Article

Information and Communication Technologies for Education Considering the Flipped Learning Model

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Abstract: Technology development has been integrated into the educational environment and has led teachers to become much better trained in educational, technological tools. Currently, education is being transformed; for this, there are new methodological approaches, and education needs the integration of digital tools. Previously and still today, traditional and not very creative strategies are applied in the teaching–learning process, which does not fully contribute to the progress of education. The present work focuses on using Information and Communication Technologies (ICT), considering the Flipped Learning Model (FL), an active methodology. However, it is also essential to know the appropriate ICT to apply during the learning process. The Information and Communication Technologies articulated with the Flipped Learning Model benefits and motivates students; in this way, through collaborative learning, communication between classmates and teachers is favored; in addition, it encourages autonomous work, helps the analysis of the contents in each of the subjects, and favors the construction of new knowledge. Therefore, knowing which ICTs are incorporated as the most efficient in the Flipped Learning Model is necessary. In this way, it is required to obtain information about the ICTs teachers have preferred to apply within the Flipped Learning Model and which ones are recommended from the classroom experience. The work shows which ICTs are most used and which ones benefit students to obtain significant learning. Consequently, considering the application of ICT and Flipped Learning in educational communities is a way to innovate the teaching–learning process.

Keywords: Flipped learning; ICT; education innovation; digital technology; learning engineering

1. Introduction

This article proposes using Information and Communication Technologies applied with Flipped Learning. Education has always been in constant change, and the main objective is to use innovations to improve education, implementing new processes, techniques, Information and Communication Technologies, and new experiences that contribute to improving the teaching quality and new collaborative communities [1–3].

In FL-based learning, the teacher should provide resources to the learners in advance for review. Afterward, the teacher should reinforce the topic and answer students' questions in the classroom [4]. Currently, students obtain information from the material provided by teachers and come with prior knowledge to the class to clarify doubts and use different technological tools in this process. The learning will have subsequent interactivity, collaborative learning, and problem-solving [5,6].

The Flipped Learning Model underwent a transformation parallel of educational software. In 2012 it was reflected as an inverted class. Its creator knew it as a form of

creative work. It offers a reorganization of the work in class, a greater use of time to explain and follow up the activities [7,8].

In the traditional model, the teacher provides the information, and then at home, the students must complete the homework. Now the flipped learning model applies ICT to ensure learning students are prepared to interact, receive feedback, and evaluate the classroom process; this is how the roles have changed [9].

This model is accepted and is related to innovative teaching using Information and Communication Technologies [10]. The Flipped Learning approach has achieved significant attention in academic circles in recent years [11]. The number of devices on which different platforms are used about academics helps the progress of education, and including technology in this approach helps improve academic training [12].

Information and Communication Technologies are defined as technological techniques or tools that help teachers and students understand subjects in a better way. These tools facilitate classes through developing the competencies acquired by the students [13].

Flipped Learning and Information and Communication Technologies have some advantages, such as students being the main protagonists of their learning, so it increases motivation and responsibility, and the students are more autonomous. FL and ICT improve academic performance. According to the articles investigated, most of them obtained positive results, and ICT increases communication between teachers and students [14,15].

They develop technological competences at a very early age and encourage group work [16,17]. Furthermore, FL and ICT help teachers make a more personalized follow-up, and it is also beneficial for reinforcement in subjects that need it since the time for performing different activities can be enhanced [18]. The model provides constructivist learning, which uses interactive activities; however, it requires great responsibility from the educational institution, which must provide adequate infrastructure and better teachers' planning with innovative strategies and optional didactic materials [19].

There are a variety of technologies available to use before class (video recordings and podcasts) and during class (audience response systems) and assessment (wikis and integrated self-assessments). Current technological developments are attributed to the rise of the inverted model [20]. The teacher's help is substantial and must guide the students' learning process, such as: guiding, facilitating, and developing various roles in transmitting information, as they are essential for the success of the experience [21].

The distribution of content by video allows for a better contextualization of the class that is often lacking in textbooks. Although textbooks should be used for educational purposes as an additional source for the teacher's explanation, they should not be obligated to fulfill all the content [22,23].

2. Related Works

Education is constantly changing to assume new social challenges. Nowadays, the implementation of Information and Communication Technologies is essential, in addition to the Flipped Learning Model (providing the material, organization in the classroom, and evaluation), allowing the teacher to apply pedagogical strategies to strengthen the students' knowledge [24].

The purpose of several investigations is to detect the Flipped Learning Model's influence on students' motivation in the teaching–learning processes. To find out, Flipped Learning favors the development of competencies. In conclusion, Flipped Learning and the use of videos have been considered as tools to promote innovation in traditional instructional methodologies [25]. This method should not be seen as a fad but should be considered a renewal process that contributes to the initial training of students and teachers.

The students who have applied this flipped learning process have responded positively, improving their academic performance. As a recommendation, they should continue to apply the process since ICTs help motivate them, activating learning [7].

The Flipped Learning Model and information and communication technologies have increased student participation and development opportunities for students to gain knowl-

edge of educational technology skills, which are indispensable foundations for educators [26].

Students get to learn through the distribution of online content, and they can control these resources considering the time and pace of learning. These are methods that benefit the teaching process, and these are collaborative learning strategies that are recommended for both synchronous and asynchronous environments [27].

Flipped Learning and Information and Communication Technologies in the teaching–learning process permit the teacher to select a topic, propose objectives, prepare digital resources, prepare quizzes, and distribute the material to students. Therefore, students at home can review and study the resources; they complete online questionnaires using various research methods. On the other hand, the teacher identifies the difficulties of the results of the questionnaires, and the teacher must establish individual time with the students.

In addition, the students do group and individual work. After class, the teacher can review the projects, offer additional resources using Information and Communication Technologies and thus motivate students to deepen their knowledge and share their projects through digital educational tools.

The use of a Learning Management System (LMS) contributes to Flipped Learning as students can access it from home and complete activities, then they can access videos and modules to reinforce the topics; finally, they can complete an individual or group assessment that allows the reinforcement of knowledge [28,29].

Learning Management Systems (LMS): Blackboard, Moodle, and online course support platforms. There are also social networks and 3D virtual worlds (Second Life, augmented reality, virtual labs, and audio feedback). Information and Communication Technologies and Flipped Learning have allowed us to propose several activities, developing active, collaborative, cooperative, reflective, and meaningful learning [30,31].

It is relevant to know students' appreciation from different levels of education on the "Digital Teaching Competence" by applying the FL to select the ICTs that favor the model. Digital competencies facilitate the learning processes to develop skills [32]. Thus, for reading classes, they used: videos (Movie Maker), infographics (Easel.ly), and concept maps (Creately) and created presentations (Prezi, PowerPoint, and Emaze); they have also allowed the creation of animated slides, and students and teachers can create their lessons in presentations, in addition to using search engines (Google Scholar), web pages (Wikipedia), videos (YouTube), and communication (instant messaging, social networks, and email).

The students mentioned that most of the classes were interesting. They learned how to use tools they did not know before and emphasized the importance of collaborative work since they can help each other. In conclusion, the students obtained a positive message about the learning model with the application of ICT [33].

Several authors mentioned using the WhatsApp messages to send project deliverables, but institutional mail is a formal alternative in the educational setting. Google Forms is used to create and analyze surveys blogs for the content of interest; with Socrative the teacher can ask questions, and students respond in real-time. In addition, Kahoot's game-based platform allows knowledge sharing between teacher and student and encourages a positive attitude through active methodologies [34].

The research was focused on the design of activities in computer science considering the Flipped Learning Model supported by ICT, intending to repair their needs. Thus, they mentioned the following tools: The Schoology educational platform: an educational tool with several alternatives; this tool creates groups of students and folders and provides study material before class. Apple's Clips: application for devices allows the teacher to record videos and present material on a fun day. Movie Maker: Microsoft software for editing videos, adding animations and effects between images and videos, and selecting music for them. YouTube: a repository of videos to share and use by other users. Students can create a channel and publish their educational videos [19].

In research, students have also preferred tools for Flipped Learning to Google Drive, Prezi, YouTube, Facebook, PowToon, Impress, Movie Maker, Sophia Learning, and Moodle; in these studies, they have coincided, and of those mentioned we can say that the ICTs frequently used by students are: Google Drive, YouTube, and Facebook. Adapting new learning environments facilitates appropriate interaction between learners and resources, and classes become productive in conjunction with Flipped Learning [35].

The use of these tools does not require individuals to be experts in the field, and they are effortless to use environments and free-access tools. However, of course, it depends on selecting the appropriate Information and Communication Technologies for each subject [36]. Through the application of ICT, favorable results were obtained, and students' attention was obtained with the recording of videos by the teacher with theoretical and practical content for the acquisition of learning, thereby achieving objectives for developing skills and use of technology [37]. Students feel motivated and watch the videos more than once, reinforcing their knowledge.

Information and Communication Technologies and Flipped Learning (FL) have been applied in different subjects,and where music is not an exception. It has also been proposed to apply this approach using videos as a primary resource for instrumental practice, adding the tools: Vegas Video Pro, YouTube, Ed puzzle, QR Codes, videos recorded in a recording studio (VEG) that offer group or ensemble interpretation of a musical theme, videos recorded by the teacher, and original videos videos with the actual interpretation of artists. Students rated the application of the tools and the Flipped Learning model as optimal, as it benefits self-learning and considerable independence from the teacher [38].

Teachers who applied Inverted Learning and digital technology (DigiTech) stated that they could optimize time with this method. They can pedagogically help teach the subject of physical education. Research has shown that more engaging, student-centered activities and increased physical activity are possible. As education becomes digital, flipped learning is being used as an effective and productive teaching method [39].

Flipped learning is an approach that benefits Student Response Systems (SRS), as it is essential to dedicate more time to student engagement. The use of SRS allows students to use devices (cell phones, tablets, and laptops. . .) to answer a variety of questions (multiple-choice, short-answer, and discussion); so, they were applied in the lectures developed online before attending face-to-face classes, encouraging students' participation while also facilitating feedback, motivating students' attendance [40,41].

Table 1 shows in which years there are more publications on Information and Communication Technologies and Flipped Learning articles; the yellow color reflects the most updated research from countries such as Cuba, Egypt, and Nigeria. However, the countries that reflect more publications are the United States (USA) and China.

In addition, the Flipped Learning Model has been a topic that has generated much research in recent times, which promotes the implementation of some options that allow it to be enriched. Therefore, the implementation of ICT to the Flipped Learning Model has been taken into account.

Table 1 indicates the top countries that have more articles on Information and Communication. Technologies for education considering the Flipped Learning Model. The table shows that the United States is the leading country in research with the most citations on the subject. In addition, the USA has connections with some countries: Spain, Taiwan, Australia, Canada, and England.

Several universities are devoting their research to evaluating this new approach to Flipped Learning accompanied by Information and Communication Technologies, betting that it will yield better results than traditional education. The University of Granada, Natl. Taiwan Univ. Sci./Technol., and the University of Hong Kong stand out at the table.

In addition, the table shows the number of articles and the number of times they have been cited. For example, the University of Granada has 57 articles cited 213 times. All the universities' contributions mentioned in the table are essential since it is possible to

obtain results from various researches and analyze the advantages and disadvantages of the application of educational ICT considering the Flipped Learning Model.

Table 1. Web of Science—Summary of studies on Flipped Learning and ICT.

Country	Articles	Citations
USA	633	8681
China	208	1356
England	73	288
Australia	109	2315
Taiwan	144	2133
Canada	57	1086
Malaysia	39	217
Spain	264	967
Singapore	12	117
South Korea	49	234
University	**Articles**	**Citations**
Univ. Granada	57	213
Natl Taiwan Univ. Sci./Technol.	34	554
Univ. Hong Kong	31	402
Univ. Extremadura	21	172
Educ. Univ. Hong Kong	20	101
Natl. Taiwan Normal Univ.	20	303
Univ. N Carolina	19	801
Monash Univ.	17	531
Univ. Zaragoza	16	35
Univ. Murcia	15	18

3. Problem Formulation and Methodology

Flipped Learning offers profitable results in its application; the articles above obtained information about improvements in the students' performance and motivation. Education seeks new strategies different from the traditional method since planning does not prepare for reality; in this case, teachers are only dedicated to transmitting knowledge and students to receive it. In the Flipped Learning Model the principal protagonists are the students, motivating them to investigate and use ICT.

Nowadays, knowledge about Information and Communication Technologies is indispensable since it is necessary to develop activities. The model is perfectly combined with Information and Communication Technologies. However, which Information and Communication Technologies are suitable for the Flipped Learning Model? For teachers, it is essential to know how to use the ICTs that facilitate reaching the students' knowledge. Information and Communication Technologies and Flipped Learning should positively direct teaching at different educational levels. Figure 1 provides an overview of the present work and its methodology and state-of-the-art evaluation.

The research population comprised students and teachers of the "Consejo Provincial de Pichincha" Educational Unit. The population was 662 students between 15 and 19 years of age. The students belong to the first, second, and third levels of high school. The population also includes 66 teachers between 25 and 54 years old. The teachers belong to the following areas of knowledge: Language and Literature, Foreign Language, Mathematics, Natural Sciences, Social Sciences, Physical Education, Cultural and Artistic Education, and Technical Areas.
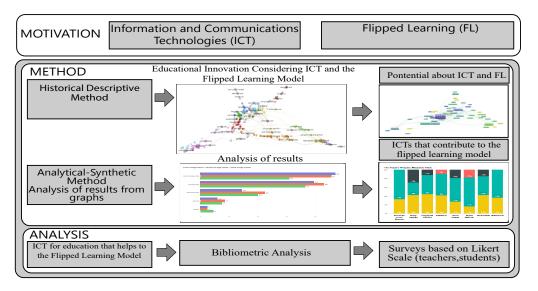
Figure 1. Educational Innovation Considering ICT and the Flipped Learning Model. Source: Authors.

One hundred fifty-one students were 15 years old; 493 students were between 16 and 18 years old; and 18 were 18 years old. Two hundred nineteen students were in the first year of high school; 245 students were in the second year of high school; and 198 students were in the third year of high school. The population also included 66 teachers between 25 and 54 years old. Twelve teachers were between the ages of 25 to 34; 20 were between 35 to 44; 18 teachers were between 45 to 54; and 16 teachers were over 54 years old. The teachers belong to the following areas of knowledge: Language and Literature (9 teachers), Foreign Language (7 teachers), Mathematics (12 teachers), Natural Sciences (11 teachers), Social Sciences (7 teachers), Physical Education (6 teachers), Cultural and Artistic Education (3 teachers), and Technical Areas (11 teachers). The academic unit has computer laboratories and internet networks, and the Ministry of Education provides access to the TEAMS platform to apply it during the teaching–learning process. Teachers often receive training directed by the ICT area, the Ministry of Education, or they maintain links with other institutions to develop knowledge and digital competence. Due to the pandemic, the academic unit is much better equipped and so are teachers and students at home; therefore, students and teachers have devices and Internet networks to connect to classes and make use of the material shared by teachers.

In order to obtain information on Information and Communication Technologies for education considering the Flipped Learning Model, a matrix of the art was created with related and more updated works, whose research contributes to the enrichment of the present investigation. A bibliometric analysis provides the results of more current works, countries dedicated to research on the Flipped Learning Model and information and communication technologies, and universities that dedicate time to benefit the learning model with ICTs.

Data were obtained through the use of surveys directed to teachers and students. Microsoft Forms was used to apply the surveys due to the current pandemic situation consequence of the number of the population in order to evaluate the ICTs that benefit Invested Learning. The questions and ICT tools placed as alternatives in the surveys were defined by researching other articles. In addition, the questions were oriented to achieve the stated objectives.

The survey addressed to teachers was composed of twenty questions. All items used a 5-point Likert scale. The teachers belonged to different areas of knowledge, for example, Language and Literature, Foreign Language, Mathematics, Natural Sciences, Social Sciences, Physical Education, Cultural and Artistic Education, and Technical Areas. In the Table 2, we can observe the questions with the total number of answers selected by the teachers.

Table 2. Survey based on 5-point Likert scale by Teachers.

Survey	P1	P2	P3	P4	P5
1. Do students have a positive perception of a Flipped Learning methodology when it is applied in class?	14	43	7	1	1
2. Is there a positive influence on students' emotions when using a Flipped Learning methodology?	15	42	7	2	0
3. Do students in a Flipped Learning scenario perform better academically than students in a traditional (lecture) setting?	11	37	12	6	0
4. Does the Flipped Learning annexed with ICT (videos, infographics, and videos.) favor a more practical than theoretical class?	27	31	5	2	1
5. Does the Flipped Learning Model linked to ICT favor the effectiveness of the teaching–learning process compared to the Traditional Model?	18	38	4	5	1
6. Does watching short educational videos from YouTube benefit and allow you to gain pre-classroom knowledge?	13	42	9	1	1
7. Do real-time response systems (Socrative and Kahoot) allow measuring the level of knowledge at the very moment of the class before viewing videos or explaining the teacher's support?	11	36	16	3	0
8. Do video editors (Screencast-O-Matic, Windows Movie Maker, Imovie, PlayPosit, and EdPuzzle) facilitate the process of creating videos to be shared before the class?	10	32	21	3	0
9. Do Moodle, Canvas, and Google Classroom, as a pillar of flipped learning, facilitate students' learning pace by hosting unit sequences, tutorials, and learning resources?	19	36	9	2	0
10. Does the use of forms (Microsoft Forms, Google Forms) facilitate collecting data from an assessment moments before or at the end of the class?	24	34	6	2	0
11. Do you use Learning Management Systems (LMS): Moodle, Canvas, Google Classroom, Blackboard?	17	27	16	4	2
12. Do you apply videoconferencing tools (Zoom, Microsoft Teams, GoToMeeting, Hangouts, and Skype) at work?	45	14	6	1	0
13. Does WhatsApp and Facebook Messenger give an informal image or little institutional in the learning processes?	11	18	15	18	4
14. Do you use Pen Tablet (graphic tablet-digital display) to solve doubts about the contents exposed during the teaching process?	11	12	13	13	17
15. Do content creation tools (Genially, Office Mix, Prezi, and PowerPoint) facilitate content presentation before and during class?	27	30	7	1	1
16. Does Flipped Learning, together with the ICTs mentioned above, facilitate content comprehension?	28	31	7	0	0
17. Is it meaningful for students to publish the results of their educational projects using appropriate ICT?	22	33	8	2	1
18. Does ICT facilitate a good evaluation process with a Flipped Learning approach?	20	34	9	3	0
19. Do ICTs implement in Flipped Learning provide the execution of new learning activities with high didactic potential?	24	30	9	3	0
20. Do the ICTs you use for Flipped Learning favor the processing of information to construct new knowledge learning?	24	34	6	2	0

Table 3 shows the percentage of each of the items of the survey applied to the teachers. This table indicates that most teachers selected the alternative: Strongly Agree and Agree with questions related to the Flipped Learning Model and Information and Communication Technologies.

Table 4 indicates the 20 questions formulated to apply to the students. All questions used a 5-level Likert scale.

Students obtained information about the purpose of the research through the surveys. The survey provided information on their perception of the Flipped Learning Model and ICTs.

The questions were also oriented to know the students' opinion if the mentioned ICT benefit knowledge acquisition, motivation, and communication with teachers. In addition, we obtained results on how often they use specific digital tools to elaborate activities. We can also observe the number of students who selected different alternatives of the Likert scale in each of the questions.

Table 5 shows the Likert-scale alternatives and percentages for each of the questions selected by student respondents from different high-school levels.

Table 3. Survey Score: Flipped Learning & ICT—Teachers.

	P1	P2	P3	P4	P5
Questions	Strongly Agree Survey %	Agree %	Undecided %	In Disagreement %	Strongly Disagree %
Q1	21 %	65 %	11 %	2 %	1 %
Q2	23 %	64 %	10 %	3 %	0 %
Q3	17 %	56 %	18 %	9 %	0 %
Q4	41 %	47 %	8 %	3 %	1 %
Q5	27 %	58 %	6 %	8 %	1 %
Q6	20 %	64 %	14 %	1 %	1 %
Q7	17 %	55 %	24 %	4 %	0 %
Q8	15 %	48 %	32 %	5 %	0 %
Q9	29 %	54 %	14 %	3 %	0 %
Q10	36 %	52 %	9 %	3 %	0 %
Q11	26 %	41 %	24 %	6 %	3 %
Q12	68 %	21 %	9 %	2 %	0 %
Q13	17 %	27 %	23 %	27 %	6 %
Q14	16 %	18 %	20 %	20 %	26 %
Q15	41 %	45 %	11 %	2 %	1 %
Q16	42 %	47 %	11 %	0 %	0 %
Q17	33 %	50 %	12 %	3 %	2 %
Q18	30 %	51 %	14 %	5 %	0 %
Q19	36 %	45 %	14 %	5 %	0 %
Q20	36 %	52 %	9 %	3 %	0 %

Table 4. Survey based on 5-point Likert scale by students.

Survey	P1	P2	P3	P4	P5
1. Do the Digital Technologies apply in the teaching–learning process motivate you to participate more during class?	117	285	188	48	24
2. Does ICT make classes more practical than theoretical?	92	301	156	87	26
3. Is FL integrating ICT better adapted to different learning paces?	88	309	175	63	27
4. Does Flipped Learning coupled with ICT provide opportunities to interact with classmates and teachers?	102	302	144	85	29
5. Does Flipped Learning provide sufficient time and space to carry out its interactive activities before, during, and after the socialization of knowledge in class?	106	314	159	54	29
6. Have you used tools such as Kahoot, and has it allowed you to secure interest by boosting skills and abilities?	46	133	228	112	143
7. Do the educational videos made in PlayPosit and EdPuzzle facilitate the content comprehension process?	78	184	191	128	81
8. Do Moodle, Canvas, and Google Classroom complement face-to-face education, thanks to the collection of didactic resources?	168	248	155	59	32
9. Has the viewing of short educational videos on YouTube benefited the pre-classroom knowledge acquisition process?	171	234	169	70	18
10. Have you used reliable information search tools (Google Scholar, Google, and Virtual Libraries), and have they facilitated obtaining reliable documents before the class?	247	238	114	44	19
11. Do content creation tools (Genially, Prezi, Office Mix, and PowerPoint) make it easy to present projects at the end of the class?	245	269	104	32	12
12. Do Learning Management Systems (LMS): Moodle, Canvas, Google Classroom, and Blackboard, benefit the explanation of content during interaction with the teacher?	143	275	155	67	22
13. Does video conferencing (Zoom, Microsoft Teams, GoToMeeting, Hangouts, and Skype) allow incorporating multiple resources into the classroom, facilitating the exchange of information and communication between teachers and students?	240	251	117	38	16
14. Do you think that using WhatsApp and Facebook Messenger help to share information with others faster and gives an appropriate image of learning processes?	316	215	88	29	14
15. Does the teacher use Pen Tablet (graphic tablet-digital display) and encourage feedback of relevant content in class?	100	223	171	96	72
16. Do the pre-class videos provide an understanding of the content to be covered in the class?	151	336	143	0	32
17. Does Flipped Learning, together with the ICTs mentioned above, facilitate content comprehension?	137	337	159	0	29
18. Do ICTs named for Flipped Learning favor the processing of information to construct new knowledge (learning)?	132	353	150	0	27
19. Do chat tools (WhatsApp and Telegram) facilitate the exchange of information and the creation of educational workgroups?	352	209	81	0	20
20. Do tools such as Padlet, Storm-board, ED Modo, and Office 365 facilitate and encourage collaborative work?	186	275	143	0	58

Table 5. Survey Score: Flipped Learning and ICT—Students..

Questions	P1 Strongly Agree Survey %	P2 Agree %	P3 Undecided %	P4 In Disagreement %	P5 Strongly Disagree %
Q1	18 %	43 %	28 %	7 %	4 %
Q2	14 %	45 %	24 %	13 %	4 %
Q3	13 %	47 %	26 %	10 %	4 %
Q4	15 %	46 %	22 %	13 %	4 %
Q5	16 %	48 %	24 %	8 %	4 %
Q6	7 %	20 %	34 %	17 %	22 %
Q7	12 %	28 %	29 %	19 %	12 %
Q8	25 %	38 %	23 %	9 %	5 %
Q9	26 %	35 %	25 %	11 %	3 %
Q10	37 %	36 %	17 %	7 %	3 %
Q11	37 %	40 %	16 %	5 %	2 %
Q12	22 %	42 %	23 %	10 %	3 %
Q13	36 %	38 %	18 %	6 %	2 %
Q14	48 %	33 %	13 %	4 %	2 %
Q15	15 %	34 %	26 %	14 %	11 %
Q16	23 %	51 %	21 %	0 %	5 %
Q17	21 %	51 %	24 %	0 %	4 %
Q18	20 %	53 %	23 %	0 %	4 %
Q19	53 %	32 %	12 %	0 %	3 %
Q20	28 %	41 %	22 %	0 %	9 %

4. Analysis of Results

After applying the surveys to teachers and students, we can detail the following results: 21% of teachers strongly agreed, and 56% agreed that students positively perceived the Flipped Learning Model. In addition, Flipped Learning also effectively influences students' emotions; teachers agreed that the approach enables students to perform much better. Forty-one percent and 47% of the teachers selected strongly agree and agreed that the Flipped Learning with ICT attached makes the class more practical than theoretical.

These favor the teaching and learning process, with 58% of teachers agreeing and 27% strongly agreeing that FL and ICT are more effective than the traditional teaching model. Questions have been asked about the ICTs frequently used by teachers in the Flipped Learning Model, and with the results of the surveys to know which ones are more reliable for synchronous and face-to-face environments.

Figure 2 shows the results of the use of YouTube for video viewing. Teachers of different areas of knowledge use this platform to watch videos before class.
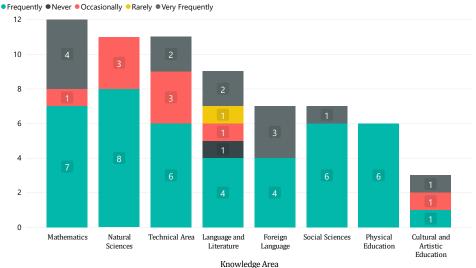

Figure 2. Using YouTube for video viewing. Source: Authors.

Figure 3 mentions the application of Microsoft Forms and Google Forms. The use of forms is frequently used in the different areas of knowledge to collect information on previous knowledge or at the end of the class. The figure shows that 33% of the teachers in the cultural and artistic education area selected the option very frequently, and 67% frequently selected to use Microsoft Forms and Google Forms, followed by technical areas. In the other areas of knowledge, it is observed that it varies occasionally and rarely, and it is worth mentioning that no teacher selected the alternative never.

Figure 3. Use of forms (Microsoft Forms, Google Forms) Source: Authors.

Figure 4a shows the number of students by educational level who use content creation tools such as Genially, Prezi, PowerPoint, and Office Mix. These tools make it easier for students to carry out activities in the class process. Students frequently use these digital tools to realize project presentations in synchronous scenarios at the end of a class. It shows the number of students by educational level who mention how often the content creation tools (Genially, Prezi, Office Mix, and PowerPoint) facilitate the presentation of projects at the end of the class in synchronous scenarios. According to the figure, 245 students representing 37% of the population agree that these tools help very frequently, and 269 students representing 40% of the population selected the alternative that frequently facilitated project presentations.

Figure 4b shows how often students use information search tools for their research before class; in the survey, tools such as Google Scholar, Google, and Virtual Libraries were mentioned. High-school students in a face-to-face setting prefer to use these reliable information tools to carry out educational activities. Thirty-seven % of the population selected the option frequently, and 36% selected the alternative frequently. The question was related to using search tools and obtaining reliable information, among the tools mentioned are Google Scholar, Google, and Virtual Libraries. According to the survey results, two hundred forty-seven students representing 37% of the population selected the option very frequently have used these tools and have facilitated obtaining reliable documents prior to class; 238 students, who are 3% of the population, chose the option frequently. The high-school students of the different levels in a face-to-face scenario prefer to use these reliable information tools to carry out educational activities. The figure also shows that the population is minimal, with 19 students representing 3% who never use the tools above to obtain reliable information.
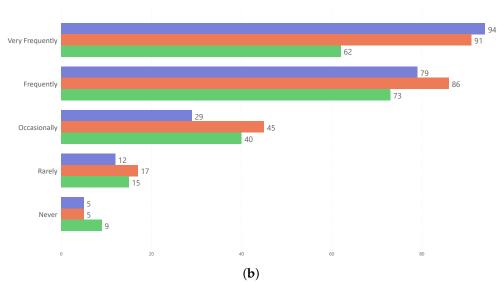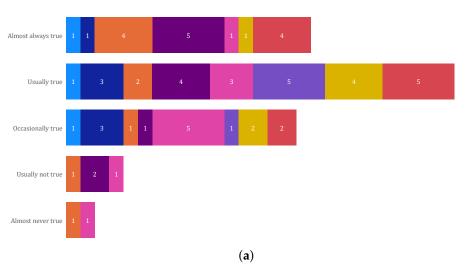
Figure 4. Students Survey: Comparative analysis of results. (**a**) Education level vs. Content Creation Tools; (**b**) Education level vs. Information Search Tools. Source: Authors.

Figure 5a concerns the use of LMS to apply the inverted learning model in synchronous scenarios; the teachers of the institution stated that they use the following tools: Moodle, Canvas, Google Classroom, and Blackboard. The figure shows the number of teachers by areas of knowledge using the tools. Seventeen teachers almost always make use of the LMS mentioned above, and 27 teachers usually make use of these tools to increase the degree of motivation in the teaching–learning process. Eleven teachers (17% of the population) selected the option "very frequently"; 42 teachers (64%) selected the option "frequently"; and nine teachers (14%) selected the alternative "occasionally." Figure 5b shows the number of teachers by knowledge areas who think that Socrative and Kahoot allow measuring the level of knowledge at the very moment of the class prior to the visualization of videos or explanation of the teacher's support. The item shows that the mentioned tools are handy in the different areas of knowledge in face-to-face scenarios. Socrative and Kahoot are educational tools that encourage motivation, increase student participation, and help the teacher create quizzes. The teacher creates quizzes to evaluate the knowledge acquired during the teaching process. In addition, the teacher can use the results of the quizzes to plan specific topics to be reinforced in the following classes.
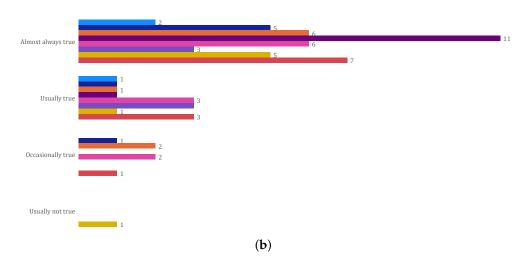
(**a**)

(**b**)

Figure 5. Teachers Survey: Comparative analysis of results. (**a**) Area of Knowledge vs. Learning Management System (LMS); (**b**) Area of Knowledge vs. Video Conferencing Tools. Source: Authors.
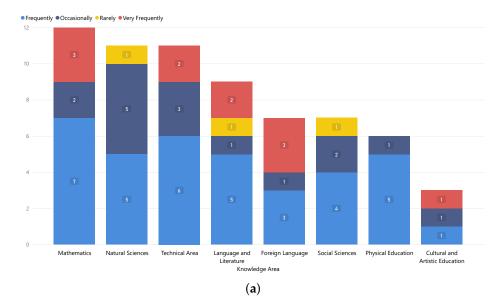
In addition, Figure 5b describes the use of digital tools such as Zoom, GoToMeeting, Teams, and Hangouts. Forty-five teachers, representing 68% of the population, use these tools in synchronous scenarios, and 14 teachers, 21%, usually apply these tools to maintain real-time virtual communication with students. The figure shows how often they facilitate the process of creating videos to be shared prior to class; the video editors mentioned are Screencast-O-Matic, Windows Movie Maker, Imovie, PlayPosit, and EdPuzzle. Ten teachers representing 15% of the teaching population selected the option frequently; 32 teachers representing 48% selected the option frequently; and 21 teachers representing 32% selected the option occasionally. The tools above benefit the enrichment processes of educational videos; the videos can be modified by introducing questions comments and making them interactive and learning dynamically. It is undoubtedly a new way to innovate in teaching and learning.
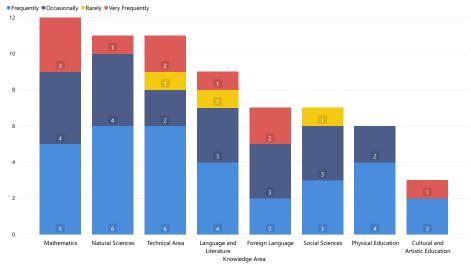
Figure 6a shows the number of teachers by knowledge areas using Socrative and Kahoot. Socrative and Kahoot are educational tools that encourage motivation to increase student participation. Teachers who frequently use Socrative and Kahoot belong to mathematics, natural sciences, technical areas, and physical education. The item shows that the tools mentioned above are handy in the different areas of knowledge in face-to-face scenarios.

In addition, Socrative and Kahoot help the teacher to create quizzes. The teacher creates quizzes to evaluate the knowledge acquired during the teaching process. Besides, the teacher can use the results of the quizzes to plan specific topics to be reinforced in the following classes.

Figure 6b shows the results on the use of video editors in the different knowledge areas. The item shows that teachers frequently use video editors of different areas of knowledge in face-to-face scenarios. The tools mentioned are Screencast-O-Matic, Windows Movie Maker, iMovie, PlayPosit, and EdPuzzle have been generated to benefit from the enrichment process of educational videos. The teacher benefits because with PlayPosit or Edpuzzle, the teacher can modify the videos by introducing questions or comments.

Furthermore, it is observed in the figure that most teachers have made use of video editors to enrich and make them interactive, and students can learn dynamically. Undoubtedly, it is a new way to innovate in the teaching–learning process.

(a)

(b)

Figure 6. Teachers Survey: comparative analysis of results. (**a**) Knowledge area vs. Real-time response systems; (**b**) Knowledge area vs. Video Editors. Source: Authors.

5. Conclusions

Through the present research, it can be stated that teachers and students have a positive perception of the Flipped Learning Model and the integration of ICT. Through the present research, it can be shown that teachers and students have a positive perception about the Inverted Learning Model together with the integration of ICT. It should be considered that this learning model, together with ICTs, has a favorable influence on learning, communicating, teaching, collaborating, participating, discussing, communicating, and empathizing, and all this requires an emotional balance and values that the educational community must transmit to the students, in order to ensure good progress in the intellectual, practical, ethical, and emotional growth of these people.

We inquired about ICT for education that contributes to the Inverted Learning Model, whose tools help to implement the work of teachers; it is essential to be updated on new ICT and methodologies that can promote critical thinking, autonomous work, collaborative work, and prepare students for new realities and the acquisition of skills.

According to the surveys, teachers who apply ICTs considering the Flipped Learning Model stated that students perform better academically than a traditional model class. The teachers who collaborated with these results belong to different areas of knowledge such as Social Sciences, Natural Sciences, Language and Literature, Foreign Language, Physical Education, Mathematics, Art Education, and Technical Areas.

Through this active learning model, the student can develop competencies and contribute to autonomous learning. According to the ICT surveys considering the Inverted Learning model, most of the teaching population stated that students perform better academically, favoring the effectiveness of the teaching–learning process compared to the Traditional Model.

In addition, the results show that the vast majority of students feel motivated to participate and interact with teachers and peers during the teaching and learning process. Students expressed that information and communication tools and the Flipped Learning Model are better suited to their learning pace.

Similarly, students expressed that ICT and Flipped Learning provide time and availability to perform their interactive activities: before, during, and after the socialization of the different topics covered in class.

The viewing of pre-class videos through YouTube is optimal for students as they can obtain knowledge or doubts to be addressed in class. Emphasis should also be placed on strengthening collaborative work in class or through collaborative tools.

It should be noted that the ICTs mentioned in the research work considering the Flipped Learning Model according to the results of the surveys facilitate students' understanding and evaluation of contents. Above all, ICTs and FL favor the information process to elaborate new learning knowledge.

Educational Engineering is gaining ground due to the articulation of ICT and pedagogy. This terminology from IEEE conferences and directed to the field of Engineering Education will be a reality in the short term to achieve the 5.0 education. This topic should be discussed in the short term to identify the advantages and disadvantages.

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