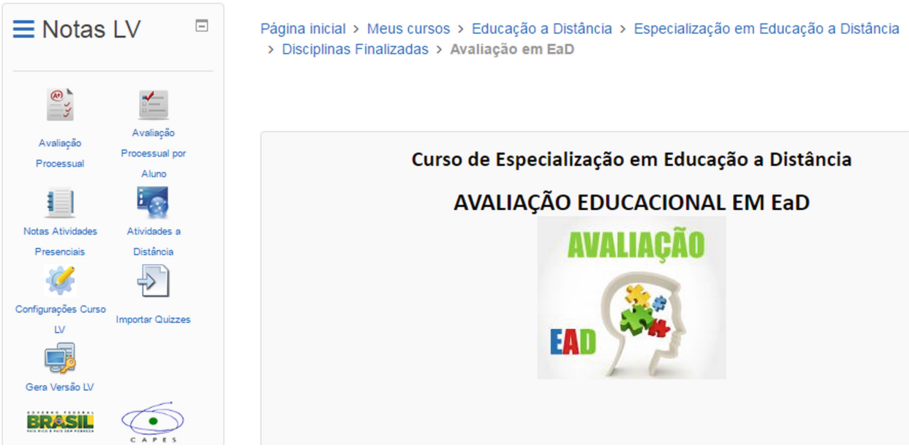

Fig. 2. LMS Helpclassonline and the plugin 'Notas LV'.

The students were evaluated through the LV Grades Plugin [9, 10] (Fig. 2) in a formative way during the period in which the forum was open.

3.1 Results and Analysis

3.1.1 Analysis of Environmental Flexibility

In order to meet the flexibility of the environment, it is considered that it must respect the fact that the student has his/her own learning pace and that the deadline for student's participation in the forum must respect this rhythm. It is thought that the deadline was sufficient because the forum in the small groups started with Tutor 1's guiding questions on September 12 and the last posting of a Group 9 student was held on October 14. In the General Forum, it was verified that the forum studied here is based on one of the components of Mastery Learning, which suggests that students should work in small groups or individually, at an adequate pace [3].

According to [3], most research on Mastery Learning shows improvement in students' self-confidence and advances in learning when working in cooperation and in

small groups, revealing new possibilities for students to demonstrate mastery of a particular educational goal.

3.1.2 Learning Culture Analysis

The discussion forum, in distance learning, provides the Culture of Learning in that it places the student as the center of the educational process, enabling him to be a more autonomous and responsible subject for his own learning, providing student-student and student-professor interactions, where the student learns with his own reflections and through the exchange with the other. The Learning Culture, in the forum under study, would have been even more stimulated if there had been at least one face-to-face meeting, where the exchange of knowledge between peers and teachers happened more intensively, with activities that instigated the student, doing so Mobilize all the knowledge acquired up to that moment, aiming at the resolution of tasks or the performance of other proposed activities.

According to [3], one of the benefits of classroom inversion is the strengthening of interactions: student-teacher and student-student, allowing the teacher to be closer to the student, perceiving their doubts and difficulties and orienting them in learning. Therefore, the face-to-face meeting allows greater interaction and a greater commitment of the student to the construction of his knowledge.

3.1.3 Analysis of Intentional or Directed Content

There is an intimate relationship between the learning objectives and the contents to which the student will have access for theoretical foundation in the LMS. In the case of the forum, object of this research, the learning objectives were not presented to the students. Baseline content was only available in LMS. One of the reference materials was a video available on Youtube on the subject of Evaluation, in a much generalized way, without addressing the theme proposed in Class 3 - Current Concepts of Evaluation. The video did not display any information about authorship. It is verified that it is not from any educational institution, because there are no credits at the beginning and at the end.

The texts 1 and 2 worked during the course of the evaluated discipline are chapters of the Doctoral Thesis [8], which deals with the conception and implementation of the Non-Linear Model of Learning Vectors (LV Model). Text 3 is about the evaluation of learning in LMS discussion forum, but more focused on an organizational perspective. Text 4 regards the importance of language to the human being and some distinctions of the ontology of language that contribute to a better relationship in communities, including virtual ones. The last two texts (3 and 4) are part of a Master's Dissertation [10], entitled "An Application of Nonlinear Dynamics for Performance Evaluation of Virtual Learning Communities - Beyond the Computer Screen: Language, Emotionality and Corporality.

The texts presented in Class 3 - Current Assessment Concepts deal with the same theme: non-linear assessment, which is used to evaluate student learning in LMS, but what if the student does not know anything about the current forms of evaluation? Are the texts indicated sufficient to support the student in relation to the proposed theme of

the class? Again, since it was not informed what is the learning objectives for this class, there is an unknown question as to whether the suggested texts and video are intentional and directed to collaborate with the student in the acquisition of the objective of learning.

As for the availability of the media for a Flexible Environment, as the course proposal is to be hybrid or b-learning, even if the student is aware of having to access the internet to use the virtual environment, it would be appropriate that the theoretical, For Class 3, would also be available in another form of access, not on-line, on a CD-Rom or DVD-Rom, for example.

3.1.4 Qualified Educator Analysis

Regarding the Qualified Educator, in respect to Active Flipped Classroom Methodologies and Inverted Mastery Learning, it is noticed that the titular teacher and the tutors, who accompanied the students during this class, or did not have much mastery over the Methodologies in analysis, not using for the planning of the forum the theoretical references of the Bloom Taxonomy and the Pillars/principles of the methodology proposed by Bergmann and Sams, or structured the forum using another theoretical reference than those previously discussed.

Therefore, there is no way to know the theoretical references used, since nothing was reported, neither by e-mail nor in the virtual environment. Returning to the forum tool under investigation, Tutor 1 launched the questions and Tutor 2 interacted with the students, both in small groups and in the General Forum - All participants group. It is noticed that Tutor 2 was active, participating effectively in small groups and in the General Forum (Table 1).

Table 1. Number of participants in the discussion in each group.

Groups	Tutor 2	Students	Total
1	5	17	22
2	2	21	23
3	8	19	27
4	4	9	13
5	5	24	29
6	4	13	17
7	6	20	26
8	5	11	16
9	13	33	46
10	–	–	0
11	6	25	31
General Forum	45	130	175

After analyzing the groups, it was identified that, from the total participation of Tutor 2 (103 posts), and considering their expertise in conducting the teaching process and the content addressed, the feedback of student learning are also considered. For [3], feedback should be immediate and critical for the Flipped Classroom and Inverted Mastery

Learning, since students must master the purpose of each module or unit in order to move to the next.

From the 103 posts, a total of 51.4% (53 posts) were carried out outside the duration of the forum, both in small groups and in the General Forum. Feedback postings, even after the deadline, will only have the effect of correcting errors or omissions that prevent the student from mastering the learning objectives if they still have access to the forum, which did not happen during the course, since a class opens only after completion of the previous one.

3.1.5 Analysis of the Forum Regarding the Theoretical References of Bloom Taxonomy

The basic idea of Mastery Learning, which uses Bloom's Taxonomy verbs to implement the methodology, consists in acquiring a series of learning objectives in a hierarchy from the smallest to the most complex and in the student's learning rhythm, or is to accompany the educator in what the student is expected to know at the end of the educational process. The use of Taxonomy contributes to the definition of learning objectives and enables the educator to create, from more basic goals, through the use of lower level verbs, to more complex goals, making the student acquire the skills of the higher level.

It was hoped that in the General Forum the learning objective would be more complex, because the lower order ability, which is to understand - verb to discuss - on the topic addressed, has already been tested in the discussions in small group forums, 3], the student learns at his own pace and progressively, acquiring the less complex skills and seeking to attain the most complex skills. It is observed that the verb of action used is Explicit (emphasis added), which is not found in the Bloom Taxonomy presented in [6]. However, the verb to explain in the Mini Aurelio Dictionary has the meaning "Make explicit" and the word "Explicit" means "Explained". Then the head teacher or tutor asks the student to "explain their understanding about".

Again, the proposal and objectives proposed by the subject's teacher and/or tutor reinforces only the ability to understand scientific content. In this way, the student was not stimulated to mature concepts and acquire differentiated skills. There was no progressive construction of knowledge and a didactic sequence of teaching and learning, which can be acquired through more abstract and dynamic processes at different cognitive levels, from the simplest to the most complex.

As limitations in the use of the Flipped Classroom and Inverted Mastery Learning, it was mentioned the difficulty of implementation of the methodologies, since the educator needs, besides giving up control of the learning process, which for some is painful, to know Its characteristics and its idealization and execution, which is not limited to providing instructional material in the LMS, but to think of pedagogical strategies that lead the student to acquire the learning objectives. To this, the use of the Bloom Taxonomy verbs is used in order to construct activities that are progressive in the student's learning, allowing him to pass and acquire abilities from both the lower level and the higher level. For this implementation, it is also suggested to adopt the pillars/principles proposed by the Flipped Learning Network.

By employing digital technologies and LMS, one may have an obstacle to the learning process if the teacher provides the instructional material in advance only

through a single medium, a video, for example, causing much technological dependence. A fair and egalitarian environment must be created with regard to access to material and learning. In this way, it is confirmed what it presents [5] when it approaches that, the student who has access to information of his house and has access to the technology, is in advantage over the student who does not have these technological resources.

4 Final Considerations

In the current context, where the speed of the transformations undergone by society imposes a new rhythm on the formation and acquisition of knowledge, it is necessary to modify also the profile of the student of the XXI century, which will become a professional for the future work market.

In addition, the use of Active Methodologies has helped the student to perceive himself responsible for the construction of his own knowledge, promoting his autonomy and mobilizing his cognitive abilities, transforming them into knowledge connected with the reality in which he is inserted.

In order to use the Flipped Classroom and the Inverted Mastery Learning according to the theoretical references used by [3], the teacher used the Bloom Taxonomy verbs in the planning of his pedagogical activities.

The purpose of using Taxonomy verbs is to develop educational objectives that provide a pedagogical sequence of learning, where the student learns at his own pace, acquiring skills sequentially, beginning with lower order skills (Remembering and Understanding) and progressing in Acquisition of the learning objectives, reaching the acquisition of the higher order skills (Apply, Analyze, Synthesize and Create), thus permeating all the necessary content for its formation.

As presented in previous sections, the incorporation of Flipped Classroom and the Inverted Mastery Learning into the teacher's practice requires the adoption of the pedagogical pillars suggested by the Flipped Learning Network: Flexible Environment, Learning Culture, Intentional Content and Qualified Educator, where the educator must always keep in mind that to reverse the classroom is to displace all the pedagogical dynamics for the student and his/her learning.

Through this study, it was verified that the discussion forum, analyzed in the discipline Educational Evaluation in Distance Education, did not use, in its planning and structuring, the Active Flipped Classroom Methodology or the Inverted Mastery Learning, since did not follow the theoretical frameworks suggested by its idealizers, not even the pedagogical pillars. Your planning should have been guided by references other than those in this survey.

It is hoped that this study can collaborate as a reference for teachers who want to adopt the Active Flipped Classroom Methodology and Inverted Mastery Learning as a way to contribute to the formation of more proactive and critical students about the society in which they are inserted.

As future studies, it is intended to experiment with the methodology, making use of the theoretical references addressed by [3] and the pedagogical pillars in other LMS Moodle tools, in order to verify its efficiency and the impacts on the use.

References

1. Santos, E.: Educação online: cibercultura e pesquisa-formação na prática docente. Tese [Doutorado em Educação]. Faculdade de Educação. Universidade Federal da Bahia — FACED/UFBA, Salvador (2005)
2. Berbel, N.A.N.: A problematização e a aprendizagem baseada em problemas: diferentes termos ou diferentes caminhos? Interface: Comunicação, Saúde, Educação **2**(2), 139–154 (1998)
3. Bergmann, J., Sams, A.: Sala de Aula Invertida: Uma Metodologia Ativa de Aprendizagem. Tradução Afonso Celso da Cunha Serra, 1 edn. LTC, VitalBook file, Rio de Janeiro (2016)
4. Trevelin, A.T.C., Pereira, M.A.A., de Oliveira Neto, J.D.: A Utilização da 'Aula invertida' em Cursos Superiores de Tecnologia: Comparação Entre o Modelo Tradicional e o Modelo Invertido 'Flipped Classroom' Adaptado aos Estilos de Aprendizagem. In Revista de Estilos de Aprendizagem **11**(12), 1–14 (2013)
5. Valente, J.A.: Blended learning e as mudanças no ensino superior: a proposta da aula invertida. Educar em Revista, Curitiba, Brasil, Editora UFPR, Edição Especial n. 4, pp. 79–97 (2014)
6. Ferraz, A.P.C.M., Belhot, R.V.: Taxonomia de Bloom: revisão teórica e apresentação das adequações do instrumento para definição de objetivos instrucionais. Gest. Prod., São Carlos, **17**(2), 421–431 (2010)
7. Gil, A.C.: Como elaborar projetos de pesquisa. Atlas, São Paulo (2002)
8. LMS Help Class on Line. http://www.helpclassonline.com.br/moodle/
9. Sales, G.L.: Learning Vectors: Um Modelo de Avaliação da Aprendizagem em EaD Online Aplicando Métricas Não-Lineares. Tese de Doutorado. Programa de Pós-Graduação em Engenharia de Teleinformática. Universidade Federal do Ceará, Fortaleza (2010)
10. Leite, E.A.M., Machado, A., Sales, G.L., Zednik, H., Maia, S.M.: Distance education evaluation: an analysis of the β factor from LV model subjectivity. In: Rocha, A., Correia, A.M., Costanzo, S., Reis, L.P. (eds.) New Contributions in Information Systems and Technologies. AISC, vol. 353, pp. 1231–1241. Springer, Cham (2015). doi: 10.1007/978-3-319-16486-1_122