Flip Classroom Approach Comparison on Perception, Motivation and Outcome of Students in Engineering Technology Instruction between Assisted Flip versus Complete Flip

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Abstract

This paper provides a comparison between two different levels of the Flip Classroom approach utilized in engineering technology course instruction. The Motivated Strategies for Learning Questionnaire (MSLQ) was distributed to the students to get their feedback in order to compare and analyze the student perception, motivation and outcome in these two different levels of Flip Classroom. The Complete Flip Classroom has advantages over the Assisted Flip Classroom approach in the aspects of student perception, motivation, and self-regulation. These results indicate that if the perception of students can be positively influenced, the student will be motivated to assign more time to self-driven learning and self-driven practicing of the Flip Classroom materials.

Introduction

The effectiveness of traditional teaching methods greatly relies on the instruction style of the professor. Because the information flow was initiated from the lecture of the professor, then students passively received this information flow by watching, listening, and note taking. Thus, the instruction style would have a significant influence on the classroom environment, student engagement, the process of knowledge recognition, acquisition, absorption, and application. Therefore, the motivation of learning and the learning process itself is highly influenced by the following two factors: the self-consciousness of the students with the self-driven desire for knowledge, plus the ability of the professor to keep the course attractive and informative.

Flip Classroom provides a different approach to stimulate the perception and motivation of students in self-driven learning, self-driven practicing, and testing. By altering from the regular teacher-centered learning patterns, Flip Classroom approach allocates the classroom time as learner-centered activities [1]. Thus, the strategy of Flip Classroom has attracted lots of educational research attention during the past decades [2-7]. The topics in previous studies focused on different aspects, such as the advantage and challenges [1], student engagement [3, 6], classroom climate [4], student assessment [8], etc. However, the different levels of Flip Classroom have not been studied adequately in the past. In this paper, different levels of Flip Classroom were compared between two courses in the aspect of student perception, motivation and outcome using the Motivated Strategies for Learning Questionnaire (MSLQ). The results indicate that if the perception of students can be positively influenced, students will be motivated to assign more time allocation on self-driven learning and self-driven practicing of the Flip Classroom material. Thus, the students can achieve a better outcome for the learning process.

Methods and Procedures

In the following sections, details on how the two different levels of Flip Classroom were conducted and the instrument used for comparison are discussed.

Assisted Flip Classroom

Assisted Flip Classroom was performed in Engineering Economic Analysis course. Although this course is traditionally taught to most engineering students, in our institution this course is only offered to the students majoring in the Bachelor of Science in Engineering Technology, with Applied Systems Technology concentration, which is a concentration with an emphasis on mechanical and manufacturing engineering technology. The student enrollment of the course was 30 in 2019 fall semester, 37 in 2018 fall semester and 43 in 2017 fall semester. The method of Assisted Flip was introduced to the students in the fall semester in 2019 and will be used again in the next coming offerings of the class. In this section, more details on how this method was conducted are discussed.

At the beginning of the semester, the Assisted Flip Classroom approach was introduced to the students with instructions on how to successfully use of materials provided by the instructor. The material was provided to the students via the Learning Managing System (LMS), in our case Blackboard, and included all the topics to be covered in the class. This setting could guarantee the students can review the required material at their own pace.

The course contents were divided into multiple session modules throughout the semester. It was expected that the students review the required material for each module before the face-to-face meeting. This course delivery method is defined as Assisted Flip Classroom, since the majority of the course materials, including lecture PowerPoint slides, online videos, online book tutorials, and recommended assignments were all available on the LMS starting from the first day of class. The class was carried out in the sequence as shown in Figure 1.

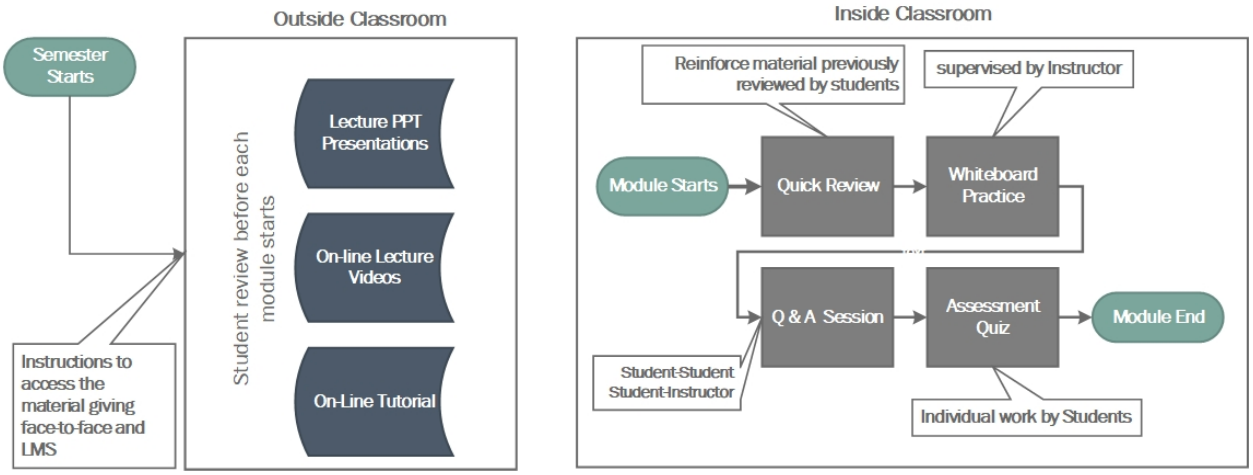


Figure 1. Flow chart of Assisted Flip Classroom sequence

Each module was carried out in the following sequence:

1. A quick review session: a summary discussion on the topic theory, formulae, and important points to remember were offered by the instructor.
2. A small group whiteboard session: students solving assigned problems in teams of 3 or 4 using a provided piece of a whiteboard paper and markers. During this group practice session, the students helped each other to better the understanding of the material and

solving the problems successfully. Sometimes the instructor intervened to ensure the correctness of the material.

3. A question & answer session: students asked questions specific to the module. The questions could be specific to the problems recently solved, regarding the theory discussed in the LMS material and/or the summary discussion.
4. A quiz session: assessing the student's individual concept understanding, and knowledge acquisition during this module

These four steps were divided and fit into different days of face-to-face meeting time, depending on the complexity of the module. As the complexity of the course progressed, more time was allocated in these steps.

Complete Flip Classroom

Complete Flip Classroom approach was conducted twice throughout 2019 fall semester in 3D Solid Modeling course. Both of the two times Flip Classroom were about one random student became the instructor, taught pre-determined content to the rest of students. Progressive challenge was applied in this Flip Classroom approach since the content of the first-time was introduced by the professor partially and the students were managed to complete, while the second-time contents were completely managed by the students.

The scenario about the Complete Flip Classroom procedures and student outcome assessment is illustrated in Figure 2. The “Professor” in green font represents the professor who oversees the course. The “Instructor” in purple font stands for the specific student, who was randomly selected to teach the Flip Classroom session on Flip Classroom presentation day. The “Students” in blue font represent the rest of students whose name was not drawn on Flip Classroom presentation day.

The preparation time left for the students to be ready for the Flip Classroom session is one week. On Day 1, the professor assigned the Flip Classroom session content. The first-time Flip Classroom content was part of a chapter in the textbook, since the professor had already started part of the chapter to help students. The second-time Flip Classroom content was another whole chapter in the textbook, all the students needed to rely on themselves to prepare. In addition to textbook, short video tutorials were provided on Blackboard. The student instructor was undefined beforehand. Therefore, every student was in need to prepare for himself or herself because the presenter, who acts as the instructor was selected randomly on the Flip Classroom session (Day 8). The probability of whose name being drawn was the same in the first-time Flip Classroom and second-time Flip Classroom. In other words, if a student was selected once, he/she might be selected a second time. This mechanism promoted the participation and involvement of each student in the self-driven learning and self-driven practicing. After five days of self-learning and practicing, on Day 6, the professor held a question and answer session to solve the problems students might encounter during the self-learning process. Then, there were two more days for the students to finish their PowerPoint slides preparation in a form of an organization and information flow they prefer. In addition, students needed to prepare a homework he/she planned to assign to the class, which was used to test the concepts understanding of the rest of students. On Day 8, a name was drawn randomly in the beginning, and that student performed as the instructor during this Flip Classroom session. That one student

gained full control during this lecture session as the “instructor”, who delivered the instruction of the assigned contents to the rest of students. The instructor guided the whole class for the best interests based on his/her understanding of the chapter. When the instruction was completed, the homework was assigned by the student instructor to test the rest of students. Additionally, the professor gave another homework to all the students including the student instructor to evaluate the understanding level of the assigned contents for the whole class.

The learning outcome assessment was evaluated separately by the different roles a student may perform: “Instructor”, “Students”, or “Absent”. The learning outcome of the student instructor was assessed through the combination of 30% weight percentage in the instruction delivery quality evaluated by the rest of students, plus 70% weight percentage of the homework given by the professor or the instruction delivery quality evaluated by the professor, whichever is higher. The learning outcome of the rest of students was assessed through the combination of the homework assigned by the professor (70%) plus the homework assigned by the student instructor (30%). A mechanism for absent students was also considered to ensure attendance while also maintain fairness for students who needed to be absent due to valid reasons such as doctor appointment, etc.

This outcome assessment system guarantees the fairness for different roles the students may perform during the Flip Classroom session. Moreover, it also avoids potential loopholes. For instance, a student who did not have any preparation but was “lucky” not being drawn out. Meanwhile, the student instructor assigned a fairly easy homework. This loophole was avoided by a large weight percentage (70%) in the homework assigned by the professor, which was in an advanced but attainable level if the assigned contents were fully understood. Through the Complete Flip Classroom approach, the students gained the capability of self-learning, self-practicing, presentation preparation and delivery, organizing and leading a speech, etc.

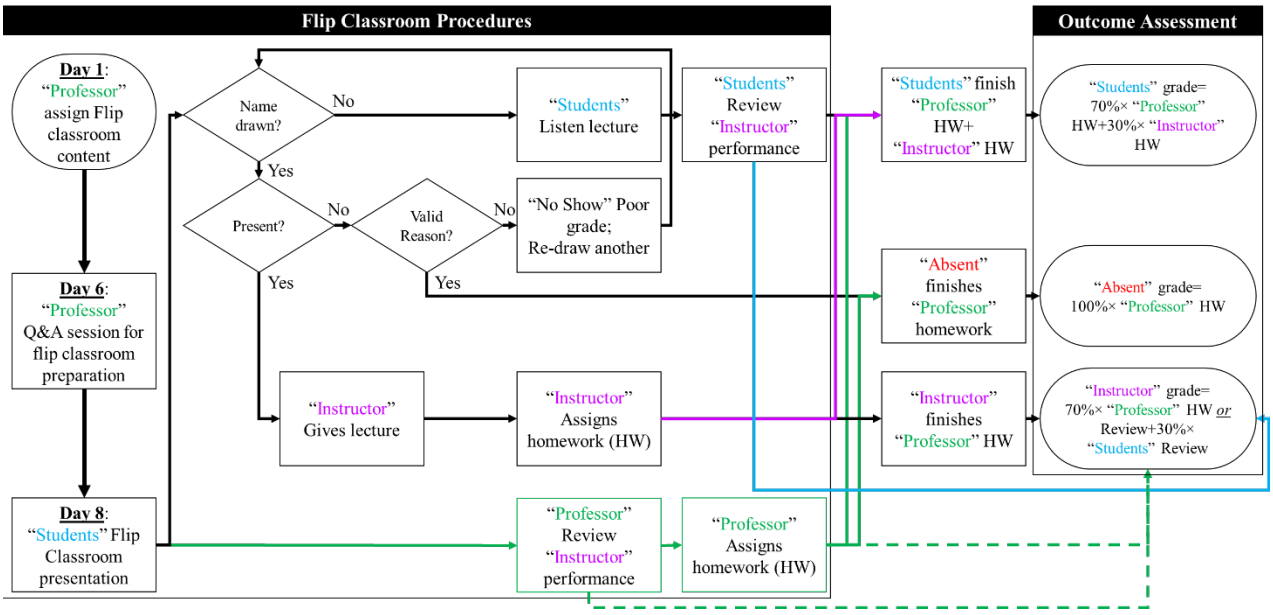


Figure 2. Flow chart of Complete Flip Classroom procedures and student outcome assessment

Perception and Motivation Comparison Instrument

In order to compare the perception and motivation of students in these two-different levels of Flip Classroom instruction approach for engineering technology courses, the Motivated Strategies for Learning Questionnaire (MSLQ) was distributed. The distribution of the questionnaire was done via Qualtrics email after the semester ended explaining the students the study and asking them to answer voluntarily and anonymously. The students were given two weeks to respond with reminders at one week, three days and one day remaining. The MSLQ is an instrument to assess the motivation and learning strategies of college students for college courses, which was developed by a group of scholars at the University of Michigan [9]. The MSLQ contains two sections: motivation section and self-regulation section. In the MSLQ questionnaire distribution, the questionnaire was following the numeric order from Question 1 to Question 44, shown as Appendix A. It avoided the thinking set of students when answering questions under a similar category since the two aforementioned sections were mingled together. The 7-point scale (1 “not at all true of me”, to 7 “very true of me”) MSLQ survey was listed in Appendix A [10].

Results and Analysis

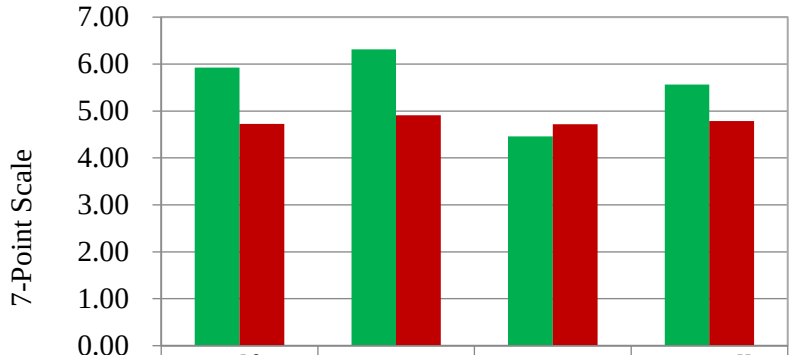
After gathering the data set from students, the data analysis was conducted in the aspect of motivation and self-regulation, where self-efficacy, intrinsic value, and test anxiety were investigated for motivational section, while cognitive strategy use and self-regulation were analyzed for the self-regulated section. Both components of the MSLQ, Motivation and Self-Regulation, are discussed in the following sections.

Perception and Motivation

Out of the total 44 questions distributed to the students, Table 1 shows the classification of perception and motivation questions in the categories of self-efficacy, intrinsic value, and test anxiety. After the data processing, Figure 3 exhibits the comparison result between Complete Flip Classroom and Assisted Flip Classroom in the aspect regarding perception and motivation. In the aspect of self-efficacy and intrinsic value, the respective average value based on the 7-point scale shows an evident favor on the Complete Flip Classroom approach over the Assisted Flip Classroom approach. Reasons lead to this phenomenon came from the freedom of choice in the Complete Flip Classroom approach, in terms of the self-learning methods, instruction methods, testing methods, practicing methods, and also the submission deadline decided by the student instructor. With full control of the classroom, students gained confidence in presenting himself or herself in front of the whole class. Thus, the self-efficacy and intrinsic value in the 7-point scale of the student participated in Complete Flip Classroom shows a 1.2 and 1.4 more than the Assisted Flip Classroom, respectively.

In terms of test anxiety, a lower value provided by a student shows the more confident this student felt during the test. Therefore, a slight advantage was displayed for the students participated in the Complete Flip Classroom over the Assisted Flip Classroom. Since the Assisted Flip Classroom provided the necessary course materials and the assignment given later was based on the course material, a transformation in the test questions or a novel question would potentially cause the panic for students who only focused on the provided materials. As a

comparison, the Complete Flip Classroom homework assigned by the professor was not revealed until the completion of Flip Classroom session. Thus, thorough preparation for the contents was expected for all the students so that the students were capable to complete the homework assigned by the professor. However, both two approaches did give some anxiety in the test, because they are different than the traditional approach where the professor would go over assignments and questions to prepare for the test. Overall, the Complete Flip Classroom shows a more favorable result in the perception and motivation section for students.



	Self-Efficacy	Intrinsic Value	Test Anxiety	Overall Average
Complete Flip	5.93	6.31	4.46	5.57
Assisted Flip	4.73	4.91	4.72	4.78

Figure 3. The perception and motivation comparison between Complete Flip Classroom and Assisted Flip Classroom

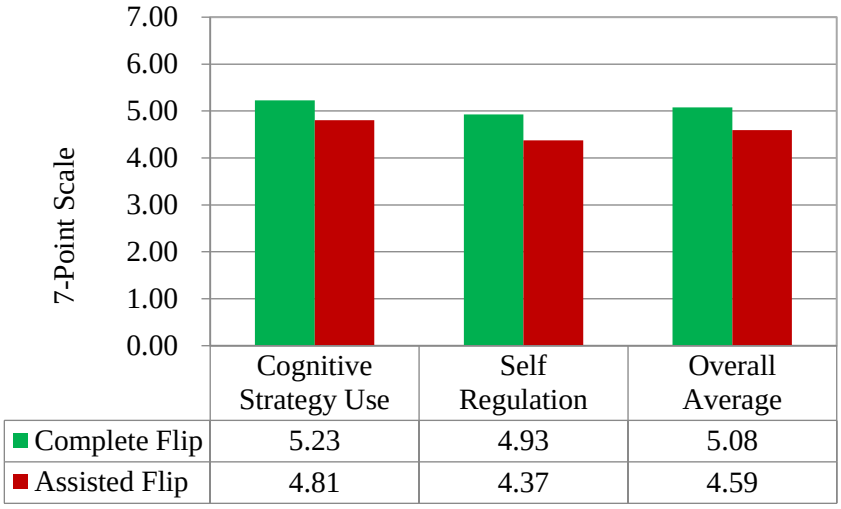
Table 1. Questions classification in perception and motivation section

	Question number and question content	
Self-Efficacy	2	Compared with other students in this class I expect to do well
	6	I'm certain I can understand the ideas taught in this course
	8	I expect to do very well in this class
	9	Compared with others in this class, I think I'm a good student
	11	I am sure I can do an excellent job on the problems and tasks assigned for this class
	13	I think I will receive a good grade in this class
	16	My study skills are excellent compared with others in this class
	18	Compared with other students in this class I think I know a great deal about the subject
	19	I know that I will be able to learn the material for this class
Intrinsic Value	1	I prefer class work that is challenging so I can learn new things
	4	It is important for me to learn what is being taught in this class
	5	I like what I am learning in this class
	7	I think I will be able to use what I learn in this class in other classes
	10	I often choose paper topics I will learn something from even if they require more work

	14	Even when I do poorly on a test I try to learn from my mistakes
	15	I think that what I am learning in this class is useful for me to know
	17	I think that what we are learning in this class is interesting
	21	Understanding this subject is important to me
Test Anxiety	3	I am so nervous during a test that I cannot remember facts I have learned
	12	I have an uneasy, upset feeling when I take a test
	20	I worry a great deal about tests
	22	When I take a test, I think about how poorly I am doing

Self-regulation

Table 2 shows the classification of self-regulation questions in the categories of cognitive strategy use and self-regulation. Similarly, it can be seen in Figure 4 that the students who participated in the Complete Flip Classroom show a better cognitive strategy use and self-regulation. Because the Complete Flip Classroom approach only defines the goal, the methods on how to achieve the goal is not limited. Thus, the habit of self-driven learning, self-driven practicing and self-driven preparation were transferrable capabilities acquired by the students, that would benefit in solving their homework questions, studying for a test, and also gathering everything together to form the course structure. Overall, the Complete Flip Classroom also displays a more favorable result in the self-regulation section for students versus the Assisted Flip Classroom.



	Cognitive Strategy Use	Self Regulation	Overall Average
Complete Flip	5.23	4.93	5.08
Assisted Flip	4.81	4.37	4.59

Figure 4. The self-regulation comparison between Complete Flip Classroom and Assisted Flip Classroom

Table 2. Questions classification in self-regulation section

	Question number and question content	
Cognitive Strategy Use	23	When I study for a test, I try to put together the information from class and from the book

	24	When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly
	26	It is hard for me to decide what the main ideas are in what I read
	28	When I study, I put important ideas into my own words
	29	I always try to understand what the teacher is saying even if it doesn't make sense.
	30	When I study for a test I try to remember as many facts as I can
	31	When studying, I copy my notes over to help me remember material
	34	When I study for a test I practice saying the important facts over and over to myself
	36	I use what I have learned from old homework assignments and the textbook to do new assignments
	39	When I am studying a topic, I try to make everything fit together
	41	When I read materials for this class, I say the words over and over to myself to help me remember
	42	I outline the chapters in my book to help me study
	44	When reading, I try to connect the things I am reading about with what I already know.
Self-Regulation	25	I ask myself questions to make sure I know the material I have been studying
	27	When work is hard I either give up or study only the easy parts
	32	I work on practice exercises and answer end of chapter questions even when I don't have to
	33	Even when study materials are dull and uninteresting, I keep working until I finish
	35	Before I begin studying I think about the things I will need to do to learn
	37	I often find that I have been reading for class but don't know what it is all about
	38	I find that when the teacher is talking I think of other things and don't really listen to what is being said
	40	When I'm reading, I stop once in a while and go over what I have read
	43	I work hard to get a good grade even when I don't like a class

Conclusion and Future Work

The results obtained by the MSLQ were quantify and classified into each component. The scale value obtained is the mean of the mean for all the questions related to each component. Differences between the Assisted Flip Classroom and Complete Flip Classroom approach were observed through the analysis.

We can see that there is a motivational section advantage in the Complete Flip Classroom, the intrinsic value obtained from this method was more than the students from the Assisted Flip Classroom course. Also, we can notice that there is less test anxiety in the Complete Flip Classroom, making us believe that the relation between the intrinsic value and the test anxiety that the students present during college courses studying.

Also, the Complete Flip Classroom aided the self-training in learning, practicing, and testing, which benefits the self-regulation section when comparing the MSLQ result with Assisted Flip Classroom. Therefore, overall, the qualitative assessment shows Complete Flip Classroom could potentially become a better method to stimulate the students learning in a college course. Because of the positively influenced perception will motivate the students to assign more time on the courses related work, then a better outcome for the learning process could be achieved.

Due to some complications with the Institutional Review Board approval process, the dissemination of the MSLQ survey was delayed, which affected the response rate of the survey. Total responses received for the Assisted Flip Classroom course were n=15, and the responses received for the Complete Flip Classroom were n=6. A significant statistical analysis was not obtainable due to the limitation of the current response rate. The data provided in this session is for qualitative assessment. Since this is a preliminary work, we are expecting to repeat the MSLQ survey and to obtain more responses in 2020.

Appendix A – Motivated Strategies for Learning Questionnaire assigned in this study

Please rate the following items based on your behavior in this class. Your rating should be on a 7- point scale where 1= not at all true of me to 7=very true of me. This questionnaire was distributed in numerical order from question 1 to question 44 to the students.

1. I prefer class work that is challenging so I can learn new things.
2. Compared with other students in this class I expect to do well
3. I am so nervous during a test that I cannot remember facts I have learned
4. It is important for me to learn what is being taught in this class
5. I like what I am learning in this class
6. I'm certain I can understand the ideas taught in this course
7. I think I will be able to use what I learn in this class in other classes
8. I expect to do very well in this class
9. Compared with others in this class, I think I'm a good student
10. I often choose paper topics I will learn something from even if they require more work
11. I am sure I can do an excellent job on the problems and tasks assigned for this class
12. I have an uneasy, upset feeling when I take a test
13. I think I will receive a good grade in this class
14. Even when I do poorly on a test I try to learn from my mistakes
15. I think that what I am learning in this class is useful for me to know
16. My study skills are excellent compared with others in this class
17. I think that what we are learning in this class is interesting
18. Compared with other students in this class I think I know a great deal about the subject
19. I know that I will be able to learn the material for this class
20. I worry a great deal about tests
21. Understanding this subject is important to me
22. When I take a test, I think about how poorly I am doing
23. When I study for a test, I try to put together the information from class and from the book
24. When I do homework, I try to remember what the teacher said in class so I can

answer the questions correctly

25. I ask myself questions to make sure I know the material I have been studying
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39. When I am studying a topic, I try to make everything fit together
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42. I outline the chapters in my book to help me study
43. I work hard to get a good grade even when I don't like a class
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