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The impact of a ‘flipped classroom’ approach to teaching on the students’ self-reported engagement in physics

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Total Word Count: 12823

Abstract

Students’ engagement is deemed essential for the effectiveness of the flipped classroom, a didactic model of teaching in which the contents are delivered at home, allocating in-class time for teamwork. This interpretivist multimethod small-scale research uses thematic analysis of the data gathered to explore the learner’s behaviours, attitudes, and feelings towards physics, how do they exercise their agency in a flipped classroom, and what could be done to improve the learning experience of physics in a flipped classroom. Despite some criticisms, students reported an active engagement with their learning and having benefitted from this methodology.

Keywords: ‘flipped classroom’; ‘physics’; ‘engagement’

Word count: 95

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1. Introduction

In the last decade, the education in Ecuador has expanded its horizons to the exploration of new teaching methodologies of active pedagogies, in concordance with a slow paradigm shift in education and how the role of teachers and students are conceived. An important influence for this transformation has been the implementation of the International Baccalaureate programme (IB) in many schools of the country, aiming to increase the quality of education delivered (IBO, 2013a), with satisfactory results (INEVAL, 2018). Currently the idea of the teacher being a guide on the side instead of a sage on a stage (King, 1993) is largely spread. However, despite the interest that the theories of active learning have raised across the world, it could be said from many Ecuadorian classes self-defined as progressivists and learner-centred that they continue to be essentially traditional (Mortimore, 1999). One of these new methodologies is the flipped or inverted classroom.

The flipped classroom is a didactic model in which students complete an individual activity before the class, in preparation for a collaborative activity in class oriented to the achievement of a learning goal (MINEDUC, 2018). The popularity of this methodology has increased in the last decade, as it promises to be a practical combination of effective and highly researched theories, such as student-centred pedagogy, active learning methods, constructivism theory, collaborative and cooperative learning, and peer-assisted learning (Bergmann and Sams, 2012). Students' engagement has been identified as essential for the effectiveness of the flipped classroom methodology (Subramaniam and Muniandy, 2019) and for learning in general (Reeve, 2012). For this reason, a deep understanding of the students' perspectives involving this methodology is desirable to identify practices that contribute or inhibit their engagement, from their subjective experience. Though there are many studies about the flipped classroom across the world (Zheng *et al.*, 2020) and the national authority of education supports and encourage the use of this methodology (MINEDUC, 2018), there is little empirical research undertaken regarding its implementation in Ecuador (Cantuña Avila and Cañar Tapia, 2020). That is why this research aims to contribute to closing this gap by investigating the impact that this approach has on students' engagement during their learning.

The setting in which the research has been conducted is a private, bilingual, upper-middle-class school in Ecuador with the Diploma Programme of the International Baccalaureate. This school delivers a combination of the international curriculum, which self-defines as a high-quality education with rigorous systems of assessment (IBO, 2013b), and the national curriculum, which is prescribed by the national authority. One of the requirements for students to get the international diploma is attending to an examination session, at the end of the two-years programme, sitting diverse externally-assessed exams in all the subjects of the programme, which could be regarded as a form of high-stakes examinations (Polesel, Rice and Dulfer, 2014).

This research focused on a group of students coursing the last year of physics where the methodology of the flipped classroom has been tried during the whole course. The researcher had a positionality of *insider* in this context (Blaxter, 2010), performing the role of teacher of physics. It is important to notice that this course of physics was the only one in the school implementing this methodology and that the other courses mainly adopted a traditional approach to teaching and learning (Alexander, 2018) with visible systems of rewards and punishments (Lupton and Hempel-Jorgensen, 2012) and strong disciplinary controls. Additionally, the students perceive their own learning as an individual and competitive activity (Reay and Wiliam, 1999), which can be evidenced by their poor interactions and their idea of assessment as a regulatory mechanism, used to rank students' abilities. In fact, the final year students with the best grades are awarded with distinction in a solemn ceremony with the whole school, which reinforces the idea of learning like a race. Therefore, this research implies and could initiate a process of transformation of practices related to teaching and learning in this context. The results from this research intend to be used in the same context in which the research has been conducted, to tailor the methodology in a way that students could benefit the most from it and could possibly be implemented in other courses of the programme.

The three interrelated research questions that led the research were: 1) *What are the learner's behaviours, attitudes, and feelings towards physics?* 2) *How do students exercise their agency in a 'flipped classroom'?* 3) *What could be done to improve the learning experience of physics in a 'flipped classroom'?*

To answer these research questions, I begin with an account of my literature search, which has been narrowed by using key search terms such as 'flipped classroom', 'engagement', 'motivation', and 'student agency', and retrieving relevant information

from specialised, online journals of education and psychology, as well as academic repositories. My review is a critical one from which my own line of argument develops. Consequently, the second chapter, literature review, is structured in three sections: Flipped Classroom, Engagement, and Student Agency, where these key terms are defined and explored. This is followed by a third chapter, research design, which presents the main ontological and epistemological assumptions, as well as the most important ethical considerations of the research methodology that has been conducted. The fourth chapter, data presentation and analysis, presents the data collected giving voice to the participants and organising the huge amount of information gathered in seven themes grouped in three overarching themes: 1) engagement and physics, 2) engagement and personal involvement, and 3) engagement and the learning context. These themes are enlightened by the literature review, used to make sense of the data and to produce a 'thick description' (Braun and Clarke, 2013) of the students' perspective that could be used to answer the research questions. Finally, I revisit my research questions and state the extent to which I have been able to answer them.

Word count: 978

2. Literature review

2.1. Flipped Classroom

The flipped classroom is a didactic model that groups the benefits of different theories widely studied, such as learner-centred pedagogy, active learning, constructivism, peer-learning and collaborative learning (Subramaniam and Muniandy, 2019); it exchanges the traditional use given to the time in and out of the classroom (Lage, Platt and Treglia, 2000). The out-of-class time is used to transmit the content of the subject (Bergmann and Sams, 2012), maximising the use of technology and the available resources (Cagande and Jugar, 2018), such as videos, simulations, web pages, digital books, or academic articles, and even resources created by the teacher (Altemueller and Lindquist, 2017). The students access those resources at home in preparation for the class (Abeysekera and Dawson, 2015). On the other hand, the in-class time is used to have engaging experiences and activities of gradual difficulty, such as projects, collaborative activities and problem-solving tasks (Zheng *et al.*, 2020). From a technical point of view of the Bloom's taxonomy revised (Krathwohl and Anderson, 2009), low-order thinking skills, such as *remembering* and *understanding*, are developed through homework, while

high-order thinking skills, such as *apply*, *analyse*, *evaluate* and *create*, are developed in class with the support of the teacher and the help of other peers (Nouri, 2016; Hernández-Silva and Tecpan Flores, 2017).

2.1.1. Benefits of the model

Many of the benefits of the flipped classroom can be synthesised in a better use of in-class time. Usually in a traditional methodology the teacher should deliver a syllabus in a hurry to comply with the program of studies (Bates and Galloway, 2012; Amponsah, Kwesi and Ernest, 2019), leaving little time to individual queries or to assign collaborative tasks. When students learn the contents of the subject at home, they can go through the topics at their own pace, and revisit those aspects that they have misunderstood, as many times as needed (Bergmann and Sams, 2012); Additionally, the class hour can be used to meet students' individual needs, solve any doubt that may have remained from their preparation, and complete tasks that require of them a more active involvement (Lage, Platt and Treglia, 2000; Abeysekera and Dawson, 2015). On the other hand, teachers have more time to interact with their students, displaying a role of an expert guide or facilitator, giving a personalised and timely feedback (Altemueller and Lindquist, 2017), oriented to the achievement of specific learning goals (Hattie and Timperley, 2007). Furthermore, the resources gathered or created by the teacher can be reused in other classes and cohorts, optimising the time spent for planning (Subramaniam and Muniandy, 2019). Research has shown that the time dedicated to lecturing can be reduced with the introduction of sessions of active learning without compromising, and in some cases even improving students' outcomes in comparison with a traditional methodology (Baepler, Walker and Driessen, 2014).

Another benefit of the flipped classroom is a better use of spaces. Traditionally, classrooms are organised in rows and columns heading to the teacher as source of knowledges. Park and Choi (2014) suggested that the classroom design conveys the educational philosophy that underlies beneath the teaching approach, and found that, in a traditional class, students can be discriminated by the place where they sit. The authors talked about a golden or preferred zone, where students can have a better communication with their instructor, as well as more visibility of the lecture materials, and a shadow or disliked zone, where students feel disregarded. This positional discrimination is less likely to occur in classrooms of active learning where students sit in groups to facilitate

collaboration. Abío *et al.* (2017) argue that students in active learning spaces show greater engagement and a tendency to sharing information and creating new ideas.

In general, students find inverted classes more engaging and fun than the traditional ones (Abío *et al.*, 2017), as well as greater opportunities to apply and consolidate their learning, cooperate with others to reach common goals and improve their attainment (Zheng *et al.*, 2020). By enhancing the teacher-student and student-student relationships, the flipped classroom focuses more on a positive construction of students' identity, and the transformative experience of learning (Lysaker and Furuness, 2011; Baepler, Walker and Driessen, 2014), rather than seeing it solely as a process of transposing skills or transmission of knowledges (Freire, 2000; Abío *et al.*, 2017).

2.1.2. Weaknesses of the model

There is the risk that students do not complete the preliminary activity, for any reason, such as low motivation, distractive elements in the study environment or lack of study habits (Abeysekera and Dawson, 2015). In the flipped classroom, completing the pre-task in preparation for the class is the subject homework and, for this reason, its failure could imply a disciplinary or academic sanction. It is important to notice that, if students do not prepare themselves for the class, the effectiveness of the in-class activity could be compromised (Zheng *et al.*, 2020), so it is of teacher's interest to foster, by mean of any motivational tool at his hand and his own expertise, that students commit themselves with the pre-task and complete it. Though students usually like the type of work in class that the flipped classroom promotes, the pre-task is one of the sensitive points of the methodology that has been criticized and attacked by the students, who argue, for example, that it is an unjust extension of the class time (Hernández-Silva and Tecpan Flores, 2017).

Another reason for a student not completing the pre-task can be related to a digital divide, manifested through poor access to technological devices, lack of good internet connection, or digital illiteracy (Park, Ross and Ledezma, 2021). Nowadays, almost every student has a smartphone and access to a computer with internet, especially in upper-middle class families, but the pandemic has increased in some cases the digital divide among students from diverse socio-economic backgrounds (Park, Ramirez and Sparks, 2021). Good computers or high-quality internet services are usually expensive, and therefore some families have only one computer that must be shared between siblings who go to school, or it can only be afforded a medium-quality internet service that

sometimes is inadequate for the heavy data transfer required in common activities of online learning (Sánchez Rodríguez, Ruiz Palmero and Sánchez Vega, 2017), such as watching online videos or participating in videoconferences. It has been said that the flipped classroom maximises the use of technology and available resources, but teachers must thoroughly reflect on how to bridge the digital divide and avoid different forms of exclusion that this methodology could accentuate (Altemueller and Lindquist, 2017).

2.2. Engagement: behavioural, emotional, cognitive, and agentic.

In an academic context, engagement can be defined in terms of how actively involved is a student in the learning activity, by assessing visible behaviours, emotions and learning strategies of the student, while motivation would be the causes behind those behaviours and emotions. The self-determination theory conceptualises motivation as the force that energises and directs behaviours, where *energy* would mean strength, intensity and persistence of that behaviour, and *direction*, would be its purpose and orientation towards a determined goal (Reeve, 2012). It can be said that *engagement* is the public, observable outcome of *motivation*, which in turn is private, psychological, and unobservable (Reeve, 2012).

The theory identifies two types of motivations: inherent and acquired. Inherent motivation comes from the satisfaction of psychological needs, such as autonomy (a sense that you are owner of your actions), competence (a sense that you can succeed in a determined task), and relatedness (a sense that you can establish significant relationships with others) (González and Paoloni, 2014). These psychological needs are essential for the growth, integration, and well-being of a person (Ryan and Deci, 2000). On the other hand, acquired motivation comes from the interactions of a subject with his environment, for example, when people internalise aspects of their social surroundings, such as norms, goals, and values. Additionally, the environment exerts an important influence and can support or thwart the intrinsic motivation of every student. External events, such as rewards, punishments, or feedback, as well as classroom affordances, such as the quality of activities or the teacher motivating style, could affect a person's sense of autonomy, competence, and relatedness (Ryan and Deci, 2000).

Though there are different approaches to how engagement is conceived and can be measured, this research adopt a conceptual model from the self-determination theory (SDT) and adapted by Reeve (2012) in which engagement is deemed as a

multidimensional construct composed of four intercorrelated and mutually supportive aspects i.e., behavioural, emotional, cognitive and agentic (Reeve and Lee, 2014). *Behavioural engagement* refers to the involvement of the student with a learning activity in terms of concentration, attention, effort, persistence, and lack of conduct problems (Reeve and Tseng, 2011); *emotional engagement* is determined by the presence of task-facilitating emotions, such as interest, curiosity, and enthusiasm, and the absence of task-withdrawing emotions, such as distress, anger, frustration, anxiety, fear, and boredom; *cognitive engagement* refers to the use of sophisticated, deep, and personalised learning strategies, such as elaboration rather than memorisation, and active self-regulation strategies, such as planning; *agentic engagement* refers to the students' proactive, constructive, and intentional contribution into the flow of the instruction that they receive, which can be seen in activities such as, asking questions, offering inputs, making suggestions, and expressing preferences and needs. Behavioural, emotional, and cognitive engagement are reactive, in the sense that students receive the instruction and act in consequence (Reeve and Tseng, 2011), while the agentic engagement is proactive and transactional, because students take actions before the learning activity begins, and negotiate with the teacher to adapt the activity in a way that it can satisfy their needs, is congruent with their goals, or is more relevant (Reeve and Lee, 2014). The four-dimensional conceptualisation of engagement has been shown to mediate and explain the motivation-to-achievement relation (Reeve and Tseng, 2011). That is, students' engagement can be used to predict positive school outcomes (Reeve, 2012).

2.3. Student agency

Agency is a concept created and studied in the social sciences that does not count with a unique definition in the literature, but can be understood as the capacity of every person of acting within an environment (Priestley, Biesta and Robinson, 2015), employing its available resources, to achieve a pre-determined goal, through strategic actions and guided by personal values (Frost, 2006). Bandura (2001) conceptualises personal agency as having four core features: Intentionality (agency implies having a proactive commitment to perform future actions), forethought (agency implies anticipating consequences of prospective actions, as well as devising the strategy to produce desired outcomes), self-reactiveness (agency implies constantly monitoring your performance in comparison with desired goals and standards to make corrections to current actions), and self-reflectiveness (agency implies the evaluation of personal

motivations, values and the meaning of life pursuits). Additionally, the International Baccalaureate Organization (2013a) presents student agency as composed of three aspects: voice, choice, and ownership, a simplified model based in the work of Bandura (2001) that was retained useful to explain some features of student agency in this literature review.

Agency is a dynamic, rather than fixed, capacity of a person, which have a bidirectional relation with his identity (Frost, 2006) and can be enabled or constrained by the contextual and structural factors of his environment (Priestley, Biesta and Robinson, 2015). The extent to which students act agentially has been shown to be conditioned by their self-image, past experiences, imagined possibilities for the future, as well as the motivating style of the teacher, the relationships with their classmates, and the classroom affordances for learning. Perceived self-efficacy plays a vital role in the exercise of student agency. Students' beliefs in their own capabilities to control their own functioning and environmental events, make them adopt either an optimistic or a pessimistic mindset which can enhance or hinder their behaviour in a determined context (IBO, 2018). Self-efficacy beliefs is thought to protect students against stress and depression in demanding situations, as well as help them develop resiliency to adversity (Bandura, 2001).

Besides personal agency, Bandura (2001) mentions other two types of agency, taking into account that every person is socially engaged with others in a determined context. *Proxy agency* is a socially mediated mode of agency that appears when somebody more expert, more powerful, or with access to special resources acts at other person's behest to help him achieve a desired result. And *collective agency*, when groups of people sharing intentions, knowledges, and skills work together for a common goal through interactive, coordinated, and synergistic actions. Both modes of agency are based on the principle that nobody can be expert in everything and that some valued outcomes can only be produced with the help of others.

The concept of agency is relevant for students in a flipped classroom approach to teaching that requires them to become inquirers, caring, life-long, and self-regulated learners (IBO, 2013b) who actively engage in dialogue with their teachers and classmates (Hardman and Hardman, 2017), participate in class discussions with the purpose of a collective construction of meaning (Mortimore, 1999), and collaborate in activities or projects for the achievement of common goals. It is in the interest of teachers to help their students flourish during the school stage and build a positive and long-lasting self-image

that could help them overcome obstacles in the future (Boaler and Selling, 2017). There are many ways in which teachers can help their students to build a positive identity, such as offering diverse opportunities for students to exercise their agency, with a more *autonomy-supportive* rather than *controlling* motivating teaching style (Reeve, 2012), through conscious teaching practices, including paying attention to the quality of feedback that they give to their students (Cowie, 2005), fostering reflection practices as both knower and thinker, promoting students' role as active agents in the educational context (Lysaker and Furuness, 2011), abandoning the self-perception of teachers-as-stars (Hunt, 2015), and adopting rather a position of facilitator of the learning process (Freire, 2000). This can be particularly difficult for those who are accustomed to hierarchical views of knowledge transmission (Lysaker and Furuness, 2011).

2.3.1. Voice

This aspect of agency captures the possibility of students of expressing their opinion, making suggestions, and communicating likes, dislikes, or preferences (Reeve and Tseng, 2011; IBO, 2018). Giving thoughtful consideration to the learner's voice (Husbands and Pearce, 2012) has been identified as one characteristic of effective pedagogies that leads to student empowerment, autonomy and sense of agency (Quinn and Owen, 2016). The teaching style can elicit or silence students' voices. For a more active participation of students in the ongoing dialog of the classroom, teachers should increase their repertoires of dialogue of teaching and learning (Alexander, 2008, 2018), focusing on a teaching talk that is not purely rote, recitation or instruction but also discussion and a rich exchange of thoughts; and on a learning talk that is not only narration or explanation, but one that allows students to speculate and imagine, ask questions, argue, reason, justify, negotiate, etc. Another useful technique to encourage students to give their opinion is the implementation of formative assessments, where the teacher asks explicitly for suggestions to obtain feedback on what could be done to improve their teaching practices (Reeve and Tseng, 2011) or improve the learning environment.

2.3.2. Choice

This aspect of agency refers to the possibility of students of making relevant decisions regarding their learning experience and path to follow. Research has shown that passiveness and low agency among students can be caused by the strict control of what is taught, strict discipline and visible systems of rewards and punishments (Lupton and

Hempel-Jorgensen, 2012). On the contrary, students can develop agency when they are allowed to choose what they want to do for their learning, for example, including open-ended, project-based activities (Boaler and Selling, 2017), or also allowing students choose the way in which they demonstrate what they have learnt, such as between diverse types of assessment (Reay and Wiliam, 1999). One immediate obstacle that has been observed at the beginning of a process of transformation of the students' role from passive to active agents, giving them more range of choice, is that students do not want to take that responsibility, or to take part in decision-making, especially when they have not been given the opportunity to experience the benefits of this form of participation before (Onurkan Aliusta and Özer, 2016).

2.3.3. Ownership

Having a voice and making relevant choices are aspects of student agency to the extent that they demonstrate ownership or responsibility of their learning (IBO, 2018). In other words, students must play a proactive role and show involvement with their learning, participating in the classroom discourse for making it more effective (Hardman and Hardman, 2017), negotiating with teacher to enrich the learning experience and make it more significant (Reeve and Tseng, 2011), collaborating with their teachers and other students to plan, present, and assess their learning needs (IBO, 2018). It is important that students see themselves as problem-posers instead of just receivers of external problems (Olson and Knott, 2013), and supersede the initial fears that cause the exigence of autonomy, open-mindedness, and risk-taking, among other essential qualities of an active knower (Lysaker and Furuness, 2011).

Word count: 2846

3. Research design

3.1. Methodological Approach

Many researchers have investigated the relation between the implementation of flipped classroom and the students' engagement adopting positivistic stances (Bates and Galloway, 2012; González and Paoloni, 2014; Nouri, 2016; Subramaniam and Muniandy, 2019). A frequent methodology followed by these researchers is classifying the population in two groups: a target group, which could be a class exposed to the flipped classroom methodology, and a controlled group, which could be a group of students in a

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traditional class (Hutchison and Styles, 2010). These groups could be simultaneous or belonging to different cohorts. Usually, the purpose of this type of research is to *measure* the effect of the intervention, for example, on the students' engagement, which is thought to be objectively determined by a properly designed instrument (Willis, 2007) and comparing results from the different groups to elaborate causal or generalisable explanations through quantitative analysis (Hardman and Hardman, 2017). In these cases, the research quality is usually discussed in terms of three traditional and widely-agreed criteria: validity, reliability, and generalisability (Bryman, Becker and Sempik, 2008).

On the contrary, this study is qualitative in nature and has the purpose of exploring in depth and *understanding* the experience of students in a flipped classroom, to identify patterns of self-reported engagement, related to the application of this methodology, which could be used to improve the teaching practices in this context. Though the quality of qualitative research could be assessed with the aforementioned criteria, some researchers argue that this is not totally appropriate (Braun and Clarke, 2013). This research adopted more informal criteria: trustworthiness, credibility, and transparency (Bryman, Becker and Sempik, 2008; Braun and Clarke, 2013; Miles, Huberman and Saldaña, 2014), which are discussed throughout the report.

The knowledge that interested this research was seen as situated, subjective, and socially constructed, an ontological stance that is frequent in the social sciences, different from the knowledge produced, for example, in the natural sciences, which can be deemed instead as objective and stable (Blaxter, 2010). This type of knowledge is difficult to measure and requires an epistemology where the researcher should elaborate appropriate interpretations of the data gathered to get a better understanding of the context under study (Hammersley, Gomm and Foster, 2009).

For the reasons exposed, it was chosen *interpretivism* as the paradigm that best fit with the purpose and characteristics of this research and, in particular, among all the interpretivist traditions, the school of interpretivist phenomenology (Willis, 2007), a philosophical and methodological current that approach the reality from the perspective and experiences of situated, sentient and social individuals, through the study of their "habits, practices, skills, or rituals" (Benner, 2008). It is not the aim of phenomenology to produce theoretical constructs, as in the grounded theory tradition, nor causal or generalisable explanations. Instead, this research wanted to produce a 'thick description'

of the students' perspectives, comparing it with the existing literature when that was relevant, to answer the research questions.

The design frame of the research chosen was *case study* (Hammersley, Gomm and Foster, 2009; Cohen, Manion and Morrison, 2018). Notwithstanding that, it is hoped that the research findings could be used in the near future as part of a greater study of *action research* (Blaxter, 2010) with multiple and successive interventions of planning, action and reflection oriented to a more successful implementation of 'the flipped classroom' methodology in physics and, possibly, other subjects of the Diploma Programme in the school where the research took place.

3.2. The case

Students of the last year of schooling currently attending to a physics class with a flipped classroom approach to teaching constituted the boundaries of the case under study and all of them have been regarded as potential participants for this research.

3.3. Methods

This study endorsed an inductive approach (Cohen, Manion and Morrison, 2018), where the data collected with the instruments was thematically analysed to let theory *emerge* from the analysis. Despite the researchers' intention of conducting a systematic and critical enquiry (Bassegy, 1992) and his aspiration of approaching the data with an open mind, it is important to acknowledge the impossibility of being completely free of preconceptions (Becker, 1967), and that the researcher's standpoint, disciplinary knowledge, and epistemology always influence the data analysis (Braun and Clarke, 2013). In this case, a theoretical framework has been employed for the design of the data collection instruments, whose questions has been formulated in the light of four engagement constructs: behavioural, agentic, cognitive, and emotional (Reeve, 2012; Subramaniam and Muniandy, 2019), to elicit answers from the participants around this categories. However, the data produced was not analysed trying to fit into this pre-existing frame, as a theoretical thematic analysis would do (Braun and Clarke, 2013). On the contrary, following an essentialist/realist epistemology, the data was approached in a 'bottom up' way, where the themes were identified at a semantic or explicit level, closer to the reality of participants, for a more complete representation of the students' perspective in this context (Braun and Clarke, 2006).

3.3.1. Instruments

To deeply explore students' perspectives, behaviours, feelings, and attitudes towards physics in relation to the flipped classroom methodology, qualitative data has been gathered through the following data collection instruments:

3.1.1.1. Questionnaires

In their study, Subramaniam and Muniandy (2019) used a Likert-scale questionnaire with thirty-five statements organised in four sections representing the four engagement constructs. With this instrument in mind, another questionnaire was designed (see Appendix 2), including open questions that could be answered with the Subramaniam and Muniandy's statements, but allowing participants to express themselves in their own words. All the students defined in the case boundaries have been invited through letter to participate. Though the use of open questions has made the analysis more intricate, it is thought that this feature has reduced the influence of the researcher's bias, because the opinions of the participants were not enforced to fit within a bunch of prescribed statements, which would remove the nuances of each subjective experience. Therefore, it is believed that the data generated is closer to the reality of participants (Burton and Bartlett, 2005), which contributes to the trustworthiness of the research.

3.1.1.2. Interviews

A sample ten students (out of forty-nine) has been invited to explore in more depth their experience with the methodology of the flipped classroom in a one-to-one semi-structured interview (Marvasti and Freie, 2017). A quick preliminary analysis of the responses to the questionnaire has been conducted before the interviews, allowing the use of this information to revise the interview design, and identify new aspects that could be added to the exploration. The complete questionnaire used for the interviews is included in the appendices (see Appendix 3). Interviews were thought to give participants an opportunity to express themselves in a more detail manner, thanks to the possibility of making probe questions and asking for more elaboration, which could compensate eventual lack of data in the questionnaire's responses due to very brief or ambiguous answers of participants.

3.1.1.3. Document analysis

All the students keep an e-portfolio as part of their formative assessment within the school (Hooker, 2017), in which they are asked to reflect on their own learning and performance in every subject, each academic term. Consent has been sought from all the students defined in the case boundaries (and their parents, for those students under 18) to conduct a thematic analysis of the physics e-portfolio that could be used to complement the data generated with the questionnaires and the interviews (Olsen, 2012). This document was considered useful for obtaining information about activities conducted by students before, during, and after their learning, not confined to the period of data collection. For example, their planning, what they have done in class, suggestions given to the teacher on how to improve the learning experience for the next time, all of which could provide evidence of their engagement and exercise of agency.

3.4. The process of analysis

Data produced with all the instruments has been deidentified (explained in the ethical appraisal section), cleaned up (removing repetitions, typos, or hesitations, taking care of not altering the meaning of the data), gathered in a unique document, translated from Spanish to English (prioritising the preservation of the original meaning), and cross-checked through triangulation to confirm findings or to identify anomalies between different sources of information. The process followed is thought to strengthen the trustworthiness and credibility of the research and, in general, that it contributes to the research quality (Roulston, 2010). Moreover, this comparison was not only interested in looking for consistency of the data, but also for patterns of dissonance that could appear in the data generated from diverse sources and could reveal hidden attitudes or feelings of the participants.

For the stage of analysis, it has been followed the process of thematic analysis presented in Braun and Clarke (2006), consisting of six phases: 1) familiarise yourself with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes and 6) produce the report. Like many qualitative investigations, the generation of sufficient and relevant themes relied rather on the researcher's good judgement than on quantitative measurements, such as statistical frequency, though some forms of counting, comparing and weighting were made (Miles, Huberman and Saldaña, 2014). The criteria used for the selection of themes were

prevalence (there are several instances of that theme across the data set), *centrality* (the theme is crucial for answering the research question), and *theoretical saturation* (the collection of new data would not add significant inputs that could alter the conclusions of the analysis (Fugard and Potts, 2020)). The resulting themes were ordered hierarchically in two layers, using three overarching themes for more clarity in the presentation of the data. A more complex structure of three layers, including subthemes, was deemed unnecessary as it would be harder to follow and analyse in depth (Braun and Clarke, 2013).

3.5. Ethical appraisal

This research was designed following international ethical protocols, in particular, the guidelines offered by the British Educational Research Association (BERA, 2018), the advice of the Open University Human Research Ethics Committee, and the accepted local guidelines (MINEDUC, 2017). Additionally, ethicality has been fully assessed with the grid presented in Stutchbury and Fox (2009), as well as an Ethical Appraisal Form (see Appendix 5), where the most relevant observations are reported in this section. The main ethical principle that guided the design of this research was that it should “maximise benefit and minimise harm” (BERA, 2018, p. 4) for all the persons involved.

Permission to undertake the research has been granted by the school gatekeeper. Potential participants and their parents or carers, for those participants under 18, have been contacted via an invitation letter (see Appendix 4) that explained the purpose and process of the research and invited them to give their consent to the different forms of voluntary engagement with it (Stutchbury and Fox, 2009), as well as their right to withdraw from it at any time, with the promise of removing all the identifiable data that could have been collected from them up to that moment (BERA, 2018). Additionally, with the commitment of minimising class interruptions, this research did not interfere in any way with the academic activities of the school (MINEDUC, 2017)

The researcher was an insider in the context where the research took place and teacher of the participants. Among the benefits identified of this positionality were the possibility of doing research during work time, ease of access to the data sources required for the investigation, and the possibility of acquiring a deep understanding of the situation quicker than an outsider researcher. On the other hand, some ethical issues regarding confidentiality and power relationships that can emerge by researching people managed

by the researcher (BERA, 2018) have been carefully considered in the design of the research, for example, problems to maintain anonymity (Blaxter, 2010) or that participants could try to accommodate their opinions to what they think that the researcher wants to hear.

The design of the questionnaire has contemplated two key features: its length and the use of language. Considering that an excessively long questionnaire could cause fatigue in respondents and therefore undermine the trustworthiness of the data (Garrett and Shortall, 2002) but, at the same time, thinking on guaranteeing that sufficient data would be elicited, it was thought that two open questions related to each engagement construct could be enough to generate the required data, for a total of eight questions. To avoid language barriers and facilitate responses (Stutchbury and Fox, 2009), each question has been formulated in the native language of the respondents (Spanish), in a simple and clear manner, avoiding technical words, and with a structure that required elaboration instead of a yes–no question. A pilot questionnaire has been sent to a focus group of students before the real data collection, to verify their comprehension of the questions and that sufficient and relevant data has been produced.

The questionnaire has been delivered through Microsoft Forms, which comply with many important ethical requirements, such as security, accessibility, and anonymity (BERA, 2018). The data was securely kept on a cloud storage with a password-protected account, where unauthorised access was prevented but, at the same time, there was less risk of data loss. Participants could access the questionnaire with ease from a variety of devices and use a *read-aloud* functionality if needed for any reason, for example, in case of dyslexia. Participants' responses were anonym, but the questionnaire was set to allow only authenticated users to submit a unique answer. In this way it was guaranteed that each respondent was one of the invited students (except in the case of identity theft), and that a participant could not alter the weight of an opinion, by sending it many times.

Anonymity was an important feature of questionnaires because it could allow participants to be confident of expressing what they really thought, without the fear of being punished for it. It was thought that if the participants did not have enough confidence to express their opinions frankly, different forms of dissent would have appeared in the questionnaires' responses, in comparison with the responses given during one-to-one interviews or the reflections in the portfolios, where the identity of participants could be perceived as exposed. On the contrary, neither interviews nor e-portfolios were

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anonym. In these cases, with the commitment of respecting the privacy of individuals (BERA, 2018), all the excerpts have been deidentified using pseudonyms for its use in the reporting stage. All personal and sensitive information that was revealed during data collection has been removed from the excerpts, taking care of not altering the meaning of the answer provided.

Representativeness in the interviews has been ensured by inviting students with various levels of academic attainment, and a balanced number of males and females. Particular care has been taken when interviewing low-achieving students, because recalling experiences of failure could have caused not-intended pain or shame in them, therefore questions that could recall such experiences has been formulated with tact.

It was hoped that the researcher could make the most of his existing positive relationship with the participants to build a secure environment of trust and respect that facilitated a fluid dialog during the interviews and to recall important events or common experiences that could be relevant to the research, but also to recognise the trustworthiness of the answers provided (Marvasti and Freie, 2017).

During the interview it was important to remark that the responses provided to the questions were confidential and would only be used for the purpose of this research. An important exception to the agreement of confidentiality that was explained to participants and their parents, was the disclosure of a situation in which the protection of a child or a vulnerable adult would be compromised or when a criminal behaviour would be confessed (Stutchbury and Fox, 2009; BERA, 2018). Situation that would have been immediately communicated to the school department in charge of these matters, as stated in the local protocols for the safeguarding of children and vulnerable adults (MINEDUC, 2020).

Consent has been sought for the interviews to be audio-recorded, alongside the written notes, for a more accurate data collection, with the promise of giving a proper treatment to this data, as stated in the invitation letter (see appendix 4). A full transcription verbatim has been prepared after the interview and sent to participants for its revision and eventual corrections. In this way participants have been fully informed of the data that they have produced, and they could confirm that what was written was exactly what they wanted to say and acknowledge that they were not identifiable from this information. All these procedures were followed to make participants feel confident that the data would

be treated with professionalism and that their voices would be fully heard and taken seriously.

This research subscribed to the values of an ethical enquiry, such as respect, integrity, responsibility, and transparency (BERA, 2018). Regarding transparency it would be important to acknowledge the researcher's sympathy for the flipped classroom methodology but, at the same time, ensure the researcher's commitment, since the beginning of the research, to tell the truth (Stutchbury and Fox, 2009) and not defended it at all costs, especially if convincing evidence of negative consequences due to its implementation were found.

Word count: 2871

4. Data presentation and analysis

4.1. Sample

From a total population of forty-nine students (potential participants), fifteen have responded the questionnaire, six have participated in the interviews and four have given consent for their e-portfolio to be included as data in the study, which represents a sample size of around 30-47 %. The exact percentage of the sample cannot be calculated because responses to the questionnaire are anonym and, therefore, some participants would have been counted multiple times. Interviewees that gave their consent to use their portfolio were counted only once. The total of participants in the study is estimated to be between fifteen (minimum) and twenty-three (maximum). According to Opie (2004), a sample size of at least 30% would allow an adequate statistical analysis. Though the study is not interested in a quantitative analysis of the data, this criterion is used to argue that the data is statistically representative and that the findings of the study can be generalisable to the entire population.

4.2. Findings

The data is presented in this section in seven emergent themes, grouped in three overarching themes for more clarity: 1) Engagement and physics, 2) engagement and personal involvement 3) engagement and the learning context.

4.2.1. Engagement and physics

4.2.1.1. *Physics is cool, is beautiful... but it's complicated!*

The title of this theme is taken from an interview (Elizabeth, Interview 4, May 31, 2022) because it summarises well a frequent idea throughout the data, though expressed in different manners, that physics is very interesting, it helps students to comprehend the world around them and to satisfy their personal curiosity, but that the subject is difficult *per se* and requires high levels of abstraction (González and Paoloni, 2014). Before starting the second year, José wrote in his portfolio:

I want to study physics because it is interesting to know how and why some phenomena of the real life occur, things that we see every day. It is beautiful to learn of these phenomena and do experiments with them.

(José, Physics portfolio no. 1, August 27, 2021)

Some students used their interest for the subject as incentive for trying better and hard despite their struggles. *“Usually, I don't understand the topics at first, but I find them interesting and continue paying attention to get a better comprehension of them”* (Questionnaire response no. 1, April 09, 2022). *“Physics is a subject that requires putting neurons to work (...) I love this subject, but sometimes I needed to read and re-read the statement several times just to understand what the question was about”* (Roberto, Interview 2, May 27, 2022). These extracts show how the emotional engagement of students towards the subject (interest, curiosity and enthusiasm) supported their behavioural engagement (pay attention, put effort) to overcome the difficulties found (Reeve and Lee, 2014). But when that effort was not enough, some students got frustrated. One student clearly stated this by saying:

Many times, during classes I don't feel good, because I feel that I'm not learning at the same pace as my classmates. It frustrates me to see them making progress in the subject and that, although I make an effort to learn, there are certain things that I still don't know. (Questionnaire response no. 15, April 26, 2022)

This student shows signs of emotional disengagement, a pessimistic attitude and probably a desire of giving up (Skinner, Kindermann and Furrer, 2009). Consequently, her feelings were transferred onto physics. *“I liked physics before but, after these two years of pandemic, not anymore. My change was due to the difficulties to learn it during*

the lockdown and the drastic change of methodology” (Questionnaire response no. 15, April 26, 2022). In this case, this student’s poor self-efficacy beliefs caused her emotional disaffection for the subject (Bandura, 2001). Across the data there were no signs of fear or boredom towards the subject or in-class activities.

The reason many students gave for saying that physics is a difficult subject was its heavy math load (González and Paoloni, 2014). *“For me, physics is applied mathematics”* (Roberto, Interview 2, May 27, 2022). In fact, many exercises of physics involve the use of advanced mathematics. Referring to his future university studies, one student said: *“I feel that I have a good background for understanding concepts in physics at the university, but that my poor backgrounds in mathematics instead are going to make things more difficult”* (Carlos, Interview 5, Jun 01, 2022). A perception of having poor mathematical skills undermined the students’ self-efficacy beliefs towards physics, producing in them anxiety and pessimism (Bandura, 2001).

Laboratory practices, both real and in simulators, were crucial for gaining more students’ interest towards physics. A student who showed little interest for the subject during the first year, commented at the end of the second year: *“I liked this year mainly because of the laboratory practices (...) I always wanted to come to the laboratory, to see what new instrument we were going to use”* (Manuel, Interview 1, May 27, 2022). The students considered laboratory practices as concrete experiences to consolidate and apply the theory of the subject. *“I love when we do laboratory practices, especially when they are connected to the real life because that helps you to understand better”* (Judith, Interview 3, May 31, 2022). *“I did have fun!”* (Elizabeth, Interview 4, May 31, 2022). *“With the interactive simulations we could play and learn more”* (Manuel, Interview 1, May 27, 2022). After an experimental verification of the Newton’s second law, a student said: *“The number of activities of this type could be increased, in order to contemplate that this subject had its origin in experiments like these”* (Roberto, Physics portfolio no. 2, November 26, 2021). Finalising the school year, when experimental activities had been finished, and the students were individually preparing for the exams, one student answered to a question that asked him how this class could be improved: *“practices again 😊”* (Questionnaire response no. 5, April 22, 2022). Despite the short answer, the emoji used shows that this student yearned the laboratory, he was emotionally engaged with its practices, and he appreciated this kind of group work.

4.2.1.2. *More than physics is what you can get with it*

Some students used their academic goals, such as passing exams, obtaining the Diploma, studying a professional career, getting a scholarship, participating in physics contests, or increasing their general knowledges, as proxies for the usefulness of physics. “*There are some topics that are useful for our daily lives, but some others do not relate to the career that I’m going to follow*” (Questionnaire response no. 10, April 22, 2022). In this sense, when the subject was deemed *useful*, students showed greater behavioural engagement. “*I spent a lot of time outside of school learning physics, because I wanted to win the scholarship in that contest*” (Carlos, Interview 5, Jun 01, 2022). And when the subject was deemed *useless*, students showed little engagement. When asked what he does when he does not understand something in this class, a student answered: “*not very much actually. Sometimes we study things in physics that aren’t very useful for me, so I don’t put effort into it*” (Questionnaire response no. 11, April 22, 2022). Referring to the syllabus that is taught in the school, a student commented, “*only those topics that will actually be examined in the International Baccalaureate should be taught. Because many times we are taught things that are just padding the course out*” (Questionnaire response no. 7, April 22, 2022). When students perceived that their learning was relevant and coherent with their goal, they showed more interest, which has been used in the literature to positively predict engagement and performance (González and Paoloni, 2014).

Outside the achievement of academic goals, few students assessed the usefulness of physics for the subject itself, for example saying how a concept of this subject has been applied in their life. To this respect, a student commented: “*I believe that my classmates see physics as something rather isolated. And not only physics, but in general the exact sciences, such as physics or mathematics*” (Carlos, Interview 5, Jun 01, 2022). When asked for a clarification of the term *isolated*, the student explained that he understood it as something that is difficult to relate to other subjects, detached from reality, or useless for the context they are commonly in (Carlos, Interview 5, Jun 01, 2022).

4.2.2. Engagement and personal involvement

4.2.2.1. *More or less participative*

When asked to describe their participation in the class of physics, many students referred to what they did in class. From their responses, it seems that students depicted participation as a continuum to assess where they were. At the one side there were those behaviours that they considered as the lowest level of participation, such as paying

attention or listening. *“My participation is quite limited. In some lessons I tend to participate more than in others, but generally I don’t ask many questions nor propose more ideas to expand our knowledges”* (Questionnaire response no. 1, April 09, 2022). At the other side, there were those behaviours that represented the highest level of participation, such as getting involved with the activities, asking questions, answering to the teacher’s queries, and even – one student mentioned it – explaining concepts to his classmates. *“My participation is active. To some extent, I believe I’m fundamental for my classmates to understand what is being taught in class. I help my classmates to understand physics”* (Questionnaire response no. 13, April 24, 2022).

In the following excerpt it can be seen how the student's perception of self-efficacy determined his level of participation (Bandura, 2001): *“My participation in this class is active when I know the topic, but if I don’t know it, I’m not very participative”* (Questionnaire response no. 9, April 22, 2022). Students participated when they felt that they had something of value to say that would contribute to the class discussion. On the other hand, the feeling of ‘being behind’ was a cause of emotional disengagement that led one student to exclude himself from participating in the class discussions:

My participation in this class is scarce. Actually, I feel that physics is the only subject where I do not feel comfortable asking questions. (...) I like physics, but I think that I don’t understand it as my classmates do.
(Questionnaire response no. 2, April 10, 2022)

Probably this student thinks that her questions would seem too elementary for her classmates, considered to be more advanced than her, and for this reason, she does not ask anything.

Most of the students said that they ask the teacher when they have not understood something. However, during the interviews it was seen that some students shy away from asking questions to the teacher alluding varied reasons. For example, timidity, lack of interest, little time to asks questions, that some students wait to see whether other classmates ask their same questions, etc. *“When I got stuck, on many occasions I didn’t ask the teacher but rather a classmate, who understood well the subject, because I’m shy”* (Manuel, Interview 1, May 27, 2022).

When I don’t understand something, I wait for the teacher finish explaining it and I ask him to repeat, unless another classmate has asked

the same question, in which case I listen carefully to the answer given to my classmate. (Questionnaire response no. 12, April 22, 2022)

4.2.2.2. *My own learning strategy*

Different participants reported having discovered the best way for them to learn. For some students it consisted of taking notes, watching videos, creating graphic organisers or summaries, for others it was applying what they have learnt to a concrete situation of the real life, some said that they looked for connections between the new knowledge and what they already knew, and divided complex contents into simpler concepts that they could assimilate. These strategies to enhance learning are examples of cognitive engagement (Reeve and Tseng, 2011).

I saw that I learn better writing down and practicing, like in maths, doing a lot of exercises. So, my strategy for learning was using a notebook to watch the videos and solve the exercises presented, before watching the solution in the video, to compare them. When I was able to find the correct solution before the teacher, I felt satisfaction. (Manuel, Interview 1, May 27, 2022)

In a previous theme it was seen how interest supports effort. However, in the last extract there is evidence of how the successful effort of Manuel (behavioural and cognitive engagement) produced in him an emotional reward (satisfaction) that increased his positive attitude towards the subject (emotional engagement), confirming the idea that the engagement constructs are mutually-supportive (Reeve and Lee, 2014).

Almost all the students showed the consciousness that *“the responsibility of learning correctly in the flipped classroom falls on the students, to a greater extent than in traditional classes”* (Roberto, Physics Portfolio no. 2, November 26, 2021), and many students reported having benefitted from the activities of the inverted methodology, which was consistent with the theory (Bates and Galloway, 2012). *“I could put my self-management skills and responsibility into practice by having to study and practice the different topics autonomously”* (Susana, Physics portfolio no. 3, November 26, 2021). Regarding the pre-task, Susana noted: *“Every week I could study at my own pace, taking enough time to understand the units”* (Physics Portfolio no. 3, November 26, 2021). Another said:

I watched part of the video before, then we came to the class, and later I finished it. (...) For example, there were exercises that I skipped because with a quick gaze I could understand what it was about, so I skipped it.

(Elizabeth, Interview 4, May 31, 2022)

The possibility of studying at their own pace was a commonly appreciated feature of online videos, as noted by other researchers such as Nouri (2016), or Altemueller and Lindquist (2017), who additionally argue that this, among other characteristics of the flipped classroom, aids differentiated learning and enhances inclusion.

However, though recognising that these resources were useful to solve their doubts with autonomy, many students admitted with some shame not having revised all the resources expected. *“Due to the short times in the International Baccalaureate, sometimes we should swallow 2 or 3 videos in just one sitting to be able to finish everything on time. For that reason, there were some topics that nobody studied”* (Roberto, Interview 2, May 27, 2022). The different approaches taken by students to complete the task, including deciding whether it was relevant to them or not, and accepting the consequences that not doing it would entail, are seen as a conscious and deliberate adaptation of their learning, characteristic of student agency (Reeve and Tseng, 2011).

Some participants tried to work independently before asking for help, as a sign of cognitive engagement (Subramaniam and Muniandy, 2019). *“When I didn’t understand something, I made an effort to solve it by myself, or tried to go as far as I could with that doubt unsolved, until there was no other choice than asking the teacher”* (Roberto, Interview 2, May 27, 2022). Often students solved their doubts searching in internet, or using the resources provided by the teacher, such as videos or online books. The students progressively built up a personal bank of resources that they could consult every time if needed. *“This methodology was easier for studying because I had all the materials available for consulting. If I wanted to review a section, I knew exactly where it was, which video, and just went straight to it”* (Elizabeth, Interview 4, May 31, 2022). Though the school have a fully equipped library, just one participant mentioned having used it (and few times) to solve her doubts, showing a preference of students for digital and online resources. This finding is not surprising due to the large upper-middle-income

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population in the school with ease of access to technology and internet at home (Altemueller and Lindquist, 2017).

Occasionally, the process of consulting the didactic resources was challenging. For example, if the resource was perceived as too complicated, excessively long, or boring:

Sometimes the teacher suggested me resources to answer my questions that I found complicated, for example, an online book where finding the information was not that easy. Sometimes these resources are too far away from what students can handle and become an obstacle that blocks people to continue investigating. (Carlos, Interview 5, Jun 01, 2022)

I don't mind watching videos, but when they are too long, like one-hour long, it is exhausting, and I fell asleep. (...) It would be better to have segments of 15-20 minutes where you can say "I have already finished this" and don't get so overwhelmed. (Judith, Interview 3, May 31, 2022)

These two excerpts show how even students with a great interest in a subject were discouraged due to inappropriate characteristics of the resources, which prevented them from studying them in depth.

4.2.3. Engagement and the learning context

4.2.3.1. *We are the traditionalists*

The deliberate transformation of the role of the teacher in class from a source of knowledge to a facilitator of learning was not always happily received. *"My classmates criticised that the teacher didn't teach, but that wasn't true. It was just that his teaching methodology was different, while we were accustomed to the traditional way"* (Carlos, Interview 5, Jun 01, 2022). The students thought that the teacher's duty was to directly instruct his pupils and that, if the content was taught using videos, there was no purpose in coming to school. *"If I don't need the teacher, why am I here?"* (Carlos, Interview 5, Jun 01, 2022). This was a serious criticism that revealed the students' internalised vision of education as purely transmission of knowledges (Freire, 2000). *"We are accustomed to learning everything in class. My classmates are closed to the methodology because we are traditionalists and don't want to reorganise our time"* (Alejandro, Interview 6, Jun 02, 2022). Two underlying thoughts of the students seem to emerge here: 'the teacher is

not doing his job' and 'I don't want to use my time to do the teacher thing'. It was already known that students tend to prefer the methodology they have been used to, and a change in class dynamics makes them uncomfortable (García Gómez, 2016). Therefore, the student's opposition to the methodology was somehow expected. But this finding dug deeper and stands as a plausible explanation for the apathy that some students show towards the flipped classroom that is surprisingly poorly documented in the literature. Furthermore, the opposition encountered could have been accentuated by the fact that "*this was the only different class*" (Carlos, Interview 5, Jun 01, 2022), because all the others were still mainly traditional, and that this was the first time that all the participant experienced this methodology.

Though a significant proportion of students resisted the implementation of the flipped classroom, as confirmed by other studies (García Gómez, 2016; Hernández-Silva and Tecpan Flores, 2017), and few of them openly said that they "*preferred the traditional classroom*" (Judith, Interview 3, May 31, 2022), in general students tried to integrate within the inverted methodology aspects commonly associated to the traditional methodology, though not necessarily incompatible. For example, one student suggested the inclusion of a form of instrumental conditioning, typical of behaviourism (Tomic, 1993), by saying: "*there should be more immediate rewards for those students who follow the planning, or verbal encouragement from the teacher, motivating us to continue*" (Questionnaire response no. 12, April 22, 2022).

Notwithstanding some planning tools made available to support autonomy, students wanted more control from the teacher in the form of deadlines and reminders. "*When you had deadlines, it was easier to organise your time*" (Alejandro, Interview 6, Jun 02, 2022). "*It would be good if the teacher reminded us of what we should do for the next class, because sometimes I forgot it or didn't see my plan*" (Judith, Interview 3, May 31, 2022). Regarding motivating strategies, there was an interesting caveat: "*marks aren't the best choice, because they are widely used and highly hated by students*" (Carlos, Interview 5, Jun 01, 2022). Another student wanted more direct instruction and traditional recitation (Reznitskaya and Gregory, 2013), such as "*classes of theory and exercises to consolidate learning*" (Questionnaire response no. 9, April 22, 2022). One student showed a form of agentic engagement by requesting assistance (Reeve and Tseng, 2011). "*After the activities, I would like to have feedback on what we did in class*" (José, Physics portfolio no. 1, January 26, 2022). It could be seen that the paradigm shift was difficult

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for students who made deliberate attempts of adapting the methodology according to their learning preferences as evidence of agentic engagement (Bandura, 2001; Reeve, 2012; IBO, 2018).

4.2.3.2. *All for one, and one for all*

In general, the students reported a cooperative work where their peers played an important role for “*developing teamwork skills*” (Susana, Physics Portfolio no. 3, November 26, 2021) and sharing different points of view, for example, to understand the exercise statements, evidencing processes of peer learning, mutual clarification of concepts, and reciprocal support, where students reminded each other what needed to be done. “*Sometimes communicating with a peer is easier than with the teacher because we use the same kind of language, easier to understand*” (Manuel, Interview 1, May 27, 2022). Most of the students reported having gone to a classmate for clarification of doubts or being themselves who explained the subject to others. Communication between peers was facilitated because they had “*like a dialect. Or maybe because between students there is more trust*” (Alejandro, Interview 6, Jun 02, 2022).

It would have been expected that advanced students rejected the cooperative work, arguing something like ‘they were giving more than receiving’. And though one student said that the role of his classmates “was poor because they didn’t understand the subject” like he does (Questionnaire response no. 9, April 22, 2022), in general, those advanced students reported that they have learned a lot while explaining to others, and therefore have benefited from it. For example, in the role of helper, Judith said: “*I was able to explain thermodynamic to my friends. That is why I think thermodynamic is my favourite topic, because I explained it several times and understood it perfectly*” (Interview 3, May 31, 2022). But as the helped one, she made a negative experience: “*Sometimes my classmates taught me like I was dumb. Anyway, I prefer the feedback from the teacher because my classmates are more likely wrong*” (Judith, Interview 3, May 31, 2022).

Some students recalled an experience in which they had seen the video before the class, and then during the class some students made a basic question that required the teacher to make a detailed explanation of something that they had to know already. “*This situation set me back because the teacher had to return to the traditional methodology, explaining something that was already in the video*” (Carlos, Interview 5, Jun 01, 2022). In this case, responsible students are discouraged to watch the video the next time because they know that the teacher will ultimately explain what they need to know. “*Once when*

I had not seen the video, during the class I did not understand anything” (Judith, Interview 3, May 31, 2022). Through this negative experience, which students should not be spared, Judith became aware of the importance of preparing herself in anticipation of the class.

Some students deemed competition motivating for learning, for example, when the activities included challenges, problems to solve or contests, such as those where something should be designed. *“You need someone to compete with. Someone running in front of you, that makes you desire catching up with him, advance with him, or beat him”* (Carlos, Interview 5, Jun 01, 2022). The last extract referred to the importance of studying with people who share the same interest and level of depth in the subject, so that they can help each other in their way through the content units. On the contrary, when there are not good challengers, students are tempted to spare their effort. For this student, a demotivating aspect was not finding in his class *“another companion to advance together, with whom discuss or even compete”* (Carlos, Interview 5, Jun 01, 2022). Like in a race, having a great gap with the second place, he simply decided to slacken off.

4.2.3.3. **Context matters**

Some students referred to how the learning environment affected them positively or negatively for studying autonomously. *“Though I understood since the beginning what this methodology of autonomous learning was about, it was difficult for me to focus and take away all the distracting elements of my environment”* (Roberto, Interview 2, May 27, 2022). For some students, the time of attending the class impacted on their engagement. They said: *“there is one day every week when we have this subject the last two hours of the day, when we are already tired”* (Questionnaire response no. 5, April 22, 2022). In these conditions, students could not concentrate well on some tasks, such as solving exercises. *“On these days, I’d rather do laboratory practices”* (Questionnaire response no. 12, April 22, 2022).

Some students indicated that the flipped classroom methodology went well for them during the lockdown:

I started with enthusiasm, during the first year of Diploma, and I liked it a lot. I have understood well the subject, and I could solve my doubts by investigating more. But later, the second year, I lost some motivation, not because I didn’t like physics anymore, but because I started practicing soccer in the afternoons, and it was more challenging the organisation of

my time. And my free time, I use it for resting or doing other things.

(Alejandro, Interview 6, Jun 02, 2022)

In this case, the change in routine made it difficult to harmonise the autonomous part of their study with their other activities.

Finally, some students also referred to the heavy academic load of the International Baccalaureate as a limiting factor to comply with their responsibilities of the autonomous study.

All the IB subjects were very tough for me. When you complete the IB you need to commit yourself with your studies, and I did keep my nose to the grindstone! But at the end I was exhausted, especially in the period where we were finishing our internal assessments and simultaneously preparing for the external examination. (Judith, Interview 3, May 31, 2022)

Students of the last year frequently feel overwhelmed because they have a shorter school year and more commitments to attend to, such as end-of-year assessments and college entrance exams (González and Paoloni, 2014).

Word count: 4427

5. Conclusions and implications

5.1. Behaviours, Attitudes, and feelings towards physics

It has been shown that the student's positive emotions towards physics enhanced their engagement with the subject, while negative emotions hindered it. The students experienced negative emotions, such as distress, anxiety, or frustration when they felt lacking the required mathematical skills, felt behind in their progress, or had too much workload with other subjects. The teacher created some opportunities to experience positive emotions, such as interest, curiosity, and enthusiasm, through teamwork activities that involved the use of technology and hands-on experiments in the laboratory.

Additionally, it was seen that students valued physics to the extent that it allowed them to achieve their personal and academic goals. When the subject was deemed useful to achieve their goals, students tended to put more effort into it, concentrate better, and repeat their tries until they succeeded. Otherwise, they showed different forms of

disengagement, such as indifference, distress, or pessimism. Many students regarded physics as an interesting subject, that unfortunately was easily put aside when competing with other priorities, because they did not perceive the relevance of it for their lives.

The teaching methodology also impacted on the attitudes, feelings, and behaviours of the students towards physics. On one side this impact was positive because the students liked to have more autonomy, to explore the contents at their own pace, in the chosen depth, with the support of the teacher, and the possibility of collaborating with their peers (Abeysekera and Dawson, 2015). In general, students found the in-class activities fun. On the other hand, it was negative because they preferred the traditional role of the teacher as speaker and students as passive listeners (Nouri, 2016) nor did they want to devote time out of class for the pre-task. The balance between likes and dislikes was sometimes transferred in form of feelings and attitudes towards physics.

5.2. Student agency in a flipped classroom

The change of methodology required from students more commitment with their own learning, a reorganisation of their own time, and the responsibility of watching the video before the lesson. The flipped classroom was more demanding for students, accustomed to a traditional approach that was still applied in all the other subjects that they were studying, and therefore it encountered some opposition. However, paradoxically this situation forced some students to show greater agency by negotiating with the teacher, and making suggestions, to adapt their learning experience according to their preferences (Reeve and Tseng, 2011).

Thanks to the flipped classroom, the students performed with greater autonomy and developed self-regulatory skills. They had the possibility of choosing how to advance through the topics, deciding how much time devoting to each. They also used some planning tools to organise their learning and control their progress, showing resilience especially during some taxing situations. Students were able to successfully apply the study methods developed in the flipped classroom during the individual investigation of physics for the exploration of a topic of their interest. The methodology also helped students to develop a positive self-image, which makes them feel capable of overcoming the challenges that the subject could pose in the future, with confidence in their success, even in the case of unknown topics. Due to less time spent on direct instruction, the flipped classroom created many opportunities for students to get involved in cooperative

activities, showing agency in their collaboration with other peers for a common goal. Additionally, student had more time to interact with their teacher, and ask him specific questions that improved their learning, receiving personalised and timely feedback.

5.3. How to improve the methodology

Apart from some negative emotions, no negative consequence has been found in the implementation of this methodology, such as self-reported failure or ineffectiveness. On the contrary, there is evidence of significant steps towards a greater engagement of students that could lead to better outcomes. By focusing on the development of high order thinking skills, the flipped classroom fostered the resolution of more complex problems and not only in the transmission of knowledges (Sánchez Rodríguez, Ruiz Palmero and Sánchez Vega, 2017). For these reasons, it is believed that this methodology could bring more benefits if it could be taught at an earlier stage in the school, and not only physics but also involving other subjects, for the students to get used to it. Additionally, it is recommended a gradual transformation of the teaching methodology, combining traditional teaching with 'flipped' teaching in the initial phases (Hernández-Silva and Tecpan Flores, 2017).

The major criticism of students against the flipped classroom that was found was the use of *their* time for watching videos at home with the subject content, because it was thought that was the teacher who had to deliver it in class, as part of his duty. However, the flipped teaching did not take away extra time from students, because they already had to use it regularly to do their homework in a traditional teaching (Hernández-Silva and Tecpan Flores, 2017). They just had to use it in an unusual way. This should be made clear to students at the beginning of the implementation of the methodology to avoid unfounded criticisms. Additionally, the teacher should devote some time for planning the pre-task carefully and make it as pleasant as possible for the students. For example, Bergmann and Sams (2012, pp. 37–47) provide useful advices for those teachers who intend to create their own videos, which include presenting the content in a dynamic way and keeping the videos short. To avoid the sense of disorientation that students may experience at the beginning, every class can start with a discussion about the video, where the teacher can make some questions to verify the comprehension of the contents before the introduction of the collaborative activity (Bates and Galloway, 2012). Finally, the teacher can include competitive activities, like contests or challenges, to increase students' engagement.

5.4. Final considerations

To conclude, it should be said that the consequences of the pandemic on the education system in Ecuador were still evident during this research, which could have impacted in unique ways on the attitude, feelings, and behaviours of the participants, and consequently in its findings. This research was not interested in a generalisation of its findings, though some other researchers and teacher could find the methodology followed and the conclusions drawn useful or illustrative for their own contexts (Fugard and Potts, 2020). Despite the seemingly controversial positionality of the researcher, it is believed that participants of this research answered with openness and honesty, which is attributed to their positive, trustful, and respectful relationship with their teacher-researcher. There were not found contradictions in the data, especially when students had the opportunity to express their opinion anonymously. Additionally, the commitment to communicate decisions, processes, and findings with transparency has been maintained, which is expected to guarantee the credibility and trustworthiness of this research. One suggested area for further investigation in the context of this research could be the relation engagement-outcome in a flipped classroom in comparison with a traditional one.

Word count: 1169

Postscript

Since the beginning of the module, I knew that I would follow the Small-Scale Investigation (SSI) path, because I wanted to develop my professional practices in the educational institution where I still work. I consider myself an innovative teacher, always trying out ideas that could create learning opportunities for my students. Although I feel very supported by my authorities, I have often encountered resistance to change, especially from parents. That made me realise that I needed to improve my connections between theory and practice to adequately justify my methods. This research was an opportunity for me to undertake a transformation that is deeply grounded in theory, producing concrete evidence of its implementation that could help me to make informed decisions. In this way I was able to work on one of the professional goals that I had set for myself in my PDP related to establishing links between theory and practice: “Share my research thinking and findings with other professionals” (See Appendix 1, ‘Links to professional practice’). For example, I created a Padlet with extracts taken from my data to group them, in preparation for my analysis stage. Despite being in a raw state, some

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interesting things began to emerge, and I decided to share them immediately with some colleagues, who were considering implementing the flipped classroom in their own classes. That was a fantastic opportunity for sharing thoughts and communicate what I had learnt during my studies and my own experience with this methodology.

I had identified in my PDP that this would have been the longest project I had ever been involved in, and therefore I needed to stay motivated all the way, while juggling with my other commitments (See Appendix 1, 'Links to professional practice'). For example, there was a time when I felt a bit unmotivated because I was working on my data transcripts, and it was very boring. That task took me more time than expected, but later it turned out to be extremely useful as all this information was inside me and I could easily refer to it when working on my analyses.

During the process of drafting my dissertation I felt great support from my tutor, who gave me feedback on how I could improve my writing. I felt that I had greatly developed the ability to make arguments fully supported by theory and with a critical perspective. For example, I had written a synopsis on student agency in one of my master's assignments and wanted to use some ideas for my dissertation, but I wasn't sure if the university's academic integrity policies would allow it, so I asked the tutor, who replied that I had to show progress in my understanding of the topic since that time (See Appendix 1, 'Knowledges and Understanding'). That feedback was important for realising that my understanding of student agency was not static but had evolved with all the things I had read about it in my literature review. For this reason, I used my previous work as a starting point to elaborate a new synthesis that reflected my growth in the subject.

Word count: 517

Total Word Count: 12823

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Appendix 1 Reflection grid

Category	Feedback received, targets achieved, and areas of development worked on	How did this shape my dissertation?
<p>Knowledge and understanding: Targets, reflections or feedback relating to:</p> <ul style="list-style-type: none"> • Knowledge of current debate and issues in your specific area of focus. • Drawing out concepts and themes. • Choosing a focus area for your dissertation. • Identifying and overcoming ethical issues. 	<p>Tutor group e-tutorial: In these tutorials I could review the main approaches to research, distinctive characteristics of action research, case study, ethnographic studies, discourse analysis, etc. I also received feedback from other students about my research questions.</p> <p>TMA02 Feedback: My tutor suggested that I rely on far more sources than those included in this assignment.</p> <p>Third Tutor Feedback: My tutor suggested that I must show development and a better understanding since my first research on student agency.</p>	<p>I was undecided whether adopting action research or case study for my dissertation, but in one of our e-tutorial, our tutor reminded the key features of each of these research approach when answering one question and I understood that the best approach, according to the characteristics of my research, was case study. One of the main reasons for my selection was time constraints, I wouldn't be able to complete many stages of action research (planning, action, reflection).</p> <p>In one of my last modules, I made an investigation on student agency, and I wanted to include some of my elaborations in my final dissertation but wasn't sure about the politics of academic integrity (my work was submitted to the OU but wasn't published). My tutor didn't mention that it would constitute a case of self-plagiarism, but he said that I should "show development" since my previous exploration. That was a smart answer that made me realise that my knowledges on student agency weren't static, in fact they were beyond my previous elaborations. For this reason, I used what I did as a starting point, from which I could elaborate a new synthesis more adequate to what I had grown since then.</p>
<p>Critical analysis and evaluation: Targets, reflections or feedback relating to:</p> <ul style="list-style-type: none"> • Justifying or challenging your personal perspective. • Interpreting and critically analysing evidence and methodologies from your own and others' research. • Analysing and evaluating themes and issues. • Sourcing and critically reviewing a wide range of publications. 	<p>Previous Feedback other modules: My tutor in a previous module told me once that I should rely on primary than in secondary sources as part of my critical skills.</p> <p>Second Tutor Feedback: My tutor reminded me to check that my arguments emerge from the critique of what I've read, checking that every claim I made is supported by evidence, especially in the literature review.</p> <p>Third Tutor Feedback: My tutor reminded me what I needed to do for a very well critical analysis:</p> <ul style="list-style-type: none"> • Demonstrate strong evidence of engagement with key concepts including those of research methods. 	<p>I think that "writing a claim that is fully supported by evidence" is one of the skills that I have improved during my masters. I have tried to put this into practice, but also it was important for me to acknowledge the limit beyond which an argument that is mine and fully supported becomes only a synthesis of the thought of many authors while my own thought is devaluated. Nevertheless, I took seriously that feedback on primary and secondary sources because I often used them (Chopin, 1830, cited in Schumann, 1834). I realised that a critical writer should not rely in excess in the interpretations of others. For this reason, when I saw a citation of something that I regarded useful, especially for my dissertation, I went to the original document and read it.</p> <p>I have used my tutor's feedback to revise my work in the light of the criteria with which it would be assessed to see to what extent it would comply with them. Sometimes I've found difficult to go beyond description, especially in the chapter where I had to present my data and a lot of description was</p>

<ul style="list-style-type: none"> • Creating an academic argument using synthesis. • Comparing and connecting practice and theory. 	<ul style="list-style-type: none"> • Show an ability to synthesise and evaluate the course and additional material. • Use these to construct an argument that is not merely descriptive or prescriptive, and that gives clear evidence of independent engagement with the ideas. <p>One way to accomplish this is to highlight sections in my work where it wasn't developed and work on them.</p>	<p>required. In this sense the word count was a big constraint.</p>
<p>Links to professional practice: Targets, reflections or feedback relating to:</p> <ul style="list-style-type: none"> • Designing and/or applying research methods. • Developing ideas from previous research and frameworks. • Reflecting and making adaptations during the research and writing process. • Addressing problems in research design. • Identifying implications for practice and professional debate. • Challenging your own assumptions. • Managing workload and personal motivation. 	<p>Personal Development Plan: I have identified some skills that needed development. Personal skills: "Maintaining enthusiasm for my research for the duration of the dissertation" and "Managing an extended project". Research skills: "Articulate my own perspective on research approaches and my influence/ assumptions within the process". Application to professional practice: "Share my research thinking and findings with other professionals" and "Consider the legacy of my dissertation for myself and others"</p> <p>TMA01 Feedback: My tutor asked me to justify not only why I was choosing interpretivism but also why I was rejecting positivism or mixed methods. He provided useful insight on the focus of my research question, which was a bit ambiguous.</p> <p>TMA02 Feedback: My tutor raised concerns regarding researching my own students, which are pertinent. I should provide an appropriate justification.</p> <p>Tutor group e-tutorial: I received feedback from other students about my research questions. It was said that my third research question was important to relate immediately my findings to practice.</p> <p>First Tutor Feedback: My tutor asked me to justify more the selection of interpretivism as</p>	<p>This was the first time I embarked such a long project; it was the first time also that I had to produce such a long dissertation. Maintaining enthusiasm throughout the whole project was a challenge for me, especially because I had many other activities, as well as my regular job. I think I lost some interest when working in the transcriptions, which was a very boring task, but that proved to be also particularly useful, because in the time of analysing the data, everything came to my mind, I knew who said it, when, or how... That was very convenient. I created a Gantt chart to organise my work, but actually I wasn't so strict with the schedule, just gave it an eye from time to time to remember what had to be done and verify that I had enough time for everything.</p> <p>My tutor played a significant role for narrowing the scope of my research. It was difficult not to think big and try to resolve all the problems in my context with one research. I was too conditioned also by my positivist stance as scientist. I had to scale down my goals and focus on just one class and one subject. I started with physics because it was reasonable to start cleaning up the house by my own room.</p> <p>Clearly the fact that I'm researching my own students may result strange to many readers, who could question the trustworthiness of my research. I think that the biggest concern would be that my students didn't tell the truth, for example, for fear to the consequences of their opinions. That is why I included a questionnaire with anonym responses that could give them the opportunity to say something that they could fear to say openly. Additionally, I think that my relationship with the students is positive, and that they are likely to tell me the truth. I need to be transparent about this in my final report.</p> <p>When my tutor asked me to clearly justify the selection of interpretivism as my research</p>

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	<p>my research paradigm and suggested that I include a rationale of the interpretive tradition that I will be following, and mentioned social constructivism, phenomenology, hermeneutics, and symbolic interactionism. I should say which I chose and why. He reminded me that I should also explain the way in which I intend to analyse the data. I must reflect also on the criteria that I will be using to assess the quality of my research: Validity, reliability, credibility, trustworthiness, etc.</p> <p>Third Tutor Feedback: My tutor reminded me to keep always checking and re-checking that I'm complying with ethical aspects of my research and avoid the risk of thinking that it is something we reflect on once and for all.</p>	<p>paradigm it seemed a simple task... but when I had to choose the interpretive tradition I got stuck. I remembered that I had participated in a collaborative activity where each of these different schools were studied by each member, with a final compilation that summarised the key features of each tradition. This summary helped me to easily discard some of these traditions and keep phenomenology as the most appropriate, because the others were too far from what I wanted to investigate. Another crucial step was to decide which type of thematic analysis would I have carried out. My options were theoretical, inductive, experiential, and constructionist. These diverse types of TA had many things in common and it was difficult to make a choice. My final decision was that I didn't want to fit my data within certain theoretical framework, but present it as it was, closer to the reality of the participants. Therefore, I chose inductive TA.</p> <p>Due to my tutor's advice, I decided to include alternative criteria to the well-known validity and reliability, to assess the quality of my research. One of these was generalisability. My research wasn't interested in producing causal explanations that could be exported to other contexts but to understand deeply the context in which the research was carried out to make improvements. That had to be made clear to the readers.</p>
<p>Structure, communication, and presentation: Targets, reflections or feedback relating to:</p> <ul style="list-style-type: none"> • Using academic style and referencing. • Presenting, managing, and sharing information in different modes. • Communicating concepts, findings, and ideas for different audiences. 	<p>TMA02 Feedback: I have received positive feedback regarding structure, communication, presentation and referencing.</p> <p>First Tutor Feedback: My tutor warned that I should include references to the BERA ethical guidelines because my research was going to be submitted in a university of the UK.</p> <p>Second Tutor Feedback: My tutor asked me to check the justification of the research, the description of the context, my positionality as researcher within that context, and the research questions are coherent and follow a logical sequence. Additionally, provide me with some tips to complete a good introduction of my work. He suggested that I do not follow a structure determined by my RQ in the analysis section and agreed that my approach should be inductive. I have clarified a way of reporting data extracts in the final draft that I wished to employ.</p> <p>Third Tutor Feedback: My tutor recommended me to add references to relevant literature in the section of data presentation and analysis for those findings that could confirm, partially confirm, or challenge what other researchers have found. A discussion of this can be added in</p>	<p>I had good skills for referencing before starting this masters' qualification. But my studies introduced me to some tools that made this task easier, and that was important for my dissertation. However, one type of reference I hadn't used very often was 'personal communications' and 'unpublished data', which were fundamental for my work. I was impacted by one of my readings 'I'll be a nothing' from Reay and William (1999) and I wanted to present my data in that way, with extracts detached from the main text, as examples of my claims. But then I realised that simultaneously presenting and analysing my data would be convenient for the word count and for this reason I adopted this style instead, embedding my extracts with my own words when that was possible.</p> <p>My tutor gave me useful advice for the structure of my dissertation. For example, he commented that it would be better not structuring the data presentation section around the research questions (because that would be done in the conclusions instead). That made me look for other options, reading</p>

	<p>the conclusions, where answering the research questions but should be surfaced also in that chapter. I need to keep my research as the central point, but I need to show that I have read, understood, and compared my results with that of others. There was also a suggestion to include references to specific parts of the BERA ethical guidelines</p>	<p>more literature regarding thematic analysis that proved to be useful also for my section of research design. For the definitive version of my themes, I put all my creativity and I had a lot of fun. The result made me very satisfied and made me think of my work as the best work I have ever done.</p>
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Appendix 2 Questionnaire

'Instructions' message

This questionnaire contains 8 open questions about the class of *Physics SL* you attend. Please answer each question with honesty and be as clear and detailed as possible.

Questions

1. How can you describe your participation in this class?
2. How do you see yourself in relation to the physics subject?
3. What are you allowed/forbidden to do during this class?
4. What has been the role of your peers and your teacher for your learning?
5. How useful is what you learn in this class?
6. What do you do when you don't understand something in this class?
7. How do you feel in this class?
8. How could this class be improved?

'Thank you' message

Thank you for taking the time to answer this questionnaire. Your answers are of high value and will be carefully considered to improve your learning experience in this subject.

Appendix 3 Interview Design

Research Questions

- What are the learner's behaviours, attitudes, and feelings towards physics?
- How do students exercise their agency in a 'flipped classroom'?
- What could be done to improve the learning experience of physics in a 'flipped classroom'?

Interview Questions

1. Can you tell me how has been your experience with the class of physics and the methodology of the 'flipped classroom'?
 - a. Which aspects have been better/harder than in a traditional methodology? (probe)
 - b. Do you think this class has contributed to your personal and academic development? (probe)
 - c. Have you had experiences of this methodology before? (probe)
2. How well have you performed in this subject?
 - a. Did you manage to complete the pre-tasks on time? Why? (probe)
 - i. Did you watch the video and complete the questionnaire before the class? (prompt)
 - b. What do you do when you get stuck or don't understand something in this subject? (probe)
 - c. Do you feel capable of overcoming the challenges posed by this subject? (probe)
 - d. Which strategies have you used to understand better this subject? (probe)
3. If you could change something in the methodology to get you more engaged, what would it be?
4. Do you think that studying this subject in this way has make you appreciate this subject more than before? Or instead, it has somehow disappointed you?

Appendix 4 Participant Information

Information Letter: Questionnaire and Documents

Dear [name]

I am currently studying on the master's module 'E822 Multidisciplinary Dissertation: Education, Childhood and Youth' at the Open University in the Faculty of Wellbeing, Education, Language and Sport. My studies are being supervised by a personal tutor [who can be contactable via: WELS-ECYS-Masters@open.ac.uk] and am following research protocols recommended by the University which have been approved by the school principal, [name].

I am using a range of ways of collecting information to answer the following questions 1) *What are the learner's behaviours, attitudes, and feelings towards physics?* 2) *How do students exercise their agency in a 'flipped classroom'?* and 3) *What could be done to improve the learning experience of physics in a 'flipped classroom'?* as part of a small-scale investigation aimed to help me better understand and develop *what is the impact of a 'flipped classroom' approach to teaching on the students' self-reported engagement in Physics* here in [name of school], and to share my findings with others for whom the findings will be relevant to changing practice.

I invite you to complete a survey by **questionnaire** in Microsoft Forms. The questionnaire is estimated to take no longer than 15 minutes. This is to be completed online and I would appreciate the return of the questionnaire by April 22nd. If you do not consent to participate in the survey, this is absolutely fine: simply do not complete the questionnaire. However, it is not possible to withdraw your consent after submitting a response to the questionnaire because it is de-identified and therefore cannot be identified for removal. If you consent, please complete, and return the questionnaire.

Additionally, I invite you to provide your permission to use the e-portfolio completed in the Physics subject as part of my study. For those students under 18, a parent/carer or guardian will also be asked to support your decision to share your e-portfolio. Please return the consent/assent form by April 08th. If you do not consent for the requested documentation to be used in my study, please contact me and I commit to excluding your data. Moreover, you can withdraw your permission for the documents to be included in my study. If you wish to do so, please contact me by April 22nd.

Information collected from the questionnaires and the e-portfolios will be de-identified and kept confidential, being stored securely on password protected devices. In the case of paper copies of the questionnaire these also will be kept confidential, and responses typed up as soon as possible. The original notes will then be destroyed.

Please feel free to ask me any questions about the questionnaire or how the e-portfolio will be used in my research before making your decision. If you would like more information, please contact me on the email address [aruiz@\[name of school\].edu.ec](mailto:aruiz@[name of school].edu.ec).

Yours sincerely

Alejandro Ruiz

Footnote: The ethics protocols and documentation to support the E822 Multi-disciplinary Dissertation: Education, Childhood and Youth have been developed with advice from the Open University Human Research Ethics Committee and have been confirmed by the Chair as fully compliant with The Open University's Ethics Principles for Research with Human Participants.

Link:

<http://www.open.ac.uk/research/sites/www.open.ac.uk.research/files/files/Documents/Ethics-Principles-for-Research-with-Human-Participants.pdf>

Consent/Assent Form: e-portfolio

(To be completed by all participants and, if the participant is a child/young person under age 18, with and by their parent/carer/guardian)

If this request relates to a child/young person under the age of 18 please would a parent, carer or guardian read these questions with them and, if necessary, complete the replies for them.

Please indicate YES or NO for each of the questions below and return the completed form by April 08th, to the email address [aruiz@\[name of school\].edu.ec](mailto:aruiz@[name of school].edu.ec).

Have you read (or had read with you) the information about the documents to be collected? YES NO

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Has someone explained the reason for collecting the documents to you?	YES	NO
Do you understand which documents will be collected?	YES	NO
Have you asked all the questions you want?	YES	NO
Have you had your questions answered in a way you understand?	YES	NO
Do you understand it is OK to withdraw your permission to use the documents?	YES	NO
Are you happy with how your data will be stored?	YES	NO
Do you understand that your name and any other real names as well as any information that would identify you will be removed from the documents?	YES	NO
Are you happy for documents relating to you to be used as explained?	YES	NO

If any answers are 'no' feel free to ask for further information. However, if you **don't** want to allow your documents to be used, please just let me know and **don't** sign your name.

If you **do** give consent, please write your name and today's date. You can change your mind later, by letting me know.

Your name _____

Date _____

If the documents were created by a child or young person under 18 and you are happy for the child or young person you are responsible for (as their parent, carer, or guardian) to share them, please could you also sign and date below.

Print name _____

Sign _____

Information Letter: Interview

Dear [name]

I would like to invite you to have an interview with me to gain your view on what learning Physics with a 'flipped classroom' methodology is like here in [name of school]. This interview is part of my studies on a masters-level course at The Open University in which I am carrying out a small-scale investigation.

I am using a range of ways of collecting information to answer the following questions 1) *What are the learner's behaviours, attitudes, and feelings towards physics?* 2) *How do students exercise their agency in a 'flipped classroom'?* and 3) *What could be done to improve the learning experience of physics in a 'flipped classroom'?* as part of a small-scale investigation aimed to help me better understand and develop *what is the impact of a 'flipped classroom' approach to teaching on the students' self-reported engagement in Physics* here in [name of school], and to share my findings with others for whom the findings will be relevant to changing practice.

You have been chosen because your views would be valuable in answering the question set for the study and I hope you might be prepared to talk to me about your experiences and opinions. In the interview I will ask you questions about what you think of the 'flipped classroom' methodology in physics. I can share the questions with you in advance if you would like to see them.

The interview should take no more than 30 minutes and I will make sure that I have checked with your teachers that when and where we talk is the most convenient for you and them. Our conversation will not be recorded but I will make notes about what you say. Permission has been given from the school principal, [name], for me to invite you to this interview. I would like to ask your consent to make an audio recording of our discussion so that I can refer back to what was said more accurately than would be possible just from my notes. If you do not wish to be audio recorded, I will accept your wish, and rely only on my written notes. Only I will have access to the audio recording. I do not need to share this with those at the University or in this practice setting. In any part of the interview which will be shared with my tutor or form part of the final dissertation report you and anyone else you name during our discussion will be referred to by a false name (pseudonym) and you will be asked if you would like to suggest what name I use.

Your participation will be treated in strict confidence in accordance with the Data Protection Act (2018). No personal information about you, such as contained in your consent forms, will be shared more widely. In the case of the audio recording and my notes of the interview, these will be kept private only to me and typed up as soon as possible. However, if you let me know anything during your interview which I consider means that you might be unsafe or have been involved in a criminal act, because this is a safeguarding concern, I will need to pass this information immediately to the

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organisation's Designated Safeguarding Officer. When I make anonymised records of the interview, as outlined above, these will be stored securely on password protected devices and the original notes and recording will then be destroyed. I can confirm that neither you as an individual nor the setting will be identifiable in my submissions to the University or any presentation that I make of my findings to interested audiences.

After reading this information sheet with your parent/carer, please read and complete the consent form. This means that you and your parent/carer sign your and their names and the date to say you are all happy for me to set up a time and place for the interview. Please return the consent/assent form by April 29th. Whether you agree or not is entirely up to you and your parent/carer, as the invitation is for you to take part voluntarily. You can change your mind later and withdraw from the study by letting me know and I will destroy the information (consent forms and interview files) I have created. This will be possible up until the time I am using your information as part of my assessment, that is to say, by June 03rd.

If you have any questions about the study, I or my tutor at the University would be very happy to answer them. Please contact me at [aruiz@\[name of school\].edu.ec](mailto:aruiz@[name of school].edu.ec) or contact my tutor, Mr. Ray Chatwin, at [\[address\]@open.ac.uk](mailto:[address]@open.ac.uk).

Yours sincerely

Alejandro Ruiz

Footnote: The ethics protocols and documentation to support the E822 Multi-disciplinary Dissertation: Education, Childhood and Youth have been developed with advice from the Open University Human Research Ethics Committee and have been confirmed by the Chair as fully compliant with The Open University's Ethics Principles for Research with Human Participants.

Link:

<http://www.open.ac.uk/research/sites/www.open.ac.uk.research/files/files/Documents/Ethics-Principles-for-Research-with-Human-Participants.pdf>

Consent/Assent Form: Interview

(To be completed by all participants and, if the participant is a child/young person under age 18, with and by their parent/carer/guardian)

If this request relates to a child/young person under the age of 18 please would a parent, carer or guardian read these questions with them and, if necessary, complete the replies for them.

Please indicate YES or NO for each of the questions below and return the completed form by April 29th, to the email address [aruiz@\[name of school\].edu.ec](mailto:aruiz@[name of school].edu.ec).

Have you read (or had read to you) the information about this interview?	YES	NO
Has someone explained this interview to you?	YES	NO
Do you understand what this interview is about?	YES	NO
Have you asked all the questions you want?	YES	NO
Have you had your questions answered in a way you understand?	YES	NO
Do you understand it is OK to stop taking part at any time?	YES	NO
Will you have an adult present with you?	YES	NO
Are you happy for the interview to be audio recorded?	YES	NO
Are you happy with how your data will be stored?	YES	NO
Do you understand that your and any other real names as well as any identifiable information will be removed from what will be shared after the interview?	YES	NO
Are you happy to take part?	YES	NO

If any answers are 'no' feel free to ask for further information. However, if you **don't** want to take part, please just let me know and **don't** sign your name.

If you **do** give consent, please write your name and today's date. You can change your mind later, by letting me know.

Your name _____

Date _____

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If the documents were created by a child or young person under 18 and you are happy for the child or young person you are responsible for (as their parent, carer, or guardian) to share them, please could you also sign and date below.

Print name _____

Sign _____

Appendix 5 Ethical Appraisal Form

E822 Ethical Appraisal Form

Masters: Education, Childhood and Youth



NB: it should be noted that The Open University is unable to offer liability insurance to cover any negative consequences students might encounter when undertaking 'in-person' data collection. It is therefore very important that you follow appropriate research protocols which should include seeking Gatekeeper permissions to undertake any data collection within your setting and adhering to ethical principles for the safety of yourself and your participants.

Because ethical appraisal should precede data collection, a completed version of this form should be included with TMA02 for those developing a Small-Scale Investigation (SSI) and as part of the EMA submission for those completing an Extended Literature Review and Research Proposal (EP) form of the Dissertation.

Fill in section 1 of this document with your personal details and brief information about your research. For section 2, please assess your research using the following questions and click yes or no as appropriate. If there is any possibility of significant risk, please tick yes. Even if your list contains all "no" you should still return your completed checklist so your tutor/supervisor can assess the proposed research.

Section 1: Project details

a.	Student name	Alejandro Tomás Ruiz Martínez	
b.	PI	[removed]	
c.	Project title	The impact of a 'flipped classroom' approach to teaching on the students' self-reported engagement in physics	
d.	Supervisor/tutor	Dr. Ray Chatwin	
e.	Qualification	Masters in Education	<input checked="" type="checkbox"/>
		Masters in Childhood and Youth	<input type="checkbox"/>

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f.	MA pathway (where applicable)	Learning and Teaching
g.	Intended start date for fieldwork	March 19 th
h.	Intended end date for fieldwork	May 20 th
i.	Country fieldwork will be conducted in <i>If you are resident in the UK and will be conducting your research abroad please check www.fco.gov.uk for advice on travel.</i>	Ecuador

Section 2: Ethics Assessment		Yes	No
1	Does your proposed research need initial clearance from a 'gatekeeper' (e.g., Local Authority, head teacher, college head, nursery/playgroup manager)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Have you checked whether the organisation requires you to undertake a 'police check' or appropriate level of 'disclosure' before carrying out your research? ¹	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Have you indicated how informed consent will be obtained from your participants (including children less than 16 years old, school pupils and immediate family members)? Your consent letters/forms must inform participants that they have the right to withdraw from the study at any time. ²	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Will your proposed research design mean that it will be necessary for participants to take part in the study without their knowledge/consent at the time (e.g., covert observation of people in non-public places)? If so, have you specified appropriate debriefing procedures? ³	<input type="checkbox"/>	<input checked="" type="checkbox"/>

¹ You must agree to comply with any ethical codes of practice or legal requirements that maybe in place within the organisation or country (e.g., educational institution, social care setting or other workplace) in which your research will take place. If required an appropriate level of disclosure ('police check') can be obtained from the Disclosure and Barring Service (England and Wales), Disclosure Scotland, AccessNI (Northern Ireland), Criminal Records Office (Republic of Ireland), etc.

² This should normally involve the use of an information sheet about the research and what participation will involve, and a signed consent form. You must allow sufficient time for potential participants to consider their decision between the giving of the information sheet and the gaining of consent. No research should be conducted without the opt-in informed consent of participants or their caregivers. In the case of children (individuals under 16 years of age) no research should be conducted without a specified means of gaining their informed consent (or, in the case of young children, their assent) and the consent of their parents, caregivers, or guardians. This is particularly important if your project involves participants who are particularly vulnerable or unable to give informed consent (e.g., children under 16 years, people with learning disabilities, or emotional problems, people with difficulty in understanding or communication, people with identified health problems). There is additional guidance on informed consent on the Masters: Education and Childhood and Youth website under Project Resources.

³ Where an essential element of the research design would be compromised by full disclosure to participants, the withholding of information should be specified in the project proposal and explicit procedures stated to obviate any potential harm arising from such withholding. Deception or covert collection of data should only take place where it has been agreed with a named responsible person in the organisation and it is essential to achieve the research results required, where the research objective has strong scientific merit and where there is an appropriate risk management and harm alleviation strategy.

5	Does your proposed design involve repetitive observation of participants, (i.e., more than twice over a period of more than 2-3 weeks)? Is this necessary? If it is, have you made appropriate provision for participants to renew consent or withdraw from the study half-way through? ⁴	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	Are you proposing to collect video and/or audio data? If so, have you indicated how you will protect participants' anonymity and confidentiality and how you will store the data?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	Does your proposal indicate how you will give your participants the opportunity to access the outcomes of your research (including audio/visual materials) after they have provided data?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8	Have you built in time for a pilot study to make sure that any task materials you propose to use are age appropriate and that they are unlikely to cause offence to any of your participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9	Is your research likely to involve discussion of sensitive topics (e.g., adult/child relationships, peer relationships, discussions about personal teaching styles, ability levels of individual children and/or adults)? What safeguards have you put in place to protect participants' confidentiality?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10	Does your proposed research raise any issues of personal safety for yourself, or other persons involved in the project? Do you need to carry out a 'risk analysis' and/or discuss this with teachers, parents and other adults involved in the research?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11	Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
12	Will the study involve recruitment of patients or staff through the NHS or the use of NHS data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'yes' to questions **12**, you will also have to submit an application to an appropriate National Research Ethics Service ethics committee (<http://www.nres.npsa.nhs.uk/>).

(Total word count: 500)

⁴ Where participants are involved in longer-term data collection, the use of procedures for the renewal of consent at appropriate times should be considered.