

Cognitive competence: comparing learning between traditional classroom and active classroom

Competência cognitiva: comparando a aprendizagem entre sala de aula tradicional e sala de aula ativa

Rosângela Minardi Mitre Cotta¹ 
Emily de Souza Ferreira² 
Rogério Elias Gomes do Prado³ 

Samantha Bicalho de Oliveira Cavalier⁴ 
Glauce Dias da Costa⁵ 
Tiago Ricardo Moreira⁶ 

^{1,3,6}Universidade Federal de Viçosa (Viçosa). Minas Gerais, Brazil. rosangelaminardi@gmail.com, rogerioprado777@gmail.com, samantha.cavalier27@gmail.com, glaucedcosta@gmail.com, tiagoricardomoreira@gmail.com

²Autora para correspondência. Universidade Federal de Viçosa (Viçosa). Minas Gerais, Brazil. emilynutufv@gmail.com

ABSTRACT | INTRODUCTION: The new student profile has required new formats of teaching and learning, with interconnected knowledge based on a pedagogical practice founded on reflection. **OBJECTIVE:** This study aimed to analyze how students evaluate what they learned using the Concept Map associated with the Inverted Classroom in the teaching, learning and assessment process compared to the Traditional Classroom. **METHODS AND MATERIALS:** A cross-sectional study was carried out with 90 students at a public university in Brazil from the years 2016 to 2018. For data collection, the authors used a high-reliability tool based on the Likert scale of 4 points containing questions regarding the competencies to be developed by the students. The Kolmogorov-Smirnov normality test was performed, and the Wilcoxon test was used to identify the differences between the two methods. The level of significance was 5%. **RESULTS:** The mean attributed to each of the two investigated methods was significantly higher ($p < 0.001$) in the Concept Map with Flipped Classroom (3.38) than in the Traditional Classroom (2.75). **CONCLUSIONS:** While the Concept Map favors the process of meaningful learning with comprehension, integration, and assimilation of content in an autonomous and co-responsible form by the students, the Traditional Classroom is based on the passive memorization of the content given by the teachers. Because of this, it is suggested that the Concept Map with a Flipped Classroom, according to students' perception, was more effective when compared to the Traditional Classroom by providing contents assimilation, interpretation, and integration.

KEYWORDS: Teaching assessment. University education. Teaching methods. Health education. Public health education.

RESUMO | INTRODUÇÃO: O novo perfil do aluno tem exigido novos formatos de ensino e aprendizagem, com saberes interligados a partir de uma prática pedagógica alicerçada na reflexão. **Objetivo:** O objetivo deste estudo foi analisar como os alunos avaliam o que aprenderam utilizando o Mapa Conceitual associado à Sala de Aula Invertida no processo de ensino, aprendizagem e avaliação em comparação com a Sala de Aula Tradicional. **MATERIAIS E MÉTODOS:** Estudo transversal realizado com 90 alunos de uma universidade pública do Brasil nos anos de 2016 a 2018. Para a coleta de dados, os autores utilizaram um instrumento de alta confiabilidade baseado na escala Likert de 4 pontos, contendo questões referentes às competências a serem desenvolvidas pelos alunos. O teste de normalidade de Kolmogorov-Smirnov foi realizado e o teste de Wilcoxon foi utilizado para identificar as diferenças entre os dois métodos. O nível de significância foi de 5%. **RESULTADOS:** A média atribuída a cada um dos dois métodos investigados foi significativamente maior ($p < 0,001$) no Mapa Conceitual com Sala de Aula Invertida (3,38) do que na Sala de Aula Tradicional (2,75). **CONCLUSÕES:** Enquanto o Mapa Conceitual favorece o processo de aprendizagem significativa com compreensão, integração e assimilação dos conteúdos de forma autônoma e corresponsável pelos alunos, a Sala de Aula Tradicional baseia-se na memorização passiva dos conteúdos ministrada pelos professores. Por isso, sugere-se que o Mapa Conceitual com Sala de Aula Invertida, na percepção dos alunos, foi mais eficaz quando comparado à Sala de Aula Tradicional, por proporcionar a assimilação, interpretação e integração dos conteúdos.

PALAVRAS-CHAVE: Avaliação do Ensino. Ensino Superior. Métodos de Ensino. Ensino em Saúde. Educação em Saúde Pública.

Introduction

The transformations arising from the new society of knowledge and the incorporation of Information and Communication Technology put in check not only the traditional way of teaching but also the learning process itself. The new student profile has required new formats of teaching and learning, with interconnected knowledge based on a pedagogical practice founded on reflection. In the twenty-first century, changes are required that demand different university agents (teachers, students, and managers) to act with audacity and courage in order to transform.¹⁻³

We need to implement formative processes with a humanistic focus centered on the human person, to overcome the technical-positivist (traditional) paradigm, towards the critical-reflexive (interpretative) paradigm, based on active participation.^{1,4-6} These transformations require a significant turnaround from the pedagogical, epistemological and psychosocial points of view, preparing the student for the dynamicity of life, which interferes with living conditions and the production of knowledge.⁵

In health, international guidelines recommend the formation of generalist, critical, reflexive, creative, humanized, and socially responsible professionals to work in universal, integral, and equitable systems, based on the demands of local communities, without losing sight of the global panorama.⁶⁻⁹

In view of this, the active teaching, learning, and evaluation methods have been shown as strategies to stimulate the exercise of reflexive, critical, creative, and innovative professional development. This puts into question the need to carry out studies that evaluate the effectiveness of these methods, when compared to traditional ones, from the perspective of the main stakeholders of the learning process, that is, the students, since few studies in the literature consider the students' perception.

In the Traditional Classroom, it is understood that lectures are given by the teachers, whose methods of evaluation are quizzes or exams (summative evaluation).¹⁰ The Active Classrooms, in turn, play a central role in the learning process in a dialogical way,

connecting students and teachers in the construction of knowledge and the development of competencies (knowledge, skills, and attitudes). Among these methods, we highlight and work in this study with the Concept Map using the Flipped Classroom, which aims to organize, represent and integrate knowledge in a collaborative way.¹¹

In the context of competency learning, the emphasis of both methods (the Concept Map and Traditional Classroom) is on cognitive development (knowledge and content). However, while the Concept Map favors the process of meaningful learning with comprehension, integration, and assimilation of content in an autonomous and co-responsible form by the students, the Traditional Classroom is based on the passive memorization of the content given by the teachers.^{1,12}

In this study, the process of constructing the Concept Map was with a Flipped Classroom, a pedagogical approach by which the acquisition of knowledge is facilitated before its application in the classroom, where the students first study the content (at a distance) and then, in the classroom, discuss with their peers (other students) in a collaborative way, clarifying doubts and doing exercises, under the teacher's guidance.¹³ The Concept Map, with a Flipped Classroom, provides active and meaningful learning, as well as the student's autonomy and student's commitment to the teaching, learning, and evaluation process.^{3,14}

For the purposes of this study, effectiveness is understood as the effect of an activity (in the case of this study, a method) and its final results, benefits, and consequences for a particular group or study population (students), when compared to the established objectives and sustainability of the process and the initiative.¹⁵ In the case of our study, we call the effect of the use of teaching, learning, and assessment methods in the teaching of students in Nursing, Medicine, and Nutrition courses effective.

This study aimed to analyze how students evaluate what they learned using the Concept Map associated with the Inverted Classroom in the teaching, learning, and assessment process compared to the Traditional Classroom.

Setting

This study was developed for three years (2016, 2017, and 2018) with all 90 students of the 4th and 5th semesters of the Nursing, Medicine, and Nutrition courses that attended the discipline of Health Policies at the Federal University of Viçosa, a public university in Brazil. 40% of the contents were developed through the traditional classroom (expository classes and exams) and 60% through the active classroom (concept map and flipped classroom and other methods not deepened in this study); thus, all students experienced both methods and the same contents.

The teaching and learning process referring to the traditional classroom is carried out individually, and the concept map and flipped classroom are in small groups (which are divided at the beginning of the school semester and remain the same until the end). The evaluation process also differs. In the active classroom, the evaluation is formative, occurring at six moments during the school semester, with assertive and timely feedback for correction of directions and achievement of the required competencies, followed by self-assessment by students and evaluation by teachers. The evaluation of the traditional classroom occurs in a punctual and summative way, using two exams, one in the middle of the semester and the other at the end, in addition to other exercises throughout the semester and lectures.

In our study, we highlight the interprofessional nature of small groups. As we have three different courses, the orientation during the formation of the groups was that it should be as interprofessional as possible, that is, it should have at least one student from each course. This expands the learning and vision of colleagues who experience different areas, strengthening interprofessional teamwork, a common practice after the graduation of students at the university.

The Research Ethics Committee of the Federal University of Viçosa approved the study under protocol 2.230.939. Students who agreed to participate were informed about the study before signing the informed consent form. All participants signed the form. Minors were not included in this study.

Development of the active and traditional methods questionnaire

For data collection, we used a questionnaire called: Student Perception Assessment Tool – SPAT (see [Annex 1](#)), built to assess the perception of students of health courses on the teaching process, learning, and evaluation through the Concept Map with a Flipped Classroom (active classroom) and the traditional classroom (expository classes and exams). The overall reliability of the questionnaire was calculated using Cronbach's alpha coefficient and was 0,917. More specifically, the reliability of the concept map with a flipped classroom was 0,880, and the traditional classroom was 0,931, which is very high. According to the scale proposed by Prado (2015)¹⁶, all these values from 0,81 to 1,00 are considered very high.

The SPAT was built based on the Likert scale in which students identify their level of agreement from 4 propositions followed in ascending order: I totally disagree, disagree, agree, and totally agree. The statements were constructed from the competencies necessary for the training of students in the health area and the learning objectives to be achieved with the methods analyzed.¹⁷⁻²⁰

Sixteen questions were included, with 8 referring to the concept map with a flipped classroom and 8 on the traditional classroom. At the end of each semester, after completing all the activities of the discipline, the students were asked, anonymously, to answer the questionnaire, thus avoiding possible biases.

Performance assessment

In addition to analyzing the students' perceptions through the answers of the questionnaires applied (SPAT), we also conducted a performance analysis. This performance was evaluated at each stage of the development of the concept map with a flipped classroom (six moments of construction and evaluation with assertive feedback during the school semester) using the Concept map Assessment Tool (see [Annex 2](#)). At the end of the school semester, the students present a single concept map of all discipline content, demonstrating the synthesis capacity and the integration of content.

During the school semester, the same contents are worked both in the traditional classroom and in the active classroom, concomitantly, that is, the student is introduced and studies at the same time through both forms of teaching. The difference is the way they are approached from learning to evaluation (summative or formative), which allows us to compare which real learning was more effective. We measured the performance based on the entire teaching, learning, and evaluation process of students, throughout the school semester.

Teaching, learning, and evaluation methods

Concept map and formative evaluation

The concept map was developed by Novak (2008)²¹ as a graphical tool to organize and represent knowledge (cognitive dimension of competence), aiming to adapt greater understanding and assimilation of a particular theme or content. It is based on Ausubel's theory of Meaningful Learning (1980)²², which highlights that effective learning demands that knowledge be understood, significantly relevant, and integrated. For Cotta et al. (2015)⁵, the concept map enables the

realization of connections between the new knowledge studied and those already existing, the review of ideas, and the organization of the content autonomously.

In the discipline of policies and health, the concept map is collectively constructed (collaborative learning) by teams consisting of 5 to 7 students and is based on the chapters of the book used as a reference of the discipline, titled "Health Policy: Designs, Models and Paradigms".²³ The construction of the concept maps occurs with the use of the CMap Tools Software, which is a free online available tool that allows the construction of concept schemes and represents them graphically.

The evaluation process of the concept map follows the precepts of the formative evaluation: it is built at six specific moments in the classroom, throughout the school semester, and with a consecutive process of self-evaluation by students and evaluation and feedback by teachers. At the end of the semester, each team builds a single concept map containing the entire content of the discipline, so students gradually incorporate new concepts, and some key concepts become secondary to the extent that students assimilate them and new concepts. Table 1 shows the moments of the construction of the concept map with a flipped classroom.

Table 1. Description of the Moments of Flipped Classroom Development and Concept Map Construction

1st Moment (presential)	Students receive the following one week in advance: - Read, summarize and list the Key Concepts of chapter "X": from the Book "Health Policies: Designs, Models and Paradigms" ¹⁶
2nd Moment Individual Activity (at a distance)	1) Study the Chapter of the book (or part of the chapter) 2) Build a Synthesis 3) List the Key Concepts The time between the given command and the delivery of the Activity is one week
3rd Moment (face-to-face and distance learning)	Students deliver the Summaries and Key Concepts listed (face-to-face), and teachers correct them (at a distance)
4th Moment Collective Activity in small groups (presential)	1) Teachers deliver corrected Synthesis and Key Concepts 2) The students divide the roles in the group (coordinator, time manager, rapporteur) and define the <i>Working Process</i> of the group 3) Students discuss, systematize and construct the Collective Synthesis from the individual Synthesis 4) Collectively list the Key Concepts of the chapter (consensus) 5) Each group builds the Concept Map from the Key Concepts they listed. Note: As new chapters are incorporated into the Concept Map, students exercise the "detachment" exercise, transforming previously key concepts into secondary concepts, excluding them, and incorporating new key concepts. 6) Feedback and face-to-face assessment - at the end, teachers evaluate each group's concept map using the Concept Map Assessment Tool. ⁴ Classroom time: 2 hours
5th Moment (presential)	If necessary, the teacher works the chapter in the classroom through dialogue or other techniques, highlighting difficulties, incorrect concepts, doubts, etc.
6th Moment (At a distance)	Submission of the new version of the Concept Map (after evaluation and feedback) - until midnight the day before the next Lecture (1 week), followed by evaluation by the teachers of the final version of the said Moment.

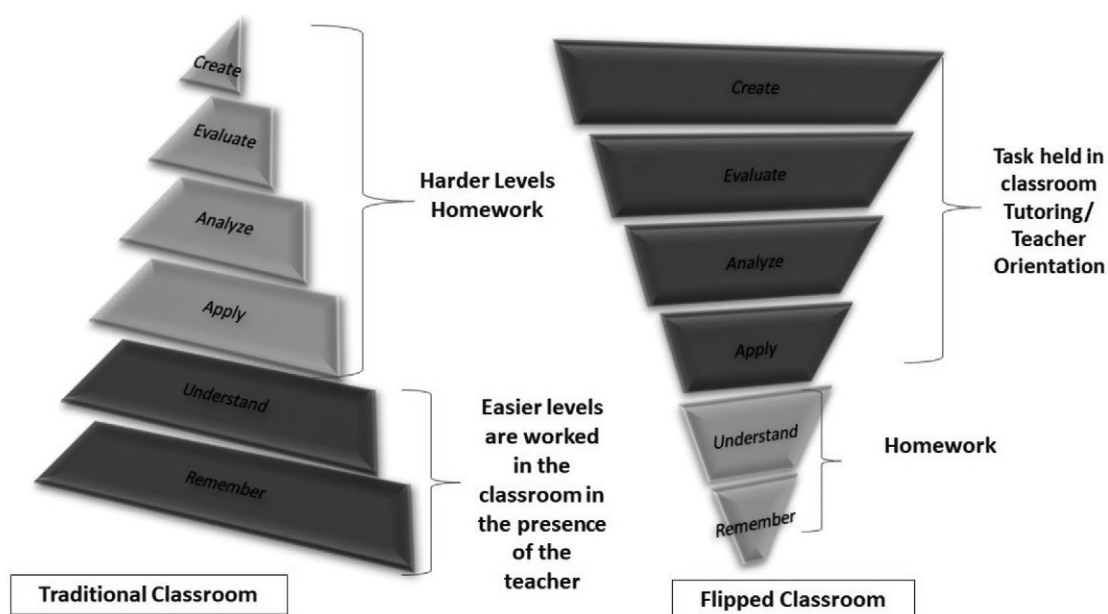
Flipped Classroom

The flipped classroom is a pedagogical approach by which students study the contents previously to the classroom. The classroom is designed for students to discuss with their peers (peer learning) and perform exercises under the tutoring and guidance of teachers.^{14,24}

Anderson et al. (2001)²⁵ presents a new structure of the revised Bloom's Taxonomy where the learning objectives are hierarchically classified, from which one can understand the difference between the traditional classroom and the flipped classroom. More specifically, in the traditional classroom, the easiest categories of Bloom's Taxonomy (remember and understand) are worked in the classroom, in the presence of the teacher.

In turn, in the flipped classroom, the opposite occurs, students study the easiest categories at home, and in the classroom, in the presence of the teacher, students practice more complex cognitive processes (apply, analyze, evaluate and create) (Figure 1).²⁶

Figure 1. Learning objectives, according to the revised Bloom's Taxonomy, worked in the traditional classroom and in the flipped classroom



Source: Adapted from Bergmann 2018.

Traditional classroom and summative evaluation

In the traditional classroom, it usually occurs through lectures delivered by the teacher. In this model, students passively receive the content, memorize it, and then prove that they have learned through cognitive and punctual assessments. The reference is the Technician-positivist model. This type of evaluation is usually called summative evaluation and aims to compare, categorize and classify students, here the final result expressed by means of grades is concerned.^{1,4}

Data analysis strategy

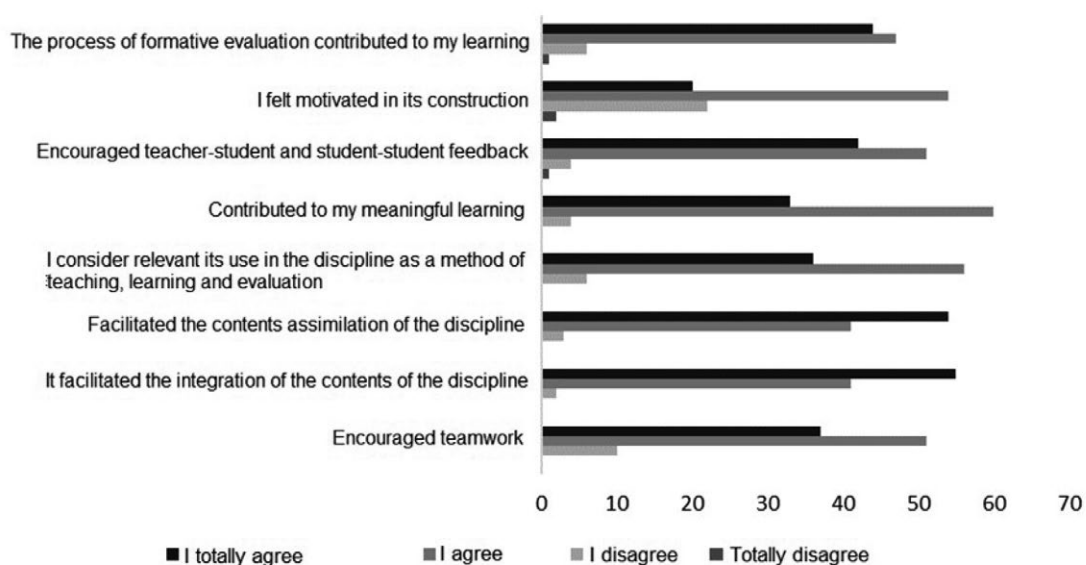
From the questionnaire of Evaluation Tool for Active and Traditional Teaching, Learning and Assessment Methods, we assigned values (scores) from 1 to 4 for the answers to the questions about each method (1 - totally disagree, 2 - disagree, 3 - agree and 4 - totally agree). In the description of the quantitative variables, the mean and median were used as measures of central tendency and interquartile range (25 and 75%) as a measure of the dispersion of each method.

The Kolmogorov-Smirnov normality test was performed, and the Wilcoxon test was used to identify the differences between the two methods. The level of significance was 5%. Statistical analysis was performed using SPSS software for Windows (Version 23.0; SPSS, Chicago).

Results

The skills worked on active methods can be seen in Graph 1, which addresses the questions provided in the SPAT questionnaire that all students answered at the end of the semester. These questions are the competencies that students develop when using the Concept Map and the Flipped Classroom for teaching, learning, and assessment. For each question presented in the graph (on the left), there is the percentage of agreement of all students.

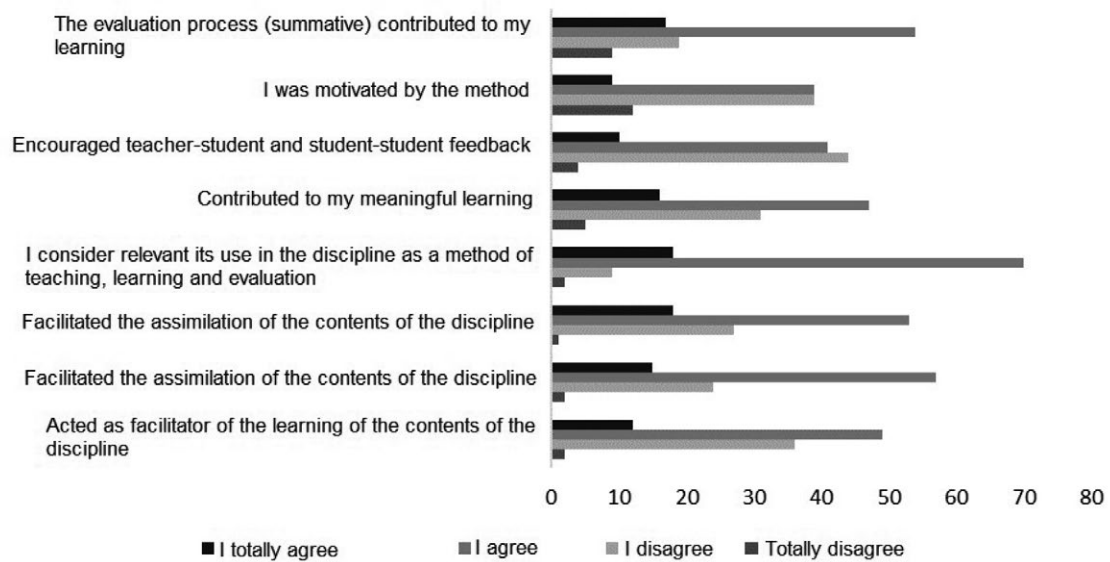
Graph 1. Students' perception using the Concept Map with the Flipped Classroom for learning



According to the frequency analysis, all competencies worked on in the Concept Map and the Flipped Classroom obtained a high approval rate (above 90%), with answers given 3 and 4 points (agree and totally agree, respectively). The students emphasize that the Concept Map contributes significantly to the exercise of the following competencies: "Facilitated the assimilation of the course content" (95,96%); "Facilitated the integration of the course content" (96,97%); "Encouraged teamwork" (88,89%); "Contributed to significant learning" (93,94%).

The Graph 2 addresses the use of the traditional classroom; the indices were lower when compared with the concept map and the flipped classroom. For example, 48,0% of the students felt unmotivated when using this method.

Graph 2. Students' perception using the Traditional Classroom



Our results indicate that students working with the Concept Map with a Flipped Classroom had a significantly higher degree of satisfaction when compared to the Traditional Classroom. Considering the sum of the minimum value (8 points) and maximum (32 points) of the adopted Likert scale, both the sum of the eight items that make up the tool and the average of them, presented higher medians when comparing the use of the Concept Map and Flipped Classroom with the Traditional Classroom (Table 2).

Table 2. Concept Map and Flipped Classroom compare to the Traditional Method

Method	Median				P value *
	Sum	IQR 25 - 75	Average	IQR 25 - 75	
Conceptual Map	27.0	24.0 - 30.0	3.38	3.0 - 3.75	< 0.001
Traditional Method	22.0	18.0 - 25.0	2.75	2.25 - 3.13	< 0.001

Notes: * Wilcoxon test

Abbreviation: IQR = Interquartile Range

Regarding Table 3, we made a comparison of learning, according to the student's perception, in the methods used: active (Conceptual Map and Flipped Classroom) and traditional (traditional classroom). It shows that for each of the questions in common with the two methods, the students preferred active methods to the traditional one, with this difference being significant in all questions ($p < 0.001$).

Table 3. Learning comparison between the Concept Map and Flipped Classroom with the Traditional Method

	Conceptual Map		Traditional Method		P value *
	Median	IQR 25 – 75	Median	IQR 25 – 75	
I consider relevant	3.0	(3.0 – 4.0)	3.0	(3.0 – 3.0)	< 0.001
Contributed to Significant Learning	3.0	(3.0 – 4.0)	3.0	(2.0 – 3.0)	< 0.001
Encouraged teacher-student and student-student feedback	3.0	(3.0 – 4.0)	3.0	(2.0 – 3.0)	< 0.001
I felt motivated	3.0	(3.0 – 3.0)	2.0	(2.0 – 3.0)	< 0.001
It facilitated the assimilation of contents	4.0	(3.0 – 4.0)	3.0	(2.0 – 3.0)	< 0.001
I believe that the evaluation process has contributed to my learning	3.0	(3.0 – 4.0)	3.0	(2.0 – 3.0)	< 0.001

Abbreviation: IQR = Interquartile Range

Discussion

The results of our study point to a better effectiveness in the development and exercise of cognitive competence, through the concept map and flipped classroom, than with the traditional classroom. The combination of the flipped classroom with the process of constructing the concept map was well evaluated by the students, mainly because they built the concept maps throughout the school semester and in the classroom in the presence of the teacher, who was available to guide them and discuss with them about important points.

Our results also demonstrated the development of the habit of regularly studying, when they made the summaries of the book chapters and listed the key concepts, first individually followed, in a second moment, by the discussion with their respective teams.

The results of this study show too that 90% of the students assessed the significant contribution of the Concept Map with the Flipped Classroom to the development of the competencies worked on in the Health Policy course. Comparing the two methods with the evaluation tool's six competencies in common, the Concept Map provided better assimilation and integration of the content, and the students reported that they felt more motivated with the teaching, learning, and evaluation processes. On the other hand, 48% of the students did not feel motivated in the Traditional Classroom.

The active classrooms are inserted in the context of the exercise of cognitive and/or metacognitive competencies. Thus, the exercise of reasoning, analysis, and synthesis, aims at the stimulation of thinking, understanding, and interpreting, leading to the improvement of strategies for the resolution of real-life problems.²⁷ The integration of new knowledge into an existing student structure (meaningful learning) can help in the absorption, integration, and application of important content, as well as allowing them to learn and assimilate new concepts and relate them to each other.¹¹

In our study, the Concept Map as an active classroom provided additional resources for the formative teaching and learning process through assertive and timely feedback from teachers, as well as constructing concrete strategies for the correction of direction and scope of the competencies outlined in partnership with the students, with a stimulus to self-evaluation of the teaching and learning process.²⁸

In a study developed by Ho et al. (2014)¹¹, besides students not resisting the use of the Concept Map, they also evaluated this method better than the Traditional Classroom. In another study by Hawkins et al. (2015)²⁸, which implemented competency-based medical education, three scoring systems were used to assess the quality, the importance of propositions, and the complexity characteristics of the Concept Map. The authors reached the conclusion that this method can be reliably administered in education.

Both the studies by Ho et al. (2014)¹¹ and Hawkins et al. (2015)²⁸ concur with the results of the present research, showing that the use of the Concept Map was assessed by students as important for the acquisition of competencies related to Health Policies, especially cognitive ones.

A study carried out by Salah and Kassab (2016)¹², whose objective was to evaluate the generalization and the sources of variance in evaluation scores of the Concept Map, obtained high reliability. This result upholds the results of our study, in which all the competencies addressed by the use of the Concept Map and Flipped Classroom obtained a score equal to or above 90%.

In a complementary way, the study developed by Schwartzstein (2017)²⁹ also demonstrated that the Traditional Classroom, by placing the student in a situation of mechanical memorization and accumulation of information, may even be efficient from the teaching point of view (for the teacher), but it is not likely to be an effective way of learning (for students). Thus, the use of the Concept Map with the Flipped Classroom as an innovative and active classroom meets the needs and learning profile of the students in the 21st century by the following: stimulating the search for information autonomously and outside the classroom; strengthening the student-teacher and student-student bond and partnership; and providing continuous and timely feedback to make corrections. This active classroom, in addition to driving students to focus on more complex content, make the teaching and learning process more dynamic, and the teachers and students co-responsible for a project built and reconstructed constantly in partnership.^{3,12}

In this way, the Concept Map and Flipped Classroom, to student's perceptions, are more adequate because they transform the teaching and learning praxis mechanistic and fragmented into innovative, critical, and reflexive, transforming educational experiences, facilitating the learning and comprehension of key concepts of the themes studied, besides providing connection between various content as well as teamwork stimulus with autonomy.⁵

As a limitation of our study, we can highlight the small sample size of this study and the impossibility of using a control group and an intervention group since

the methods are applied in a single school subject, which is why all students try all methods: active and traditional. On the other hand, our study was able to provide enough statistical power to adequately demonstrate significant differences between the two methods and the high reliability of the Cronbach alpha coefficient (α), from 0,880 for the Concept Map and Flipped Classroom and 0,931 for the Traditional Classroom, decreases possible biases of the study.

Conclusion

We evaluated and compared two methods whose emphasis is on the teaching and learning of cognitive competence, that is, in learning content and theoretical knowledge, one being an active and innovative method (Concept Map and Flipped Classroom) and the other technical-positivist (Traditional Classroom). The results of this study indicate that the use of Concept Map with a Flipped Classroom is superior to that of the Traditional Classroom by providing content assimilation and integration, teamwork stimulation, meaningful learning, and the development of autonomy.

We infer, therefore, that the Concept Map with a Flipped Classroom, when used in the context of formative teaching, learning, and evaluation, provides co-responsibility of the students and places them in a situation of the protagonist, having its strong point in the formative evaluation carried out longitudinally during the semester, with assertive and timely feedback, assisting in didactic planning and course correction.

Ethics approval and consent to participate

The study was approved by the Ethics and Research Committee with Human Beings of the Federal University of Viçosa, and all the participants signed the Term of Free and Informed Consent.

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Authors' contributions

Cotta RMM coordinated the study, participated in the data collection, the article's topic design, and review throughout its construction. Ferreira ES participated in the collection and analysis of the data and revision of the article during its production. Prado REG and Cavalier SBO participated in the collection and analysis of data and scientific writing. Moreira TR participated in the statistical analysis of the data and final review of the article. Costa GD participated in the review of the article during its production. All authors read and approved the final manuscript.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

References

1. Cotta RMM, Costa GD. Portfólio reflexivo: método de ensino, aprendizagem e avaliação. Minas Gerais: Editora UFFV; 2016.
2. Delphino FBB, Oliveira E, Felisbino AM, Sgorbissa ML, Souza DR. A utilização de metodologias ativas em cursos superiores para uma aprendizagem significativa. In: Jerez O, Silva C, organizators. Innovando en la educación superior: experiencias clave em Latinoamérica y el Caribe 2016-2017 (Volumen 3: Integración de TIC's). Santiago: Facultad de Economía y Negocios, Universidad de Chile; 2017. pp. 67-77. <https://doi.org/10.34720/7khq-d689>
3. Costa GD, Driessen E, Silva LS, Campos AAO, Costa TMT, Donateli CP, et al. Collective portfolio: assessment of teaching and learning in health undergraduate courses. *Ciênc Saúde Colet.* 2018;23(11):3779-787. <https://doi.org/10.1590/1413-812320182311.27072015>
4. Roget AD, Serés MVG. La práctica reflexiva: bases, modelos e instrumentos. Madrid: Narcea S.A. de Ediciones; 2014.
5. Cotta RMM, Costa GD, Mendonça ET. Critical and reflective portfolios: a pedagogical approach centered on cognitive and metacognitive skills. *Interf.* 2015;19(54):573-88. <https://doi.org/10.1590/1807-57622014.0399>
6. Cotta RMM, Silva LS, Cotta RM, Cotta FM, Bastos MAP, Campos AAO, et al. The Conceptual Map as a tool for teaching and meaningful learning about the Unified Health System. *J Manag Prim Health Care.* 2015;6(2):264-81. <https://doi.org/10.14295/jmphc.v6i2.306>

7. Delors J. La educación encierra un tesoro. Madrid: Santillana; 1996.
8. Frye AW, Hemmer PA. Program evaluation models and related theories: AMEE guide no. 67. *Med Teach.* 2012;34(67):288-99. <https://doi.org/10.3109/0142159x.2012.668637>
9. Conselho Nacional de Saúde (Brasil). Resolução MS/CNS nº 569, de 08 de dezembro de 2017 [Internet]. Brasília: Conselho Nacional de Saúde; 2017. Available from: <https://conselho.saude.gov.br/resolucoes/2017/Reso569.pdf>
10. Blanco A. Desarrollo y evaluación de competencias en educación superior. Madrid: Narcea S.A. de Ediciones; 2009, p. 17-34.
11. Ho V, Kumar RK, Velan G. Online testable concept maps: benefits for learning about the pathogenesis of disease. *Med Educ.* 2014;48(7):687-97. <https://doi.org/10.1111/medu.12422>
12. Kassab SE, Fida M, Radwan A, Hassan AB, Abu-Hijleh M, O'Connor BP. Generalisability theory analyses of concept mapping assessment scores in a problem-based medical curriculum. *Med Educ.* 2016;50(7):730-37. <https://doi.org/10.1111/medu.13054>
13. Flipped Learning Network. Definition of Flipped Learning [Internet]; 2014. [updated 2014 mar. 12; cited 2019 jun. 01]. Available from: <https://flippedlearning.org/definition-of-flipped-learning/>
14. Chen F, Lui AM, Martinelli SM. A systematic review of the effectiveness of flipped classrooms in medical education. *Med Educ.* 2017;51(6):585-97. <https://doi.org/10.1111/medu.13272>
15. Organización Mundial de la Salud. Evaluación de la promoción de la salud: principios y perspectivas. Metodologías para la promoción de la salud [Internet]. Washington, D.C.: OPS; 2007. 524 p. Available from: <https://iris.paho.org/handle/10665.2/3070>
16. Prado LB, Avila NR, Llobet MP, Canut MTL, Rodriguez SF, Lajara MAG. Escala de Autopercepción del Pensamiento Crítico en Alumnos de Enfermería [Internet]. III Congreso Internacional sobre Aprendizaje, Innovación y Competitividad (CINAIC); 2015 oct. 14-16; Madrid, Spain. [cited 2021 oct. 01]. Available from: http://138.4.83.137/dmami/documentos/liti/Actas_CINAIC_2015.pdf
17. Zabalza MA. Competencias docentes del profesorado universitario: calidad y desarrollo profesional. 2a. ed. Madrid: Narcea S.A. de Ediciones; 2009.
18. Lizarraga MLSA. Competencias cognitivas en Educación Superior. 2a. ed. Madrid: Narcea S.A. de Ediciones; 2010.

19. Cotta RMM, Costa GD. Assessment instruments and self-evaluation of reflective portfolios: a theoretical-conceptual construction. *Interf.* 2016;20(56):171-83. <https://doi.org/10.1590/1807-57622014.1303>
20. Cotta RMM, Silva LS, Costa GD, Cotta FM, Cotta RM. Portfólio coletivo reflexivo: ferramenta potencializadora do trabalho em equipe, raciocínio crítico e tomada de decisões. *Rev S Greg* [Internet]. 2017;16:12-21. Available from: <https://revista.sangregorio.edu.ec/index.php/REVISTASANGREGORIO/article/view/416>
21. Novak JD, Cañas AJ. The theory underlying Concept Maps and how to construct them, Technical Report IHMC CmapTools 2006-01. Florida Institute for Human and Machine Cognition [Internet]. 2006;(6):1-36. Disponível em: <https://cmap.ihmc.us/publications/researchpapers/theorycmaps/TheoryUnderlyingConceptMaps.bck-11-01-06.htm>
22. Ausubel DP, Novak JD, Hanesian H. *Educational psychology*. 2a. ed. New York: Holt, Rinehart and Winston; 1980.
23. Cotta RMM, Costa GD, Mendonça ET. Reflective portfolio: a proposal for teaching and learning geared on competencies. *Ciênc Saúde Colet*. 2013;18(6):1847-56. <https://doi.org/10.1590/S1413-81232013000600035>
24. Cotta RMM, Ferreira ES. Mapas conceituais e aula invertida: benefícios para o processo de ensino e aprendizagem sobre as políticas de saúde. *Rev Invest Educ Univ* [Internet]. 2019;2(1):22-32. Available from: <http://revistas.educacioneditora.net/index.php/RIEU/article/view/26>
25. Anderson LW, Krathwohl DR. *A taxonomy for learning, teaching and assessing: a revision of Bloom's Taxonomy of Educational Objectives*. Nova York: Addison Wesley Longman; 2001.
26. Bergmann, J. *Aprendizagem invertida para resolver o problema do dever de casa*. Porto Alegre: Penso; 2018.
27. Daley BJ, Torre DM. Concept maps in medical education: an analytical literature review. *Med Educ*. 2010;44(5):440-48. <https://doi.org/10.1111/j.1365-2923.2010.03628.x>
28. Hawkins RE, Welcher CM, Holmboe ES, Kirk LM, Norcini JJ, Simons KB, et al. Implementation of competency-based medical education: are we addressing the concerns and challenges? *Med Educ*. 2015;49(11):1086-102. <https://doi.org/10.1111/medu.12831>
29. Schwartzstein RM, Roberts DH. Saying goodbye to lectures in medical school - paradigm shift or passing fad? *N Engl J Med*. 2017;377(7):605-07. <https://doi.org/10.1056/nejmp1706474>

Annexes

Annex 1. Student Perception Assessment Tool (to be continued)

Student Perception Assessment Tool (SPAT)

REFLECTIVE PORTFOLIO	Completely disagree	Disagree	Agree	Completely Agree
I consider relevant the use of Reflexive Portfolio in the discipline as a method of teaching, learning and evaluation	1	2	3	4
The Reflective Portfolio stimulated my critical capacity as a student, university student and citizen	1	2	3	4
The Reflective Portfolio stimulated my reflective capacity as a student, university student and citizen	1	2	3	4
The Reflective Portfolio stimulated my autonomy as a student, university student and Citizen	1	2	3	4
The Reflective Portfolio stimulated my reflective capacity as a student, university student and citizen	1	2	3	4
The Reflective Portfolio stimulated co-responsibility for the teaching, learning and evaluation process	1	2	3	4
The Reflective Portfolio stimulated teamwork	1	2	3	4
The construction of the Reflective Portfolio encouraged me to pay more attention, to understand and to argue about the current events of Health Policies of Brazil and the world	1	2	3	4
The Reflective Portfolio contributed to the study of the topics related to the Health Policies in the actual days	1	2	3	4
I was able to perceive my personal growth and as a student of the Health area with the construction of the Reflective Portfolio	1	2	3	4
The use of the Reflective Portfolio contributed to my Significant Learning	1	2	3	4
The Reflective Portfolio stimulated teacher-student and student-student feedback	1	2	3	4
I was motivated by the process of building the Reflective Portfolio	1	2	3	4
I believe that the process of evaluation (formative) of the Reflective Portfolio contributed to my learning	1	2	3	4

Annex 1. Student Perception Assessment Tool (conclusion)

CONCEPTUAL MAP ASSOCIATED TO FLIPPED CLASSROOM	Completely disagree	Disagree	Agree	Completely agree
I consider relevant the use of Conceptual Map with the Flipped Classroom in the discipline as a method of teaching, learning and evaluation	1	2	3	4
The Conceptual Map with the Flipped Classroom facilitated the assimilation of the contents of the discipline	1	2	3	4
The Conceptual Map with the Flipped Classroom facilitated the integration of the contents of the discipline	1	2	3	4
The Conceptual Map with the Flipped Classroom stimulated teamwork	1	2	3	4
The use of Conceptual Map with the Flipped Classroom contributed to my Significant Learning	1	2	3	4
The Conceptual Map with the Flipped Classroom stimulated teacher-student and student-student feedback	1	2	3	4
I felt motivated by the process of building the Conceptual Map with the Flipped Classroom	1	2	3	4
I believe that the process of evaluation (formative) of the Conceptual Map with the Flipped Classroom contributed to my learning	1	2	3	4
TRADITIONAL CLASSROOM (lectures and exams)	Completely disagree	Disagree	Agree	Completely Agree
The Test facilitated the assimilation of the contents of the discipline	1	2	3	4
The Test facilitated the integration of the contents of the discipline	1	2	3	4
The Tests served as a facilitator of the learning of the contents of Health Policies	1	2	3	4
The use of Tests contributed to my Learning significantly	1	2	3	4
The Test stimulated teacher-student and student-student feedback	1	2	3	4
I felt motivated with the realization of Tests	1	2	3	4
I believe that the process of evaluation (summative) of the Tests contributed to my learning	1	2	3	4

Annex 2. Conceptual Map Assessment Tool (to be continued)

Conceptual Map Assessment Tool

Student / Group Name: _____

Class: _____ () 1st. Evaluation - Presential – date: _____ () 2ª Evaluation- Presential – date: _____
 Long distance – date: _____ Long distance – date: _____

() 3rdª. Evaluation - Presential – date: _____ () 4ª Evaluation - Presential - date: _____
 Long distance – date: _____ Long distance - date: _____

TOTAL: _____

EVALUATED ASPECTS	1st MOMENT (PRESENTIAL)			2nd MOMENT (LONG DISTANCE)				Score
	Teacher’s Evaluation: Guidelines held in class – which must be embodied by students			Teacher’s evaluation of the student’s e-mail sent version, after feedback given in class.				
	Send new version in a week			Did the students embody guidelines held in class?				
KEY CONCEPTS	Yes	No	Justifications	Yes	No	Partially	Justifications	
Presence of wrong Concepts (1.0 points)								
Presence of repeated key-concepts (0.2 points)								
Lack of key-concepts that are needed to build the Conceptual Map (1.0 points)								

Annex 2. Conceptual Map Assessment Tool (continuation)

Presence of more than one key-concept in the text box (0.5 points)								
Presence of secondary concepts in text boxes (0.3 points)								
BINDING TERMS	Yes	No	Justifications	Yes	No	Partially	Justifications	Score
Presence of key concepts in binding terms (0.5 points)								
Inappropriate binding terms (0,5 points)								
Not using binding terms to form proposition (0.3 points)								
OTHER IMPORTANT ASPECTS	Yes	No	Justifications	Yes	No	Partially	Justifications	Score
Inappropriate Propositions (Wrong sentences) (2.0 points)								
Presence of arrow overlap and / or no arrowhead (0.2 points)								
Ability to synthesize (replace / exclude key concepts, which become secondary as the knowledge about Health Policy is expanded) (1.5 points)								

Attachments 2. Conceptual Map Assessment Tool (conclusion)

<p>Graphic Organization of the Conceptual Map (allowing a clear and coherent visualization of the parts and the whole) (0.5 points)</p>				
<p>Does the Conceptual Map allow you to visualize the integration of the key contents of the studied chapters? That is, as new key concepts are learned, are they integrated into the MC in a coherent and harmonious way, avoiding the fragmentation of contents? (1.5 points)</p>				

Observations.: _____

Source: Cotta RMM, et al. O Mapa Conceitual como ferramenta de ensino e aprendizagem significativa sobre o Sistema Único de Saúde. J. Manag Prim Heal Care. 2015; 6(2):264-281.