# The Mediation of Engineering Students' Academic Motivations and Subjectivities by Flipped Teaching

A thesis submitted to the University of Manchester for the degree of Doctor of Education in the Faculty of Humanities

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SCHOOL OF ENVIRONMENT, EDUCATION AND DEVELOPMENT

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## Glossary

AS: Activity System

AT: Activity Theory

EEE: The Department of Electrical and Electronic Engineering, at the University of Manchester

FC: Flipped Classroom

HE: Higher Education

The Mediation of Engineering Students' Academic Motivations and Subjectivities by Flipped Teaching.

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Key words: Activity Theory, Engeström, engineering, flipped classroom, Higher Education, motivation, Q methodology, subjectivity, Vygotsky.

# Abstract

The Flipped Classroom has attracted increasing interest in Higher Education. Many studies have been published, each typically comparing a single Flipped Classroom with an equivalent one that uses non-flipped teaching approaches. The majority of these studies have based their analysis on measures such as exam scores and student satisfaction, and are based on survey results. Only a small minority of such studies can be found that have used a theoretical framework in their analysis. In this thesis, which uses a case study approach, I use Activity Theory to analyse the mediation of students' academic motivations and subjectivities by flipped teaching. The study was carried out during 2020-21, within a university engineering department, where I taught. An extensive literature search revealed that it is relatively rare to find Activity Theory used in studies of flipped classrooms at university level. Furthermore, at the time of writing, there appear to be no such studies involving engineering programmes.

Initially, a single year-1 flipped course was planned to be used as the vehicle for the research. The original intention was to use ethnographic techniques for data collection, however, this had to be abandoned following the intervention of the global Covid-19 pandemic. The corresponding response of the university resulted in the conversion of almost all taught courses to an online flipped model. This necessitated a change to the methods used for collecting data, but it also provided an opportunity, by widening the arena for data collection across all modules and all undergraduate years. Instead of using ethnography, Q Methodology, supported by semi-structured interviews, was used to operantly identify and analyse learners' academic subjectivities and their relation to flipped teaching and learning.

The results of the study support the hypothesis that flipped teaching approaches accentuate certain systemic contradictions in undergraduate engineering classrooms. This accentuation can be accounted for largely by the role-changes required of both learners and teachers in flipped classrooms. The results demonstrate that links can be drawn between the pedagogic tensions that arise from these contradictions, and learners' subjectivities and academic motivation.

The results from the Q data revealed that learner subjectivities could be categorised broadly into one of three factors/dimensions, each characterised by different views, attitudes and dispositions to learning. Learners whose subjectivities align with one of these factors/dimensions, and who express a preference for collaborative/collective forms of learning, are more likely than others to be impacted by implementations of flipped classrooms that limit their relational agency.

The findings also show that learner's academic motivations are particularly sensitive to the implementation of the synchronous components of flipped classrooms. Furthermore, they show that students will almost always disengage temporarily from the weekly cycle of synchronous and asynchronous learning imposed by flipped classrooms. All these results are discussed in detail in the thesis.

This study contributes to knowledge by making both theoretical and methodological contributions to the understanding of Flipped Classroom pedagogy in undergraduate engineering. A theoretical contribution is made by the use of Activity Theory to examine the origins and effects of tensions and contradictions experienced by learners within Flipped Classrooms. A methodological contribution is made by using Q methodology to operantly investigate learners' subjectivities under flipped learning.

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## The Author

Geoffrey Rubner completed his undergraduate and postgraduate studies at the University of Manchester Institute of Science and Technology. Following a career in microelectronic circuit design and software engineering, he joined the Department of Electrical and Electronic Engineering at the University of Manchester initially as a lecturer, and was later promoted to senior lecturer. His research interests centred on flipped teaching and the development of educational innovations using smartphones.

# Chapter 1 Introducing the Research

In this chapter I introduce and describe the rationale for the research, and the main question that it sets out to address. I also introduce many of the terms used and outline the layout of the thesis.

## 1.1 Introduction

In the aftermath of the first global pandemic in a century, the landscape of education has changed in significant ways, including in the engineering faculty in the university in which this research was conducted. In common with similar institutions across the world, the university's response to the rapid spread of Covid-19 was to suspend face-to-face teaching and adopt online teaching across all of its taught undergraduate and postgraduate degree programmes. This step change in teaching approach created unprecedented challenges for both students and teachers alike, with the latter having to quickly acquire the skills and knowledge needed to successfully manage the transition. The demands on teachers were further complicated by the Faculty's requirement to use a Blended Learning model, which, in the majority of cases, meant using 'flipped' learning. Thus, flipped learning, which is more formally known as the 'Flipped Classroom', became, almost overnight, the norm for thousands of students. The decision also had a significant impact on my research because, coincidentally, its centre of inquiry is also flipped learning.

The Flipped Classroom is a pedagogic approach which disrupts the traditional weekly lecture-homework cycle and encourages the use of active learning techniques in the classroom. A particular objective of this research is to understand the impact and mediation of flipped classrooms on students' academic motivation and subjectivities, in the case study presented here. Originally, and before the pandemic, a single, year-1 undergraduate module was to be used as the vehicle for the study. This module was chosen because it had been converted to the flipped format a few years previously. It was envisaged that ethnographic methods would be used to permit close-up observation of the moment-to-moment details of student learning, during both classroom and laboratory sessions. Of particular interest were their responses to the tensions and pressures that flipped learning was hypothesised to introduce. However, the wholesale conversion of almost every taught module to the flipped learning format widened the scope of the research. Almost overnight, the pool from which study participants might potentially be drawn was expanded to include all years of the undergraduate cohort. On the other hand, the restrictive learning conditions meant that the study had to be conducted entirely online, and any hope of using ethnographic methods had to be abandoned. Furthermore, the conditions introduced additional tensions and pressures on students beyond what was expected.

As this thesis documents, the effects on students' learning experiences due to the pandemic, and the Faculty's response to it, were profound. As with teaching staff, students had to rapidly adjust to a new learning paradigm, one that was constrained by the placement of strict limitations on their personal freedom of movement. For much of the time that these restrictions were in place, it was impossible for them to receive 'bricks and mortar' teaching in person, and learning was largely confined to the home. Students who were unused to online learning, experienced frustration at the often longer times needed to obtain answers to questions, and to receive feedback. For the times when it was possible to physically attend class, social distancing limited their ability to participate collaboratively in formal learning contexts. The conditions also restricted their ability to collaborate in informal ways, too. The end result was to constrain and limit the building of on- and off-campus learning communities, upon which many learners thrive and draw benefit from.

The impact of the pandemic also had significant consequences for my research, especially given that it was conducted over an extended period of time (beginning in 2016). As reported at various points in the thesis, a number of sub-studies were undertaken whose purpose was intended to inform the main part of the research later on. However, due to the changed circumstances and the need to use purely online methods of data collection, the results of these early studies did not always fit seamlessly into the main study. Thus, I found, for example, that the Q sort concourse (see Chapter 4, section 4.2.1) was only partially integrable with the Activity Theory analysis that is presented later on. Although this presented difficulties with regard to completing the thesis, it was reflective of the journey of the research as it evolved, over a period of time that included the effects of the pandemic.

Despite the challenges, it was possible to make a number of tentative conclusions regarding links between flipped teaching and learners' academic motivation and subjectivities. These conclusions, which I report on later, speak to the broader intention of the research, i.e., to contribute to a better theoretical understanding of the Flipped Classroom, which is known to lack a theoretical framework.

## 1.2 Why the Flipped Classroom?

The Faculty's decision to mandate flipped learning was informed in part, by knowledge that it can be used in an entirely online real-time teaching environment *(Lo, 2022)*. It was also partly informed by the belief that the Flipped Classroom provides benefits to learners *(Hew et al 2021)*. As my literature review (Chapter 3) shows, there is accumulating evidence to support the claim that flipped classrooms can offer improvements in learner performance, compared to non-flipped ones. This evidence has been harvested over several years from studies across a range of university programmes, including engineering *(Lo and Hew, 2019)*. There is also evidence that flipped learning improves retention among students *(Kerr, 2015, p. 818)*.

In most implementations, the format of a Flipped Classroom combines two forms of learning: asynchronous and synchronous. In the former, learners are expected to study subject materials on their own, in advance of attending class. Synchronous learning takes place in the classroom, where learners participate in active learning tasks guided by a teacher. The asynchronous materials are provided online, typically in video format, from which, as long as they do so in advance of class, students learn in their own time. In contrast, synchronous learning takes place in class, and therefore students' physical presence is expected. To implement the transition to flipped learning, the Faculty required teachers to provide video versions of lecture materials, and to transform the synchronous components into a fully online format that provided, as closely as possible, the same levels of experience for students as face-to-face lectures.

The conversion of lectures to video format, was for most teachers, an achievable, albeit time-consuming exercise. However, in addressing the requirements for synchronous learning, teachers faced a huge challenge in matching the levels of student attention and engagement which are normally possible in face-to-face learning in the classroom. Furthermore, given the linkage between asynchronous and synchronous learning, careful attention had to be paid to ensure conceptual coherence between these two components. Previously, and within the faculty as a whole, very few academic teaching staff had prior experience of converting modules to the flipped format. As I discuss in the next section, I was one of only a small number who had such experience. In rising to the demands of the Faculty, my teaching colleagues were to learn, as I had years before, that one can significantly underestimate the amount of time and resources involved.

## 1.3 Personal Experiences

I became interested in the Flipped Classroom in 2013-14 when I was asked to rewrite an introductory computer programming module for first-year students. With several years' experience of teaching undergraduate programming already behind me, I had reached the view that lecture-centred approaches were not ideal. Learning a programming language shares surface similarities with learning a spoken language, including the notion that substantial practice is required in order to develop a good standard of proficiency. I had decided that an approach that included active learning methods, particularly in the classroom, would be more suitable. Therefore, motivated by a desire to switch from a teacher-centred approach to a more learner-centred one, I was attracted to the Flipped Classroom.

However, when first running the module, I encountered certain difficulties. For example, I generally found that it was almost always necessary to begin classroom and laboratory sessions with short review lectures. This was because many students had failed to undertake and complete the required asynchronous learning, which was expected in advance of the corresponding synchronous sessions (i.e., the classroom sessions). Furthermore, even though I used collaborative, active learning methods in class, attendance was sometimes poor. I quickly learned that the poor attendance was often due to the academic demands placed on learners by other modules in the curriculum. I also found that amongst those students who did attend class, some were resistant to collaborative working, and preferred to solve the problems by themselves. It felt that students' engagement with the module was 'patchy' and intermittent, which left me with a sense of disappointment, overall.

I wondered if the behaviour I had witnessed was a problem of academic motivation, particularly due to the apparent reluctance of large numbers of students to undertake the asynchronous learning activities in a timely fashion. A related question was what effect there might be of students' views, opinions and dispositions (i.e. their subjectivities) towards flipped learning, on their learning behaviours.

Over time, I discovered that the problems were not as straightforward as first thought. I was to learn that arguably, the most significant consequences of using flipped teaching compared to non-flipped approaches, were due to the changes in the roles (and therefore in the mindset and expectations) required of both learners and teachers. As I discovered through the course of the research and through my own experiences, it is easy to underestimate the impact these changes can have. They can result in profound consequences for learning both inside the classroom and outside it. Both learners and teachers must negotiate challenges and subjective tensions (discussed in detail later) that these changes can generate. As I was to learn, sometimes this results in compromises that lead on to further challenges and tensions. This led me to inquire into the Flipped Classroom more closely, analytically and theoretically, as I discuss in the next section.

## 1.4 Understanding the Flipped Classroom, Theoretically.

As a teaching approach, the Flipped Classroom is undoubtedly popular, as a search quickly reveals. There are, literally, hundreds of published studies available across diverse subject domains, at all educational levels. The majority of those in Higher Education report on comparisons of student learning in flipped classrooms to that in equivalent, non-flipped ones. Mostly, they provide quantitative data on performance outcomes and learner satisfaction. However, only a few studies have attempted to go further, and use a conceptual or theoretical framework in their analysis *(Karabulut-Ilgu et al, 2018; Hew et al, 2021)*.

The Flipped Classroom itself lacks a theoretical foundation. It is founded upon a particular combination of teaching practices that are known to work, rather than upon pedagogic theory. In recognition of this, some scholars have suggested that a theoretical framework can be built by first considering learners' academic motivation *(Abeysekera & Dawson, 2015)*. Picking up on this suggestion, a small number of studies have explored the use of motivation theory in flipped classroom research. A common feature of many of the theories cited is that each views motivation primarily as a person-centred, cognitive phenomenon. In this conceptualisation, while the importance of the environment/social context is acknowledged, it is ultimately only of secondary importance *(Hickey, 1997; Walker, 2010)*. In an alternative view, advanced by sociocultural theorists, motivation is understood to arise as a result of participation in social contexts. Learning, similarly, is understood to arise from participation, rather than acquisition. Thus, from a sociocultural perspective, the motivation associated with learning activities is linked directly to collective participation *in them*. This is a viewpoint that I found myself in agreement with, given my earlier flipped teaching experiences.

Sociocultural approaches to motivation and learning are founded on ideas advanced by L.S. Vygotsky, in the former USSR. A conceptual framework, based on Vygotskian approaches to knowledge and learning, known as Activity Theory (sometimes also called Cultural-Historical Activity Theory), proved to be very useful in this research. In Activity Theory, a systemic, object-oriented view of human activity is taken, in which individual and collective actions, mediated by the use of artefacts/tools, are directed towards an object. The object defines the underlying motive of the activity, which is, essentially, to satisfy a socially-determined need. As I argue in this thesis, Activity Theory holds promise as a theoretical framework with which to study the Flipped Classroom.

## 1.5 Significance of the Research.

The systemic view of activity taken by Activity Theory includes not only its cultural and historical aspects, and mediating artefacts, but also the tensions and contradictions that are encountered by individuals/subjects. These tensions and contradictions play a critical role in driving an activity system forward as a whole, as individuals adjust to, and attempt to resolve them. When applied to learning, the tensions and contradictions associated with the adopted pedagogical approach are, therefore, a natural focus in Activity Theory analysis. Such analyses offer promising ways of understanding the activity of flipped learning, from both learners' and teachers' perspectives.

Although a number of general studies have been carried out using Activity Theory in Higher Education, very few have used it to analyse flipped classrooms, and, as far as I know, none have done so in engineering. It is partly to address this gap, that this research is aimed. It is hoped that the research presented in this case study will contribute towards a better theoretical understanding of flipped classrooms, which could also be used to improve their future planning and implementation. The overall aim is summed up in the following main research question:

**How are engineering students' academic motivations and subjectivities mediated by flipped teaching?**

## 1.6 Structure of the Thesis and Notes on the Use of Terms.

This chapter has introduced the rationale and context for the research presented in this thesis. The subsequent chapters include the theoretical and conceptual framework for the study, the literature review, the methodology used, the quantitative and qualitative results and analyses, and finally a presentation of the conclusions. In Chapter 2, Activity Theory is presented and discussed; in Chapter 3, I present the findings of my literature review. In Chapter 4, I present the methodology used. The analyses and results are discussed in Chapters 5 (quantitative) and 6 (qualitative). In Chapter 7, I discuss the findings and limitations of the study, and make recommendations for future research.

### Notes on the Use of Terms

Depending on the context, I sometimes interchange the terms ‘flipped learning’, ‘flipped teaching’, and ‘Flipped Classroom’. I also occasionally use the terms ‘student’ and ‘learner’ to represent the student study participants. Likewise for teaching staff, the terms ‘lecturer’, ‘module leader’ and ‘teacher’ are sometimes interchanged. I occasionally use the term ‘traditional approaches’ to mean non-flipped teaching models.

# Chapter 2 Theoretical Background

In this chapter I develop the case for using Activity Theory for analysing the Flipped Classroom. I begin with a review of the characteristics and distinguishing features of flipped teaching, which, although popular, lacks a solid theoretical pedagogical foundation. Despite it lacking a theoretical basis, some scholars have argued that an analytical framework for the Flipped Classroom can be constructed by focussing on motivation *(Abeysekera & Dawson, 2015; Kim, T.Y., 2009)*. This is based on the suggestion that learner motivation may be a critical factor in undertaking the preparatory (pre-class) learning tasks that are necessary for its success. After a brief review of contemporary theories of motivation, I discuss what I see as their major (common) limitation and how this is overcome by adopting a sociocultural approach to motivation, based on Vygotskian notions of knowledge and learning. This leads directly to a discussion of Activity Theory, and a review of its fundamental principles. I then discuss how, by using Activity Theory and focussing on dialectical contradictions in particular, the mediation of flipped teaching on learner motivation and subjectivity may be understood.

## 2.1 The Flipped Classroom

### 2.1.1 Introduction: What is a Flipped Classroom?

Although it lacks a rigorous definition, the term ‘Flipped Classroom’ (FC) refers to a teaching approach or style that requires learners to undertake and complete learning tasks in advance of, and in preparation for related learning activities in the classroom. These pre-class activities are essentially used to introduce new subject material and concepts, which are then reinforced through practice and application once in class. A distinguishing feature of FCs is the use of active learning techniques in the classroom, typically involving high levels of interaction and engagement. In the literature on the FC, this teaching approach is sometimes described as an inversion of instructional strategies in which the main use of the classroom is to introduce learners to new subject materials and concepts (typically via transmissive teaching) that are then reinforced through post-classroom tasks such as homework. In the following sections, I refer to such strategies collectively as ‘traditional’ approaches.

For example, in undergraduate teaching, the ‘traditional’ approach is usually centred around the lecture as the main vehicle for introducing new subject materials via direct instruction. In traditional approaches the learning of new topics is therefore synchronised to in-class teaching. By contrast, in the FC, this is achieved asynchronously, by requiring learners to engage with new topics in their own, private time. Thus, the flipped approach intentionally moves directed forms of instruction from the “large group learning space [i.e. the classroom] into the individual learning space“ *(Hamdan et al, 2013, p.4).*

Of course, requiring learners to engage with subject materials in advance of, and in preparation for lectures is not a new idea. Nor is the use of the lecture as a space for promoting interaction and dynamic engagement with learners. However, what the FC does is to take these ideas and formalise their combination into a pedagogical approach. This involves adjustments in the normative roles of both teacher and learner; for teachers, there is less emphasis on delivery of basic content and more on facilitating its understanding and application; while for learners, more responsibility for attaining the basic content is assumed, and articulation of their understanding is expected.

In flipped teaching, because learners access new materials and concepts asynchronously, before coming to class, they are said to have control over the timing, location and pace over their learning. Once in class, the new concepts and materials are then explored in more depth using active learning methods. These typically involve tasks requiring collaboration, for example group-based work and peer interaction.

Teachers might choose to introduce variations to the flipped approach. For example, some pre-class activities might involve homework based on earlier teaching; equally, a teacher may choose to introduce a new topic during a classroom session. Teachers might also optionally require learners to complete post-class tasks, which might take the form of formative and/or summative assessments. However, despite such variations, a key aspect of the FC is its use of classroom time primarily for active learning activities.

A further distinguishing feature of FCs is the use of online videos for the pre-class activities. These commonly have a transmissive style format, but may also include an interactive element, for example through the use of self-test quizzes. It is commonplace nowadays to see these provided via an online learning management system such as Blackboard or[1] Moodle[2]. Such systems offer learner access and performance data, so that a teacher can check, for example, what proportion of the cohort accessed the online content, and what scores were achieved on self-test

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[1] https://www.blackboard.com *(accessed 01 September 2022)*
[2] https://moodle.org *(accessed 01 September 2022)*

questions. This information may permit a teacher to tailor the in-class sessions to address any concerns revealed by the results.

The pre-class, in-class and optional post-class activities form a learning cycle that repeats each week of a typical teaching semester. This cycle is depicted in Figure 2.1.

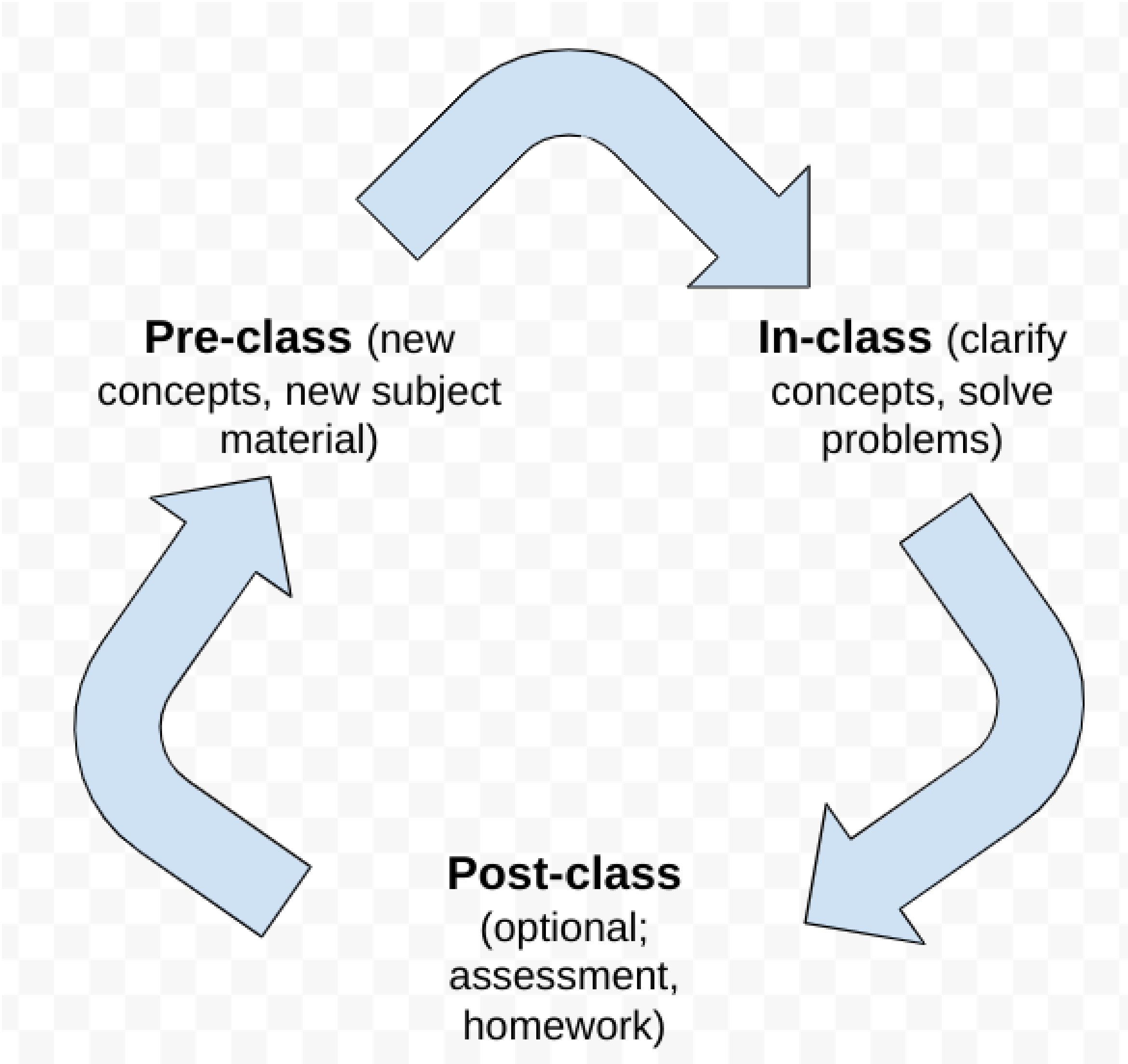


Figure 2.1 Flipped Classroom (*adapted from* https://www.hetl.org/a-review-of-flipped-classroom-research-practice-and-technologies/ *(Estes et al., 2014; accessed 02 September 2022)*

Some observers have described the FC as "both a disruption and an opportunity" in higher education *(Estes, Ibid).* The FC disrupts the structure of traditional teaching approaches as described, while at the same time facilitating the opportunity to use the classroom for active learning tasks.

In undergraduate engineering FCs, preparatory, pre-class activities are often augmented by laboratory-based work. These are also used to explore subject materials and concepts in more depth. Laboratory activities are typically organised around small groups or teams and offer further opportunities for collaborative/collective learning.

### 2.1.2 Relationship to Blended Learning

Flipped learning is considered by some to be a type of Blended Learning when the preparatory activities are online but the lectures are in-person (at least in pre-pandemic times) *(Staker & Horn, 2012; Clark et al, 2018)*. As with the 'Flipped Classroom', the term 'Blended Learning' also lacks a consensus on a rigorous definition. However, Staker and Horn have offered the following:

> "a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace" *(Ibid., p. 3)*

The Blended Learning approach blends in-class ("bricks-and-mortar") learning and online learning, while often incorporating technology-rich teaching. In one model of Blended Learning, learners rotate between different learning modalities (for example, between in-class and online), either on a fixed schedule or at the teacher's or learner's discretion.

The FC fits well within this model because it also mandates rotation, while assigning specific purposes for in-class and online learning, as described.

### 2.1.3 Flipped Classroom Studies

As I discuss in my literature review in Chapter 3, very few studies of the FC have been carried out using an analytical framework. Most report on learning outcomes and student attitudes and fall into one of two types: case studies in which researchers report the outcomes of flipping their own classrooms; or comparison studies, in which a flipped classroom is directly compared with a comparative non-flipped classroom. Overall, despite criticisms of flipped teaching attributed to learners, a majority of studies (of either type) report that students have, in general, favourable dispositions towards flipped teaching.

However, as some researchers have pointed out, the problem with many of these FC studies is that there may be variables involved that are not controlled for *(Jensen et al, 2015)*. These may arise as the result, for example, of the first-time introduction of active learning techniques and/or the use of technology and online learning, making it “difficult, if not impossible, to disaggregate them” and identify individual causal factors *(Jensen et al, Ibid)*.

### 2.1.4 Active Learning

Most advocates of the FC claim that it promotes engagement of learners by facilitating active learning. For example, in their large meta-analysis of comparative studies in HE, which compared active learning with traditional lecturing in STEM subjects, Freeman and colleagues reported that student performance improved when active learning methods were used *(Freeman et al, 2014)*. The study also reported that there was a smaller risk of student failure when active learning techniques were used:

> “on average, students in traditional lecture courses are 1.5 times more likely to fail than students in courses with active learning” *(Ibid., p. 8410)*.

However, as with reports of the effectiveness of flipped learning, one should exercise caution, especially given that the term ‘active learning’ is also hard to define. This is widely acknowledged by researchers. For example, Li and colleagues, in their scoping review of literature exploring links between active and flipped learning, reported that

> "from the empirical literature it is nearly impossible to understand what 'active learning' specifically entails," *(Li et al, 2021, p. 4).*

One of the earliest attempts at a definition was provided by Bonwell and Eison in a 1991 study:

> "Active learning is generally defined as any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing' *(Bonwell and Eison 1991, 2).*"

Unfortunately, this rather lacks precision, and is arguably more a *description* of active learning than a 'definition'.

According to Li et al, a widely accepted description of active learning is that provided by Prince who, in his review of the literature, locates active learning activities in the classroom:

> "The core elements of active learning are student activity and engagement in the learning process. Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor" *(Prince, 2004, p.223)*.

Despite the lack of a precise definition, the conclusion reached by Freeman et al that active learning strategies tend to result in learning gains has, nevertheless, been documented by other research *(Crouch & Mazur, 2001; Hake, 1998; Michael, 2006)*.

Some researchers have speculated that improvements attributed to flipped teaching may be mainly due to the use of active learning techniques in the classroom. In a study comparing a flipped classroom with non-flipped classroom, in which both used active learning techniques, Jensen et al found no differences with respect to learning gains and student attitudes *(Jensen et al, 2015)*. According to the authors, both classrooms used the same instructional materials and were each taught using Bybee's (1993) 5-E learning cycle *(Bybee R., 1993).* The active learning techniques that were used included requiring students to "discover patterns, put forth hypotheses, and analyze data." *(Jensen et al, 2015, p. 3)*.

### 2.1.5 Summary

The literature suggests that the FC is founded on a combination of particular teaching practices, rather than pedagogic theory. Flipped teaching consists of elements of teaching that, while not new, are formalised into an approach consisting of asynchronous and synchronous components. Flipped teaching has been categorised as a type of blended learning. Several studies have claimed that flipped teaching leads to learning improvements, but these may also be explained by the use of active learning techniques that are known to work.

In the next section I discuss how, as also reported in the literature, a FC can be undermined if learners do not adequately prepare for the in-class activities. I then report on how inadequate preparation has been linked to questions of learner motivation. Finally, I discuss sociocultural approaches to motivation, and Vygotskian concepts of knowledge and learning.

## 2.2 Flipped Teaching and Motivation

### 2.2.1 Inadequate Preparation for In-class Activities

A critical element in the flipped approach is that learners engage with, and make sense of, the preparatory (i.e., asynchronous) pre-class learning activities. The research in this thesis and elsewhere, shows that when they do not, learners are very unlikely to engage with synchronous components. By not doing so, the value of the in-class activities is diminished, and the whole premise of the FC is undermined. Evidence suggests that this problem may be widespread. In a review of meta-analyses of FC studies, Hew et al reported on multiple studies that showed large percentages of cohorts did not always undertake the required pre-class preparation *(Hew et al, 2021)*. In their systematic review of flipped-classroom literature, Akçayir and Akçayir reported that inadequate preparation before class was the most commonly reported problem *(Akçayir & Akçayir, 2018).* These reviews are reported on in more detail in the next chapter, and collectively suggest that there may be multiple reasons why students fail to adequately prepare and learn from flipped teaching.

### 2.2.2 The Use of Incentives

Some researchers have speculated that inadequate preparation might be a question of motivation: learners are expected to commit personal time and energy regularly, at critical times outside of the classroom, to complete the preparatory work. Some published research has considered this problem and reported the use of incentives by some teachers, to help make sure this happens. These typically take the form of credit-bearing quizzes to complete after watching the videos, and/or awarding marks for completing problem-solving activities in the classroom *(Yeung & O'Malley, 2014; Fautch J. M., 2015; Christiansen M. A., 2014).* Unfortunately, offering incentives such as marks for attending and completing learning tasks is not guaranteed to succeed *(Ryan & Deci, 2017).* As I report in Chapter 6, I tried this in one of my own flipped classrooms with disappointing results. However, these ‘carrot-and-stick’ methods may be the wrong approach on theoretical grounds. Underlying the use of incentives is the belief that the teacher can, or *has* to motivate learners: i.e., to elicit greater effort than individuals are normally willing to expend in learning activities to satisfy their need for marks and grades. Getting students to do the required work, the argument goes, is 'only' a question of motivation (using the common, every-day meaning of the term). However, the notion of motivation as an undifferentiated, unitary concept was challenged long ago. Modern theories of human motivation are based on more nuanced conceptualisations that incorporate multiple factors that are thought to be significant. In the next section I elaborate further on contemporary theories of motivation.

### 2.2.3 Theories of Motivation

Human motivation continues to be one of the most extensively researched areas of psychology. There are different conceptualisations of what it is, and how it operates. This has given rise to several theories, each reflecting different conceptions of motivation. Each theory emphasises particular motivational factors that are considered to be the most significant in determining the reasons for given behaviours. Common to each is the idea that the different factors (sometimes called 'constructs') are related to the satisfaction of human need.

As a brief example, in Self Determination Theory (SDT), motivation is conceptualised in terms of three psychological needs: 1) to have good, supportive relations with others, 2) to develop competency, and 3) to develop a sense of autonomy (volition). According to the theory, when these needs are met, intrinsically-motivated behaviours that are self-determined and autonomous are more likely to result. There is a considerable body of published research to support this claim *(Ryan & Deci, 2017, Ibid; Howard, et al 2021; Van den Broeck et al, 2016)*. Drawing on SDT, Abeysekera and Dawson suggested that student motivation might be improved in the FC "if it creates a sense of competence, autonomy and relatedness." *(Abeysekera and Dawson, Ibid)*. SDT differentiates motivation into extrinsic and intrinsic forms *(ref. Ryan & Deci, 2017, Ibid.)*. Extrinsic motivation refers to actions and behaviour engaged in by individuals who are motivated by separable outcomes (for example, grades and rewards). Intrinsic motivation, on the other hand, refers to actions and behaviour by individuals who are motivated because they find them inherently interesting and enjoyable. Intrinsically-motivated behaviours are claimed to be more self-determined and autonomous than those that are extrinsically motivated. With respect to learning, intrinsically motivated learning has been shown to result in better outcomes (for example better grades), than when it is characterised by extrinsic motivation *(Ryan & Deci, 2017, Ibid.)*.

However, SDT is only one theory of motivation, and there are several others. The following is an abbreviated list provided by Reeve: *(Reeve, 2001)*

- Achievement Motivation Theory
- Cognitive Dissonance Theory
- Expectancy Value Theory
- Goal-Based Theory
- Self-Efficacy Theory
- Attribution Motivation Theory

Each theory is predicated upon specified motivational constructs, such as self-efficacy, competence, perceived locus of control, goals, expectancies, self-worth, or self-regulation. The terminology associated with each one reflects the different ways in which motivated behaviour is conceived and understood. For example, terms such as ‘expectancy’, ‘flow’, ‘performance-oriented’, ‘mastery-oriented', and so forth, are commonly used.

What SDT and the majority of the theories listed by Reeve have in common, however, is that each conceives of motivation as an individual, cognitive phenomenon. Thus, motivation is person-centric and is described in individualistic terms. Although the influence of the social context is acknowledged, it is seen as secondary. In this view, an individual’s motivation (and their associated feelings, dispositions and opinions) emerges and develops as they interact with their environment (for example, learning). Thus, motivation primarily develops on a personal (internal) plane of cognition and is then shaped by interaction with an external plane (the environment). As Sivan observed, this approach places the individual “as the agent who alone processes environmental, cognitive, and affective information” *(Sivan, 1986)*

Since the late 1990s, alternative approaches have been developed that see motivation primarily as a *social* phenomenon, arising as the result of socially negotiated processes *(Hickey, 1997; Walker, 2010)*. In this alternative view, individual motivation, and, by extension, individual knowledge and learning, are socially constructed through participation in the wider sociocultural milieu. In other words, the social context takes a primary role in the origin of human motivation. Individual 'meaning-making' then takes place with the assistance of others, (including teachers) by engaging with, and using the norms, protocols, tools and signs of the embedding culture.

In the next section I expand further on sociocultural conceptions of motivation and knowledge, particularly as they apply to learning.

### 2.2.4 Sociocultural Conceptions of Motivation

Walker et al have defined a sociocultural perspective of motivation as one in which it arises from "social processes in the first instance and only secondarily [as] the result of individual processes" *(Walker, 2010, p. 3)*. Such a view challenges the primacy of the individual, cognitive-centred understanding of motivation, as discussed in the previous section.

A key point is that "individuals and the social environment of which they are a part constitute mutual elements of a single, interacting system" *(Ozdemir, 2011, p. 299).* This implies that the determination of an individual's motivation, and the social environment in which he/she participates, are inseparable. Thus, the 'dualist' notion at the centre of non-sociocultural theories of human motivation, i.e., of the individual interacting with an external world that shapes and influences motivation, is rejected. The social context is not, therefore, a 'well-spring' of yet another set of factors in moulding the human experience of motivation. Instead, it is suggested that motivation is produced as a result of collective participation by individuals in social practice. Such participation therefore takes centre stage and becomes a natural focus of interest. As will be discussed soon, a critical aspect of participation in social practice is its mediation not only through the use of tools and instruments, but also communities and their norms/rules.

A valid question is how does individual motivation (and other higher mental functions) arise from/is remediated by participation in social practice? A common explanation given by sociocultural theorists is that it develops through a process of internalisation, which Wertsch has described as “a process involved in the transformation of social phenomena into psychological phenomena” *(Wertsch, 1988, p.63).* This is a rather broad description of internalisation, one lacking in important details, which I shall return to later in this thesis. Ultimately, however, sociocultural theories of motivation are founded on Vygotskian concepts of knowledge and learning, and these are discussed next.

### 2.2.5 Vygotskian Concepts of Knowledge and Learning

As Hickey et al have observed, assumptions regarding motivation in learning are tied to “assumptions about the nature of knowledge” *(Hickey & Grenade, 2004, p. 226)*. Sociocultural concepts of knowledge as they are understood today lie in pioneering work undertaken by L.S. Vygotsky, in the USSR in the early twentieth century. These concepts are founded on the idea that knowledge should be understood in terms of historical and cultural experience. Thus, in any given domain, knowledge is socially and historically bound, and “inextricably tied to its use” *(ref. Hickey & Grenade, Ibid).* Therefore, to be knowledgeable means to participate in the socially-defined uses of that knowledge. In such participation, an individual uses the associated concepts, symbols, tools and language to achieve real-world objectives. For example, a knowledgeable electronics engineer uses the well-known laws of circuit analysis and its associated language to design and build analog or digital circuits. Such laws, established long ago, belong to the engineering community as a whole, and are disseminated (typically) through textbooks and programmes of study.

A key point about participation in activities using socially-defined knowledge is that not only do individuals transform the objects to which those activities are directed, but they also transform themselves in the process. Returning momentarily to our circuit design analogy, in the creation of new circuits and systems the engineer also transforms herself into a more knowledgeable, more experienced designer. Note that this does not preclude the possibility that socially-defined knowledge itself might also be transformed by the engineer, who finds hitherto unknown (but new) applications for it. There are also possibilities for the community, its norms and rules, and instruments, to be transformed and to ‘develop’.

By implication, learning consists in successfully acquiring the concepts, symbols, tools and language of such knowledge in the domain in which it resides. Successful learning requires access to resources, a crucial element of which is help from teachers (‘more capable’ others). An important concept in this regard is the notion of the Zone of Proximal Development (ZPD). The ZPD was defined by Vygotsky as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” *(Vygotsky, 1978).* The zone refers to the range of help needed by an individual to increase their (successful) participation (in learning) relative to their ability. The boundary of the zone is met when the individual can continue successfully alone, i.e., when further help is unnecessary. For example, an individual who is able to compute eigenvalues for 2x2 matrices, might need assistance to compute them for more complex (higher-order) ones. Some scholars have used the notion of the ZPD to help explain how internalisation operates *(McCaslin, 2009)*, conjecturing that it may be intimately connected with questions of participation *(ref. Hickey, Ibid; Walker, Ibid)*.

Vygotsky’s work laid the foundations for the development of a conceptual framework that was later developed by A.N. Leontiev and others. One version of this framework became known as Activity Theory (AT), in which motivation is intimately connected with the notions of activity and object-orientedness. A theoretical approach based on AT, and stemming from the work of Y. Engestrom was used in my research and will be described later (section 3.7). In the next section, I present some of the fundamental ideas in Activity Theory, in which I draw selectively from the writings of Vygotsky, Leontiev, and Kaptelinin and Nardi, amongst others.

### 2.2.6 Summary

It is speculated that motivation is potentially a critical factor in the success or otherwise of flipped teaching. Contemporary theories of motivation start from the assumption that it is primarily a personal, cognitive phenomenon, in which the social context plays an influential, but secondary, role. Sociocultural theories of motivation challenge this and instead view individual motivation arising from participation in social practice; in this alternative view, the social context is of primary, not secondary, significance. Sociocultural theory in its modern form owes much to the work of L.S. Vygotsky and his co-workers.

## 2.3 Activity Theory

### 2.3.1 Introduction and Key Concepts

As mentioned earlier, Activity Theory (AT) is a conceptual framework whose origins can be traced to the work of L.S. Vygotsky, A.N. Leontiev and others *(Kaptelinin et al, 1995)*. The theoretical orientation of AT is descriptive, rather than predictive. It provides a lens with which to study human activity while taking into account its social, cultural, and historical context. Within this framework, activity, which encapsulates the actions of a 'subject' directed towards an 'object', is the fundamental unit of analysis. Essentially, individual subjects enter into collective activity with an object to satisfy a (socially-determined) need. Thus, activities, subjects and objects mutually determine one another.

Some key concepts in AT include the notions of object-orientedness, mediation, the hierarchical structure of activity, internalisation-externalisation, development, and contradictions *(Kaptelinin et al, 1995)*. In the remainder of this section, I briefly review each of these concepts in turn.

### 2.3.1.1 Object-Orientedness

Briefly, object-orientedness refers to the object to which activity is directed. The object should not be thought of as simply a physical entity, but more generally as something that is socially and culturally determined. As Miettinen stated

> "an object of activity should not be understood as a distinct entity, but rather as a complex and contradictory assembly of heterogeneous materials embedded in social and economic relationships." *(Miettinen, 2005)*

Thus, the object is likely to be connected to a socially defined purpose, to which the collective subject is motivated. During activity, the object is transformed through the agency of the subject (which might be one or more individuals, depending on interpretation), mediated via one or more artefacts/instruments. During such transformation, there are reciprocal processes that also transform the subject and even potentially the mediating artefact(s).

An individual's subjective contemplation of the object is manifest in the reflection of the object in the minds of the subject. As Kaptelinin and Nardi explain:

> "The object of activity thus has a dual status; it is both a projection of the human mind onto the objective world and a projection of the world onto the mind." *(Kaptelinin & Nardi, 2006)*

The object also carries with it purpose, i.e., motive. As the same authors put it, the object of activity is also a 'sense-maker':

> "From a research perspective, the concept of the object of activity is an analytical tool providing a means of understanding not only what people are doing, but also why they are doing it" *(Ibid., p. 138)*

It might also be that the motive can be inferred from the 'outcome' of activity.

The intimate connection between object and motive was captured by Leontiev in his oft-quoted phrase: “the object of an activity is its true motive” *(ref. Leontiev, 2009, p. 98).* For example, for students considering enrolling on an EEE programme, the goal/object is most likely to learn electrical engineering and work as qualified graduate engineers. Thus, identifying the object leads one to learn the motive associated with the activity of studying engineering (in this case, the education of competent neophyte engineers). From the motive, one also understands the need to be satisfied (the societal need for more engineers).

However, Kaptelinin and Nardi have argued that the concept of a singular, i.e., one-to-one, relationship between object and motive may be problematic when multiple needs remain to be satisfied *(Kaptelinin & Nardi, Ibid, p. 140-150)*. The one-to-one model precludes the possibility that there may be multiple motives associated with certain activities, i.e., that activity might be *poly-motivated*. For example, there are often multiple reasons why people enrol in educational programs. For the prospective EEE graduate, obtaining a well-paid job with good career prospects is often quoted alongside wanting to help society at large (as this thesis will later show).

## 2.3.1.2 Mediation

A further, key idea within AT, is that activity is mediated. In his writings, Vygotsky referred to two types of mediating artefacts: tools (technical) and signs (psychological). The function of mediating artefacts -whether technical or psychological- is to mediate human activity in changing their environment, i.e., to service the intentional changes in objects. Examples of technical tools include material things such as chisels, hammers, or drills, or more complex ones such as computers *(Pohio, 2016)*. Psychological signs (such as words/languages) are used to mediate higher mental processes, and are generally intended to bring about changes in the self or in others. Psychological signs are cultural and social in character: they are not ‘invented’ by individuals, nor ‘discovered’ or even inherited, but instead are appropriated “by virtue of being part of a sociocultural milieu” *(ref.*

*Wertsch, Ibid., p.80).* Examples of psychological signs include symbols, language, protocols, or even works of art or literature.

The distinction between physical and psychological instruments is not always clear cut, however. Kaptelinin and Nardi make an important point in this respect, writing:

> "For instance, a pen is a technical tool in the sense that it is used to change a thing (e.g., to write a note on a piece of paper).." *(Kaptelinin & Nardi, Ibid, p. 284, Note 2).*

However, as they explain, it is also psychological "..since it is used to write a message intended to affect people's beliefs." *(Ibid).*

### 2.3.1.3 Hierarchical Structure of Activity

A further fundamental concept within AT is that an activity possesses a hierarchical structure, consisting of three levels. At the top level is the collective activity itself, directed towards the object. As before, we think of the undergraduate students aiming to become qualified graduate engineers (their goals forming part of the object) by participating in a programme of study (the activity). Below this top level, the activity is viewed as being composed of one or more actions directed towards specific goals. These actions are typically coordinated and may be executed in sequence in order to fulfil the requirements of the overall activity. Continuing the analogy with the undergraduate student, goals could be, for example, passing individual course units by completing the tasks associated with them.

It is typical for actions to be relatively independent, in the sense that they may be shared between different activities. Furthermore, although individuals are usually fully conscious of their goal-directed actions, depending on the circumstances, it may also be that they are unaware of the object/motive of activity while doing so *(Leontiev, 2009, p. 171).* For example, in passing a relatively obscure course unit, it is possible that an individual may be unaware of its importance to the activity of the profession of engineering as a whole.

At the third (lowest) level are what, in Leontiev's AT, are called 'operations'. These typically refer to the 'components' of actions, i.e., routine processes and actions/behaviours which may or may not be consciously executed. Operations can be characterised as 'improvisations', made by an individual when adapting to changed conditions. Such improvisations can result in change in how activity is conducted. Operations can also be characterised as 'automated', when an action might become routine through practice and repetition *(Kaptelinin & Nardi, Ibid., p.62-63)*.

As an example activity, consider cyclists participating in a weekend club ride. The routine actions involved in riding a bike are observable, but largely unconscious, such as changing gears, applying brakes, etc. The associated actions engage conscious goals such as keeping together, and marshalling duties at the front and back of the group; while the collective has a group motive of everybody enjoying the ride, while arriving safely back home at the end.

#### 2.3.1.4 Internalisation-Externalisation

AT includes the sociocultural concepts of internalisation (the transformation of social phenomena from the external to the internal/personal plane) and that of externalisation, which is a reciprocal process involving the transformation of internal activities into external ones. According to Kaptelinin and Nardi,

> "Activity theory emphasizes that it is the constant transformation between the external and the internal that is the basis of human activity."
> *(ref. Kaptelinin & Nardi, Ibid., p.70)*.

The processes involved in internalisation-externalisation are dialogical in character, enabling social relations to develop through both individual and collective activity.

### 2.3.1.5 Development

In AT, activity is understood within its historical context. The recognition that an activity unfolds and develops over time requires knowledge of the social and historical conditions under which it is undertaken. Thus, activity is viewed essentially as a historical sociocultural process. In AT, contradictions (discussed next) are considered as major sources of development and change within or between activity systems.

### 2.3.1.6 Contradictions

Contradictions may manifest themselves as tensions that a subject experiences in goal-directed activity, as, for example, when an individual is forced to choose between two goals. There are several reasons why contradictions arise in activity. For example, the introduction of a new tool or rule could cause problems for the subject, particularly if it is ill-suited for the tasks required. Contradictions might also arise between separate activities that the subject is engaged in, whether individually or collectively. Examples of tensions surfaced by contradictions include dilemmas, paradoxes, double-binds, or personal conflicts and clashes.

Contradictions are not necessarily obstacles for development; they may create new opportunities for the subject, and lead to a broadening of the activity. However, as individuals work to resolve contradictions, the overall activity in which they experience them is shaped and developed. Contradictions are not always resolvable, but are sometimes superseded by new, emergent ones *(Williams and Ryan, 2019).*

Of the different types of contradiction that could arise, arguably the most significant are those that possess an inherent structural/systemic character and which may be more difficult to resolve: for some theorists, only these really ‘count’ as contradictions. For example, according to Engestrom,

> “Contradictions are not everyday solvable problems but historically accumulating structural tensions within and between activity systems” *(Engestrom, 2001a, p.137)*.

In this regard, Engestrom is referring to contradictions that are *internally* contradictory, in contrast to those that Roth termed *logical* contradictions (and which may be removed) *(Roth, 2012, p.94)*. Internal contradictions are said to have a dialectical character, arising from 'forces' that are in opposition to each other. This corresponds to Ilyenkov's definition of contradiction as 'the concrete unity of mutually exclusive opposites' *(Ilyenkov, 2009, p.185)*. As an illustration, the educational system in the UK is, itself, a source of such contradictions: for example, the contradiction between what Lave called the 'exchange value' of knowledge (learning to achieve a passing grade) and its 'use value' ("learning to know", *Lave & Wenger, 1991, p.112).*

The study of contradictions in activity is fundamental to the use of AT in analysis. As such, they represent a key part of my research, and are discussed further in later sections.

#### 2.3.1.7 Summary

Having discussed the fundamental ideas underpinning AT, I next briefly trace its historical development. Over time, different versions of the theory have appeared, largely as a result of different interpretations of some of the core ideas. I focus on the version due to Engestrom in particular, supporting the discussion using diagrammatic representations of activity systems.

### 2.3.2 The Historical Development of AT: a brief sketch.

According to Engestrom *(Engestrom, 1991)*, one can distinguish three versions, or 'generations', of AT:

- First generation -due to Vygotsky and his co-workers.
- Second generation -due to Leontiev, and extended by Engestrom.
- Third generation -due to Engestrom.

In ‘first-generation’ AT, mediated activity is expressed as a triad of individual Subject, Mediating Artefact, and Object. This is depicted in Figure 2.2.

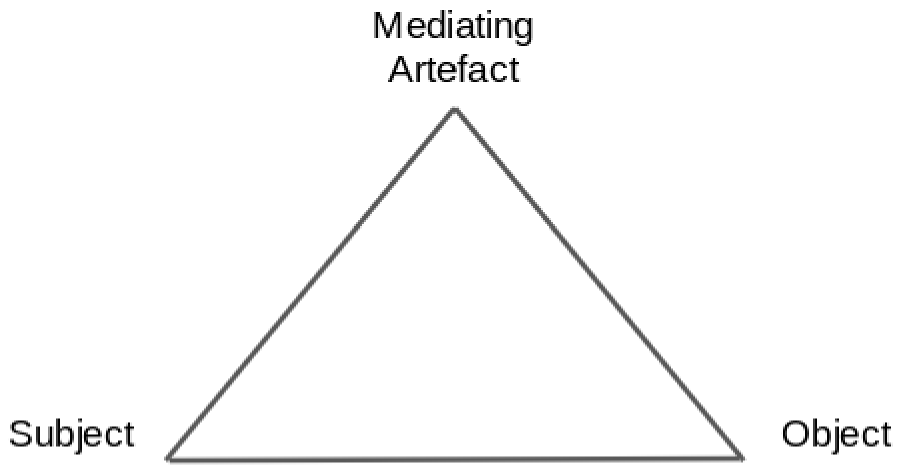


Figure 2.2. Activity System diagram due to Vygotsky
*(adapted from Engestrom, 2001b, p.134)*

Figure 2.2 captures Vygotsky’s idea of the cultural mediation of activity involving subject, (cultural) object and mediating artefact. Its main limitation however, is that its focus is at the level of individual actions, and does not take into account collective activity.

In ‘second-generation’ AT, the concept of mediated activity is expanded to emphasise its collective nature. It was in this second generation that Leontiev distinguished between an individual’s goals and actions and the overall object-oriented activity of the community of which he/she is a part. This, in turn, is connected to the notion of a hierarchy of activity which was described earlier.

Engestrom expanded the structure of activity into what he describes as an ‘activity system’, by adding several other elements to acknowledge its contextual nature. These include ‘Community’, ‘Rules’ and ‘Division of Labour’, and are shown as additional ‘nodes’ in Figure 2.3.

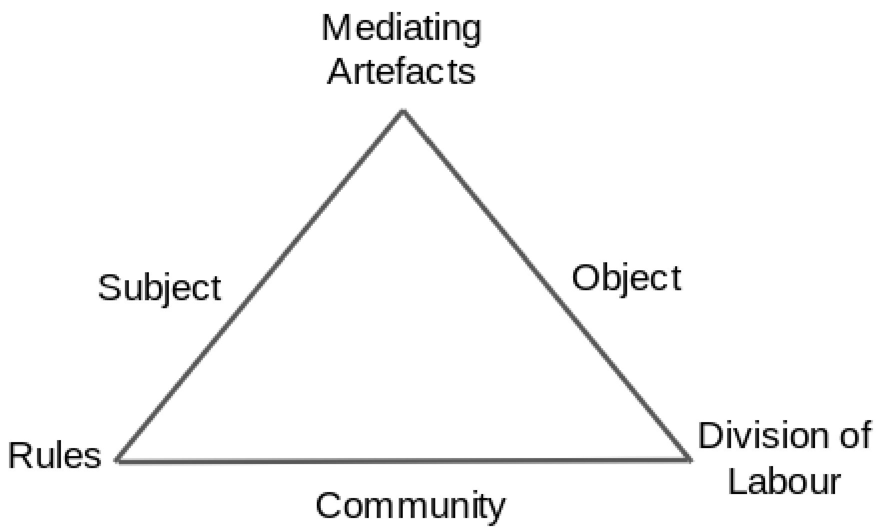


Figure 2.3. Activity System diagram due to Engestrom *(adapted from Engestrom, 2001b, p.135)*.

Briefly, 'Community' refers to the categories of people who have a direct interest in the outcome of the activity; the 'Rules' mediate subject-community relations, and 'Division of Labour' refers to specialised roles within the activity and which mediate the community-object relations.

When this framework is applied to particular domains, subject, object, etc, take on specific meanings. For example, when adapted for learning activities, the nodes of the triangle are taken to mean the following:

- 'Mediating Artefacts' are the tools/instruments and resources that the subject uses in learning, for example the lectures and lecture materials, computer software, online tutorials, and so on.
- 'Rules' shape and determine patterns/norms of relations between subject/learners and the community within the Activity System. These include the norms and protocols associated with the adopted teaching model.
- The 'Community' consists of categories of people that have a direct interest in the outcome of the learning activity. This includes institutional support and administrative staff, and academics.

- ‘Division of Labour’ represents specialised roles within the activity, for example the roles played by others who mediate the relationship between the community and the object. This may reflect a division of power and status, between, for example, teachers and teaching assistants.

In ‘third-generation’ AT, Engestrom added further extensions to account for interacting activity systems, which might partially share objects or other aspects of their activity, such as instruments, or norms/rules, etc. This permits the analysis to shift outwards, beyond the boundary of a single system/activity.

#### 2.3.2.1 Differences between 2nd and 3rd Generations of AT

It is worth pausing here briefly to comment on these different ‘generations’. In his account, Engestrom presents them in a way that might be read as a natural, evolutionary development of the theory. It may be tempting therefore, to accept his version as somehow ‘better’ or more ‘mature’, than that due to Leontiev. However, on close examination, it is apparent that there are subtle differences in the interpretation of some of the key fundamental concepts, made by each version.

In a comparison of the two, Kaptelinin and Nardi identify these differences, warning/reminding us that “the same concept can have different meanings in different contexts.” *(Kaptelinin & Nardi, Ibid., p. 141).*

One example of a difference in interpretation, identified by Kaptelinin and Nardi, is the relationship of subject to object. For Leontiev, the object is the ‘true motive’ of activity, whereas for Engestrom, the object is ‘‘the ‘raw material’ to which the activity is directed at *(Engestrom, 2001b)*. For the latter therefore, although motive is not entirely discounted, the object is viewed primarily as something to be *produced* in order to satisfy human need. Further differences are apparent in the analytical approach taken by each version: in Leontiev’s writings, although he did not explicitly exclude the analysis of activity by collectives, the focus of analysis is at the level of the individual. For Engestrom, activity analysis is undertaken primarily at the level of the collective; in particular, the object of activity is defined by, and acted on by, the community as a whole *(Kaptelinin & Nardi, Ibid., p.142)*.

These differences are due -as Kaptelinin and Nardi explain- to Engestrom's approach in applying AT to the analysis of organisations and their development:

> "While Leontiev introduced the object of activity as a psychological concept, for Engestrom this concept is an analytical tool for studying organizational change." *(Kaptelinin & Nardi, Ibid., p.143)*.

By repurposing AT in different domains, therefore, one should be careful; there is a risk that subtle changes in interpretation can lead to substantive differences in analytical approach. On these grounds, in contemplating the use of AT to analyse the FC, it might be argued that I am risking a similar outcome. However, in my research, I found Engestrom's inclusion of Community, Rules and Division of Labour useful because it extends the framework to allow for a more explicit investigation of contradictions involving these entities. As I suggest later, such contradictions contribute in significant ways to learner motivation within flipped classrooms. I will also argue that they represent significant factors in forming and shaping learner subjectivity. Before doing so, however, I will briefly discuss the limitations of the use of triangular schematics to represent activity systems.

### 2.3.2.2 Limitations of AT Diagrams

Some scholars have urged caution when representing activity systems in diagrams such as that depicted in Figure 2.3. As Barab et al have pointed out "The temptation is to look at any activity system as a black box, static in both time and structure." *(Barab et al, 2004)*. The diagrams hide the dynamics of the interrelationships between the various components, and the detailed actions that compose the activity. They also obscure their historical and developmental changes.

Roth has also criticised the triangular representations, arguing that they are reductionist and exclude important factors such as subjectivity, emotions and feelings. In a case study of activity at a fish hatchery, he wrote:

> “..without articulating and theorizing needs, emotions, and feelings, we are hard pressed to arrive at more than a reductionist image of activity generally, and concrete activity systems such as the hatchery I studied particularly. Only by including these needs, emotions, and feelings do we capture the activity system as a whole, that is, as intended by cultural-historical activity theory since its inception. (p. 70)” *(Roth, 2009).*

Barab and Roth raise important issues, especially for subjectivity which is part of my research question, and which will be discussed soon.

### 2.3.3 Contradictions and Tensions in Activity Systems

As discussed earlier, dialectical contradictions are viewed as significant sources of development and change in activity. They essentially manifest themselves as tensions and conflicts that individuals experience. Such tensions and conflicts are appropriate to the activity that they are engaged in. For example, in learning activities students typically experience pedagogic tensions. These can arise in a multitude of different ways, for example during interactions with teachers or with other learners, and/or in attempting to learn from subject materials.

To clarify, I understand tensions as phenomena experienced by individuals when their subjectivities are activated, as, for example, when they are challenged or confronted. In this view, tensions are experienced as subjective dilemmas, i.e., as conflicts between an individual’s subjectivity and the contradictory choices they face, within or between goals. Within the context of this research, I focus on pedagogic tensions that are related to dialectical contradictions hypothesised to be accentuated by flipped teaching. In the later sections on analysis, I show how I classify tensions reported by learners into tension categories, which are then, in turn, grouped under the appropriate contradiction.

Individuals’ reactions and responses to tensions and conflicts are helpful in understanding what motivates their particular actions, and the overall development of the activity that they are engaged in *(Barab et al, 2009, p. 80).* Thus, tensions and

their associated contradictions are likely to be implicated in determining both learners' motivation and their subjectivity.
In sum, identifying contradictions -which is a natural starting point in conducting activity analysis using AT- is likely to be useful in helping answer my research question.

In Engestrom's version of AT, contradictions in activity are classified into one of four types:

- 'primary', meaning contradictions *within* each node; i.e. within Subject, Community, Rules, etc.
- 'secondary', which are contradictions *between* nodes. For example, between Subject and Mediating artefacts, or say, between Subject and Rules.
- 'tertiary', which refers to contradictions between an existing state of an activity system, and its potential, future state. For example, perhaps the organisation is, itself, resistant to change.
- 'quaternary', which refers to contradictions between activity systems (3rd generation AT). For example, two or more such systems might subject a shared object to conflicting transformations.

Diagrammatic representations of activity are readily adapted to illustrate these different types. For example, Figure 2.4 illustrates potential secondary contradictions.

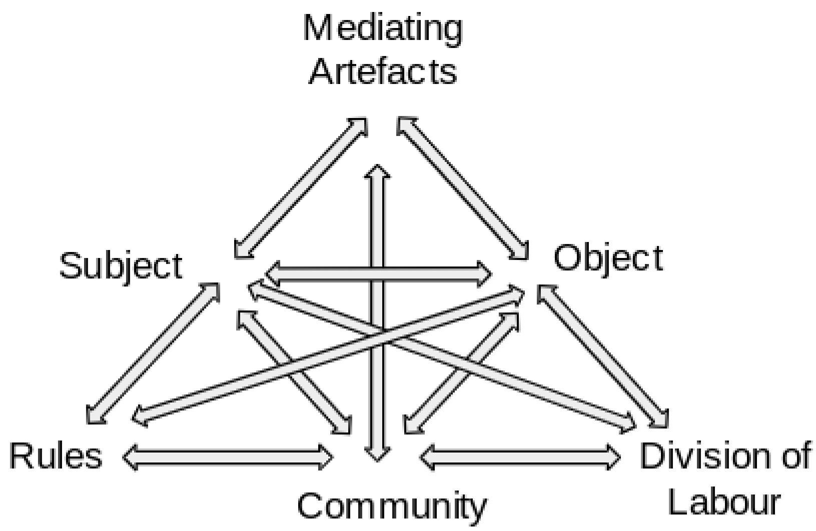

Figure 2.4. Potential Secondary Contradictions in an Activity System *(adapted from Gedera & Williams, 2013, p.34)*.

Despite their previously noted limitations, representations such as Figure 2.4 can help in identifying structural contradictions between elements in activity. By modelling a FC as an individual activity system, such diagrams are a useful visual aid in answering the question of what activity system contradictions arise, and/or are accentuated, as a result of flipped teaching? This is discussed further in the next section.

### 2.3.4 Contradictions in Flipped Classrooms

In an attempt to answer the question just posed, I conducted a small-scale study with a flipped Y1 undergraduate class in EEE, using AT as the theoretical framework. The study (conducted in 2019) aimed to identify contradictions via the pedagogic tensions reported by the participants *(Rubner, 2019b)*. The study identified several contradictions, of which two in particular could be said to be accentuated by flipped teaching. Furthermore, these two (listed below), could also be characterised as being structural/systemic, pervasive and long-lasting:

1. Teacher-led v Learner-centred learning.
2. Individual v Collaborative learning

These two contradictions are dialectical in character in terms of Ilyenkov's definition, in that they each constitute a "unity of opposites that condition and influence each other" *(Ilyenkov, Ibid.).* Contradiction 1 arises because flipped teaching intentionally shifts the emphasis to self-centred learning and away from classroom-based directed teaching -for example, through the requirement to learn new subject material outside of the classroom. Thus, a learner may expect a teacher to direct their learning, when instead the FC intentionally shifts the responsibility onto their shoulders. This is likely to result in pedagogic tensions experienced by the learner, over and above what would be expected. Contradiction 2 relates to collaborative working, which although emphasised by flipped teaching, may not suit all learners. The study found that some students who may prefer to learn individually might also resist collaborative forms of learning which the FC intentionally encourages and promotes. Similar to contradiction 1, this is likely to result in such students experiencing greater/additional pedagogic tensions than would otherwise be expected.

These two contradictions were also identified in a study of a flipped mathematics classroom carried out by Fredriksen and Hadjerrouit *(Fredriksen & Hadjerrouit, 2018)*. Contradiction 1 was also identified in separate research by Barab et al *(Barab et al, 2009).*

In my small-scale study I also found that learner subjectivities tended to reflect how the study participants negotiated these contradictions *(Rubner, 2019b)*. To an extent, these were also replicated in the study data presented in later chapters in this thesis. In general, one would anticipate that as an individual engages in learning, their subjectivity would also be impacted. This would be expected via the reciprocal transformative process of object upon subject, as discussed previously (see **Object-Orientedness**).

A further, relevant question here is: how might subjectivities be understood theoretically within the framework of AT, and more generally in sociocultural theory? This is discussed in the next section.

### 2.3.5 Subjectivities in the FC

Understanding how student academic subjectivities are mediated under flipped teaching is an objective of my research. Therefore, a legitimate question to ask is, how might a theoretical understanding of subjectivity be obtained using AT, and in using sociocultural theory in general?

One possible way forward for extending sociocultural theory to account for, and analyse subjectivity is signposted by the work of González Rey. Building on the concepts of subjective sense and perezhivanie developed by Vygotsky, González Rey defines subjectivity as a “configurational system” of social and individual subjectivities *(González Rey, 2021).*

This configurational system -more formally described as a *subjective singular configuration system*- is responsible for the complex inter-weaving of individual and social subjectivities, individual emotion, and individual historical and cultural experiences *(González Rey, Ibid.)*. In this perspective, subjectivity is closely linked to individual motivation:

> “González Rey regards subjectivity as primarily a motivational system because social realities and experiences can only engage individual actors when they are subjectively configured. He defines motivation as a subjectively configured process and a specific quality of the subjectively configured system. The motivational character of a human experience is defined together with other subjective senses in a complex subjective configuration of senses. So, a motive does not relate directly to a given object. It is an integrative expression of subjectivity as a system of subjective configurations” *(ref. O. Dreier, 2021, p. 62).*

Although this differs from Leontiev’s conception of object/motive, the implication here is that gaining an understanding of an individual's subjectivity should, in turn, lead to insights into their motivation. This, in fact, is the approach that I took during my research, as will be discussed later in the thesis.

The work of González Rey in extending sociocultural theory to account for subjectivity and motivation is recognised by respected theorists and scholars in the field, and is therefore deserving of much greater attention than I can give here.

Wrapping up, understanding the impact of flipped teaching on learner motivation and subjectivity begins with an analysis of dialectical contradictions and their associated tensions in the FC. In Chapter 4, I present and discuss a methodology for capturing and analysing learners’ subjectivities and academic motivations.

### 2.4 Summary

In this chapter I have argued that Engestrom's version of AT provides an appropriate framework for investigating the FC. Although the triangular diagrammatic representations can be said to be reductionist in several senses of the word, they do at least provide a structural approach to the investigation of dialectical contradictions that are widely regarded as significant sources of change in activity systems. In the next chapter I report on the results of my literature searches that helped inform the theoretical approach presented here, and the remainder of my research.

# Chapter 3 Literature Review

In this chapter I present the results of my literature review. The review was influenced by the theoretical approaches discussed in the previous chapter, and also the results of a previously examined narrative literature review of the Flipped Classroom (FC), that I undertook earlier in my doctoral studies *(Rubner, 2017)*. That earlier review surveyed materials published up to the end of 2016, and examined FC studies in HE, with an emphasis on engineering. It was partly guided by questions related to factors believed to determine the efficacy of flipped teaching, such as academic motivation, which was identified as a potential critical factor in the problem highlighted earlier, i.e., learners' willingness to undertake preparatory, pre-class learning activities. It also examined the literature for the use of theoretical models with which to analyse the FC, particularly those based on theories of motivation. The results confirmed the relevance of learners' motivation in flipped learning in multiple subjects, including engineering. However, only a small number of studies used a theoretical framework, and these were based only on person-centred, cognitive theories of motivation, i.e., non-sociocultural approaches (as discussed in Chapter 2). Other findings of the review included a lack of reporting in studies, regarding the effect of class size on learning in FCs. Also lacking in detail in many reports was how laboratory classes were integrated into FCs.

The information presented here represents the results of a re-examination of FC literature in HE generally, but particularly in engineering education. It should be noted that a major difference between this review and the one I conducted in 2016, is that here the literature is examined primarily from learners' perspectives; in the earlier review it was examined from both learners' and teachers' viewpoints.

Given this background, there were three main objectives of this review: the first was to re-examine the evidence for the claim that learners in HE benefit from flipped teaching. A second goal was to explore in particular, how researchers have approached the problem arising when students do not engage with pre-class learning activities. A final objective was to re-examine the use of theoretical frameworks -especially Activity Theory- in analyses of the FC in engineering education. Summarising, the objectives were to answer the following research review questions (RRQs):

> **RRQ1** What is the recent evidence for the claimed advantages and benefits for learners in FCs in general, and in engineering education in particular?
>
> **RRQ2** How have researchers approached the problems for teaching and learning when learners don't engage with pre-class learning activities in FCs?

**RRQ3** Which theoretical approaches have been used in recent FC research? In particular, how has Activity Theory been used as a framework to analyse FCs from learners' perspectives?

The chapter is structured as follows: after a short introduction, I briefly discuss how the searches were performed and the criteria used; this is then followed by sections that address each of the above questions in turn.

## 3.1 Introduction

As my review in 2016 noted, descriptions of the Flipped Classroom (FC) first appeared at around the turn of the century. The total number of reports was low at first, until 2012, when a rapid increase in the numbers of FC-related academic conference papers and journal articles was observed *(Karabulut-Ilgu, 2018)*. The increase in academic output was reflected across multiple subject areas, including engineering. This is illustrated in Figure 3.1, which shows the early growth in studies to 2015.

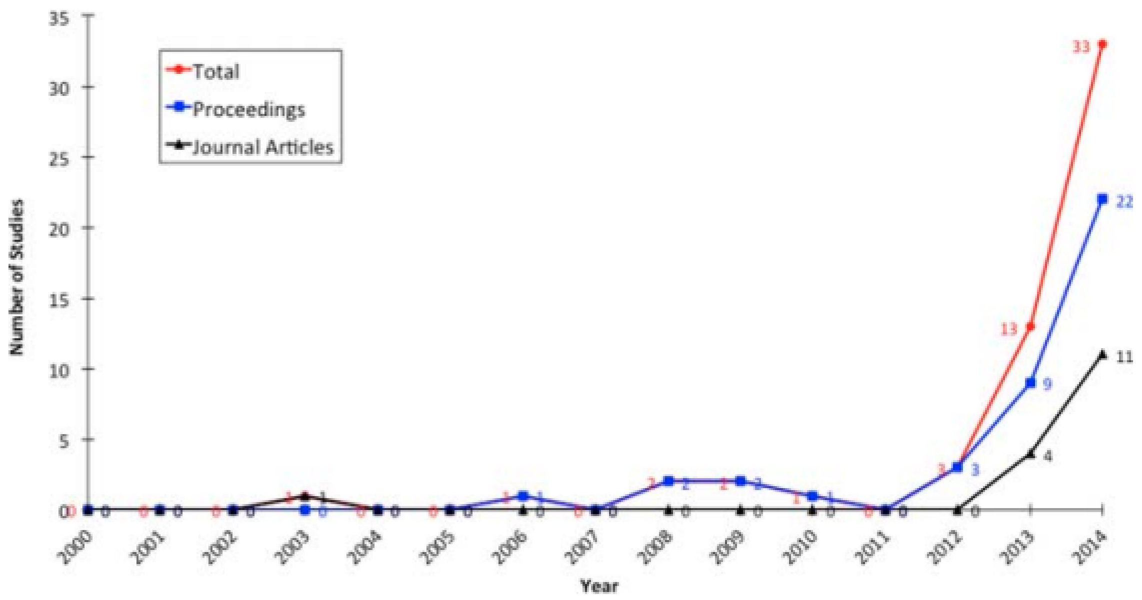


Figure 3.1 The number of FC studies in Engineering Education, published from 2000 to May 2015. *(Reproduced from Karabulut-Ilgu et al, P. 401)*

Increasing interest in FCs was evident in my 2016 review, which identified over 100 items. The increase in publications in all subject areas continues to the present day, and has accumulated into a significant body of research, reflecting increasing interest in flipped teaching. Although it is difficult to obtain a precise figure for the number of engineering-only publications at the time of writing, the literature indicates that it is likely to be several thousand. For example, in their search for FC studies published in the ten-year period to 2017, Lo and Hew identified a total of 3345 records *(Lo and Hew, 2019)*. Interest in flipped teaching has been given further impetus by the recent pandemic, which has triggered the widespread appearance of fully online FCs.

The increase in publications has been accompanied by an increase in the number of meta-analyses which, in total, encompass hundreds of individual studies. These meta-analyses are essentially surveys of FC research and provide cross-sectional views of what is now a large and extensive set of quantitative and qualitative data (at least compared to 2016). As such they are a useful source of information and analysis, and I draw extensively on them in the following sections.

## 3.2 Search Engines and Search Criteria

The literature searches were performed using the following engines and databases: Google and Google Scholar, Web of Knowledge, PsycINFO, Education Resources Information Center (ERIC), American Society for Engineering Education (ASEE), IEEEXplore, and YouTube. ASEE and IEEEXplore are sources of scholarly work focussing on engineering education. The main types of materials that I examined include journal articles, conference proceedings, books and book chapters. Popular online articles and videos (YouTube) were also occasionally used. No restriction on time range for article selection was used, however given that the review is partly informed by what I learned in 2016, materials published since then were of particular interest. A total of 70 items were examined in detail.

Access to many sources required authentication, which I obtained by first logging in to the University of Manchester library website before initiating searches. Search terms relevant to my review research questions were used, including ‘flipped classroom’, ‘flipped learning’, ‘flipped teaching', ‘engineering’, ‘engineering education’, ‘motivation’, ‘subjectivity’, ‘activity theory’ and ‘sociocultural theory’. These terms (with the exception of the last two) were also used in my 2016 review. Given the focus on university programmes, these were often combined with other terms including ‘undergraduate’, ‘tertiary’ and ‘higher education’. Articles were selected on the basis of relevance after scanning their titles, abstracts and summaries, and numbers of citations. Often, after a fuller reading, additional articles were selected based on the references provided. I also occasionally uncovered relevant articles that had been missed in my 2016 review. All the articles examined were published in English, and were mostly drawn from either US-, UK- or Australian-based sources. As mentioned, meta-analyses of published FC research, which were previously available only in limited numbers, proved to be a valuable source of information. They are discussed next.

## 3.3 Meta-Analyses

Several meta-analyses of FC research have emerged in recent times, all of which appear to report on studies that were published in the years before the pandemic. Many of them focus on measures of ‘effect’, for example comparing the effect of flipped teaching with traditional approaches *(as defined in Chapter 2)* (*Hew et al, 2021)*. Collectively, these analyses are informed by hundreds of individual studies with thousands of study participants, making them a valuable resource in understanding the FC research landscape. Furthermore, many use sources drawn from a wider number of countries, not just English-speaking ones.

Of the 70 items that I examined, 9 were meta-analyses, and these are listed in Table 3.1.

| # | Authors | Time range of FC studies reported on | Education Level; Subject Area |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Al-Shabibi & Al-Ayasra, 2019. | 2012-2019 | Secondary and Higher Education; all disciplines. |
| 2 | Algarni, 2018. | 2010-2017 | Secondary and Higher Education; mathematics. |
| 2 | Bredow et al, 2021. | to May 2019 | Higher Education; all disciplines. |
| 3 | Chen, K.S. et al, 2018. | to June 2016 | Higher Education; health sciences. |
| 4 | Cheng et al, 2019. | 2000-2016 | Secondary and Higher Education; all disciplines. |
| 5 | Gillette et al, 2018. | 2000-2017 | Higher Education; pharmacy. |
| 6 | Hew et al, 2021. | to July 2019 | Primary, Secondary and Higher Education; all disciplines. |
| 7 | Låg, and Sæle, 2019. | to May 2017 | Primary, Secondary and Higher Education; all disciplines. |
| 8 | Lo and Hew, 2019. | 2008-2017 | Secondary and Higher Education; engineering. |
| 9 | Van Alten et al, 2019. | 2006-2016 | Secondary and Higher Education; all disciplines. |

**Table 3.1 Meta-Analyses Examined.**

The majority of those meta-analyses listed in the table based their analysis mainly on achievement-based outcomes such as final course examination scores, although some also included measures such as “meta-cognitive skills, critical thinking, and teamwork” *(Bredow et al, p. 886)*. Some encompassed the use of flipped teaching across all levels of the educational spectrum, while others limited their scope to one education level only (say, HE), or to specific subject areas, such as health sciences (including nursing), mathematics, engineering, and second-language learning (*Hew et al, 2021)*. Of the meta-analyses that I examined, only one was found that reported exclusively on the use of FCs in engineering: this was in the aforementioned study by Lo and Hew, who analysed 29 such studies *(Lo and Hew, 2019)*. A second review by Karabulut-Ilgu and colleagues also examined, exclusively, FC studies in engineering *(Karabulut-Ilgu et al, 2018)*. While this second review proved to be useful, and is quoted from in later sections, it should be noted that it was a *systematic* review, rather than a meta-analytic (i.e., a statistics-based) one.

Although the analyses and reviews I examined used different research questions and reporting styles, they all shared a basic set of common criteria, such as only including articles published in peer reviewed journals or conference proceedings, and drawn from within a specific time range. In some cases, the selection criteria were more stringent. For example, some only included studies that compared an ‘experimental' group with a ‘control’ group, while others excluded ones containing student self-report data *(Lo and Hew, 2019, p. 4)*. Some only included studies where the FC met their definition of flipped teaching. Other criteria that narrowed down article selection included language, for example specifying English-only articles.

As might be expected, there were occasional overlaps in the articles selected by meta-analyses and reviews, especially when undertaken in the same subject area. This occurred with the aforementioned meta-analysis and review conducted by Lo and Hew, and Karabulut-Ilgu and colleagues, respectively.

### 3.3.1 A Meta-Analysis of the Meta-Analyses

In 2021, Hew and colleagues produced a meta-analysis of 19 FC meta-analyses. These covered a range of different subjects (not just engineering) across different education levels (*Hew et al, 2021)*. Their report criticised some meta-analyses on methodological grounds and questioned the basis on which their evidence was synthesised. For example, in some of the studies examined, they claimed there was inadequate assessment of publication bias, or of adequately controlling for factors that might affect statistical outcomes. The issue of article selection overlap between meta-analyses was specifically noted, which, in some cases, was considerable. Although this might be expected from shared selection criteria, it implies that individual analyses are not as independently informative as might be thought on a first reading. Regarding article exclusion criteria, they noted that “The most common exclusion criterion was elimination of primary studies due to insufficient information to calculate effect sizes.“ *(Ibid., p. 10).*

Taken together, the concerns reported by Hew et al raise questions regarding the credibility and trustworthiness of the results contained in the meta-analyses that they examined. Despite this however, they concluded that overall, there *is* empirical evidence in favour of the FC compared to traditional classrooms.

In the following sections, I draw further on Hew et al's meta-analysis, and also that of Lo and Hew, to examine the current state of FC research in general and in engineering education specifically. I also draw on the systematic review produced by Karabulut-Ilgu and colleagues. It should be noted that given the difference in the types of analysis undertaken by Lo and Hew, and Karabulut-Ilgu et al, the reporting of their results was also quite different. Lo and Hew's analysis was mainly a quantitative assessment, in which they examined their data for causal factors for effects, using what are termed 'moderator' variables. In contrast, Karabulut-Ilgu and colleagues' analysis was based mainly on a qualitative synthesis of their data. It should be further noted that (as might be expected), although Lo and Hew's analysis was included as one of the 19 examined by Hew et al, that of Karabulut-Ilgu and colleagues was not. Finally, note that because these meta-analyses were published before the global pandemic, they do not include reports of fully online FCs, which have begun to appear recently.

In the next section I address my first review research question (RRQ1) by reporting on the picture of FC research in general, and on engineering education in particular.

## 3.4 RRQ1

**What is the recent evidence for the claimed advantages and benefits for learners in FCs in general, and in engineering education in particular?**

In addressing this RRQ, I begin by reporting that within the flipped teaching 'landscape' there is a wide diversity of FC implementations. This is largely due to ambiguities in the term 'Flipped Classroom', which as noted in chapter 2, lacks a rigorous definition. I then report on the overall results of studies comparing FCs with traditional classrooms, with a particular focus on engineering subjects. After examining the typical content of engineering FCs, I report on their cited benefits and advantages, and delve deeper into the results. Finally, I briefly examine the claim that it is really the use of active learning methods in the classroom that is responsible for the apparent benefits of flipped teaching.

### 3.4.1 Flipped Classrooms and Flipped Teaching

As mentioned, there are nowadays hundreds of published studies of FCs. On close examination, it is clear that while each FC is constructed according to the general principles outlined in chapter 2, there are differences in how each is implemented. This appears to be due in part to the ambiguity associated with the very term ‘Flipped Classroom’. The same can be said for closely related terms such as “flipped learning” or “flipped teaching”. Although most studies attempt to define what is meant by them, none do so in ways that may be regarded as rigorous and unambiguous. Instead, one finds loose, working definitions that refer, in general, to each term being understood as either a ‘teaching approach’, or an ‘instructional strategy’, or a sub-type of blended learning, or a pedagogical style, or similar.

In the absence of a rigorous definition for a FC, it is not surprising that there also appears to be no widely agreed ‘prescription’ for how one should be designed and implemented. This has given rise to differences in the interpretation of flipped teaching that are reflected in the literature. For example, there are some researchers who specify that unless video lectures are used for the pre-class instructional materials, it's not really a FC *(Bishop J.L, Verleger M.A., 2013)*. However, others disagree, and there are examples in the literature that use pre-class learning materials in other formats, such as PowerPoint slides or pdf files *(Lo and Hew, 2019)*. It is apparent that although teachers structure their FCs according to the aforementioned general principles i.e., with pre-class and in-class phases, they tailor them according to local needs. While there may be nothing surprising in that, it does mean that one finds a diverse universe of FCs, each of which might have a different mix of pre-class and in-class strategies. As mentioned, there are also purely online implementations nowadays, with noticeable increases in this type of FC during the pandemic *(Stohr et al, 2020)*.

### 3.4.2 The Overall Picture

The research questions associated with most FC research are typically centred around comparisons of student performance and satisfaction with traditional classrooms. In general, performance and satisfaction are measured using common quantitative data, such as exam scores and course survey evaluation results *(Karabulut-Ilgu, 2018, Ibid.)*. To a lesser extent, qualitative data are also used, typically obtained from interviews, classroom observations and student self-reporting *(Ibid.)*. However, as will be detailed soon, the results of FC studies paint a somewhat mixed picture: although many describe learning gains and positive student evaluations of flipped learning when compared to traditional classrooms, others indicate otherwise, with some even reporting that the FC impairs student learning. These mixed results are somewhat similar to what I found in my 2016 literature review. They add to the uncertainty regarding the claimed benefits of flipped learning, a debate that continues today. Despite this however, as mentioned, overall the evidence does appear to favour flipped teaching. Cautioning that the mean effect sizes varied between “weak” and “strong”, Hew et al claim that the FC “does increase learner cognitive and behavioral outcomes more than [the] non-flipped classroom” *(Hew et al, Ibid., p. 12)*. The term “cognitive outcomes” refers here, to subject knowledge assessed by tests and exams, while “behavioural outcomes” refers to competency in performing tasks *(Ibid.)*. The researchers also noted that there appears to be a greater effect size with smaller participant numbers *(Ibid., p. 8)*.

Hew et al also examined learner perceived satisfaction, in this case reporting relatively small effect sizes, suggesting that flipped learning has only a slight effect on this measure. Speculating, they claim that “This is possibly due to students’ unhappiness about the perceived increase in workload in flipped learning” *(Ibid., p. 6)*.

The conclusion that overall, the evidence favours the FC is mirrored in the case of engineering education: both Lo and Hew, and Karabulut-Ilgu and colleagues each concluded that there was a small effect size in favour of the FC over traditional classrooms.

### 3.4.3 The Content of FC Learning Activities

In their meta-analysis, Lo and Hew report that the content of pre-class, in-class and (optional) post-class activities in engineering FCs follow expected patterns *(Lo and Hew, 2019, p. 3)*. Thus, as expected, video lectures, text-based materials, and online quizzes are commonly used in pre-class activities. In some FCs, students' performances in these quizzes were used by teachers to monitor their mastery of course content.

In-class activities typically involve active learning techniques, including individual and small-group activities such as collaborative problem-solving (both in classrooms and laboratories). Some also include reviews of pre-class materials and quizzes with feedback; and sometimes a short lecture on new material is added to the mix.

Post-class activities, when used, typically involved the use of an online quiz and/or exercise problems.

### 3.4.4 Cited Benefits and Advantages of the Engineering FC

According to Karabulut-Ilgu and colleagues, one of the most highly cited advantages claimed for the FC in general, is the ability for learners to flexibly access course materials to fit around their personal circumstances. The ability of learners to learn collaboratively in the presence of the lecturer/teacher was also cited as an advantage; most learners appear to enjoy negotiating goals and meanings with their peers *(Karabulut-Ilgu et al, p. 404)*. In general, learners appear to willingly participate in interactive, higher-order activities. This is corroborated to an extent by Lo and Hew, who noted in their analysis, that "self-paced learning and more problem-solving activities were the two most frequently reported benefits that promoted student learning" *(Lo and Hew, 2019, p. 1)*.

Learners' study behaviour was also reported as a positive benefit of flipped learning. Karabulut-Ilgu et al stated that some individual studies claimed that students developed better study habits when compared to those in traditional classrooms

*(Karabulut-Ilgu et al, p. 404)*. The authors also noted that classroom attendance was sometimes claimed to be generally better; although not all studies found this, with some reporting no difference, or even decreased attendance. A similar picture emerged for student engagement, with some studies reporting increases, while others claiming no change, or even reduced engagement. This variability was confirmed by all the meta-analyses and reviews that I examined, and correspond with the conclusions reached in my earlier 2016 review.

### 3.4.5 Digging Deeper into the Data

Given the finding that overall, learners' performance is improved in FCs compared to non-flipped classrooms, Lo and Hew attempted to discern which particular learning activities might be responsible, and of these which might be the most significant. Subjecting their data to further quantitative analysis, they examined several moderator variables each representing categories of activities in the pre-class, in-class and post-class phases.

For pre-class activities, they reported that no significance appeared to be attached to the type of activity undertaken. For example, it did not appear to matter whether text-based materials were used instead of video-based ones, or whether online quizzes were included, or not. Combinations of these activity types were also probed, but no effect was apparent *(Lo and Hew, 2019, p. 9)*.

Regarding in-class learning, the study data was examined for the effects of the following five activities: a lecture on new material, a short review lecture given at the start of class that reviewed pre-class materials, a quiz with feedback, individual learning tasks, and small-group learning tasks. Again, these activities were investigated statistically, both individually and in combination. When examined individually, only the short review lecture was, by itself, found to produce a "significantly higher intervention effect than when no review was given" *(Ibid., p. 9)*. When combinations of these activities were examined, it was found that when a short review lecture was coupled with individual and small-group learning activities, then this combination was found to offer "the best method for improving student achievement" *(Ibid., p. 10)*. Although of less statistical strength, the addition of a quiz to this combination was also shown to be beneficial; as was the combination of a lecture on new material with individual learning tasks.

A finding of further note was that by themselves, different combinations of individual and small-group tasks appeared to be of little significance. For example, “individual tasks only”, or “small-group tasks only”, or a mix of both types, appeared to have no effect *(Ibid., p. 10)*.

Lo and Hew also examined their data for the effects of instructor equivalence (i.e., testing whether it mattered if the same, or if different instructors taught the FC and non-flipped classes (including the number of face-to-face classroom hours in each type). Students’ initial knowledge (i.e., testing if students’ prior/initial subject knowledge had any significance), and country of origin, were also examined. There appeared to be no significant difference in terms of these variables, except for the category ‘students’ country of origin’, where a slightly greater effect was reported for non-US FC studies (a minority of the total examined). In reporting this however, Lo and Hew cautioned against any generalisation due to the sometimes small number of studies per moderator variable category, and also the lack of detail provided in some studies, hindering analysis.

Summing up, Lo and Hew concluded that benefits ascribed to engineering FCs appear to be enhanced the most by in-class activities that combine a review of pre-class materials with individual tasks and small-group activities. This would appear to be a significant result, which may have implications for future practice. Clearly, the inclusion of a review at the start of class strengthens the connection between pre-class and in-class learning. In addition, it provides opportunities for teachers to answer students’ questions regarding the pre-class learning content. If a quiz is also used to assess learners’ level of understanding, feedback can be provided and teachers can make last-minute teaching adjustments, if required.

The effect of in-class learning activities was also examined by Låg and Sæle in their meta-analysis of 272 FC studies *(Låg and Sæle, 2019)*. Låg and Sæle’s data set was drawn from studies in several subjects, not just engineering. Supporting Lo and Hew’s findings, they also concluded that the inclusion of a review activity appears to help, reporting that testing student preparation by quizzing students at the start of classroom sessions yielded a higher effect size. Commenting on the result, Låg and Sæle noted that it may be explained partly as “a consequence of the indirect, motivational influence of testing, affecting students’ willingness to engage in preparatory learning activities” *(Ibid., p. 12)*. Their result is corroborated by Hew et al in their (more general) meta-analysis, who also noted that the inclusion of formative assessments resulted in a positive effect in favour of FCs. By way of further explanation, Hew et al suggest that such assessments are typically accompanied by feedback. Quoting from Hattie and Timperley, who conducted extensive studies of feedback in learning, they speculate that “feedback is also a key mechanism underpinning the effectiveness of the flipped classroom.“ *(Ibid., p. 8; Hattie & Timperley, 2007)*.

Therefore, given all these results, it would appear that the inclusion of review lectures and formative assessments, coupled with individual and small-group learning tasks, contributes positively to learning in FCs. One should be cautious in generalising these conclusions, however, as there appears to be some overlap in the studies examined by Lo and Hew and by Låg and Sæle. Furthermore, Låg and Sæle’s meta-analysis is included in Hew et al’s dataset, thereby partly explaining the latter’s corroboration of the former.

### 3.4.6 Active Learning

As mentioned in Chapter 2, it has been suggested that the improvements in learner performance seen in FCs may be attributable to the use of active learning techniques in the classroom. The evidence just discussed would appear to support this claim. It is also supported by a sizable body of evidence that suggests that the use of active learning methods in classrooms in general, benefits learners *(Hake R (1998), Crouch and Mazur, 2001; Knight and Wood, 2005, Michael, 2006, Freeman et al, 2014)*. In an attempt to test the differential effect of active learning, Jensen and colleagues compared a flipped classroom with non-flipped classroom, using a quasi-experimental design in which active techniques were used in both. They claimed that after controlling for the varying effect of the instructors, and “for as many of the other potentially influential variables as possible“, no differences were found either in learner performance or satisfaction with respect to the course *(Jensen et al, 2015)*.

This appears to be a significant finding, especially considering that teachers typically invest considerable time and resources into converting traditional classes to the flipped format. However, despite the fact that Jensen et al's study was published in 2015, searches revealed only a handful of similar studies since. These tended to agree with Jensen. This was the case, for example, in Leatherman and Cleveland's study, which compared students' performance in a non-flipped course that included a "significant amount of active learning", with a flipped version "with the same content" *(Leatherman and Cleveland, 2020, p. 328)*. A similar finding was reported by Mennella, in a 2016 study comparing two sections of a sophomore (i.e., second-year) genetics course that were taught in parallel. In the study, one section was flipped and the other was taught using a traditional approach, but with active learning methods used in each.

The question being considered here is an important one, and certainly worthy of further investigation. It is surprising that only a limited number of similar studies to that of Jensen et al appears to be available. One possible reason may be that setting up such studies could be difficult to achieve for practical reasons. Carefully controlling the 'potentially influential variables' that Jensen and colleagues referred to, which include for example, teacher equivalence, different formative and summative assessments, and/or controlling for selection bias by students who are able to choose which class to attend, is understandably challenging.

### 3.4.7 Summary

Summing up, the previous sections have surveyed the current state of FC research, both in engineering education, and in general, until at least relatively recently. It is clear that there is much more detail and complexity to the landscape than when I conducted my literature review in 2016. Compared to then, there is now a substantial amount of evidence supporting the claim that the FC, both in general and in engineering education, offers advantages regarding learner performance compared to traditional classrooms. Some quantitative analyses appear to show that these

benefits may be enhanced by using in-class learning activities that combine a short review lecture and/or a quiz, with individual and small-group learning tasks.
A further noticeable difference with 2016, is that FC research has moved well beyond comparisons with traditional classrooms: there are nowadays many more studies whose goal is to examine specifically how students learn within FCs, including the challenges and problems they face. One of these problems is discussed in the next section, where I address my next RRQ.

## 3.5 RRQ2

**How have researchers approached the problems for teaching and learning when learners don't engage with pre-class learning activities in FCs?**

Before addressing this question directly, I begin this section with a brief review of the general challenges faced by learners within FCs. Then, after noting the surprisingly high percentages of cohorts that fail to complete the preparatory learning activities, I discuss how this problem has been linked by researchers to questions of learner engagement and self-regulation. Finally, given that the FC is recognised as a type of Blended Learning (BL), I discuss how the problem is reported in BL literature.

### 3.5.1 Common Challenges for Learners in FCs

The challenges experienced by learners in FCs are typically reflected in their complaints, which arise with all aspects of FCs in both the pre-class and in-class phases. Complaints and criticisms are reported in many FC studies, and generally correspond with what I learned in my 2016 review. As then, there are complaints about increased workloads before and during class, the length of videos and their content, and difficulties in transitioning and adapting to the flipped format from traditional instructional strategies *(Seery M.K., 2015, Cheng et al, 2019, Hew et al, 2021)*. Complaints commonly voiced by learners include:

- Finding the time necessary to undertake the designated pre-class preparation.
- An inability to question the teacher during video lectures.

- Poor implementations of in-class group learning activities.
- Being ‘forced’ to work in small-group activities rather than individual ones.

These, and other criticisms and complaints, are also noted in Low and Hew’s, and Karabulut-Ilgu and colleagues’ analyses of engineering FCs. There are noticeably many associated with pre-class learning activities in particular, reflecting difficulties that learners have in engaging with preparatory tasks. As noted previously, when students don’t engage with these tasks, it undermines the very premise upon which flipped teaching is predicated. Furthermore, this problem is reported in significant numbers of studies. For example, in their systematic review of 71 FC studies (which were mostly drawn from HE and covered multiple disciplines), Akçayır and Akçayır stated that “The most commonly reported problem is students' limited preparation before class time” *(Akçayır & Akçayır, 2018, p. 341)*. This is supported by Hew et al, who, in their meta-analysis, identified studies claiming that high percentages of cohorts undertook little or no preparation. For example, one reported that only 27.7% did any preparation, while another stated that 39% did not do any preparation beforehand. Another reported that “more than 70% skipped the pre-class learning activities” *(Hew et al, 2021, p. 2)*.

The problem of learners being poorly prepared before class was also mentioned in both Low and Hew’s and Karabulut-Ilgu and colleagues’ analyses. This problem, which has been linked to factors underlying learner engagement, is discussed further in the next section.

### 3.5.2 Preparatory Activities and Learner Engagement

Teachers know that learner engagement is critical in determining learning outcomes. As O’Flaherty and Phillips have observed “students who are most deeply engaged will reflect, question, conjecture, evaluate and make connection[s] between ideas. In contrast students who are disengaged appear to take a surface approach to learning by copying out notes, focusing on fragmented facts and jumping to conclusions.” *(O'Flaherty and Phillips, 2015, p. 85)*. In FCs, of course it is desirable for learners to be engaged in all learning activities, in both pre-class *and* in-class phases. Arguably, however, it is the pre-class activities that are the most significant, for the reasons discussed. The consequences of little or no engagement can be particularly serious for teachers, potentially requiring a re-teach of materials, and clearly undermining the whole flipped approach. Furthermore, when learners do not fully engage with the preparatory tasks they may choose to not attend class at all. This was the case for several students that I interviewed in my own research, as I report later on.

Two questions that naturally arise at this point are: why, if the evidence suggests that learners benefit academically from FCs, do they appear to do so despite reported low levels of pre-class preparation? Secondly, what *are* the reasons behind learners' disengagement?

The first question does not appear to have been addressed directly in the literature, but it may be that limited/no pre-class preparation by learners is mitigated to an extent by teachers' actions in providing additional and/or different forms of learning support in both the synchronous and asynchronous components. For example, and as already discussed, the provision of short review lectures and/or quizzes at the start of class appears to be effective for FCs. For learners who choose to not attend in-class teaching, the 'loss' might be mitigated in part by teachers recording the sessions and making them available afterwards. To mitigate complaints about difficulties in learning from videos at home, a common approach is to attempt to make them more interactive and engaging through the use of in-video quizzes. These were all strategies that I and many of my colleagues used, to varying extents. Other forms of learning support included providing additional online 'surgeries', as well as answering questions by email. Pre-exam 'review' video lectures were also sometimes provided. It is also, of course, not unknown for teachers to associate 'rewards' with the preparatory activities, for example by awarding additional marks for their completion. There are also reports in the literature of teachers supporting students' while studying at home by utilising discussion boards, and/or SMS text messaging *(Fautch J. M., 2015)*. These are all possible reasons for the apparent success of FCs in the face of reported low levels of pre-class engagement by students.

The second question, (i.e., the reasons behind learners' disengagement with pre-class learning) has, by contrast, been considered in depth by some researchers.

For example, in their investigation into the factors affecting learner engagement in FCs, Lee et al examined the issues from the behavioural, cognitive and affective aspects *(Lee et al, 2022)*. They found that “For content and learning-related outcomes, behavioral engagement, such as learners’ persistent effort, mattered most”, signalling the importance of learners’ self-regulation *(Ibid., p. 224)*. Sun et al examined the role of prior domain knowledge, self-efficacy, and self-directed learning strategies in determining learning outcomes *(Sun et al, 2018)*. Basing their analysis on self-regulated learning theory, they found that self-efficacy and “the use of help seeking strategies were all significantly positively related with academic achievement in both pre- and in-class learning environments.” *(Ibid., p. 41)*. Further research has also identified the significance of self-regulation in learning, and is discussed in the next section.

### 3.5.3 Learner Self-Regulation and Engagement

The connections between learners’ engagement and their self-regulation in HE has been investigated by several researchers. It is widely acknowledged that in transitioning from secondary to tertiary education, students are expected to increasingly self-regulate their learning, and learner self-regulation is clearly of importance to the success of flipped learning. As Broadbent has noted, “Self-regulated learners are motivated, persistent, manage their time effectively, and seek assistance when necessary” *(Broadbent, 2017, p. 24)*.

Be that as it may, not all learners exhibit good self-regulation, and the need to provide them with support has long been recognised by teachers. Eggers et al conducted a systematic review of the use of self-regulation strategies in HE. They reported that the focus of most studies is on the use of metacognitive strategies to support learners *(Eggers et al, 2021)*. Such strategies centre around planning, monitoring and evaluation. They include, for example, helping learners to create a plan for their learning objectives, and monitoring and evaluating progress made towards meeting them. As a specific example, Lai and Hwang investigated the use of a self-regulation monitoring system in supporting FC learners *(Lai and Hwang, 2016)*. The system allowed students to set goals and self-evaluate their progress, which was also monitored by teachers. A quasi-experimental design was used to evaluate academic performance in a ‘regular’ FC compared to a FC using the monitoring system. Their results showed that learning achievements were greater when the monitoring system was used, than without. The authors also claimed that learners using the monitoring system exhibited higher self-efficacy than those in the ‘regular’ FC.

For a long time, researchers have explored the theoretical basis of learner self-regulation. In the literature, one can find several papers that discuss different theoretical models. According to Panadero & Tapia, most theories integrate or incorporate the effects of cognition, metacognition, motivation, and emotion *(Panadero & Tapia, 2014).* For example, one frequently-cited model is that produced by Pintrich, which contains a comprehensive set of constructs for assessing self-regulatory strategies. In Pintrichs’ model, cognition is said to refer to techniques to retain knowledge such as rehearsing, note-taking, evaluation, time-management and help-seeking, while metacognition refers to strategies to support cognition such as setting goals and targets and self-monitoring *(Pintrich 1991).* There is substantial evidence that the use of such self-regulation techniques and strategies is correlated with academic success, generally. In a meta-analysis conducted in 2012, Richardson and colleagues found that they were positively correlated with student grades *(Richardson et al, 2012)*.

### 3.5.4 Blended Learning Studies

Given that the FC is considered to be a type of Blended Learning (BL), searches were made to ascertain if, and how, problems of learner engagement and self-regulation were also reported in BL literature. Results revealed that such problems are well-recognised in BL *(Anthonysamy et al, 2020; Boelens et al, 2017; Cho and Shen, 2013; Grunschel et al, 2016; Rasheed et al, 2020; Zhu and Yates, 2016)*. Given that the focus here is on the question of pre-class engagement, the online portion of BL was of particular interest. To clarify, ‘online’ in this context means students carrying out their studies online, at their own pace independently of the teacher/instructor.

Evidence was found in the literature that specific attention has, indeed, been given to the online component. For example, in their systematic review of BL, Rasheed and colleagues directly addressed “challenges in the online component” *(Rasheed et al, 2020).* Their large-scale review (nearly 600 studies reviewed) examined challenges experienced by learners, teachers and institutions. Several factors contributing to deficiencies in learner self-regulation were identified, including motivation and motivational-related factors such as procrastination and poor time management skills *(Ibid.)*.

The relationships between learner engagement, self-regulation and motivation are well-established, and have been investigated by several researchers *(for example, see Artino & Stephens, 2009; Dabbagh and Kitsantas, 2004; Greene and Azevedo, 2007)*. The general conclusion appears to align with what might be expected: that motivated learners exhibit higher levels of self-regulation that keep them on task, continuously monitor their learning goals, standards and strategies, and maintain positive beliefs about their capabilities *(Artino & Stephens, 2009)*.

### 3.5.5 Summary

In summary, the literature shows that alarmingly high percentages of cohorts fail to complete the preparatory learning activities in FCs. It is a problem that has also been reported in studies of BL environments, especially in the online component of BL. The impact of this on teachers and learners alike is potentially considerable, with significant consequences to corresponding in-class learning activities. The problem is also clearly linked to questions of learner self-regulation and motivation. The apparent success of flipped teaching, despite reported low levels of pre-class preparation, may be explained by a range of mitigating actions taken by teachers to support learners.

In the next section I address my third RRQ, which concerns the use of theoretical approaches in analyses of FCs.

## 3.6 RRQ3

**Which theoretical approaches have been used in recent FC research? In particular, how has AT been used as a framework to analyse FCs from learners' perspectives?**

A major finding from my 2016 review was that there were very few reports that presented an analysis of the FC in HE using a theoretical or conceptual framework. In fact, only three were found from a set of sixty four papers that were examined in detail; of these three, only one could really be said to have undertaken an in-depth theoretical analysis (this was a study by Strayer, which is discussed later in this section). The two other reports -one by Lage and colleagues, and a second by Abeysekera and Dawson- used theory only loosely (at least compared to Strayer). Lage and colleagues' study focussed on adapting teaching to the different learning styles reported by their students *(Lage, M. J., Platt, G. J.,Treglia, M., 2000)* . In contrast, Abeysekera and Dawson's paper (which was referenced in Chapter 2), was more speculative, and argued for a propositional agenda that Self-Determination Theory and Cognitive Load Theory might be useful in understanding FCs *(Abeysekera L, Dawson P., 2015)*.

In the next section I discuss the findings from my more recent examination of the literature for studies that use theoretical frameworks to analyse FCs. I also report on FC studies that used AT as an analytical framework.

### 3.6.1 Use of Theoretical Frameworks

As mentioned above, in my literature review of 2016, I identified only a small number of articles reporting research that used theoretical approaches in the design and/or analysis of FCs. Unfortunately, the number of such articles is still relatively small today, including engineering education in particular. As Karabulut-Ilgu and colleagues noted in their review:

> “There is a paucity of reporting regarding theoretical or conceptual frameworks guiding the development and evaluation of the flipped approach.” *(Karabulut-Ilgu et al, 2018, p. 401)*

Of 62 studies they reviewed, “only 13 referred to a theoretical or conceptual framework.” *(Ibid.)*. I examined the 13 studies referred to above and found that they mostly contained only passing references to a theoretical framework, rather than an extended discussion of one. The frameworks that were mentioned in any detail were: Distance learning transactional theory (due to Moore), Thayer Method (a US military teaching methodology), Socio-constructivist theory, and Self-directed Learning theory *(Chen, Y., Wang, Y., Kinshuk, Chen, N-S., 2014; Chetcuti, S.C., Thomas, H.J., Pafford, B.J., 2014; Redekopp, M. W., & Ragusa, G. (2013); Rutkowski, J. (2014))*. In each case, the underlying theoretical issues were discussed, but only to a limited extent.

But the picture is not as ‘bleak’ as perhaps implied by Karabulut-Ilgu et al’s observations. As noted in the previous section, researchers have examined FCs using self-regulation theory. Furthermore, socio-constructivism, which is regarded as being ‘close’ to Activity Theory, has also been used by some researchers. For example, Steen-Utheim and Foldnes used socio-constructivism in a small-scale FC study in HE *(Steen-Utheim, A.T. and Foldnes, N., 2018).* Socio-constructivism shares similarities with Activity Theory, in that knowledge is socially constructed and that learning develops from social interaction, engagement and participation; this is a premise, also, of Vygotskian socio-cultural theory.

There is also research that has explored the use of theories of motivation in FCs. For example, Sergis and colleagues used Self-Determination Theory (SDT) to investigate the experiences of students in a study using three FCs *(Sergis, et al, 2017)*. Ha et al also used SDT to investigate the learning experiences of students and teachers in a FC *(Ha, et al, 2019)*. These studies were each influenced, in part, by Abeysekera and Dawson's highly cited paper, referenced in Chapter 2 *(Abeysekera L, Dawson P., 2015)*. In both cases, the researchers claimed that the theory explained the results they observed, i.e. that learners’ motivation appears to be sustained through satisfying their needs for autonomy, competence and relatedness (see Section 2.2.3).

One of the most highly cited detailed studies of a FC is that due to Strayer, who compared a flipped statistics course with a non-flipped version *(Strayer, 2007)*. As this was examined in detail in my earlier (2016) review, only a summary is given here. Although his approach was influenced by Activity Theory (AT), Strayer's focus was the effect of the FC on the learning environment, as experienced by his study participants. The research examined the role of contradictions in determining learners' adaptation to the environment. In his analysis, Strayer used a concept he called "comfortability with learning activity" to help understand his students' approach to learning activities, linking it to their mind-set and willingness to engage with and undertake them. Thus, a student who was uncomfortable with any given learning task is more likely to exhibit a negative mind-set towards undertaking it. Strayer argued that students' approach and mind-set are critical determinants in whether they would successfully adapt to, and complete, the set learning activities. This theoretical framework, he claimed, helped him understand why some study participants were more resistant to the FC than others.

In the years since Strayer's work appeared, further detailed studies have been published, including some that used AT. Since my primary research interest is the use of AT as an analytical framework, the next section discusses these.

### 3.6.2 Activity Theory Studies

A broad search (i.e., one not limited to the FC) for the use of AT in HE, yielded a large number of results. They show that AT has been used as an analytical framework in studies in diverse fields such as teacher education, science education, engineering education, language learning, and expansive learning *(Wilson, V., 2014; Kahveci et al, 2008; Cawood, K.W., 2021; Miles, R., 2020; Engeström Y, 2015; Moffitt, P. and Bligh, B., 2021).* A common approach in such studies is to examine the tensions and contradictions experienced by the study participants. The analysis is typically carried out using Engestrom's interpretation of AT, where the Activity

System (the ‘unit of analysis’) encompasses the learning environment in which the subject is taught. A major objective is then to identify the dialectical contradictions in the system and use their explanatory power to understand the character and dynamics of the interactions within and between say, Subject, Rules, Community, Tools and Object.

As an example, Barab and colleagues’ used AT to investigate contradictions in an introductory HE astronomy course *(Barab et al, 2002)*. In the course, (which was not organised as a FC) lectures were replaced with collaborative, project-based learning activities. These activities were based on the use of a Virtual Reality (VR) system to assist in learning, by modelling various astronomical phenomena. Engestrom’s triangular diagrams were used to model the learning environment, in which the study participants built a number of 3-dimensional VR models. The dialectical contradictions they identified (which they labelled ‘systemic tensions’) are reproduced in Figure 3.2.

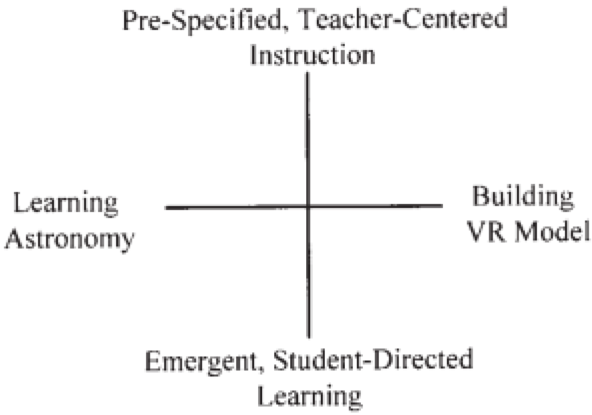


Figure 3.2 Contradictions/’Systemic Tensions’ in Barab et al’s Study *(reproduced from Ibid., p. 86)*

In Figure 3.2 the contradictions are represented along the north-south and east-west axes, where each represents tensions between opposing goals. The north-south contradiction (which the authors termed ‘Teacher Guidance-Student Autonomy’) refers to the contradiction between the teacher retaining close control of learning activities, and the expectation that the student is expected to exhibit greater autonomy over them. This particular contradiction is similar to one that I identified in the previous chapter, labelled ‘Teacher-led v Learner-centred learning’. The east-west axis refers to the contradiction that time taken learning how to build the VR models negatively impacts the actual learning of astronomy.

The researchers suggested that these contradictions should be understood as tensions which, as they enter the activity system “become the moving force behind disturbances and innovations and eventually drive the system to change and develop” *(Barab et al, 2002, p. 80)*. Following Wenger, they recommended that the design goal should then be “to leverage the dynamics of system dualities and not to treat them as polar opposites or to eliminate one side or the other.” *(Wenger, 1998; Ibid.)*. This implies adopting a strategy designed to balance the influence of tensions where appropriate, to support the evolution of “activity systems designed to support learning” *(Ibid., p. 104)*. In their study, they claimed this was achieved by “introducing new tools, modifying rules and expectations, or modifying divisions of labor to facilitate the production of new outcomes.” *(Ibid., p. 103)*.

In their analysis, the authors broke down learning activities into nested ‘micro-units’, arguing that AT can be used at both the ‘macro’ and ‘micro’ levels. For an example of the latter, in portions of their analysis, the VR model developed by learners in one task (this being the Object, in AT terms) became a Tool in building the next. Although this might appear to be a practical application of Engestrom’s diagrams, it is arguable whether AT was meant to be used at this scale. A further result that emerged from the study was that the tensions associated with the contradiction ‘Learning astronomy vs Building VR Model’ did not always play out resulting in an “either or” outcome, as it might suggest. As the researchers noted, “Results suggested that instead of detracting from the emergence of an activity system that supported learning astronomy, model-building actions frequently coevolved with (were the same as) astronomy-learning actions” *(Ibid., p 77)*. In passing, one might question whether this is a dialectical contradiction at all: all activity systems require the knowledgeable use of tools, and there will inevitably be a period of adjustment where the Subject acquires the necessary skill(s). In conclusion, this second ‘contradiction’ might be better characterised as a conflict (that was overcome). That is not to say that the associated tensions did not provide any impetus for the evolution of the activity system in this case.

As a second illustrative example, Stouraitis and colleagues investigated the tensions and conflicts experienced by teachers when introducing new curricula materials to their students *(Stouraitis K, Potari D, Skott J. 2017)*. A major focus for the study was in identifying contradictions -often presenting as 'conflictual' disagreements- from recorded dialogues between teachers in two different primary schools. The contradictions were termed 'dialectical oppositions', or 'DO's, by the authors after Ilyenkov *(Ilyenkov, p. 185)*. In total, 141 DOs were identified and classified according to whether they were related to the epistemological dimensions of mathematics learning, or related to "general pedagogy" *(Ibid. p. 211)*. DOs related to mathematics learning were further classified into groups such as "structure vs process", or "conceptual understanding vs. procedural fluency" *(Ibid., p. 211)*. DOs relating to "general pedagogy" were classified into three groups: "individual-collective", "quality-quantity", and "teacher's guidance-student autonomy". As a point of note, the first and third of these groups correspond to contradictions that I hypothesised would be accentuated in FCs, as I discussed in Chapter 2. Stouraitis and colleagues reported that when the teachers dealt with the contradictions/DOs, they did so either by attempting to synthesise the opposing tensions, or adopting one and distancing themselves from the other, or finally by accepting that both are relevant *(Ibid., p. 211)*.

The examples just discussed are two of several that were revealed after searching for studies that used AT as an analytical framework in HE. However, the majority do not use FCs. If one narrows the search to include FC-only studies, the number of results is dramatically reduced. In fact only a handful could be found (none of which, unfortunately, concerned purely engineering FCs). One of the most detailed is a study of a flipped mathematics classroom by Fredriksen and Hadjerrouit, and this is discussed next.

### 3.6.3 Activity Theoretical Study of a Mathematics FC

Fredriksen and Hadjerrouit used AT to investigate tensions and contradictions in a flipped mathematics classroom in an engineering-related programme in HE *(Fredriksen & Hadjerrouit, 2020)*. The research consisted of a sequence of two studies, involving 20-25 student participants. Initially, a pilot study was undertaken, and data was collected via a survey instrument. This then informed a more elaborate follow-up study, in which both in-class and out-of-class data was collected. Overall, the combined studies provided a useful example of applying AT as a theoretical framework to analyse a FC.

In the follow-up study, the researchers used an ethnographic approach in the data collection process, which was augmented by semi-structured interviews and filmed sessions of classroom activities. In the study, one of the researchers acted as both teacher (and thus an "insider") and observer (i.e., an "outsider"). The 'blind spots' that might occur as a result of this participative role, and the possibility that students might be reluctant to divulge their true feelings to their teacher, were both acknowledged, however no mitigation strategy was reported.

In the analysis, the researchers used Engestrom's classification of contradictions, i.e., 'primary', 'secondary', 'tertiary' and 'quaternary' (see section 2.3.3, Chapter 2). This classification was used as a framework with which to examine the tensions experienced by the study participants. The authors identified tensions based on criteria such as disagreements among the students, disagreements between a student and the pedagogical structures, and/or rules and objectives. Some tensions were considered not to represent contradictions, as for example, when participants complained about lacking "mathematics fluency", or when "questioning the purpose of learning mathematics as a topic in their education" *(Ibid., p. 14)*. The report claimed to find a total of 158 tensions which were classified into what were termed "Tension Categories", or "TCs". A total of 26 TCs were found, of which some were based on an open-coding approach, while the remainder were categories hypothesised to exist by the researchers *(Ibid., p. 8)*.

Finally, an AT theoretical framework was used to analyse and interpret the TCs to identify the dialectical contradictions. The TCs were classified according to which contradiction they represented, as follows: *(Ibid, p. 11-12)*:

- Conceptual-Procedural.
- Teacher Guidance-Student Autonomy.
- Individual-collective.

Taking each in turn, the contradiction ‘Conceptual-procedural’ is similar to that described by Stouraitis and colleagues as ‘conceptual understanding vs. procedural fluency‘, i.e., referring to the ability to think abstractly/conceptually about mathematics, as compared with learning mathematics by focussing on algorithmic procedures.

‘Teacher Guidance-Student Autonomy’ corresponds to a similar contradiction identified in both the Barab and Stouraitis studies. According to their report, the majority of tensions associated with this contradiction were: “Students’ inability to meet higher demands on self-discipline and structure to prepare for in-class active learning”, “Students group work suffering from individuals not preparing watching videos”, and “Video preparation considered too time-consuming by the students”. The researchers considered such tensions to arise from “the redistribution of the in-class/out-of-class time that [the] FC imposes” *(Ibid., p. 13)*. In terms of the diagrammatic representations of activity systems, the researchers consider this contradiction to be related to the division of labour (between teachers and students), “in that both need to constantly balance their practices in the teaching-learning interaction process in a dialectical and reciprocal manner” *(Ibid., p. 16).*

The third contradiction, ‘Individual-collective’, refers to the use of in-class collaborative working, which according to the researchers, was resisted by some participants. For such students, group working is a restriction on their autonomy, rather than an affordance. This would seem to contradict what the researchers Abeysekera and Dawson claimed in their highly cited article, that approaches like the FC “may be more likely to facilitate student needs for autonomy and competence” *(Abeysekera L, Dawson P., 2015, p. 5)*. As I show later in this thesis, I also found a small minority who prefer to work in solitude, requiring only occasional help from a teacher.

Finally, as mentioned in Chapter 2, in my own small-scale study conducted in 2019-20, I also identified the ‘Teacher Guidance-Student Autonomy’ (which, as noted, I termed ‘Teacher-led v Learner-centred learning’) and ‘Individual-Collective’ contradictions. It is these two that I conjectured (in Chapter 2) would be likely to be accentuated by the FC, for which the studies reviewed above appear to provide support.

## Section Summary

There are still only relatively few studies that have used a theoretical or conceptual framework to analyse FCs in HE. Those that report on the analysis of engineering FCs are even smaller in number. Regarding the use of AT, although there are several studies in which it has been used, again, very few involve FCs, of which none focus exclusively on engineering. Of the examples that were examined, each used Engestrom's version of AT as an analytical framework. In each case, this led to the identification of one or both of the dialectical contradictions that I have hypothesised would be accentuated by flipped teaching. Research shows that one of these -'Teacher-led v Learner-centred learning'- may offer insights into the tensions and problems associated with learner (dis)engagement with pre-class, preparatory learning activities.

## 3.7 Summary

The objectives of this literature review were firstly, to check and confirm the findings regarding claims of FC benefits that were reported in my 2016 review **(RRQ1)**; secondly, to examine the issue of learners not engaging with preparatory, pre-class activities **(RRQ2)**; thirdly, to report on the use of theoretical frameworks (and especially AT) in FC studies in engineering education **(RRQ3)**.

Although one should exercise caution when interpreting the results reported by the sources examined here, the evidence would seem to support the claim made in most studies that learner performance is enhanced in FCs compared to traditional classrooms. This appears to be true for engineering FCs, as well as in the general case. Active learning methods such as short review lectures and/or quizzes, combined with individual and small-group tasks, appear to explain this result, although further evidence is needed.

The problem of learners not fully engaging with the preparatory, pre-class activities is widely acknowledged, and there are reports of high proportions of FC participants failing in this respect. In the wider literature, this problem has been related theoretically to issues of learner self-regulation and motivation.

AT has been used as an analytical framework to investigate several educational interventions in HE. However, its use in the study of FCs is relatively small, and apparently non-existent in the case of engineering FCs, at least at the time of writing. Furthermore, such studies generally limit their objectives to identifying and characterising systemic contradictions, in order to understand the dynamics and evolution of their particular Activity Systems. It appears, therefore, that in seeking to understand learners' academic subjectivities and motivations within a FC, the use of AT represents an opportunity to contribute to this area of engineering education.

In FC studies in which AT has been used, Engestrom's triangular representations of Activity Systems were employed to investigate and identify the tensions reported by learners within them. Many of these tensions were linked to dialectical contradictions, some of which correspond to ones hypothesised in the previous chapter. In several respects, the AT studies reviewed in this chapter proved to be useful and instructive for my own research. For example, the modelling of an individual course module as a single Activity System, provides a useful structure with which to investigate the tensions experienced by learners within it. The subsequent grouping of these tensions into categories, and their association with particular contradictions, appears to be a useful way to view learning behaviours within a module configured as a FC. As I discuss later, this was, indeed, the approach I used in the analysis of my own data.

Finally, one has to exercise caution in connecting the conclusions drawn above to my own research. The review presented here has been based on studies that were conducted during 'normal' times, in which learners were usually given a choice whether to participate in FCs, or not. In my study, which has been conducted under the conditions of a global pandemic, participants had little or no choice regarding flipped teaching and learning, which was foisted upon them.

In the next Chapter, I explain the methodological approach I used in the collection of the data, beginning with learners' subjectivities.

# Chapter 4 Methodology

In this chapter I discuss the background and reasons for the choice of methodology that I adopted for collecting and analysing the data. To provide a focus for the following sections, I have reprised my main research question below:

**How are engineering students' academic motivations and subjectivities mediated by flipped teaching?**

A key objective of the research was therefore to capture and analyse learners' subjectivities and academic motivations within a flipped teaching environment. As I argued in Chapter 2, the expectation was that gaining an understanding of an individual's subjectivity would in turn lead to insights into their motivation. Therefore, a principal aim was to select appropriate methods that placed subjectivity at the centre of inquiry.

A two-stage design was envisaged, such that data would first be collected and analysed, and the results used to inform a second stage in which follow-up interviews would be conducted. For the first stage, I had originally planned to use an ethnographic approach, where the learning activities of approximately 20 study participants would be closely monitored for timed periods, as for example during classroom and laboratory sessions. However, the circumstances of the pandemic forced me to abandon the plan and rely instead entirely on electronic methods. Q methodology, which is an efficient and scalable way of capturing subjectivity, can be used in an electronic format, and proved to be very useful for this study. In the following sections I explain the background and reasoning behind this choice. In doing so, I draw mainly on the work of William Stephenson (the inventor of Q), Steven R. Brown, and Simon Watts and Paul Stenner. References to their work, and to that of others, are given at various points in the text.

The structure of this chapter is as follows: section 4.1 discusses the background reasons for choosing Q methodology. Then, in section 4.2, I describe the steps involved in a full Q methodological study. In section 4.3 I examine some potential problems and shortcomings with my chosen approach, before briefly considering an alternative method using surveys to collect the data.

## 4.1 Choosing a Methodology

To help address my research question, I required methods and procedures that capture students' subjectivities in a systematic way. A further requirement was to be able to compare them with each other to discern areas of commonality and consensus. Methods were needed whose outputs were readily amenable to examination and analysis, both qualitatively and quantitatively. Therefore, an approach that provided both interpretive *and* statistical methods was desired. Before choosing an appropriate methodology however, it is important to have a clear understanding of the objectives, and the information required. Underpinning that choice are assumptions regarding the character and nature of the knowledge that is sought. These are questions of ontology and epistemology and will be discussed shortly.

The first thing that was needed was a working definition of subjectivity, and this is discussed next.

### 4.1.1 Subjectivity

A quick search reveals that there are multiple definitions of subjectivity. One that is in common use is that given by the Oxford English Dictionary, as follows:

> "The quality or condition of viewing things chiefly or exclusively through the medium of one's own mind or individuality."
> *(www.oed.com) (accessed 06 September 2022)*

Although this definition does not explain how subjectivity arises, it nonetheless implies that subjectivity is a property of the mind, i.e., it is personal and internal. It is exposed when an individual expresses their self-referent beliefs, dispositions, opinions, values, and views of the subject towards which it is directed. These are, in turn, shaped by the individual's personal history and cultural interactions. Their subjectivity is *their* interpretation of the world, i.e., of objective reality as they 'see' it, constructed through lived experience. Of course, the primary focus of this study is subjectivity, not objectivity. Furthermore, the purpose is not to try to judge whether one person's opinions are 'right', or another's are 'wrong'. Instead, the aim is to capture, interpret and compare them, assigning equal value and rank to each in doing so. This suggests that a methodology with a relativist ontological foundation is required, whose methods are, in epistemological terms, interpretivist in character *(Crotty, 1998)*. As will soon be argued, Q methodology meets this requirement, in part by using methods that permit the capture of subjectivity operantly.

### 4.1.2 Operant Subjectivity

Although subjectivity may be thought of as a condition of the mind, it is said to acquire an operant quality when revealed through language and actions. Operant subjectivity is the natural communication of an individual's personal views, beliefs and values from their internal, personal frame of reference *(McKeown and Thomas, 2013)*. A research approach that is used to capture and analyse subjectivity operantly is Q methodology *(Ibid.)*. Despite being relatively unknown, Q methodology ("Q") has been used for many years to study individuals' viewpoints across a wide range of disciplines. In studies that use Q, the goal is not to inquire into a person's overall subjectivity (whatever that means), but merely a slice/segment of it, in relation to a specific item or topic of interest. In Q, this slice/segment is captured operantly by the completion of a Q sort. A Q sort is performed by an individual in which they are "presented with a set of statements about some topic and are asked to rank-order them (usually from 'agree' to 'disagree')" *(Brown, 1993)*. The result is an ordering reflecting the expression of an individual's point of view, one which is neither 'right' nor 'wrong'.

Q sorting stands in contrast to conventional approaches which use devices such as questionnaires or scales. These devices impose the researcher's operational interpretations of 'objective' meaning on measurement, such as 'right or wrong', 'left-right', etc*.* Instead, operant approaches seek "to examine the world from the internal standpoint of the individual being studied, i.e., by taking a position on the frontier of behavior, stripped of rating scales which carry their own meaning.." *(Brown, 1980, p. 1)*. The point is to examine beliefs and values from participants' perspectives, not those of the researcher. This suggests that methods that are free from the researchers' subjective preferences and views are desirable. Q sorting is one such method, and, as will be shown, it is an efficient and effective way to capture subjectivity. The statements that are used in Q sorting are themselves drawn from a larger set called the 'concourse'. The definition of the concourse is one of the preliminary steps necessary to conduct a full Q methodological study, and is described after the next few sections, in which I elaborate further about Q.

### 4.1.3 Q vs R Methodology

Q emerged from the work of William Stephenson in human psychology in the 1930's *(Ibid.)*. Stephenson's motivation was that the established techniques of 'by-variable' statistical analysis -which he dubbed 'R Methodology"'- led principally to insights into the character of populations, not individuals. For example, differences within a sample of individuals in terms of physical traits such as height, age, or gender, which would be a natural focus for 'R Methodology'', allow us to calculate statistical quantities such as average values and standard deviations; however, they don't help "define those individuals in any sort of holistic fashion." *(Watts and Stenner, p.12).* In contrast, Q replaces investigations on a 'by-variable' basis with ones based on a 'by-person' analysis. In factor analysis terms, correlations between persons are considered, “rather than correlations between tests or variables.” *(Ibid.).* Furthermore, compared to ‘R’ methodological studies, the number of participants is less significant, and it is acceptable to use comparatively smaller sample sizes. In fact, with Q, even single-participant studies are possible *(Ibid., p.73).* As a consequence, the researcher who uses Q has to accept from the outset that its findings are unlikely to be generalizable to the wider population. However, that isn’t the goal, since, as Watts and Stenner have commented, “Q Methodology aims only to establish the existence of particular factors or viewpoints.” *(Ibid.).* Once these factors are established, they can then be made subject to statistical inquiry to determine, for example, how ‘close’ they are to each other, how many people ‘load’ on each one and to what extent, and so on. Only a limited number of factors are expected to be found, reflecting the notion that “only a limited number of distinct viewpoints exist on any topic” *(van Exel, 2005, p.3).*

### 4.1.4 Abduction

Through factor analysis, Q is also said to offer the researcher an *abductive* approach to the interpretation of results and the production of explanations and hypotheses. As Watts and Stenner point out, abduction is similar to induction in this respect, except that the latter “observes or studies facts to establish a generally applicable *description* of the observed phenomenon”, whereas abduction “studies them in pursuit of an explanation and new insights.” *(Watts and Stenner, p. 39).* Essentially, abduction refers to the ‘abducting away’ of an explanation of the facts, whereas inductive logic seeks to infer a general principle from them. In Q, abductive insights are usually gained during and after factor rotation (described soon). Abductive logic also plays an important role in supporting factor interpretation.

### 4.1.5 Q Methodology in FC Studies

Searches were conducted to check for reports of studies using Q in flipped classrooms in HE. I used the same databases and search engines that were listed in section 3.2 and, in addition, the archives and recent issues of the journal Operant Subjectivity, which is a primary source for Q methodological papers and reports. As expected, a general search for reports involving Q returned a large number of results, covering diverse subjects and educational programmes. However, when the search was restricted to include only those that used FCs, the result was disappointingly small. Only six studies were found, of which three appeared to be authored by the same researchers. These reported on the use of Q in FCs in human anatomy, business, nursing, statistics, physics, and 'learning, design, and technology' *(Chen, L., Chen, T.L. and Chen, N.S., 2015; Chen, T.L. and Chen, L., 2017; Chen, L., Chen, T.L. and Liu, H.K., 2020, Rieber, L.P., 2020; Ramlo, S., 2015)*. Unfortunately, none involved engineering courses. A common objective for these studies was to use Q to learn students' attitudes and opinions to flipped teaching in order to improve future FC implementations. For example, Ramlo used Q to investigate student views regarding a flipped undergraduate physics module *(Ramlo, S., 2015)*. She identified two viewpoints/factors, one of which reflected positive attitudes towards the FC, and the other negative attitudes. Students who adopted the first viewpoint were, as expected, more likely to complete the preparatory pre-class learning tasks than those who adopted the negative one. The data in the report appeared to support the conclusion that the former were more likely to benefit from the in-class active learning tasks than the latter. Those students that adopted the negative viewpoint preferred traditional teaching, and struggled with the flipped approach. According to the author, the results were used by the teachers to make changes to the course, with a particular aim being to align students' expectations with FC pedagogy.

In conclusion, the proposed use of Q to understand subjectivity within engineering flipped classrooms would appear to be breaking new ground.

In the next section I discuss the selection of software to help conduct Q methodological studies.

### 4.1.6 Software

In the pre-computer age, Q analysis was carried out manually. Nowadays, a computer is almost always used, and there are a number of software packages to choose from. They are available either as web-based tools, or as standalone applications; some are free, while others are commercially licensed. For this research I chose PQ Method *(Schmolk, 2002)*, which is a free, Windows-based application, available for download from:

http://schmolck.org/qmethod/downpqwin.htm *(accessed 24 June 2020)*

PQMethod is an old-fashioned application that has a 1990's DOS-style menu-driven interface. An alternative free tool is a web-based application called 'Ken-Q', that I sometimes used to check and verify the results obtained with PQMethod *(Ken-Q Analysis, 2019)*. Ken-Q is compatible with PQMethod and can be accessed at:

https://shawnbanasick.github.io/ken-q-analysis/ *(accessed 24 June 2020)*

### 4.1.7 Remote Data Collection

So far, the considerations suggested that Q was a suitable choice of methodology to help answer my research question. One further question however, concerned the circumstances of the pandemic. Given that Q sorting is traditionally administered in a face-to-face environment, the need for lockdowns and isolation forced the widespread use of distance-based and online methods. Fortunately, such methods for Q have existed for many years and a number of reviews of them are available in the Q literature *(Meehan et al, 2022; Reber et al, 2000).* In validation studies comparing computer-based vs paper-based Q sorting, Reber, Kaufman and Cropp concluded that the computer-based method "allowed users to accomplish the desired Q sort task at least as well as did the traditional physical paper method." *(Reber et al, p.208)*.

### 4.1.8 Summary

In summary, despite a dearth of FC studies using Q, the methodology appears to be well-suited to my research. In the remaining sections I discuss the required procedures in detail; these include preparing and defining the concourse and 'Q-set', followed by factor extraction, rotation and interpretation.

## 4.2 Q Methodological Study: step-by-step

In the previous section I outlined the background and reasons for the choice of methodology. In this section, I detail the steps necessary to conduct a study using Q, beginning with the preparatory work required to create a concourse.

### 4.2.1 Concourse

When asked to perform a Q sort, each participant is presented with a set of items called a 'Q-set'. In most Q studies, the items are typically statements which are printed onto small tiles or cards for use in the sorting procedure. The tiles/statements are then placed onto a paper-based grid in positions dependent on the extent to which participants either agree or disagree with each one. The Q-set thus provides the raw data on which the study is based. Its contents should provide

> "good coverage in relation to the research question. It must be *broadly representative* of the opinion domain, population or concourse at issue." (Watts & Stenner, 2012, p. 58).

It is important to try and ensure that the Q-set is balanced, in the sense that it "does not appear to be *value-laden* or *biassed* towards some particular viewpoint or opinion" *(Ibid.).* The Q-set is, in turn, drawn from a pre-established concourse of items, which itself can be thought of as the 'universe' of things one can say about a situation or context *(Stephenson, 1986)*.

The composition of the concourse is therefore critical to the study and should, in principle, represent the full range of views and opinions relevant to the topic under investigation. To determine these different views and opinions, the researcher could use any number of different empirical techniques and methods. These might include, for example, interviews, focus groups, scholarly and popular literature, surveys, reports and observations. However, in Q literature, one finds that there is no single, 'right' way to generate the concourse; instead, only general advice is given.

In generating the concourse for this study, my broad objective was to generate statements that allowed participants to express their subjectivity in relation to the main research question (RQ). I aimed to follow a structured approach in which its content would be organised into representative categories and sub-categories. I began with the goal of creating a list representing what is ‘sayable’ about both flipped teaching and motivation from learners’ perspectives. Initially, I relied upon selected items from my early (2016) literature review to provide a starting set of learner opinions and viewpoints. This was supplemented by the results of earlier pilot studies that I conducted with students from EEE during 2018-19 and 2018-19 *(Rubner 2018; Rubner, 2019a; Rubner, 2020)*. These studies were small-scale mixed-method investigations into students’ academic motivations, subjectivity and identity within a single, Y1 EEE module, which was taught as a flipped classroom. The methods used included surveys, questionnaires and interviews. Two of these studies were focussed mainly on understanding students’ academic motivation, not just within flipped teaching but more generally within their degree programme. The third study was a small-scale investigation that served as a pilot for this thesis study.

The result was a concourse of statements representing different themes and sub-themes related to learners’ attitudes and opinions towards flipped teaching, their personal academic motivation, and towards their peers and to study in general. The concourse is listed in Appendix 1.

### 4.2.2 Q-Set

The next step, the selection of statements from the concourse used to form the Q-set, has been called “more of an art than a science” *(Brown, 1980, p. 186).* There is always likely to be some uncertainty in its composition because of the anticipatory element on the part of the researcher, regarding how participants will express their subjectivity. However, following Wint *(Wint, 2013, p.46-47)*, I selected ones that:

- used terminology appropriate to the context of the study,
- weren’t duplicates,
- contained only a single proposition,
- were clear and easy to understand.

This final point proved particularly important, as the profile of the EEE undergraduate cohort consisted of native and non-native speakers of English in an approximate ratio of 50:50. This was also an early warning that the wording of the statements in the Q-set needed to be as free from ambiguity as possible.

Although there is no prescription for the number of items that comprise the Q-set, a number between 40-80 is recommended by some authoritative researchers *(Stainton Rogers, 1995)*. In the end, I used 50 statements, as this seemed a reasonable compromise between subject coverage and the time needed by participants to complete the sort.

### 4.2.3 Two Studies, Two Q-Sets

Although a single, 2-semester long study was originally envisaged, it was ultimately felt necessary to conduct 2 separate, single-semester studies. The reason for this was that mid-way through semester 1 it was realised that the relevance of certain assumptions underlying the study's design had diminished. This was due in part to the changes in learning conditions caused by the Faculty's adoption of a new teaching model. It was thought that more focus was needed on the particular circumstances of flipped teaching, which students were now experiencing across the entire programme, not just in a single Y1 module. In particular, it was felt necessary to include statements specifically relating to attitudes towards the synchronous and asynchronous elements that students were now facing. This led to a decision to make changes to the composition of the original Q-set by creating a new one in advance of semester 2. The data collected and analysed during semester 1 was later given the title "Study 1", while the title "Study 2" was applied to the data collected and analysed in semester 2. The results of "Study 2" therefore form the basis for the analysis and discussion in the remainder of this thesis. More detailed reasons for the decision to split the study into two shorter studies are given in Appendix 5.

### 4.2.4 Recruitment of Participants

The original aim was to recruit 40-60 study participants; however, as mentioned, large numbers of participants are unnecessary with Q, and it was decided to reduce the total to around 20 *(Watts and Stenner, 2012 p. 72; Brown, 1980, p. 192).* Originally, participants were to be drawn from the same Y1 module that was used in the earlier studies, however, as mentioned, the intervention of the pandemic resulted in the wholesale transition of all taught modules to the flipped style. This meant that candidate participants were, in principle, also able to be drawn from Y2 and Y3.

Prior to the commencement of the study, ethical approval was sought and gained from the University. This consisted in completing an online ethics application that explained how participants were to be approached and recruited. It also documented the processes involved in their participation, including that interviews would be audio-recorded and transcribed. The document explained their rights and expectations, including the right to withdraw at any time. It also covered what would happen to their data, how risks would be managed, and mitigation strategies. A data management plan was also created that detailed the data collection and storage processes. Of particular importance were GDPR concerns, in particular the safeguarding of anonymity. For this, encryption would be used, and the data stored only on university-owned computer systems.

Once the ethics application was approved, invitations were sent out by email. Initially a preliminary, informal online chat was held with candidate participants to explain what was involved. Not everybody that responded agreed to participate, but those that did were sent a Participant Information Sheet and were asked to sign and return a Consent form. A total of 21 students, distributed roughly in equal numbers from years 1-3, were recruited, with 9 from the UK and 10 from overseas.

Once the concourse and Q-set were defined, and the participants identified, the next steps were data collection (i.e. Q sorting), factor analysis and interpretation. These are next discussed in turn.

### 4.2.5 Q Sort

Each participant was invited to complete a Q sort, which, in pre-pandemic times would have been carried out with physical artefacts (tiles and grid). Due to the circumstances, participants were asked to complete it electronically using PowerPoint, and return the file by email. However, the sorting process is the same: in accordance with general practice, participants are first asked to initially sort the statements into three categories: agree, neutral, and disagree. This initial sort is then refined by placing the statements into positions on the grid, indicated by a scale determining how strongly they agreed/disagreed with them. The columns of the grid were marked numerically from -4 to +4, corresponding to the scale. In many Q studies, the grid has the appearance of an inverted 'bell' curve, although this is only one possibility. The grid and statements that were used in Study 2, and which were part of the PowerPoint file distributed to participants, are illustrated in Figures 4.1 and 4.2.

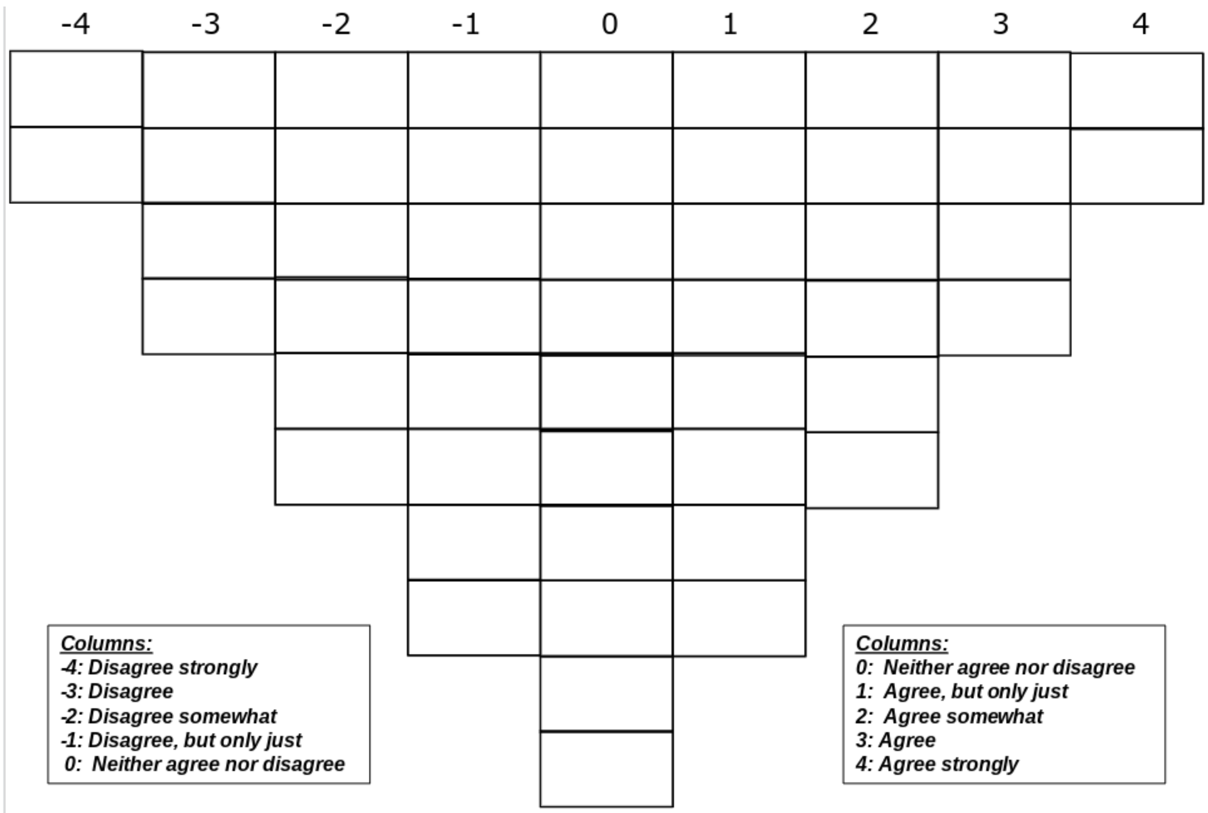


Figure 4.1 50-item Q Sort Grid.

**Instructions: drag and place each statement into the appropriate square on the grid**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. Passing each module is always the most important thing. | 2. I will sometimes skip lectures if I'm less interested in the subject. | 3. It matters a lot if I don't learn everything in a module. | 4. I tend to be passive when working in teams. | 5. My aim is to completely master all the material taught to me. | 6. I never look for help outside of the course materials (e.g YouTube). | 7. I never miss any of the asynchronous activities given each week. | 8. The attitude of my lecturers has a big effect on my motivation to study. |
| 9. I'm not very clear about my overall academic objectives. | 10. I learn academic material by myself, regardless of others, including teachers. | 11. I find it hard keeping up with the course. | 12. If I could choose how material is taught I would do it differently. | 13. I don't expect to do well in my degree. | 14. Flipped teaching makes it easier for me to learn. | 15.Learning with other students is mostly a pain. | 16. I prefer learning with my fellow students. |
| 17.My attitudes to learning are strongly affected by what my fellow students say. | 18. To do well, I must have good relationships with my fellow students. | 19. I want to prove to others that I can succeed in my studies. | 20. I am more motivated by my fellow students than by my lecturers. | 21. I am striving to do well compared to other students. | 22. Synchronous lectures don't have much value for me. | 23. I sometimes seek help from other students, e.g. using social media. | 24. My goal is to avoid performing poorly compared to others. |
| 25. I was motivated to study engineering by one or inspirational people. | 26. Understanding the taught material is always the most important thing. | 27.Completing the coursework is less important than passing the exam. | 28.I don't always fully complete the coursework in modules. | 29.I will sometimes skip lectures when close to submitting coursework. | 30. I prefer course material that really challenges me so I can learn more. | 31. My goal is to perform better than the other students. | 32. Getting good grades is the most important thing to me. |
| 33.I need a very deep understanding of material in order to pass the exams. | 34. Academic malpractice rules sometimes make me frustrated. | 35. My strategy is to learn just enough to pass each module I (e.g YouTube). | 36. My subject is interesting, but my main goal is to pass the exams. | 37. Working in a team does not motivate me to want to learn more. | 38.I never rely on fellow students when completing coursework. | 39. I don't like flipped teaching and prefer traditional ways of learning. | 40. It is not my fault if I don't learn the material in the course. |
| 41.There's generally not enough support available to help me with academic work. | 42. At any given time, I work equally hard on all my modules. | 43. You can pass the exams just by practising the past papers. | 44. I have perfected my personal approach to academic study. | 45. I prefer someone else teaching me rather than having to learn by myself. | 46. My approach to study has not changed since starting the course. | 47. I'm confident I can learn the most complex material in the course. | 48. I want to become an engineer mainly to help fix the world's problems. |
| 49.I want to become an engineer mainly to have a good career and life. | 50. It is very important for me to get better grades than other students. | | | | | | |

Figure 4.2 Q-Set Statements.

The grid shown in Figure 4.1 is called a 'forced-choice' distribution, because it forces the participant to assign a fixed number of items to each column. In general, the range and degree of kurtosis in the chosen distribution is relevant to the topic under consideration; a steeper kurtosis might be useful if it is anticipated that there are more statements for which participants will *not* have strong feelings about. The layout shown in Figure 4.1 was thought suitable for this study, since it was felt it matched the likely pattern of responses from the participants.
These patterns formed the basis for questions in the follow-up corresponding interviews, in which participants were asked to elaborate on the reasons for their choices. Analysis of the interview data can be found in Chapter 6.

It is also possible to use non-forced, or non-fixed frequency distributions. These allow the Q sorter to position an arbitrary number of items in any of the columns.

According to Brown, the impact of non-forced distributions vs forced ones is negligible “within the factor-analytic framework” *(Brown, 1980, p. 288-289).* In practice however, a forced distribution is often preferred for the simple reason that popular software packages only support fixed-choice layouts.

In passing, it is briefly worth considering whether a survey could be used to administer each Q Sort. In principle, the statements could be distributed in survey format, and participants asked to rank them according to a matching Likert scale. Instructions would be issued to direct them to limit the number of statements allocated to positions on the scale. The survey could be in either electronic or paper form and returned to the researcher afterwards. While this may be feasible, it is known that people are reluctant to respond to surveys with too many items, as it can tax their motivation to complete the task accurately *(Dillman, 1999)*. Equally, Q sorting can also be time-consuming. For example, sorting 50 statements can take upwards of 45 minutes, as I found in my earlier, pre-pandemic studies. It could, of course, be argued that such concerns are mitigated partly by participants’ expectation of a follow-up interview, in which they would be asked to explain their choices. Overall, however, it is difficult to argue that the use of a survey format offers a significant advantage over Q sorting.

In general, surveys are a staple of ‘R’ methodological studies, but it has not gone unnoticed that a research design might use *both* Q and R methods to inquire into both subjectivity and related quantitative measurements. For example, a small-scale Q study might reveal attitudes and opinions towards a topic of interest, the results of which feed into a follow-up R study that inquires into related demographic variables. A successor study to this one might use such a design to investigate, say, correlations between individual academic performance and personal motivation. But this is only one possibility, and are other combinations possible *(Danielson, 2009; Brown, 2002)*.

### 4.2.6 Factor Extraction: Conceptualisation

The next stage, factor extraction, is achieved with the help of software. Its purpose is to identify groupings of Q sorts that rank the statements in similar ways, i.e. that reflect shared viewpoints. The result is the production of one or more factors representing these viewpoints, typified by the Q sorts that load on them.

In conceptualising factors, Watts and Stenner use a nice analogy: if a cake represents the sum total of the captured viewpoints, then each factor is analogous to a “slice of this cake” *(Watts and Stenner, 2012, p. 95).* The mathematical ‘machinery’ involved in factor extraction and analysis is well-established, and only an overview is given here *(Brown, 1980)*.

The process of factor extraction begins by examining the Q sorts to see to what extent they are intercorrelated. This results in the creation of a ‘correlation matrix’ -the ‘cake’ in Watts’ and Stenner’s analogy- from which patterns of statistical similarity may be identified. Groups of Q-sorts that have similar configurations will be expected to be more highly intercorrelated, indicating a higher level of agreement between them. As mentioned, such groupings form the basis for the identification of factors, which cumulatively account for the amount of variance observed in the data. The correlation matrix forms the starting point for the steps involved in factor extraction, which is discussed next.

### 4.2.7 Factor Extraction: Process

Although in general there are several methods of extracting factors from correlation matrices, in Q it is typically achieved using either Principal Components Analysis (PCA), or the Centroid method *(Akhtar-Danesh, 2017; Kline, 2014; Brown, 1980, p.235).* The criteria for choosing each approach is a matter of debate amongst Q methodologists, however some advocate the Centroid method on the basis of its claimed additional flexibility *(Watts and Stenner, 2012)*. The Centroid method is also the oldest, and is simpler computationally compared to PCA. Although the procedural differences between them are subtle, there is more statistical indeterminacy associated with Centroid, than compared to PCA, which is said to be amongst the more "determinant forms of analysis" *(Brown, 1993, p.121)*. As Watts and Stenner state "PCA will resolve itself into a single, mathematically *best*, solution which is the one that *should* be accepted." *(Watts and Stenner, 2012, p. 99)*. They argue however, that a PCA solution "deprives us of the opportunity to properly explore the data or to engage with the process of factor rotation in any sort of abductive, theoretically informed or investigatory fashion" *(Ibid, p. 99)*. For this reason, I chose the Centroid method as the primary method of factor extraction, although I also used PCA on occasion when there was some ambiguity in the data (see Chapter 5).

Whichever method is used, the selection of factors is not , in general, a single, 'one-shot' procedure, and a certain amount of experimentation is necessary before deciding on the final number to extract. A common strategy is to start by first asking the software to extract seven factors, and then use the strength of selected statistical criteria to determine the significance of each one *(Brown, 1993)*. Those that meet the criteria are retained, while the others are discarded. For example, one commonly used criterion is a factor's eigenvalue, which is a measure of the cumulative normalised values of the Q sorts that load on it. In many Q studies, a factor is determined as being significant when its eigenvalue is greater than 1.0 *(the so-called 'Kaiser-Guttman' measure) (Guttman, 1954)*. Other criteria include inspection of the factor loadings to determine how many Q sorts load significantly on each one; one method for determining this is Humphrey's Rule *(Brown, 1980, p.223).* According to this rule, if two or more such Q sorts are found, the associated factor is retained. In both Study 1 and Study 2, I used this rule together with the Kaiser-Guttman criterion to initially determine which factors to keep and which ones to discard.

As mentioned, it is common to repeat the aforementioned steps until the final number has been determined. For example, it might be that of the original seven extracted, perhaps only the first three meet the criteria. A further cycle of extraction involving these three factors would then be undertaken, resulting in new values of their eigenvalues and variances. However, a final decision on how many factors to retain is generally not determined until further criteria are considered. These criteria are associated with factor rotation and the production of factor arrays, the details of which are discussed next. Thus, using software, a number of iterations of factor extraction and rotation may be necessary to arrive at the final number of factors to extract.

### 4.2.8 Factor Rotation

At the end of each factor extraction cycle a table of factor loadings is produced. This is the ‘unrotated factor loading’ table, and indicates the loading of each Q sort on each factor. It is also the starting point for factor rotation. The purpose of factor rotation is to provide different perspectives of the data in the same manner that someone would pick up and inspect an object from different angles. With the help of software, a graph with coordinate axes can be produced to visually clarify the loading pattern of the Q sorts, i.e., to inspect their distribution in relation to one another. Typically, one chooses two or three factors such that each is represented by a single axis. The Q sorts are then indicated on the plot in positions corresponding to their loadings on each factor/axis (essentially, x-y-z coordinates). This makes it easier to inspect their distribution in relation to one another, and to see the effect of rotations. It should be pointed out that, technically, it is the axes that are rotated, not the factors. Thus, following a rotation, the positions of the Q sorts relative to one another are unchanged. Orthogonal or oblique rotations may be performed, with the former usually preferred as it doesn’t alter the intercorrelation of the factors involved *(Kline, 1994, p.62)*.

Ideally, a particular rotation will be found that results in separate groupings of Q sorts lining up alongside each factor. It is often the case, however, that some Q sorts load on two or more factors to different extents, reflecting the partial sharing of viewpoints. Depending on these extents, such sorts are sometimes labelled ‘confounded’ in Q. It might also be the case that some do not load on any factor in any significant amount, leaving the situation inconclusive as far as they are concerned. Alternatively, it might be that rotating the factors to bring them into one particular orientation results in Q sorts that are in ‘opposition’ to one another, perhaps indicating that their respective viewpoints are diametrically opposed *(ref. Brown, 1980, Figure 17, p. 227-228).*

There are two rotation methods in general use: ‘Varimax’ (automatic) rotation, and manual rotation. Varimax is a computer-generated scheme that aims -as far as possible- to produce a result such that each Q sort loads on only a single factor *(Kline, 1994, p.67-68).* However, it is not uncommon to use the two rotation methods together in sequence, for example Varimax first, followed by judgemental (manual) rotation. This is recommended by some authors *(Watts and Stenner, 2012, p.126)* and was done in both Studies 1 and 2 to fine tune the results. Details given in Chapter 5.

Once the extraction and rotation steps are determined to be complete, the next step is the production of factor arrays: one per factor. As Watts & Stenner explain, “A factor array is, in fact, no more or less than a single Q sort configured to represent the viewpoint of a particular factor” *(Watts and Stenner, 2012, p. 140).* Essentially, a factor array is a theoretical Q sort, with a configuration prepared by someone loading at the 100% level on that factor. Its usefulness is that it forms the basis for the interpretation of that factor. As mentioned, however, it is possible that the Q sorts will load on multiple factors, each to a greater or lesser amount. Fortunately, the factor arrays can be produced by the software, which makes their production easy. Although the factors are orthogonal, there will likely be some inter-correlation amongst the factor arrays. This can be useful in factor interpretation: if two factor arrays are judged to be significantly correlated, they may represent different manifestations of the same viewpoint. The general advice in this situation is to reduce the number of factors and repeat the extraction-rotation cycle. I found this to be necessary in Study 2, and give details of the outcome in Chapter 5.

### 4.2.9 Interpretation

According to Watts and Stenner:

> “The interpretative task in Q methodology involves the production of a series of summarizing accounts, each of which explicates the viewpoint being expressed by a particular factor.“ *(Watts and Stenner, 2005, p.82)*

Unfortunately, there is no recipe that tells you exactly how to ‘do’ interpretation in Q, nonetheless, the starting point is the examination of each factor’s array.

Taking each factor in turn, it is tempting to use the statements at the extreme ends of the array (e.g., grid positions +4 and -4 in Figure 4.1) to characterise the viewpoint that they represent. This could be further supported by cross-factor item comparisons occupying the same or nearby positions. For example, we might find that certain items in say, factor 2 are ranked in a significantly different way to the other factors. This might be useful in distinguishing the viewpoint that factor 2 represents, from the others. However, focussing on the extremes at the exclusion of everything else detracts from the aggregate approach that Q methodology takes. Furthermore, it might miss the interrelationship of items within each factor and their role in its interpretation. As Brown commented about Q factor analysis “..it is more gestaltist and wholistic, rather than analytic and atomistic.” *(Brown, 1980, p. 14).* Furthermore, it is often the case that none of the Q Sorts load 100% on any one of the factors. This is a good argument for including the entire Q Sort configuration for interpretation purposes, not just those at the extremes.

One systematic approach that helps “the researcher to deliver genuinely holistic factor interpretations” is the method of ‘crib’ sheets, as described by Watts and Stenner *(Watts and Stenner, 2012, p.150).* This entails the creation of a ‘crib’ sheet for each factor, where each one contains four categories: statements that are ranked the highest (+4), statements that are ranked the lowest (-4), statements ranked *higher* than in any other factors, and statements that are ranked *lower* than in any other factors. The crib sheet method focuses attention not only on items at the extremes but also on those in or near the centre of the distribution. This can be significant, because an item marked at 0 for one factor, might be marked at +3 or +4 in the others, signifying a potentially important difference between the viewpoints.

Crib sheets are an invention of Simon Watts, formerly of Nottingham Trent University, and have been used in several Q-based research studies *(Wint, 2013; Plummer, 2012; Bashatah, 2016).* They facilitate the holistic approach to the analysis and interpretation of factors that Brown recommended, and were useful to this study.

### 4.2.10 Interviews

It is generally recommended that interviews are conducted after a Q sort, “so that the Q sorter can elaborate his or her point of view.“ *(Brown, 1993, p.106)*. The aim is to obtain a more penetrating insight into the viewpoints that each Q sort represents, and to see how closely they support the conclusions produced by the quantitative factor analysis outlined earlier.

An online interview was planned with each study participant shortly after they had completed the sort and returned their PowerPoint files. As mentioned, participants' agreement to be interviewed was subject to consent, with details of the purpose and content given in advance in the Participant Information Sheet *(Appendix 2)*. Each interview was to last between 45 minutes and 1 hour, and be audio-recorded and transcribed, with both recordings and transcriptions saved in encrypted form. Participants were informed that if they decided to take part they were still free to withdraw at any time, without detrimental effect on their academic standing or progress.

The interviews were planned to be semi-structured, such that each would first establish a participant's personal background and motives regarding their choice of degree programme. The questioning would then be directed by the pattern of responses within their respective Q-sorts, with the intention of validating their choices and exploring the reasons for them in depth. A particular aim -and one directly related to my research question- was to inquire into the motivational factors associated with their goal-directed actions under flipped teaching. In this respect, the questioning would be guided by the two hypothesised systemic contradictions and the tensions caused by them.

Interviews were to be analysed by first obtaining transcripts, and then applying an open coding technique to identify and categorise the tensions reported by interviewees *(Coe et al, 2021)*. An important first aim would be to verify and confirm the interpretation of each factor undertaken during the earlier analysis. Following that, I planned to look to see to what extent the reported tensions can be explained by the hypothesised contradictions, using the framework of Activity Theory. A further important aim was to explore the links between student academic subjectivity and motivation.

### 4.2.11 Summary

I have described the methodological procedures in detail. In the next section I discuss some anticipated shortcomings and potential problems with selected aspects of my chosen methodological approach.

## 4.3 Potential Problems and Shortcomings

It is important to recognise that any methodological approach will have limitations and potential shortcomings. This is no different for this study, with my planned use of Q and follow-up interviews. Here I present some potential issues and problems that might arise, and which should be borne in mind.

### 4.3.1 Sample Size and Generalisability to the Wider Population

As mentioned earlier, Q methodological studies are, in general, less sensitive to sample size than compared to comparative ‘R’ studies. With Q, the goal is to uncover the viewpoints expressed towards a given topic or subject, not the proportion of the population that hold them. The view that larger participant numbers are not necessarily better was addressed by Brown, who pointed out that “Increasing the number of persons on a factor merely fills up factor space, but has very little impact on the scores.” *(Brown, 1980, p.67).* If we are interested in what percentage of the population actually holds the different viewpoints uncovered, then larger sample sizes and other techniques, such as surveys, are necessary.

### 4.3.2 Reliability and Replicability

A further difference between the ‘R’ and Q methodological worlds is the meaning of the term ‘reliability’. With the former, reliability generally refers to the *method*, for example its repeated use to obtain consistently similar results. However, as Watts and Stenner state “Repeated administration of a Q sort to a single participant actually tells you more about the reliability, or otherwise, of the participant’s viewpoint than it does about the reliability of the method.” Such test-retest procedures involving the same participants have been reported in the Q literature. For example, in a widely cited study, Brown reported a correlation coefficient of 0.8 between the first and the second tests *(Brown, 1980)*. However, depending on the timescales involved, an individual’s opinions and viewpoints sometimes change, and it might be considered unlikely to reproduce similar results between tests. It is important to recognise that a Q Sort is really a ‘snapshot’ of participants’ operant subjectivity at the time that it is produced. If subjectivity is to be tracked over time, then a longitudinal research design would be needed.

Studies involving the administration of the same ‘raw’ material (i.e., the same Q-set) to *different* groups of participants have also been undertaken. In one case, Watts reported a correlation of 0.86 between the two tests *(Brown, 1980, p.98; Watts, 2008, p.31)*. What was surprising about this result was that the tests were administered eight years apart, and yet demonstrated the replicability of factors. Irrespective of the details of this case, one would, in general, expect the composition of the participant sample to have some effect on outcomes. Taking, for example, the particular circumstances of this study, the attitudes towards the introduction of flipped teaching expressed by Y1 undergraduate students might be expressed differently compared to their Y2 and Y3 peers, who can draw on their pre-pandemic learning experiences.

### 4.3.3 Concourse and Q-Set: Bias and Clarity

In theory, the statements that comprise the concourse should represent ‘everything’ that can be said about a topic or subject. However, unless that topic is narrowly defined, this will clearly be a challenge. For both flipped teaching and academic motivation, where a very large corpus of published material already exists, the task of populating the concourse inevitably involves compromise. Also, whatever is chosen will likely carry some bias on the part of the researcher ‘armed’ with a theoretical framework. Similarly, the Q-set, a chosen subset of the concourse which is of limited size for practical reasons, will also involve some compromise. Any problems with its content may not be discovered until it is in use, and Q Sorts are returned. As mentioned earlier, I found that changes to the Q-set were needed in advance of semester 2. This was due not only to the changed learning conditions, but also partly to a lack of clarity in the wording of some statements resulting in their misinterpretation. For example, the statement "My goal is to avoid performing poorly compared to others." was interpreted by some as meaning "while working in a team", rather than "compared to my classmates generally". Similarly, the statement "I want to prove that I can succeed in my studies" was sometimes interpreted by a participant self-referentially, i.e., wanting to prove to *themselves* that they can succeed, rather than proving so to others, which was the meaning the researcher had originally intended. Furthermore, I learned that most participants had only a weak understanding of the meaning of the term 'flipped learning'. Therefore, changes and refinements to the wording of certain statements were needed in advance of the semester 2 study.

In passing, it should be noted that any given Q study may not produce *all* the factors/viewpoints that exist for a given topic or subject; there may be others that are revealed by using a different sample of statements from the concourse (i.e. Q-set).

### 4.3.4 Forced-Choice Distributions

Forced-choice distributions may not mean that the pattern of responses any given Q Sort accurately reflects the views of the respondent. For example, a participant may want to express equal preference for some statements, but due to limited space is forced to place them in adjacent columns. This could potentially result in mistaken conclusions. A further point is that the column numbering does not necessarily represent a linear scale. Thus, the difference between +3 and +2 ('Agree' and 'Agree, somewhat') might be closer in the mind of the participant than between say, +2 and +1 ('Agree, somewhat' and 'Agree, but only just').

### 4.3.5 Problems and disadvantages with Interviews

Interviews are a natural method of eliciting information, permitting interviewer and interviewee to explore topics in depth. However, as with other methods, there are potential problems that should be considered. Here, I briefly review some of the issues that can arise, including those associated with the use of *online* interviews:

- **Power**

  An interview is often not just a simple conversation. There usually exists a power 'balance' between interviewer and interviewee, in which the former exercises control over the interview's direction and flow, while the latter exercises authority over its content. The interviewee may not always act as a passive provider of information, but may respond in ways that display sensitivity to the nature and character of the question and the way it is asked. In some cases, the response might be whatever the interviewee believes the interviewer wants to hear. This can be particularly pertinent in situations in which the power relationship takes on a more formal character, as in this study, in which I interviewed students some of whom I had recently taught.

- **Authenticity**

  In constructing responses to questions, respondents exercise choice in the information given. Their accounts rely on their capacity to recount personal experiences and behaviours accurately. The interviewer -as an active listener- needs to exercise judgement over the authenticity of these accounts. Although deliberate deceit may be the least thing expected in responses to questions, a given exposition may be only partially complete. Some memories might be upsetting and suppressed, in part or whole. Thus, the interviewer needs to remain alert to the potential for accounts that are missing pertinent information which can lead, in turn, to mistaken conclusions.

- **Bias**

  A further potential factor that might undermine the value of an interview is that of researcher bias. In the back-and-forth between interviewer and interviewee, there is a risk that the former's personal preferences and partiality might result in bias towards some responses and away from others. There is an ever-present danger that the interviewer may select/pursue 'evidence' to support a hypothesis of presumed importance, yet ignore others that signal otherwise, or which support an alternative one *(Nunkoosing, 2005)*.

- **Online Interviews**

  In addition to the aforementioned concerns, further issues can arise with the use of online interviews. Communicating over an Internet connection can restrict the interviewer's observations of nuances and other non-verbal clues. This might be particularly apparent when trying to comprehend non-native English speakers whose language skills are weak. Even with good language skills, establishing trust and rapport in an online conversation can sometimes be more challenging than in traditional settings, in which both parties are physically present. All these problems may be amplified by technological problems with Internet connections, and/or computer equipment.

## 4.4 Summary

No methodological approach is without its problems and limitations, and Q is no exception. The concerns with generalisability, reliability and replicability of results, bias, and clarity are legitimate ones, but some of them may be mitigated by careful attention to planning and approach. Despite their own associated issues, I still regarded interviews with participants as the best way to understand the pattern of responses given in each Q-Sort, and they remained an integral part of my research design. In Chapter 6 I discuss how they helped to inform the interpretation of factors uncovered in the quantitative analysis.

In summary, Q methodology, coupled with post-sort interviews, appeared to be a good approach for this study. The operant 'take' on subjectivity, coupled with statistical and interpretive evaluation through the use of factor analytic techniques and follow-up interviews, offers both the qualitative and quantitative approaches that I needed.

In the next chapter, I discuss the quantitative analysis of my Q research data.

# Chapter 5 Quantitative Analysis

## 5.1 Introduction

In this chapter I describe and discuss the details involved in the quantitative analysis of my research data. Having earlier explained the purpose and reasoning behind the steps required, here I present the details of how each one was carried out.

As explained previously, although a single, 2-semester study was originally envisaged, it was ultimately felt necessary to conduct 2 separate, single-semester studies. Here, I describe in detail the procedures involved in entering and analysing the data, which were the same for each study. These include the critical steps of factor extraction and analysis that are necessary to identify the different viewpoints held by the study's participants. The final task is then to interpret and characterise each factor/viewpoint, the results of which will be used to support the qualitative analysis of interviews later on. These steps were followed for both studies, and results were produced and conclusions drawn from each. However, since Study 2 effectively replaced Study 1, only those of the former are presented. The results of Study 1 are reported in Appendix 4.

This chapter is structured as follows: in section 5.2 I detail the procedures necessary to carry out the analysis, namely: data entry, extraction and rotation of factors. Then, in section 5.3, I present and discuss the interpretation of each factor. Finally, in sections 5.4 and 5.5, I present a summary and conclusions.

## 5.2 Data Analysis and Related Procedures

As mentioned in the previous chapter, the data was analysed using 'PQ Method' , a DOS-based software package. The end 'product' of the statistical part of the analysis is a factor array which captures learners' subjectivity in numerical terms. This factor array is then used as the basis for interpretation. PQ Method was used separately for each study; in each case the online software tool 'Ken-Q' was sometimes used to cross-check and verify the results.

### 5.2.1 Data Entry

The first task in using PQ Method is to enter the data, which includes the Q-set and the grid used to capture each Q Sort. For the latter, the 50-statement grid discussed in Chapter 4 (shown in Figure 4.1) was used. With PQ Method, each phase of data entry and analysis is menu-driven. Figure 5.1 shows the user interface when the program is launched.

```
          +--------------------------------------------------|
          |                 The QMethod Page:                |
          |            http://schmolck.org/qmethod/          |
          +--------------------------------------------------+


  Enter [Path and] Project Name:
S1_21

 Current Project is ...  C:\EdD Study 2020-21  Semester 1\Quant Analysis/S1_21
 Choose the number of the routine you want to run and enter it.

  1 - STATES   - Enter (or edit) the file of statements
  2 - QENTER   - Enter q sorts (new or continued)
  3 - QCENT    - Perform a Centroid factor analysis
  4 - QPCA     - Perform a Principal Components factor analysis
  5 - QROTATE  - Perform a manual rotation of the factors
  6 - QVARIMAX - Perform a varimax rotation of the factors
  7 - QANALYZE - Perform the final Q analysis of the rotated factors
  8 - VIEWLIST - View output file S1_21.lis
  X - Exit from PQMethod

    Last Routine Run Successfully - (Initial)
```

Figure 5.1 PQ Method User Interface.

Initially, the user enters a project name and selects the first menu item ('STATES'). The user is then prompted to enter the item number (starting at 1) and text of each statement in the Q-set. Each statement is then added in turn, until the last one has been entered. The item number of each statement is important, as it is used to locate its position on the grid during the Q Sort entry phase (see ‘QENTER’, below). The Q-sets used for each study can be found in Appendix 5.

Once all 50 statements have been entered, menu option 2 (‘QENTER’) is used to enter each Q Sort. The program first prompts for the numbers of rows and columns that define the grid. Each column is given a number corresponding to that shown in Figure 4.1. Once the grid’s dimensions and column numbers have been given, each Q Sort is entered by first adding a participant identification code, followed by the item number of each statement in each column of the grid, starting at the left hand side. Therefore, those statements with which the participant most strongly disagreed are entered first. Continuing to work across to the right hand side, further statements are added until all 50 statements for the Q Sort have been fully entered. This process is repeated until all Q Sorts are entered.

The data entry and allied procedures described above were followed in each of the two studies. In the remaining sections I focus exclusively on the results of Study 2 carried out in semester 2. As a point of note, 19 students participated in Study 1, while 21 participated in Study 2.

The remainder of the quantitative data analysis consists of several steps: factor extraction, factor rotation, identification of factor-exemplifying Q Sorts, the production of factor arrays and interpretation. These are described next, beginning with factor extraction and the determination of the number of factors to extract.

### 5.2.2 Factor Extraction

The function and purpose of factor extraction was outlined in Chapter 4. As I explained there, there are two principal methods in general use, Principal Component Analysis (PCA) or Centroid, and PQ Method offers a choice of both. Mostly I chose the Centroid method, only occasionally using PCA to check if better results could be obtained.

As I also explained, the determination of how many factors to extract is an iterated process. In line with common practice, I began by asking the software to extract 7 factors (the maximum number possible with PQ Method). This was achieved using menu option 3 (‘QCENT’), which produced a table of ‘unrotated’ factor loadings, as shown in Table 5.1.

Unrotated Factor Matrix

| SORTS | Factors 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1 | 0.8272 | 0.1017 | 0.1099 | 0.0102 | -0.0329 | 0.0008 | 0.0263 |
| 2 | 0.5218 | -0.2476 | -0.2297 | 0.0750 | -0.2112 | 0.0425 | -0.0553 |
| 3 | 0.4445 | -0.0143 | -0.3413 | 0.0830 | 0.2933 | 0.0912 | -0.3494 |
| 4 | 0.5788 | 0.0844 | 0.1691 | 0.0156 | 0.2690 | 0.0758 | -0.0749 |
| 5 | 0.4418 | -0.4780 | 0.1819 | 0.1544 | 0.0058 | 0.0001 | -0.2757 |
| 6 | 0.3913 | 0.3959 | -0.0899 | 0.1083 | 0.2769 | 0.0806 | -0.3014 |
| 7 | 0.7617 | -0.1182 | -0.0948 | 0.0157 | 0.1273 | 0.0165 | 0.1947 |
| 8 | 0.7873 | -0.0340 | -0.0153 | 0.0011 | 0.1577 | 0.0253 | 0.2086 |
| 9 | 0.2456 | -0.3196 | 0.4846 | 0.1975 | 0.0586 | 0.0038 | 0.2085 |
| 10 | 0.6739 | -0.2729 | -0.0873 | 0.0495 | -0.2413 | 0.0565 | 0.2420 |
| 11 | 0.6303 | 0.2759 | -0.2321 | 0.0901 | -0.2452 | 0.0585 | 0.0070 |
| 12 | 0.4063 | 0.1563 | -0.2175 | 0.0518 | -0.1528 | 0.0215 | 0.2081 |
| 13 | 0.4105 | 0.0728 | -0.2191 | 0.0399 | -0.2858 | 0.0816 | -0.3091 |
| 14 | 0.7156 | -0.2356 | -0.1529 | 0.0503 | 0.2925 | 0.0907 | 0.1586 |
| 15 | 0.1731 | -0.0497 | 0.4274 | 0.0971 | -0.2414 | 0.0566 | -0.3500 |
| 16 | 0.0535 | 0.4401 | 0.1145 | 0.1286 | -0.3677 | 0.1443 | 0.2496 |
| 17 | 0.4874 | -0.0705 | -0.1179 | 0.0145 | -0.0104 | 0.0000 | -0.1949 |
| 18 | 0.1420 | 0.3368 | 0.5115 | 0.2326 | 0.0454 | 0.0026 | -0.0178 |
| 19 | 0.6393 | 0.2350 | -0.4000 | 0.1537 | 0.2589 | 0.0699 | 0.0020 |
| 20 | 0.2347 | 0.1635 | 0.2659 | 0.0498 | 0.2597 | 0.0703 | 0.2187 |
| 21 | 0.5749 | -0.4364 | -0.0070 | 0.1140 | -0.2635 | 0.0684 | 0.1617 |
| Eigenvalues | 5.8798 | 1.4042 | 1.3774 | 0.2244 | 0.9338 | 0.0838 | 0.9428 |
| % expl.Var. | 28 | 7 | 7 | 1 | 3 | 0 | 4 |

Table 5.1 Unrotated Factor Loadings for Study 2 (7 factors)

In Table 5.1, the factors are the columns and the rows are the Q Sorts. The values shown are the factor loadings of each Q Sort, which “show the extent to which each individual Q Sort is associated with each of the study factors following extraction, but before rotation has taken place” *(Watts and Stenner, p. 203)*. The percentage of variance explained by each factor is shown at the bottom, together with their corresponding eigenvalues.

In choosing which factors to retain, I used the so-called Kaiser-Guttman test *(see Chapter 4)*, which is based on the eigenvalues for each factor. This test recommends that only those whose values are 1.0 or above, should be chosen. From the table, we see that factors 1, 2 and 3 satisfy this criterion. Furthermore, these factors account for 42% of the total observed variance in the underlying data.

A further test, which is outlined by Brown *(Brown, 1980, p.223)*, is to accept only those factors that have two or more Q Sorts whose loading is greater than a threshold value known as the ‘significant factor loading’ value, calculated at the 0.01 confidence level. This value is calculated using the following expression:

$$\text{significant factor loading } S_f = 2.58 \times (1/\sqrt{N})$$

where N = number of items in the Q Set. Applying this equation, and given that N=50,

$$S_f = 2.58 \times (1/\sqrt{50})$$
$$= 2.58 \times 0.1414$$
$$= 0.37 \text{ \textit{(rounded to 2 decimal places)}}$$

Applying the threshold 0.37 to the data in Table 5.1 reveals that only factors 1, 2 and 3 meet this criterion.

Finally, there is a further ‘rule of thumb’ that says one factor should be extracted for “approximately every six to eight participants in a study” *(Watts & Stenner, p. 112).* Therefore, given that there were 21 participants, 3 factors were chosen for the analysis (i.e., factors 1-3), and the software was used again to extract just these.

### 5.2.3 Factor Rotation

The goal of factor rotation was explained in the previous chapter. PQ Method offers two rotation methods: manual and automatic (called ‘Varimax’), with the latter attempting to ensure that each Q Sort “has a high factor loading in relation to only *one* of the study factors” *(Watts and Stenner, p.125)*. Each method has its own set of advantages and disadvantages, but as previously mentioned they are often used together in Q Methodological studies. Varimax is typically applied first, followed then by hand rotation, and this was the procedure that I followed. The results are shown in Table 5.2.

Loadings

| QSORT | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 0.6513 | 0.4128 | 0.3350 |
| 2 | 0.4682 | -0.1297 | 0.3878 |
| 3 | 0.5286 | -0.1389 | 0.1248 |
| 4 | 0.4138 | 0.3707 | 0.2492 |
| 5 | 0.1310 | 0.0747 | 0.6588 |
| 6 | 0.4802 | 0.2401 | -0.1724 |
| 7 | 0.6351 | 0.1209 | 0.4304 |
| 8 | 0.6411 | 0.2338 | 0.3944 |
| 9 | -0.1334 | 0.3314 | 0.5193 |
| 10 | 0.5143 | 0.0261 | 0.5206 |
| 11 | 0.7111 | 0.1472 | 0.0003 |
| 12 | 0.4857 | 0.0291 | -0.0009 |
| 13 | 0.4656 | -0.0095 | 0.0705 |
| 14 | 0.5919 | 0.0034 | 0.4905 |
| 15 | -0.0853 | 0.3854 | 0.2433 |
| 16 | 0.1155 | 0.3159 | -0.3106 |
| 17 | 0.4363 | 0.0328 | 0.2549 |
| 18 | -0.0395 | 0.6234 | -0.0707 |
| 19 | 0.7898 | -0.0066 | -0.0085 |
| 20 | 0.1076 | 0.3722 | 0.0486 |
| 21 | 0.3458 | -0.0167 | 0.6334 |
| % expl.Var. | 22 | 7 | 12 |

Table 5.2 Factor Loadings after Rotation (Study 2).

As can be seen by comparing Tables 5.1 and 5.2, the rotation has increased the loading values on factors for certain Q Sorts and reduced them for others. Taking Q Sort 15 for example, the loading on Factor 2 has increased from -0.0497 to 0.3854; similarly, the loading on Factor 1 for Q Sort 1 has decreased from 0.8272 to 0.6513. The total amount of variance explained by the factors has not changed by very much, as can be seen by a quick comparison. Taken together, the three factors now explain 41% of the observed variance (“% expl.Var”). In the remainder of this, and the following sections, the three factors are referred to as ‘F1’, ‘F2’ and ‘F3’.

PQ Method provides a visual way to display the data, through an ancillary program called ‘pqrot’. The pqrot program produces a graphical output, showing the positions of the Q Sorts relative to any pair of factors (represented by the x and y axes). A plot of the values for F1 and F2 is shown in Figure 5.2. In the figure, the number of each Q Sort is shown accompanied by a ‘dot’. The factor numbers (1,2) appear at the ends of the axes, with ‘1’ representing F1 along the vertical axis and ‘2’ representing F2 along the horizontal axis. Factor 3 is represented by the z-axis, which passes vertically through the plane of the figure. Thus, positive and negative values of F3 are imagined to be vertically above (i.e. “out of”), and vertically below (i.e., “into”) the plane of the figure, respectively.

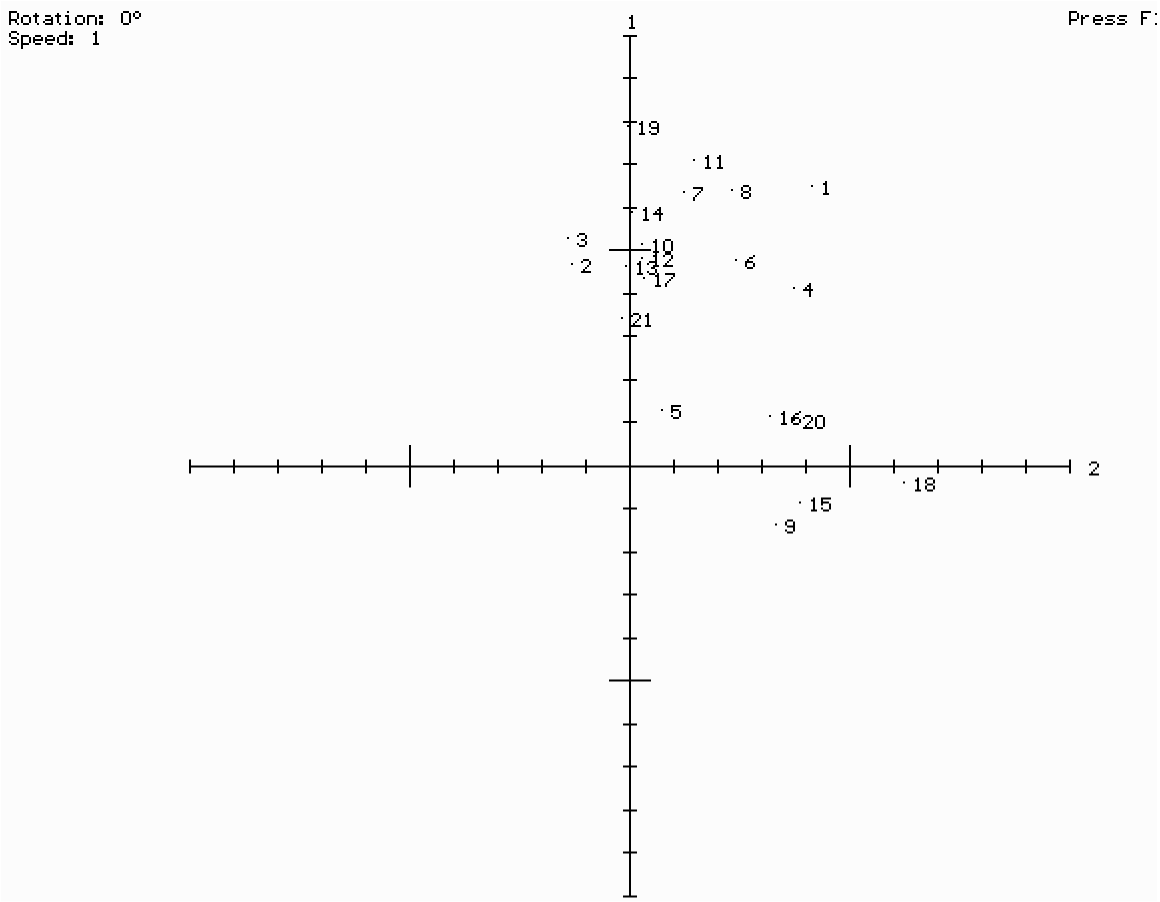


Figure 5.2 Factor Loadings (F1 and F2) after Rotation (graph view).

The plot in Figure 5.2 illustrates that several Q Sorts are distributed along the F1 and F2 axes, with a small number in the ‘no-man’s land’ in the top right quadrant between the axis lines. It is noticeable that a larger number of Q Sorts align along F1 than F2.

The distribution of Q Sorts between F1 and F3 is shown in Figure 5.3. As with the previous plot, several Q Sorts are aligned near the vertical axis, with a smaller number aligned close to the horizontal axis.

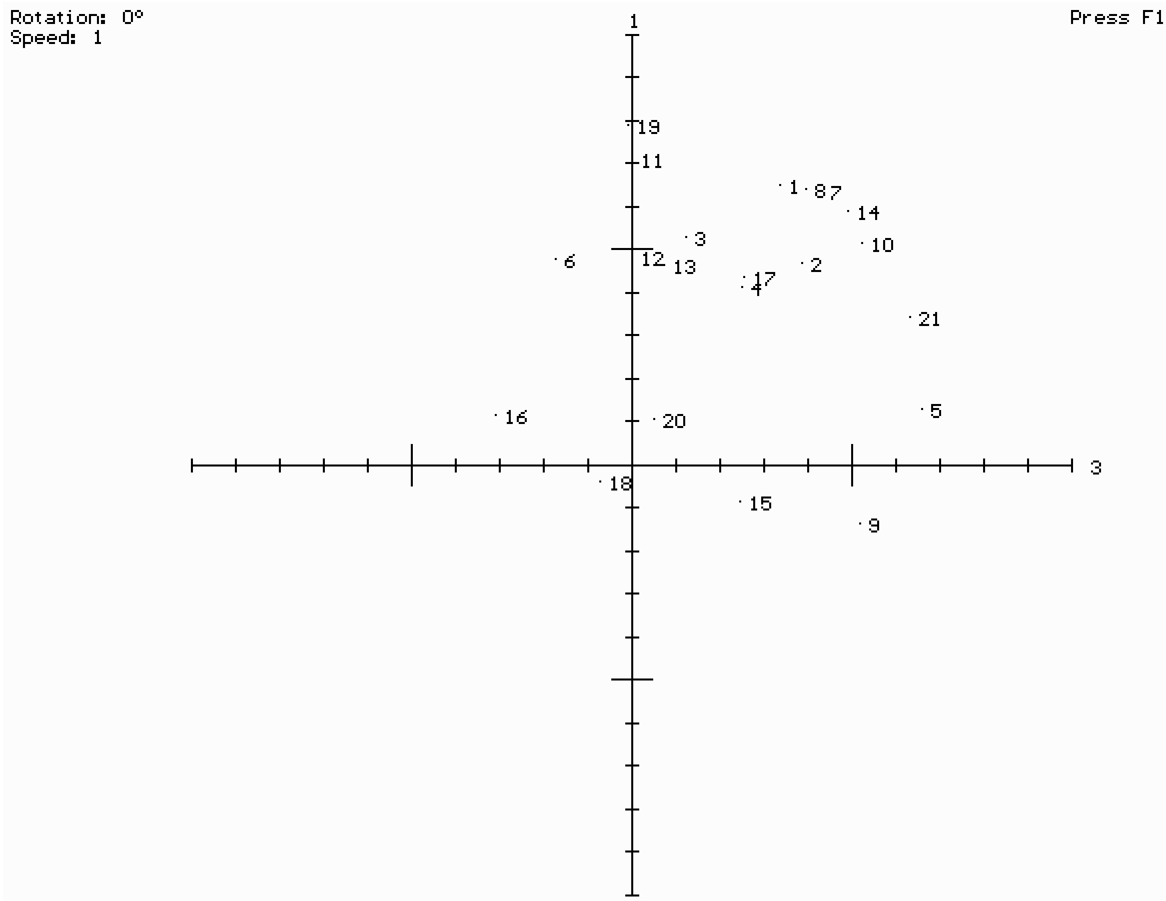


Figure 5.3 Factor Loadings (F1 and F3) after Rotation (graph view).

Finally, the distribution of Q Sorts between F2 and F3 was examined, and this is shown in Figure 5.4.

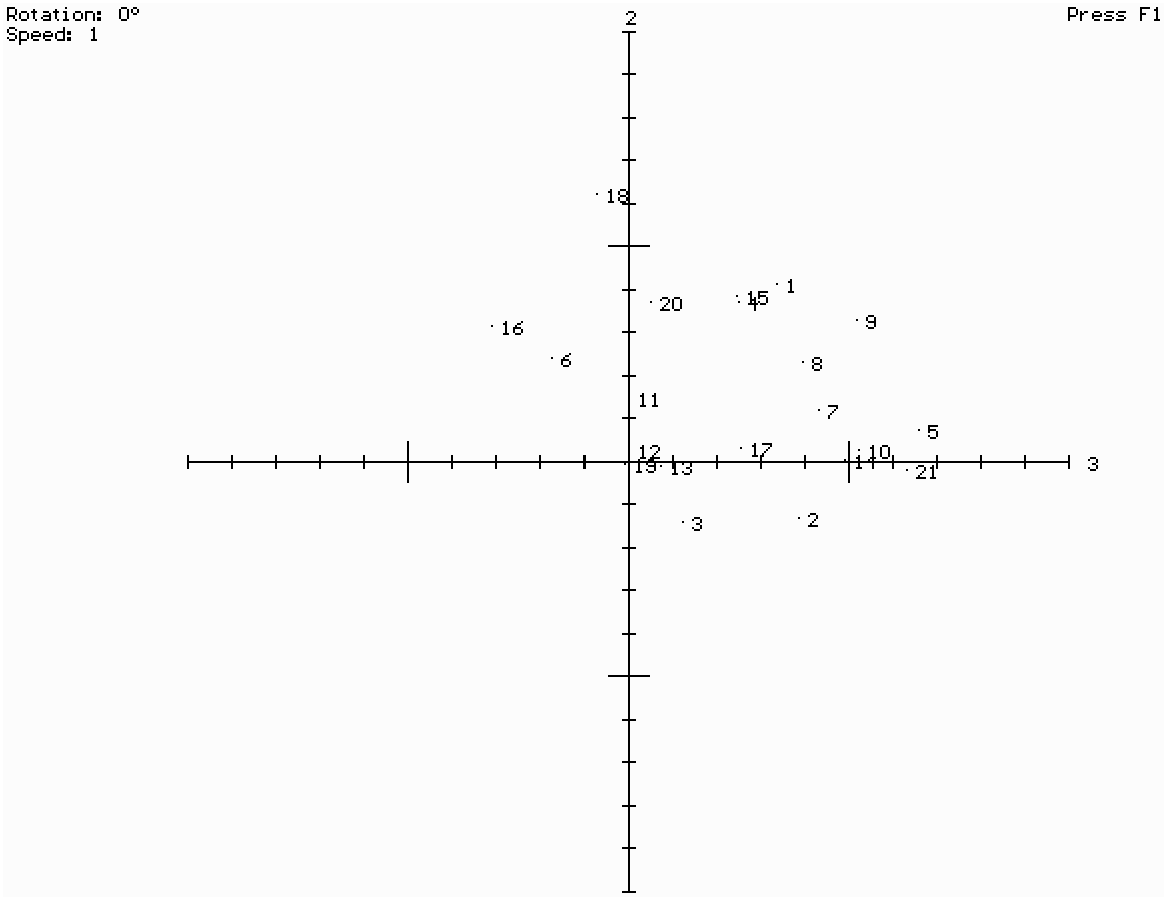


Figure 5.4 Factor Loadings (F2 and F3) after Rotation (graph view).

Similar to Figures 5.2 and 5.3, some Q Sorts are aligned near to one axis (F3, horizontal), with a few close to the other (F2, vertical).

### 5.2.4 Factor-exemplifying Q Sorts

A useful next step in the analysis is to identify those Q Sorts that load significantly on a single factor, and thereby *exemplify* them. This will show us not only the number of Q Sorts that load on each factor, but also identify candidate Q Sorts for interview purposes later on. This information has been extracted from Table 5.2 and presented in Table 5.3.

| Q Sort | F1 | F2 | F3 | Comments |
|---|---|---|---|---|
| 19 | **0.7898** | -0.0066 | -0.0085 | |
| 11 | **0.7111** | 0.1472 | 0.0003 | |
| 1 | 0.6513 | 0.4128 | 0.3350 | *confounded* |
| 8 | 0.6412 | 0.2338 | 0.3944 | *confounded* |
| 7 | 0.6531 | 0.1210 | 0.4304 | *confounded* |
| 14 | 0.5919 | 0.0034 | 0.4905 | *confounded* |
| 3 | **0.5286** | -0.1389 | 0.1249 | |
| 12 | **0.4857** | 0.0291 | -0.0009 | |
| 6 | **0.4802** | 0.2401 | -0.1724 | |
| 2 | 0.4682 | -0.1297 | 0.3878 | *confounded* |
| 13 | **0.4656** | -0.0095 | 0.0705 | |
| 17 | **0.4363** | 0.0328 | 0.2549 | |
| 4 | 0.4138 | 0.3707 | 0.2493 | *confounded* |
| 18 | -0.395 | **0.6234** | -0.0707 | |
| 15 | -0.0853 | **0.3854** | 0.2433 | |
| 20 | 0.1076 | **0.3722** | 0.0486 | |
| 16 | 0.1156 | 0.3159 | -0.3106 | - |
| 5 | 0.1310 | 0.0747 | **0.6588** | |
| 21 | 0.3458 | -0.0167 | **0.6334** | |
| 10 | 0.5143 | 0.0261 | 0.5206 | *confounded* |
| 9 | -0.1334 | 0.3314 | **0.5193** | |
| **Totals** | **7** | **3** | **3** | **7** |

Table 5.3. Factor Loadings (Study 2).

Table 5.3 shows that seven Q Sorts load significantly on F1, and three on each of F2 and F3. Only one Q Sort (16) appears to not load significantly on any of the factors, and seven Q Sorts are confounded, meaning that each is loaded significantly on more than one factor. Between them, the three factors appear to account (uniquely) for a total of 13 of the 21 completed Q Sorts. It is noticeable that none of the Q Sorts loaded at 100% on any factor.

### 5.2.5 Factor Correlations

Before proceeding to factor interpretation it is worth checking the intercorrelation of factors. Both the PQ Method and Ken-Q software produces a table of values indicating by how much each of the factor scores are intercorrelated. This is reproduced in Table 5.4.

| | **F1** | **F2** | **F3** |
|---|---|---|---|
| **F1** | 1.0000 | 0.0888 | 0.5198 |
| **F2** | 0.0888 | 1.0000 | 0.1201 |
| **F3** | 0.5198 | 0.1201 | 1.0000 |

Table 5.4. Factor Score Correlations (Study 2).

From Table 5.4 we see that there is little correlation between F1 and F2 (0.0888), and between F2 and F3 (0.1201). However, F1 and F3 are quite strongly correlated (0.5198), implying that these factors might be variants of the *same* viewpoint, and are not necessarily distinct. In these circumstances, the general advice is to run the analysis again, this time extracting one less factor *(Watts and Stenner, p.212)*. This advice was followed, and two factors were extracted. Unfortunately, this 2-factor extraction was found to offer no advantage: the intercorrelation between the two factors increased to approximately 60%. Furthermore, the Q Sorts were distributed such that very few were aligned along either axis, and when examined with pqrot, they were found to be mostly situated in the top right hand quadrant. I therefore decided to retain the 3-factor solution, and proceeded to the next step (Factor

Interpretation) from there. The close correlation between F1 and F3 was noted, however, for investigation later on.

## 5.3 Factor Analysis

The analysis and interpretation of factors is based on the factor arrays that are produced by the software. As previously explained, a factor array is a Q Sort configured to represent a 100% ‘pure loader’ on that factor. The analysis of each factor is presented in this section, beginning with F1 and its associated array. Note that PQ Method helpfully combines the array values for each factor into a single table. The data is presented in Appendix 6. PQ Method also usefully provides tables of descending arrays of differences between pairs of factors, which help identify the distinctions between them. These tables are also available in Appendix 6, and will be partially reproduced at certain points in the following discussion.

### 5.3.1 Factor Analysis: F1

Figure 5.5 shows the F1 Array produced with the Ken-Q software *(Appendix 6 contains the arrays for F2 and F3).*

## Composite Q sort for Factor 1

| -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| I dont expect to do well in my degree. | I tend to be passive when working in teams. | Academic malpractice rules sometimes make me frustrated. | Theres generally not enough support available to help me with academic work. | If I could choose how material is taught, I would do it differently. | I want to prove to others that I can succeed in my studies. | I am striving to do well compared to other students. | Passing each module is always the most important thing. | Understanding the taught material is always the most important thing. |
| I don't always fully complete the coursework in modules. | Its not my fault if I don't learn the material in the course. | I never look for help outside of the course materials (e.g YouTube). | I will sometimes skip lectures if I'm less interested in the subject. | I need a very deep understanding of material in order to pass the exams. | I have perfected my personal approach to academic study. | It matters a lot if I don't learn everything in a module. | Getting good grades is the most important thing to me. | I want to become an engineer mainly to have a good career and life. |
| | Im not very clear about my overall academic objectives. | I find it hard keeping up with the course. | Learning with other students is mostly a pain. | It is very important for me to get better grades than other students. | At any given time, I work equally hard on all my modules. | Flipped teaching makes it easier for me to learn. | My aim is to completely master all the material taught to me. | |
| | My strategy is to learn just enough to pass each module. | I don't like flipped teaching and prefer traditional ways of learning. | I will sometimes skip lectures when close to submitting coursework. | My goal is to perform better than the other students. | I never miss any of the asynchronous activities given each week. | I want to become an engineer mainly to help fix the worlds problems. | I prefer course material that really challenges me so I can learn more. | |
| | | Completing the coursework in a module is less important than passing the exam. | I was motivated to study engineering by one or more inspirational people. | Synchronous lectures don't have much value for me. | I learn academic material by myself, regardless of others | My goal is to avoid performing poorly compared to others. | | |
| | | My attitudes to learning are strongly affected by what my fellow students say. | I am more motivated by my fellow students than by my lecturers. | You can pass the exams just by practising the past papers. | I sometimes seek help from other students, e.g. using social media. | The attitude of my lecturers has a big effect on my motivation to study. | | |
| | | | My subject is interesting, but my main goal is to pass exams. | Working in a team does not motivate me to want to learn more. | I prefer someone else teaching me rather than having to learn by myself. | | | |
| | | | To do well I must have good relationships with my fellow students. | I never rely on fellow students when completing coursework. | I'm confident I can learn the most complex material in the course. | | | |
| | | | | My approach to study has not changed since starting the course. | | | | |
| | | | | I prefer learning with my fellow students. | | | | |

Figure 5.5 Factor Array for Factor 1 (Study 2).

As Figure 5.5 shows, the two statements with the highest scores (+4) are: “Understanding the taught material is always the most important thing.” and “I want to become an engineer mainly to have a good career and life”. Similarly, the two statements with the lowest scores (-4) are: “I don’t expect to do well in my degree.” and “I don’t always fully complete the coursework in modules.”

As discussed in the previous chapter, rather than focus mainly on the +4 and -4 items in the array for interpretation purposes, it is better to include the whole configuration. As also discussed there, a systematic way to do this is to use 'crib' sheets for each factor.

To begin the interpretation process, the crib sheet for F1 has been reproduced in Table 5.5. Note that items 3-20 are given with their actual rank shown in () brackets.
*Note: the table continues on the next page.*
*Legend: '#' = item number. 'No.' = Q Set statement number.*

| # | Items Ranked at +4 | No. |
|---|---|---|
| 1 | I want to become an engineer mainly to have a good career and life. | 49 |
| 2 | Understanding the taught material is always the most important thing. | 26 |
| | **Statements Ranked Higher in Factor 1 than in other Factors** | |
| 3 | It matters a lot if I don't learn everything in a module. (+2) | 3 |
| 4 | I never miss any of the asynchronous activities given each week. (+1) | 7 |
| 5 | The attitude of my lecturers has a big effect on my motivation to study. (+2) | 8 |
| 6 | I want to prove to others that I can succeed in my studies. (+1) | 19 |
| 7 | I am striving to do well compared to other students. (+2) | 21 |
| 8 | My goal is to avoid performing poorly compared to others. (+2) | 24 |
| 9 | I prefer course material that really challenges me so I can learn more (+3) | 30 |
| 10 | My goal is to perform better than the other students. (0) | 31 |
| 11 | Getting good grades is the most important thing to me. (+3) | 32 |
| 12 | I have perfected my personal approach to academic study. (+1) | 44 |

| | Statements Ranked Lower in Factor 1 than in other Factors | |
|---|---|---|
| 13 | I will sometimes skip lectures if I'm less interested in the subject. (-1) | 2 |
| 14 | I’m not very clear about my overall academic objectives. (-3) | 9 |
| 15 | I find it hard keeping up with the course. (-2) | 11 |
| 16 | If I could choose how material is taught, I would do it differently. (0) | 12 |
| 17 | Completing the coursework in a module is less important than passing the exam. (-2) | 27 |
| 18 | I will sometimes skip lectures when close to submitting coursework. (0) | 29 |
| 19 | My strategy is to learn just enough to pass each module. (-3) | 35 |
| 20 | My subject is interesting, but my main goal is to pass exams. (-1) | 36 |
| | **Items Ranked at -4** | 31 |
| 21 | I don’t expect to do well in my degree. | 13 |
| 22 | I don't always fully complete the coursework in modules. | 28 |

Table 5.5. Factor 1 Crib Sheet (Study 2).

A narrative can be assembled from the table as follows: starting with the statements ranked at +4 (i.e., items 1 and 2), these respondents strongly agree that understanding the taught material is “always the most important thing”. In fact, it matters to them if they don't learn everything they’re taught (item 3). They also strongly agree with the motive of becoming an engineer “to have a good career and life”. They prefer challenging course material (item 9), and do not find it difficult keeping up with the course (item 15). Their strategy is to learn more than just enough to pass (item 19), and they appear to disagree strongly with the suggestion that they “don't always fully complete the coursework in modules” (item 22); in fact, achieving good grades is strongly important to them (item 11). They are clear about their overall academic objectives (item 14), but don’t feel any need to prove to others that they can succeed in their studies (item 6).

They’re in reasonably strong agreement that completing the coursework is as important as passing the exam (item 17), but probably miss some of the weekly asynchronous activities (item 4). However, they expect to do well in their degree (item 21).

They're in agreement that the lecturer's attitude has "a big effect" on their motivation, and they don't appear to feel strongly about choosing how material is taught (items 5 and 16). It appears that they are competitive to the extent that they are "striving to do well compared to other students", and want to "avoid performing poorly" compared to them (items 7 and 8). However, this appears to be 'tempered' somewhat by their apparent neutrality regarding item 10: "My goal is to perform better than the other students".

They appear to have no strong feelings either way regarding skipping lectures, either "when close to submitting coursework", or when they are "less interested in the subject" (items 13 and 18). They are also neutral regarding the notion that they have 'perfected' their "personal approach to academic study" (item 12), or that their "main goal is to pass exams" (item 20).

## Summary: F1

Learners that load highly on factor 1 appear to be confident of keeping up with, and of doing well in their academic studies. Overall, they're clear about their academic objectives, and are committed to the goals of understanding the material and passing all the modules. They prefer more challenging course material, and it is important to them that coursework is fully completed. They don't appear to express any strong feelings either approving, or disapproving of flipped teaching. However, they are competitive learners, to the extent that comparisons with fellow students are somewhat important. The attitude of the lecturer also appears to be important with regard to their personal motivation to learn, where 'motivation' here means 'intensity of effort'. Finally, it should be borne in mind that this summary is an ideal characterisation of someone loading highly on this factor alone. From Table 5.3, we see that there is only a single entry (Q Sort 19) that approaches this case, which loads on F1 at nearly 79%.

The crib sheets for factors 2 and 3 are examined in the next two subsections, in which similarities and differences with F1 will also be identified.

### 5.3.2 Factor Interpretation: F2

The crib sheet for Factor 2 has been reproduced in Table 5.6. The actual rank, where shown, is given in ( ) brackets. *Note: the table continues on the next page.* *Legend: '#' = item number. 'No.' = Q Set statement number.*

| # | **Items Ranked at +4** | **No.** |
|---|---|---|
| 1 | If I could choose how material is taught, I would do it differently. | 12 |
| 2 | I prefer someone else teaching me rather than having to learn by myself. | 45 |
| | **Statements Ranked Higher in Factor 2 than in other Factors** | |
| 3 | I will sometimes skip lectures if I'm less interested in the subject. (+3) | 2 |
| 4 | I tend to be passive when working in teams. (+2) | 4 |
| 5 | I'm not very clear about my overall academic objectives. (+1) | 9 |
| 6 | I learn academic material by myself, regardless of others. (+2) | 10 |
| 7 | I don't expect to do well in my degree. (+1) | 13 |
| 8 | Flipped teaching makes it easier for me to learn. (+3) | 14 |
| 9 | Learning with other students is mostly a pain. (0) | 15 |
| 10 | My subject is interesting, but my main goal is to pass exams. (+3) | 36 |
| 11 | Working in a team does not motivate me to want to learn more. (+1) | 37 |
| 12 | It's not my fault if I don't learn the material in the course. (-1) | 40 |
| 13 | You can pass the exams just by practising the past papers. (+2) | 43 |
| 14 | My approach to study has not changed since starting the course. (+2) | 46 |
| 15 | I'm confident I can learn the most complex material in the course. (+3) | 47 |
| | **Statements Ranked Lower in Factor 2 than in other Factors** | |
| 16 | It matters a lot if I don't learn everything in a module. (-1) | 3 |
| 17 | My aim is to completely master all the material taught to me. (-1) | 5 |
| 18 | I prefer learning with my fellow students. (-1) | 16 |
| 19 | My attitudes to learning are strongly affected by what my fellow students say. (-3) | 17 |
| 20 | To do well I must have good relationships with my fellow students. (-3) | 18 |

| | | |
|---|---|---|
| 21 | I am more motivated by my fellow students than by my lecturers. (-2) | 20 |
| 22 | I am striving to do well compared to other students. (-2) | 21 |
| 23 | I was motivated to study engineering by one or more inspirational people. (-2) | 25 |
| 24 | Understanding the taught material is always the most important thing (+1) | 26 |
| 25 | I need a very deep understanding of material in order to pass. (-3) | 33 |
| 26 | My strategy is to learn just enough to pass each module. (0) | 35 |
| 27 | At any given time, I work equally hard on all my modules. (-3) | 42 |
| 28 | I want to become an engineer mainly to help fix the world's problems. (0) | 48 |
| 29 | I want to become an engineer mainly to have a good career and life. (+1) | 49 |
| | **Items Ranked at -4** | |
| 30 | My goal is to perform better than the other students. | 31 |
| 31 | It is very important for me to get better grades than other students. | 50 |

Table 5.6. Factor 2 Crib Sheet (Study 2).

The data in Table 5.6 suggests that F2 learners have strong feelings regarding how material is taught (item 1). They also express a strong preference for being taught by someone else, rather than learning by themselves (item 2), although item 6 ("I learn academic material by myself, regardless of others") might also be connected to this observation. However, they don't agree that it is someone else's fault if they fail to learn (item 12).

Items 30 and 31 indicate that competition with other students is unimportant to them, a conclusion which is also supported by item 22. Regarding social forms of learning, they appear to be neutral about preferences for learning with their fellow students (items 9 and 18). Furthermore, it appears that they tend to avoid taking an active role when working in teams, and derive little personal motivation from them (items 4 and 11). In fact they do not express any dependency on their fellow students for their attitudes and motivation towards learning (items 19 and 21); nor do they need to have good relationships with them "to do well" (item 20).

They are in strong agreement with the view that, although their subject is interesting, their main goal is to pass exams (item 10). This view may be connected with their agreement with the notion that “you can pass the exams just by practising the past papers” (item 13). It may also be connected with their apparent neutrality with regard to the goal of learning everything in a module, or that of achieving complete mastery of all the taught material (items 16 and 17). There may be a further connection with their strong disagreement with the statements that a very deep understanding of material is necessary in order to pass, or that “understanding the taught material is the most important thing” (items 24 and 25). It also appears clear that they don’t always work equally hard on all my modules (item 27). Furthermore, it appears that their approach to study hasn’t changed significantly since beginning the course (item 14).

They agree with the notion that flipped teaching makes it easier to learn (item 8), and they’re confident of learning the most complex material (item 15), although they will sometimes skip lectures if they’re less interested in the subject (item 3). However, their apparent mild agreement with the statement that “I don’t expect to do well in my degree” (item 7), might suggest a lack of self confidence in their overall academic abilities. This may also be linked to their not being very clear about their overall academic objectives (item 5).

Finally, there are a small number of statements (items 26, 28 and 29) relating to motives for studying engineering and overall academic strategy, with which these learners do not appear to express either strong agreement or strong disagreement.

## Summary: F2

Learners that load on factor 2 appear to have strong feelings about how material is taught, while also agreeing that “flipped teaching makes it easier to learn”. They express a strong preference for being taught by someone else rather than having to learn by themselves, but don’t necessarily blame others for failing to learn.
Unlike F1 learners, there appears to be an absence of competitive feelings toward their fellow students. It is also apparent that their attitudes towards learning are

unaffected by their peers, and that they do not appear to need to have good relationships with them.

There seems to be a focus on passing exams, at the expense, potentially, of needing a deep understanding of taught material. This might be a ‘strategic’ choice, and may be connected to their sometimes skipping lectures for subjects that they’re less interested in. The focus on exams may also be connected to their agreement with the idea that exams can be passed “just by practising the past papers”. Furthermore (and unlike F1), it doesn’t seem to greatly matter to them if they don’t learn everything, or achieve a deep understanding of the taught material.

Finally, although they appear to be reasonably confident of learning the most complex material, there is some indication that they’re less confident of “doing well” in their degree, again in contrast to F1 learners.

## F1 vs F2

Having so far considered F1 and F2, a useful exercise at this point is to examine the specific differences in statement rankings between each of these factors. These are provided by PQ Method in the form of tables of ‘descending arrays of differences’, that were mentioned earlier. For this particular case, the table ‘Descending Array of Differences Between Factors 1 and 2’ contains the data, which is listed using standardised scores. The full table is included in Appendix 6, however an abbreviated version is shown in Table 5.7, which lists those statements for which the difference is greater than, or equal to, a score value of 1.0. These statements were drawn from the top and bottom halves of the full table, which are shown below, separated by the dashed line.

| Statement | No. | Type 1 | Type 2 | Difference |
|---|---|---|---|---|
| I am striving to do well compared to other students. | 21 | 1.170 | -1.227 | 2.397 |
| My aim is to completely master all the material taught to me | 5 | 1.487 | -0.669 | 2.157 |
| At any given time, I work equally hard on all my modules. | 42 | 0.621 | -1.339 | 1.960 |
| Getting good grades is the most important thing to me. | 32 | 1.563 | -0.351 | 1.914 |
| It is very important for me to get better grades than other | 50 | 0.038 | -1.856 | 1.894 |
| My goal is to perform better than the other students. | 31 | 0.000 | -1.697 | 1.697 |
| I need a very deep understanding of material in order to pas | 33 | 0.167 | -1.282 | 1.449 |
| It matters a lot if I don't learn everything in a module. | 3 | 1.014 | -0.423 | 1.437 |
| I want to prove to others that I can succeed in my studies. | 19 | 0.704 | -0.717 | 1.421 |
| I have perfected my personal approach to academic study. | 44 | 0.692 | -0.717 | 1.409 |
| I want to become an engineer mainly to have a good career an | 49 | 1.771 | 0.503 | 1.268 |
| I prefer course material that really challenges me so I can | 30 | 1.199 | -0.062 | 1.261 |
| Understanding the taught material is always the most importa | 26 | 1.997 | 0.807 | 1.191 |
| You can pass the exams just by practising the past papers. | 43 | -0.016 | 1.035 | -1.051 |
| My approach to study has not changed since starting the cour | 46 | -0.138 | 0.956 | -1.095 |
| I'm confident I can learn the most complex material in the c | 47 | 0.309 | 1.505 | -1.196 |
| I will sometimes skip lectures if I'm less interested in the | 2 | -0.210 | 1.061 | -1.270 |
| I prefer someone else teaching me rather than having to lear | 45 | 0.338 | 1.856 | -1.519 |
| If I could choose how material is taught, I would do it diff | 12 | 0.173 | 1.759 | -1.586 |
| My strategy is to learn just enough to pass each module. | 35 | -1.971 | -0.311 | -1.660 |
| I find it hard keeping up with the course. | 11 | -0.895 | 1.035 | -1.930 |
| My subject is interesting, but my main goal is to pass exams | 36 | -0.563 | 1.401 | -1.963 |
| I don't always fully complete the coursework in modules. | 28 | -2.172 | -0.192 | -1.980 |
| I'm not very clear about my overall academic objectives. | 9 | -1.406 | 0.767 | -2.173 |
| I tend to be passive when working in teams. | 4 | -1.246 | 0.980 | -2.227 |
| I don't expect to do well in my degree. | 13 | -2.130 | 0.517 | -2.648 |

Table 5.7. Descending Array of Differences Between Factors 1 and 2.

In Table 5.7, F1 and F2 are labelled ‘Type 1’ and ‘Type 2’. We see at the top that statements 21 and 5 are much more positively ranked in F1 than in F2; similarly, at the bottom, statements 4 and 13 are ranked more positively in F2 than in F1. These and the other differently ranked statements support the observations made in the narratives given above. For example, for F2 learners, performance comparisons with their peers are less important than for F1 (statements 21, 31, 50); achieving mastery of material is more important for F1, who also prefer it to be more challenging (statements 5, 3); also, again unlike F2, F1 learners claim to work equally hard on all modules (statement 42); F1 learners appear to be considerably more confident about expecting to do well, and appear to be clearer, overall, about their academic objectives (statements 9, 11, 13). Finally, we can see how F2 learners tend to prioritise exam passing compared to their F1 peers (statements 33, 35, 43).

The differences between the other pairs of factors are explored in the next subsection.

### 5.3.3 Factor Interpretation: F3

The crib sheet for Factor 3 has been reproduced in Table 5.8. Again, the actual rank, where shown, is given in ( ) brackets.

*Note: the table continues on the next page.*

*Legend: '#' = item number. 'No.' = Q Set statement number.*

| # | **Items Ranked at +4** | **No.** |
|---|---|---|
| 1 | Passing each module is always the most important thing. | 1 |
| 2 | Understanding the taught material is always the most important thing. | 26 |
| | **Statements Ranked Higher in Factor 3 than in other Factors** | |
| 3 | I prefer learning with my fellow students. (+2) | 16 |
| 4 | To do well I must have good relationships with my fellow students. (+3) | 18 |
| 5 | I sometimes seek help from other students, e.g. using social media. (+2) | 23 |
| 6 | I was motivated to study engineering by one or more inspirational people. (+3) | 25 |
| 7 | I will sometimes skip lectures when close to submitting coursework. (+2) | 29 |
| 8 | I need a very deep understanding of material in order to pass the exams. (+1) | 33 |
| 9 | I don't like flipped teaching and prefer traditional ways of learning. (+1) | 39 |
| | **Statements Ranked Lower in Factor 3 than in other Factors** | |
| 10 | I never miss any of the asynchronous activities given each week. (-2) | 7 |
| 11 | I learn academic material by myself, regardless of others including lecturers. (-1) | 10 |
| 12 | Flipped teaching makes it easier for me to learn. (0) | 14 |
| 13 | Learning with other students is mostly a pain. (-3) | 15 |
| 14 | Synchronous lectures don't have much value for me. (-1) | 22 |
| 15 | Working in a team does not motivate me to want to learn more. (-3) | 37 |
| 16 | You can pass the exams just by practising the past papers. (-2) | 43 |
| 17 | I have perfected my personal approach to academic study. (-2) | 44 |
| 18 | I prefer someone else teaching me rather than having to learn by myself. | 45 |

| | | |
|---|---|---|
| | (0) | |
| | **Items Ranked at -4** | |
| 19 | I never look for help outside of the course materials (e.g., YouTube) | 6 |
| 20 | Academic malpractice rules sometimes make me frustrated. | 34 |

Table 5.8. Factor 3 Crib Sheet (Study 2).

The data in Table 5.8 suggests that F3 learners are in strongest agreement with wanting to pass each module and understand all the taught material (items 1 and 2). This is something they have in common with F1 learners, as is their apparent neutrality on the notion that a very deep understanding of it is needed in order to pass the exams (item 8). They disagree with the claim that “you can pass the exams just by practising the past papers” (item 16), which is something that F1 learners are neutral about, but with which F2 learners agree.

They appear to hold a neutral attitude towards flipped teaching (items 9 and 12). However, it appears that they may miss some of the weekly asynchronous learning activities, and “will sometimes skip lectures when close to submitting coursework” (items 7 and 10).

They appear to prefer learning with, and to need good relationships with their fellow learners, and disagree strongly with the view that “learning with other students is mostly a pain” (items 3, 4 and 13). They agree with the statement “I sometimes seek help from other students, e.g. using social media” (item 5), and are in strong disagreement that no ‘motivation to learn’ is derived from team-working (item 15), which together suggest that they enjoy social forms of learning.

They disagree with the notion that they have perfected their “personal approach to academic study” (item 17) and are more likely than F1 and F2 learners to look outside the course materials for help (item 19). They claim that they were “motivated to study engineering by one or more inspirational people” (item 6).

Lastly, they appear to be neutral with statements regarding independent learning of academic material (item 11), the value to them of synchronous lectures (item 14), and preferences regarding someone else teaching them rather than learning by themselves (item 18); they disagree strongly that academic malpractice rules make them frustrated (item 20).

### Summary: F3

Learners that load on factor 3 view understanding the taught material and passing each module as being strongly important, which is a view they share with F1 learners. They are also close to F1 in agreeing that it matters a lot if they "don't learn "everything in a module" (i.e., statement 3 -see Table A.6.9 in Appendix 6: statement 3 is +2 on F1 and +1 on F3). These observations might go some way to explaining the relatively high intercorrelation between F1 and F3.

However, unlike F1, it appears that getting good grades is not viewed as strongly important, nor is any preference for more challenging material. Also unlike F1, F3 learners appear to find it hard keeping up with the course (something they have in common with F2). In common with F2 learners, they will sometimes skip lectures, particularly when close to submitting coursework. However, they differ from both F1 and F2 learners in appearing to hold little enthusiasm for flipped teaching. They also differ from F1 and F2 in the apparent importance of having good relationships with their fellow students; F3 learners value this more highly. F3 learners also differ from F2 in disagreeing that "you can pass the exams just by practising the past papers".

### F1 vs F3

As before, it is worth checking the tables of 'descending arrays of differences' to examine more closely the differences between the factors. Considering F1 and F3 first, the table 'Descending Array of Differences Between Factors 1 and 3' is reproduced in part in Table 5.9. Once again, those statements for which the difference is greater than, or equal to, a score value of 1.0, are listed. As before, these statements were drawn from the top and bottom halves of the full table and are shown below, separated by the dashed line.

| Statement | No. | Type 1 | Type 3 | Difference |
|---|---|---|---|---|
| Getting good grades is the most important thing to me. | 32 | 1.563 | -0.311 | 1.874 |
| Working in a team does not motivate me to want to learn more | 37 | -0.053 | -1.781 | 1.728 |
| I never miss any of the asynchronous activities given each w | 7 | 0.574 | -0.958 | 1.532 |
| I am striving to do well compared to other students. | 21 | 1.170 | -0.131 | 1.301 |
| I never look for help outside of the course materials (e.g Y | 6 | -0.810 | -2.109 | 1.299 |
| Academic malpractice rules sometimes make me frustrated. | 34 | -0.794 | -2.089 | 1.295 |
| I have perfected my personal approach to academic study. | 44 | 0.692 | -0.582 | 1.275 |
| Learning with other students is mostly a pain. | 15 | -0.225 | -1.351 | 1.127 |
| I prefer learning with my fellow students. | 16 | -0.181 | 0.964 | -1.145 |
| My strategy is to learn just enough to pass each module. | 35 | -1.971 | -0.804 | -1.167 |
| I will sometimes skip lectures when close to submitting cour | 29 | -0.231 | 0.958 | -1.190 |
| Completing the coursework in a module is less important than | 27 | -1.081 | 0.278 | -1.359 |
| I don't like flipped teaching and prefer traditional ways of | 39 | -0.911 | 0.467 | -1.377 |
| I don't always fully complete the coursework in modules. | 28 | -2.172 | -0.461 | -1.712 |
| To do well I must have good relationships with my fellow stu | 18 | -0.696 | 1.135 | -1.831 |
| I find it hard keeping up with the course. | 11 | -0.895 | 0.958 | -1.853 |
| I was motivated to study engineering by one or more inspirat | 25 | -0.552 | 1.511 | -2.063 |

Table 5.9. Descending Array of Differences Between Factors 1 and 3.

In the table, F1 and F3 are labelled ‘Type 1’ and ‘Type 3’. As a reminder, at the top are statements that are much more positively ranked in F1 than in F3 (e.g., statements 32 and 37). Similarly, at the bottom, statements 11 and 25 are ranked more positively in F3 than in F1. A quick cross-check of the statements appears to largely support the comparison between these two factors given in the above summary.

## F2 vs F3

To compare F2 and F3, the table ‘Descending Array of Differences Between Factors 2 and 3’ is reproduced in part in Table 5.10. *Note: the table continues over the page.*

| Statement | No. | Type 2 | Type 3 | Difference |
|---|---|---|---|---|
| Working in a team does not motivate me to want to learn more | 37 | 0.869 | -1.781 | 2.650 |
| I tend to be passive when working in teams. | 4 | 0.980 | -1.634 | 2.614 |
| I prefer someone else teaching me rather than having to lear | 45 | 1.856 | -0.038 | 1.894 |
| I don't expect to do well in my degree. | 13 | 0.517 | -1.331 | 1.849 |
| You can pass the exams just by practising the past papers. | 43 | 1.035 | -0.691 | 1.726 |
| Learning with other students is mostly a pain. | 15 | 0.344 | -1.351 | 1.695 |
| Its not my fault if I don't learn the material in the course | 40 | -0.318 | -1.811 | 1.493 |
| My subject is interesting, but my main goal is to pass exams | 36 | 1.401 | 0.039 | 1.362 |
| Flipped teaching makes it easier for me to learn. | 14 | 1.372 | 0.029 | 1.343 |
| I learn academic material by myself, regardless of others in | 10 | 1.028 | -0.294 | 1.321 |
| I'm not very clear about my overall academic objectives. | 9 | 0.767 | -0.544 | 1.310 |
| If I could choose how material is taught, I would do it diff | 12 | 1.759 | 0.459 | 1.300 |
| I never look for help outside of the course materials (e.g Y | 6 | -0.843 | -2.109 | 1.266 |
| My approach to study has not changed since starting the cour | 46 | 0.956 | -0.152 | 1.108 |
| Synchronous lectures don't have much value for me. | 22 | 0.456 | -0.568 | 1.024 |

| | | | | |
|---|---|---|---|---|
| I am striving to do well compared to other students. | 21 | -1.227 | -0.131 | -1.096 |
| Understanding the taught material is always the most importa | 26 | 0.807 | 2.222 | -1.415 |
| At any given time, I work equally hard on all my modules. | 42 | -1.339 | 0.084 | -1.423 |
| I don't like flipped teaching and prefer traditional ways of | 39 | -1.013 | 0.467 | -1.480 |
| My goal is to perform better than the other students. | 31 | -1.697 | -0.195 | -1.502 |
| I prefer learning with my fellow students. | 16 | -0.807 | 0.964 | -1.771 |
| I need a very deep understanding of material in order to pas | 33 | -1.282 | 0.504 | -1.786 |
| It is very important for me to get better grades than other | 50 | -1.856 | -0.064 | -1.793 |
| My aim is to completely master all the material taught to me | 5 | -0.669 | 1.170 | -1.839 |
| I was motivated to study engineering by one or more inspirat | 25 | -1.082 | 1.511 | -2.594 |
| To do well I must have good relationships with my fellow stu | 18 | -1.585 | 1.135 | -2.720 |

Table 5.10. Descending Array of Differences Between Factors 2 and 3.

Table 5.10 is shown in the same format as tables 5.7 and 5.9. These results also largely confirm the differences identified earlier between these two factors, i.e., a relative dislike of flipped teaching, and the claim about being able to pass the exams just by practising past papers. However, the difference in attitudes towards team working is brought into stark contrast with statements 4 and 37: Appendix 6 shows statement 4 loads at +2 on F2, but loads at -3 on F3, while statement 37 loads at +1 and -3, respectively. There is also a strong contrast in expectations of doing well in their degree (statement 13). However, the strongest difference is recorded in their need for good relationships with fellow students (statement 18). Appendix 6 shows this statement loads at -3 for F2 and +3 for F3.

Thus, there appear to be stronger differences between F2 and F3 in certain cases than between F1 and F3 or F1 and F2.

## 5.4 Summary

The analysis of the Q Sort data has uncovered three apparently distinct factors (i.e., viewpoints), that I have termed F1, F2 and F3. A summary list that compares hypothetical learners who load 100% on each one, is given below:

- F1 learners appear to be confident of their academic abilities, are committed to learning as much as they can and passing each module.
- F1 learners are somewhat competitive with their peers, unlike F3 learners, who appear to be only mildly so. F2 learners express very little competitiveness.

- F2 learners are neutral, or perhaps even averse toward cooperative forms of learning. In contrast, F1 and F3 learners appear to favour social forms of learning, the latter more strongly so.
- F2 learners appear to be strategic in their focus on passing exams, possibly at the expense of acquiring deeper learning, which is a noticeable difference with both F1 and F3.
- There are indications/suggestions that both F2 and F3 learners may be somewhat less confident in their academic abilities, compared to F1.
- F3 learners appear to share some attitudes with F1, regarding understanding taught material, although there are differences relating to the importance of achieving good grades and the preference for more challenging topics.
- There are differences in attitudes towards flipped teaching, with F1 and F2 agreeing that it makes it easier for them to learn (statements 14 and 39), with F3 learners appearing to lack enthusiasm for it by remaining neutral. The data suggest that all learners likely miss some of the weekly asynchronous activities (statement 7), and are neutral in the attitudes towards the perceived value of synchronous lectures (statement 22).

It should be remembered that learners do not all fall exclusively and uniquely onto any one factor. Furthermore, the three factors/viewpoints are not entirely orthogonal, as there is evidence of correlations between them, more strongly so between F1 and F3, than between other pairings (Table 5.4).

## 5.5 Conclusions

What was expected to be a single year-long study unfolded into two smaller-scale, single-semester studies. As explained, the second of these became the major focus, the analysis of which identified three major different viewpoints. The data so far has revealed the choices that participants made through their placement of statements, and interpretations have been drawn.

The three viewpoints/subjectivities, F1, F2 and F3, characterise the learner's experiences of flipped teaching in this study. As they stand, they can be thought of as a 'snapshot' of views, opinions and dispositions, produced from the Q sort data. But by themselves, they do not answer the larger question of how learners' subjectivities are mediated by flipped teaching, which is part of my main research question, and remains, as yet, unaddressed.

As outlined in Chapter 2, one hypothesis underlying the research is that certain tensions experienced by learners are accentuated by flipped teaching. The analysis reported in this chapter cannot, by itself, be yet said to support this proposition. However, there are hints that suggest there may be some superficial linkage: for example, learners that load on F3 appear unenthused by flipped teaching, while those on F2 appear more independent and disinclined towards cooperative forms of learning. F1 learners appear to be confident learners who may be relatively less affected by aspects of flipped teaching. These, and other observations, are explored further through interviews and qualitative analysis in the next chapter.

# Chapter 6 Qualitative Analysis

In this chapter I analyse students' subjectivity and motivation qualitatively, using the lens of Activity Theory (AT). The results of this, together with those of the previous chapter, are used to help provide answers to my main research question.

## 6.1 Introduction

As explained in Chapter 4, each student participant was required to perform a Q Sort, followed shortly afterwards by participation in a semi-structured interview. The Q Sort and interview data was collected throughout the teaching semester, and their analysis is presented here. The interviews were conducted prior to undertaking the factor analysis that was outlined in Chapter 5.

The interview data was examined to see how closely it supported the conclusions of the quantitative analysis reported in the previous chapter. The results of this are discussed first, in section 6.2. Then, in section 6.3, I present an extended discussion and analysis of the tensions experienced by learners, using supporting interview extracts. This is structured around each of the two hypothesised systemic contradictions. In section 6.4, I discuss what I consider to be significant contextual factors that impacted the study. Following that, in section 6.5, I examine the findings using AT, with the goal of developing an analytical understanding of how flipped teaching impacts learners' subjectivity and academic motivation. In section 6.6, I briefly discuss certain limitations with respect to the conduct of the interviews, and the use of AT diagrams. Finally, in section 6.7, I present some concluding remarks.

## 6.2 Support for the Quantitative Analysis Conclusions

The results of the quantitative Q Sort analysis presented in chapter 5, identified three different viewpoints or factors, which I labelled F1, F2 and F3. From a total of 21 Q Sorts, 13 were non-confounded, of which the majority (7) loaded on F1, 3 loaded on

F2, and 3 loaded on F3.  Although F1, F2 and F3 differed in significant ways, overlaps between them were also identified.

After the interviews had been conducted, I used Table 5.3 (section 5.2.4, ‘Factor-exemplifying Q Sorts’) to select and examine the transcripts associated with each factor. For each transcript, I was able to verify and confirm the characteristics that were identified. These were signalled more strongly in some transcripts than in others, however in almost every case, there were also indications of differences and characteristics that were shared with other factors. This would not be unexpected, since no Q Sort loaded on any one factor uniquely at the 100% level, and several Q Sorts loaded relatively highly on 2 of the 3 factors.
For example, the participant associated with Q Sort 11, which loaded 71% on F1 (the second-highest), claimed not to feel any sense of competition with fellow students. This is a difference from the ‘characteristic’ F1 learner identified earlier. Similarly, the transcript of Q Sort 20, which was loaded on F2, claimed that achieving a deep understanding of material is very important, a belief that is shared by F1, but not F2. Finally, the participant associated with Q Sort 9, who loaded on F3, claimed he liked flipped teaching, a view shared with F1 and F2 learners, but not F3. Thus, as expected, there was some variability in the data, and there were several other examples like this.

Differences between the three factors were less clear-cut for statements that related to the pedagogy of flipped teaching. Thus, although F3 learners differed with their F1 and F2 peers on whether they thought flipped teaching made it easier to learn (Q Set statement 14), all study participants agreed that synchronous lectures did not add “much value” to their learning (statement 22). Finally, all but one of the participants indicated that they failed to complete some of the weekly asynchronous activities (statement 7).

To understand the reasons for these differences/agreements in attitudes and views towards flipped teaching, required a closer examination of the interviews, and this is presented next.

## 6.3 Interview Analysis -Introduction

In this section and the remainder of this chapter, I present the analysis of the interviews that I held with student participants. Interviews were additionally held (separately) with 6 members of academic staff to get their perspectives on flipped learning, and these are also discussed. Each interview transcript was carefully analysed to identify the tensions experienced by participants.

Using a similar approach to Fredriksen & Hadjerrouit, tensions were examined and categorised according to their character and similarity *(Fredriksen & Hadjerrouit, 2020)*. This was done in two stages. First, tensions that were similar in character to each other were grouped together into categories. Then, in the second stage, the categories were themselves grouped with the particular systemic contradiction that seemed most appropriate. The characterisation of tensions proceeded as follows: in the first stage, tensions were categorised based either on the activity/process that they arose from, or on a determination of their character. For example, tensions associated with learners' dissatisfaction after experiencing little or no problem-solving activities in synchronous sessions, were categorised under 'Teacher-led activities in the synchronous sessions'. Similarly, tensions associated with the extended times sometimes needed to learn from asynchronous videos, were categorised as 'Difficulties in learning from the asynchronous materials'. For those tensions that did not fit in a simple way into a singular activity/process, the categorisation was decided according to their character. For example, tensions associated with restrictions/limitations in being able to solve problems collaboratively/collectively, or for example, being unable to quickly turn to a classmate to check mutual understanding, were characterised under the more general category of "Few opportunities for collaborative working."

Once this first stage of categorisation was complete, the tension categories themselves were then grouped under one of the two primary systemic contradictions hypothesised to be accentuated by flipped teaching, which were identified by earlier research (Rubner, 2019b). These are reprised below:

1. **Teacher-led v Learner-centred learning**
2. **Individual v Collaborative learning**

As discussed in Chapter 2, these two systemic contradictions are dialectical in the sense that they each constitute a “concrete unity of mutually exclusive opposites” which condition and influence each other *(Ilyenkov, 2009, p.185).* Furthermore, such contradictions cannot be resolved in a way to fully satisfy each ‘opposite’.
In the next section I explain how I identified and classified the different tensions that were identified in the study.

### 6.3.1 Identification and Classification of Tensions

As explained in Chapter 4 (Methodology), interviews were transcribed and coded using an open coding technique *(Coe et al, 2017, p. 104)*. A total of 80 different sources of tension were identified from the interviews, and then grouped according to similarity into several categories, as described in the introductory section above. The tensions ranged from ones associated with individual complaints regarding learning activities in specific modules, to more general expressions of dissatisfaction with flipped teaching overall. A list of tension categories and tensions is presented in Appendix 7. It proved possible to cross-check and confirm many of the identified tensions with the results of an independent internal survey conducted by EEE mid-way through the 2020-21 academic year *(EEE Survey 2020-21)*.

In the following sections the tension categories are presented in tables, grouped under the primary contradiction with which they were associated. Categories that were determined to not fall under either of the primary contradictions are also listed. Tensions related to systemic/dialectical contradiction 1 (‘Teacher-led v Learner-centred learning’), are discussed first in section 6.3.2, followed by those related to systemic/dialectical contradiction 2 (‘Individual v Collaborative learning’) in section 6.3.3. Examples of tensions not considered to represent either systemic contradiction uniquely are presented and discussed in section 6.3.4. Finally, tension categories related to teachers’ experiences are shown and discussed in section 6.3.5.

### 6.3.2 Tension Categories Related to Teacher-led vs Learner-centred Learning

Table 6.1 contains the categories that cover tensions considered to fall under the Teacher-led vs Learner-centred contradiction. Table entries are listed in descending order of frequency of occurrence. Thus, tensions associated with dissatisfaction with the synchronous sessions (table entry 1) occurred more frequently than the number that occurred in connection with the asynchronous materials (entry 2). Both occurred more frequently than tensions associated with table entries 3 or 4.

| (no.) | **Tension Category** |
|---|---|
| 1 | Dissatisfaction with the teacher-led activities in the synchronous sessions. |
| 2 | Difficulties experienced in learning using the asynchronous materials. |
| 3 | Poor quality support in the use of tools mandated in learning. |
| 4 | Passing the exam at the expense of acquiring a deeper understanding of the taught materials. |

Table 6.1. Tensions related to Teacher-led vs Learner-centred learning.

Each of these tension categories will be discussed in turn. This will be followed by a discussion of tensions associated with Individual v Collaborative learning.

**“Dissatisfaction with the teacher-led activities in the synchronous sessions”**

Each study participant acknowledged that the main purpose of the synchronous sessions was to provide opportunities to engage in learning activities led by the teacher. Typically, these were expected to lead to a deeper understanding of the subject material, through for example, undertaking problem-solving tasks. Tensions arose when the sessions did not satisfy or fulfil their expectations. Dissatisfaction was expressed by all learners, regardless of the factor they loaded on (i.e., F1, F2, or F3).

The most common reasons given by interviewees in connection with this category are listed below:

- A sense that many synchronous sessions are dull, and do not enthuse or engage learners.
- Repetition: the teacher repeating information already presented in the asynchronous materials.
- Learners not being fully prepared, usually due to a failure to engage with some or all of the asynchronous materials.
- An insufficient number of exam-type or tutorial-type problems discussed by the teacher.

The following interview extract illustrates some of these points, as indicated by the highlighted passages:

*[Interviewer] "*So why haven't you found the synchronous lectures helpful?"

> *[Student]* "It depends. Like, some of the lecturers are good at uh, um giving them, but sometimes it just kind of, **I guess it feels like you're sitting there for a long time without actually going through anything**. I mean some of the lecturers take different approaches to it as well. Some of them decide to introduce new content in the synchronous ones, and some of them decide to **go back over the asynchronous content that you should have looked at**. But sometimes for whatever reason, **you might not have had a chance to look at that material yet**, which makes that lecture.. it's, well, there's not much point actually going to it if you know that they're going to be going over stuff which you're not going to have any clue about yet."

This exchange was characteristic of the views expressed by several study participants, and it reflects one of the results from the quantitative analysis: that only some of them attached much value to the synchronous sessions *(Appendix 6: Q Set statement 22: "Synchronous lectures don't have much value for me.").*

The reasons for the low perceived value, and variability in experience reported by learners can be traced in part to the design of these sessions by different teachers. Although teachers received some general advice from Faculty leadership as to how the sessions should be constructed, they were free to choose how they were implemented.

From personal experience, I know that teachers had good reasons for wanting to repeat or re-explain subject material before moving on to new topics. For example, it might have been that one or more students had asked for help with a concept or task that was a component part of the asynchronous materials. Or it might have been that an asynchronous quiz revealed a large proportion of the class misunderstood an important concept. Alternatively, it might simply have been that an insufficient number of students undertook the quiz leading to some uncertainty in the teacher's mind as to whether they were sufficiently prepared for the planned synchronous problem-solving activities. Then again, it is entirely natural that the teacher wanted to briefly recap previous material, simply to link it to new, soon-to-be-introduced material. I knew that I sometimes needed to repeat or re-explain asynchronous material for each of these different reasons in my own teaching. Either way, repetition of material would tend to leave less time for problem-solving tasks and activities, which was one of the complaints that were made. Of course, it also demonstrates a need to engage students in teachers' pedagogic motives. Further insights into teachers' perspectives on synchronous sessions are given in section 6.3.5.

The cited extract also includes one of the most commonly cited reasons for non-attendance at synchronous sessions: insufficient student preparation by not engaging with the corresponding asynchronous activities. This is supported by one of the findings in the previous chapter: that each student study participant is likely to miss at least some of the weekly asynchronous activities *(Appendix 5: Q Set statement 7: "I never miss any of the asynchronous activities given each week.")*. This is discussed further in section 6.4.5. Finally, a small number of interviewees admitted to a loss of belief generally in the value of synchronous sessions, and intentionally chose not to attend most of them.

It emerged from many of the interviews however, that not all synchronous sessions were viewed negatively. Those that were enjoyed the most were associated with two year-1 modules. Students enrolled on those modules generally regarded their synchronous sessions as being both highly engaging and interactive, in contrast to those of others. The evidence from the interview data was that the teachers leading these modules intentionally encouraged interaction and collaborative learning, partly by utilising the virtual ‘Break-out Room’ facility provided as part of the online software. To the students, these teachers seemed more enthusiastic than others, and some said that this had positive effects on their attitude and willingness to attend and engage.

**“Difficulties experienced in learning using the asynchronous materials.”**

The most frequently cited reason for dissatisfaction with the asynchronous materials was the length of time needed to understand its content. Several study participants complained about this, with a slightly higher number drawn from F3 than compared to F1 or F2. Frequently, the complaint was that some videos were simply too long. Although teaching staff were advised to create videos of 30 minutes or less, this advice appears to have been interpreted liberally, with reports that some videos were up to 1 hour long. This is significant because several students felt that learning from videos was more time-consuming than compared to traditional face-to-face teaching, as exemplified in this exchange:

> Student: “There will be lecturers that do, you know, 40 minutes of asynchronous video um, that's probably harder to digest than some lecturers do in an hour [of face-to-face teaching].”
>
> Interviewer: “So, obviously there's some variability here, but are you saying there are some videos that take longer to process and understand, than others?”
>
> Student: “**Yeah, even if they're shorter in length they still might take longer to understand**..you’re rewinding and replaying to make sure you've got the understanding.”

As might be expected, the time needed to assimilate the asynchronous video information by learners is not necessarily related to its size/length, as indicated by the highlighted text in the above exchange. The longer times that were sometimes needed, may have contributed to student’s oft-repeated complaint that flipped learning felt ‘harder’ (discussed later).

Although several study participants praised the general good availability and good quality of the asynchronous material, some claimed that certain materials were inadequate for supporting independent learning. When it was felt that they were not sufficiently clear at explaining concepts, a typical response was to look for other sources of help, for example from more knowledgeable friends and classmates, or from external online instructional-style videos. One year-3 student (an F2 learner) reported that he sometimes found better explanations on YouTube :

> “I think one of the biggest things that frustrated me was that I could go on YouTube and I could get a better video about the topic than what I [was] presented [with] in my asynchronous [video]. So it's like, I mean you may not find the whole lecture course [on YouTube] but **you will find individual things which are explained in a much better way.**“

Some interviewees openly stated that for subjects that they did not like, their goal was just to pass the module. Some of these students said they found that reading the learning materials and practising past papers was more efficient than watching videos.

The criticisms made of asynchronous materials were balanced to a certain extent by praise for them given by other interviewees. For example, one said that the videos did a good job of condensing the material down into appropriately sized “chunks”, while others stated that they were useful for revision. Significantly, a majority said they would support their retention in future years when it was hoped life returned to normal.

**“Poor quality support in the use of tools mandated in learning”** and **“Passing the exam at the expense of acquiring a deeper understanding of the taught materials.”**

The perceived poor quality of support associated with the software mandated on learners’ computers was raised a few times with one module in particular. But on the whole, it appears that support in general was perceived to be good and caused very few problems. Two interviewees also claimed that they believed that some asynchronous materials were better suited to passing exams rather than on achieving a deep conceptual understanding of subject material that they desired.

## Effects on Learners' Motivation

Flipped teaching approaches prescribe the use of teacher-led active learning techniques in the classroom, and the interviews contain example accounts from learner's when this can work well (see section 6.3.3). When these techniques are absent or are used in ways that do not meet learners' expectations, tensions can rise, but there can also be a corresponding impact on motivation. Students' perceptions of synchronous teacher-led activities and the effect on their personal motivation to study, were probed in several interviews. It is important to note that the word 'motivation' was interpreted by both interviewer and interviewee to signal willingness to expend effort in goal-directed behaviour.

Based on their accounts, students were clearly dis-incentivised from attending and participating in synchronous sessions when they were perceived to be of poor quality and failed to meet expectations. The following extract from an interview with a year-3 student is illustrative:

> "I feel like the lecturer is um, if the lecturers put together a Powerpoint and they're just going to read off the Powerpoint um, and it feels like they don't really care if we understand, well, it kind of sucks for us. Then I have almost no interest in trying hard in that module."

This, and similar accounts indicated that intrinsic interest in the subject was often impacted negatively after experiencing dissatisfaction with synchronous sessions. Although learners appeared demotivated by such experiences, they indicated that the significance of learning from the asynchronous tasks and activities did not diminish, nor did the goals of completing coursework and passing the module. They further indicated that more energy and attention was instead devoted to other areas of academic work.

Equally, of course, desire and intrinsic interest can also be sustained. For some interviewees, their willingness to engage and expend effort was strongly linked with lecturers' enthusiasm. The following snippet is an example:

> "The more enthusiastic [the] lecturer is, [it's] more likely to give me more motivation. It makes me feel I want to study it more because I can see *they care about it (my emphasis)* and their energy is sort of infectious in terms of transferring that to me. Um, but, using Electronic Methods *(pseudonymised name)* as an example, um, Dr Jones *(pseudonymised name)* is really, [and] you can tell he's really passionate about it and helping people [learn]. [But] I still find it *[the subject]* really hard and I sort of accept that his attitude is only one factor. **But yes, the better their attitude, or the more upbeat their attitude, the more I am motivated to do it**".

These examples support the observation made in Chapter 5, in which the majority of learners (regardless of factor) agreed with the statement "The attitude of my lecturers has a big effect on my motivation to study." Of course, a connection between teachers' attitudes and learners' motivation would be expected in 'traditional' (i.e., non-flipped) teaching approaches too.

Responses to tensions were not always accompanied by a diminution of interest or effort. As was noted, when learners' experienced dissatisfaction with the asynchronous learning materials and activities, they sought out other resources for help, from friends and/or the Internet. Similarly, when students struggle with particular academic subjects tensions naturally rise, but the result is not always automatic demotivation and a diminution of effort. Thus, fear of academic failure can drive the opposite reaction, and result in an increase in intensity and determination, as many of their accounts showed.

## Section Summary

It was clear that at one time or another, and irrespective of which factor they loaded on, all students experienced tensions in learning in the teacher-led (i.e. synchronous) module components. This was clearly reflected in their views, attitudes and opinions. Learners also experienced tensions in the learner-centred (i.e. asynchronous) components, with a slightly higher number of F3 learners voicing complaints and criticisms than compared to either F1 and F2. All the study participants reported experiencing considerable variability in the implementations of both synchronous and asynchronous components, across several modules. As will be discussed later in this chapter, this is reflected in some teachers' accounts of implementing the flipped teaching model.

Some students found it difficult adapting to flipped teaching. It is also evident that isolation from others and online working exacerbated and amplified the tensions they experienced, and for some there was a detrimental effect on their study routines.

Regarding the impact on academic motivation caused by the tensions associated with the 'Teacher-led vs Learner-centred Learning' contradiction, students' responses depended on the source of those tensions. It was apparent that for some learners, the character of motivation associated with their goal-driven behaviour changed. It was not possible to distinguish between F1, F2 or F3 learners, in this regard, however. In some cases there was a loss of basic intrinsic interest, in others extrinsic factors appeared to be instrumental in maintaining/increasing their effort, one most prominently being the need to pass each module.

### 6.3.3 Tension Categories related to Independent vs Collaborative learning.

| (no.) | **Category** |
|---|---|
| 1 | Few opportunities for collaborative working. |
| 2 | Poor or bad experiences working in teams. |
| 3 | Competition between learners. |

Table 6.2. Tensions related to
Independent vs Collaborative learning.

**"Few opportunities for collaborative working."**

In common with many of the tensions discussed so far, those reported in this category were also accentuated by enforced home-study. One impact of the lockdowns was, of course, greatly reduced opportunities for learners to meet each other in person. On the very few occasions when it was possible to meet up on the campus for formal learning activities, social-distancing rules meant that individuals were spaced apart by at least 2 metres. It was unsurprising that several study participants admitted that even towards the end of the second semester they knew very few of their classmates.

In each interview I explored the impact of isolation on participants' relationships with fellow students. For some, the absence of peer contact was an important factor, as shown by the following extract:

> "I think more **just to have someone to kind of talk to and consult** [with]. I think it's pretty important um, uh even if it is just a little bit, like that feeling of being completely isolated, kind of puts me off. But just being able to kind of ask and uh answer questions, it just makes me feel a bit better with understanding, you know?"

The desire expressed here: **"just to have someone to kind of talk to and consult"**, expresses the (natural) need to check her understanding. A different student put it this way:

> "I don't know if 'reassuring' is the right word but, like, having people there that you can talk to about the things you're doing, um **it's just much more enjoyable**, um, for me personally, you know? So being able to talk to your classmates about solving problems helps in some way, because if I talk to someone else and they, you know, understand it in the same way [that] I do and then it's, like, reassuring to know that, okay, I don't think I've missed anything here, rather than just relying on myself. **So it's a little bit like checkpointing your understanding with somebody else**."

These responses also express the pleasure ("**it's just much more enjoyable"**) in the ability to consult and cross-check ("**checkpointing your understanding"**) with others.

The interview data contains similar examples from learners associated with each of the three factors, F1-F3. This underscores the importance attached by students of being able to communicate and consult with each other, in and out of the classroom, and the subsequent tensions that occur when this can't happen in a free-flowing and open way. In practice, although formal opportunities for collaborative working were provided in some synchronous sessions, the experiences of study participants was quite varied, as already reported.

However, when formal collaborative learning worked well, some participants expressed their enjoyment. For example, the following is an extract from an interview with an F3 learner, with reference to the two year-1 modules that were mentioned earlier:

> "I liked very much how Dr. Jones *(pseudonymised name)* delivers [his] lectures. He is the only one who tried to connect us and made us *[do]* exercises and said that um, he would ask after the exercises to see our answers. Generally, when they *[meaning the other lecturers]* split us into groups *[referring to Break-out Rooms]*, no one talks and isn't doing anything. However, when Dr. Jones said that after the uh, the breakout rooms, he will test us to see if we have done them. He said that he will pick five, for example, people to solve the equation [and] the questions. The majority [of participants] talk [in the Break-out Room], and this is something that I really liked. Uh, I mean me and some other uh, people from my course uh, **collaborated in solving the problem**, **which I really liked**. I like collaborating with other people to solve problems and all of that."

This extract, conveying the enjoyment felt by this student when able to collaborate with his classmates (**"collaborated in solving the problem**, **which I really liked"**), is from one of the few accounts of when collaborative learning was reported to work well.

When such opportunities were not available, the online chat facility for synchronous session participants provided some compensation. I tried this in my own sessions and observed that it was used by participants to both ask questions (of me), and to answer questions posted by others. Of course, communicating via an online chat facility in this context is considered by some to be an inferior experience compared to being present in a physical classroom. The following extract, from a student relating his experience of a programming lab, is an example of this:

> "Programming in your room sometimes.. and quite sort of like, you're not quite sure where you're going wrong, and you're frantically typing in a

> chat [window] trying to see where everyone else is going, where you've gone wrong and generally struggling.”

Although it seems there were times when there was a perceived lack of formal opportunities for collaborative learning, students made their own informal ones using, typically, social media forums. Outside of class, almost all study participants mentioned that they used social media utilities such as WhatsApp or Facebook groups, for seeking help from peers.

In my own teaching, I tried to stimulate collaborative forms of activity in several of my module’s lab sessions. I did so by providing virtual breakout rooms to encourage students to work together. To manage the class size, I assigned a Graduate Teaching Assistant (GTA) to each room and monitored activity within them by checking on each on a round-robin basis. The results were patchy, with some rooms ‘busy’ with discussions about the work, and others largely quiet. While there might have been several explanations for this observation, my impression was that the ‘busier’ ones were hosted by GTAs that I knew were more strongly motivated (towards teaching) than those that hosted the ‘quieter’ ones.

Study participants reported very few formal opportunities associated with the asynchronous materials. Teaching staff mostly implemented the asynchronous components of modules in ways that largely emphasised individual, rather than collaborative learning.

In pre-pandemic times, undergraduate engineering students mainly experienced formal collaborative learning during laboratory sessions. Of course, given the circumstances, lab work this year was largely undertaken individually, however in normal times small groups of two or three students work collaboratively. The groups undertake formative learning by following scripted instructions to obtain measurements and other data. These usually require students to write and submit reports which are often credit-bearing. For many, the laboratory sessions are normally opportunities for discovery and enjoyment, as revealed by this interview snippet from a year-2, F3 participant:

> "I'm really missing labs in person, so I think I would have much more fun if I were on campus doing physical labs and soldering or building something."

Another year-2 participant, when asked about his recent experiences with classmates in lab sessions, reflected on the 'efficiencies' of face-to-face group learning compared to the purely online experience:

> "[I] wish we could just like sit in a lab together and perhaps go through some um, like course works together, because a lot of the labs [last year] had that element where you know, instead of a demonstrator explaining it to each student one by one, he would just explain it to one [person] and the other person would be like "Oh no, you're supposed to do it this way!" and then like, that way **a group would understand how things** are [meant to] work out."

These snippets capture the desire for collaborative working, expressed by many study participants. However, collaborative learning appears to be not universally seen as crucial/critical by all. As will be discussed soon, although the enforced isolation caused problems for many, a small number saw it as an advantage.

**"Poor or bad experiences working in teams."**

Tensions in this category refer to a single, compulsory module in year 2. Although this was the only module that formally required collaborative working, tensions were once again exacerbated by the conditions due to the pandemic.

In the module, students are placed into groups of five or six and are guided to produce a working design for a teacher-specified product. Under guidance from teaching staff, teams are expected to self-organise and divide up the work amongst themselves, with one member assigned as team leader. It is typical that team members are assigned individual responsibilities for different parts of the design, with each expected to produce a well-defined output. In normal times, a team would meet at least once per week, but the conditions meant that meetings were conducted entirely online.

In practice it was evident that difficulties sometimes arose, either due to personality clashes or by team members not fulfilling their responsibilities and failing to deliver their expected outputs. Sometimes, differences arose because of different expectations of standards, as this example from an F1 learner shows:

> “I think working in a team, it's actually pretty hard and we have been having less than average results and uh, I’m a little bit disappointed. But to be honest, I feel like I cannot do much to really change anything, like um, some of my team members might be like, okay if their work was worth 70 percent, they think [they] have done enough if they have done this much. Like, **I think 70 is too little**, and they think that 70 it's uh, quite a lot.”

Of course, the difference in perceptions of what represents a ‘good’ mark (**“I think 70 is too little“**) would be expected in both flipped and ‘traditional’ forms of learning.

There were also examples of communication issues that were further strained by team members working at home in different parts of the globe, in different time zones. On the other hand, there were also examples where the team appeared to work well, and interviewees reported few interpersonal stresses of any significance to them. These experiences mirrored those in pre-pandemic times, however the online format strained them further.

## “Competition between learners”

Each study participant was asked about competition between themselves and other learners. Their responses largely mirrored the findings in the previous chapter, in which F1 and F2 learners were more likely to experience a sense of competition than F3 learners. However, despite feelings of competition all said they were willing to help their classmates when asked, as the following extract illustrates:

> Interviewer: “You said you are striving to do well compared to other students, yet you are willing to help them. Do you see that as inconsistent?”
>
> Student: “Uh no, not really. You don't want to see other people doing poorly but you still want to try and uh, do as well as you can. And a lot of the times that can be seen by uh, **if you're performing better or worse than them**.”

A different participant, responding to the same question, said the following:

Student: “I believe competition is healthy, right, so if I strive to be the best student and if another student strives to be the best student, then that will only help us get better you know. So, **I've always believed in competition because it uh, kind of motivates you to do well and do better all the time**.”

Interviewer: “But are you also in competition with each other? “

Student: “Um not necessarily. But uh, I would still say that there is a competition, you know that helps us do better, right? Competing with someone doesn't necessarily mean that you don't have to help them.”

Clearly, although learners are aware they are in competition with each other, it is seen by some as a useful check (“**if you're performing better or worse than them**“), and as motivation (“**motivates you to do well**”).

## Effects on Learners’ Motivation

One of the claimed advantages for flipped teaching is the encouragement of collaborative forms of learning in the classroom. Unfortunately, these appeared to be either absent, or implemented only weakly, in the majority of modules. In general, most teachers appear not to have emphasised collective activities. This caused frustration for many, who missed the ability to easily and freely exchange ideas and thoughts on the academic material being taught.

In the synchronous sessions, the use of the online chat facility was regarded as a poor substitute for being present in person, as in pre-pandemic times, and was a further source of frustration. The absence of group-based activities, which F3 learners reported as being motivating, only added to their disappointment. However, given this, and the other reported frustrations, it was less easy to detect their impact on learners’ personal motivation to study. There appears to have been no deleterious effect, for example, on their willingness to help and support their peers, despite any sense of competition with them.

## Section Summary

A major reason for the reduced opportunities for collaborative working was the enforcement of online working due to lockdowns and social distancing. Tensions inevitably arose and were amplified when communication and collaboration, both formal and informal, were restricted. This appeared to be true for all study participants, with marginally more F3 learners affected than for F1 and F2.

Learning was, for most participants -and by extension the entire cohort- more heavily weighted towards individual, rather than collaborative study. Formal opportunities for collaboration were reportedly few and far between, although students clearly appreciated it when it was provided, and done well. It is also apparent that for some, the separation from their classmates affected them emotionally. However, not all were affected negatively by the enforced isolation; a small number adapted well to the new learning conditions.

The majority stated that their desire to help their classmates outweighed any sense of competition with them, and this did not appear to have diminished despite the circumstances. Finally, due to the limited opportunities for collaborative working, it was less easy to make any definitive conclusions regarding the impact of this particular contradiction on students' academic motivation.

### 6.3.4 Other Tension Categories

| (no.) | **Category** |
|---|---|
| 1 | Isolation and working from home. |
| 2 | Difficulties in adapting to the change in learning approach. |
| 3 | Pressure to meet coursework deadlines, prepare for exams, and timetabling issues. |
| 4 | Technical problems associated with online learning. |
| 5 | Different and inconsistent modes of communication. |
| 6 | Financial problems causing stress. |

Table 6.3. Tensions that could not be allocated uniquely to either of the identified systemic/dialectical contradictions.

The items in these tension categories were more difficult to assign unambiguously to either one or the other of the two hypothesised systemic contradictions. Nonetheless, the interviews revealed that they were not insignificant for students.

**“Isolation and working from home”**

Learners experienced significant tensions associated with feelings of isolation due to lockdown and enforced working from home. One year-2 student in particular was quite explicit about the effect (“ups and downs”) on his personal motivation:

> “University experience is obviously very different to what I experienced last year. I find myself putting in more hours working because, [and] I don't even think it's because of lockdown, because there's nothing else to do. I think it's because like, I do find myself more involved in reading more, there's a lot more videos out there, [and] there's a lot more material for me to really like, get my teeth into. **But I do find that I have, like, ups and downs of my motivation because there's no sort of stimulation of, like, social like, sort of the excitement of going into a lecture and like, wondering what's going to happen**. Because obviously, like, when your lecturers talk and they put their own spin on things..and with a video it's a lot more automated I think, in a way.”

The interview data contained several examples like this, of students struggling with feelings of isolation and forced to work online.

Another participant (F1) hinted at the effect of isolation on his personal motivation, claiming that he felt it made him ‘lazier’:

> “Uh, I guess it's just the lack of, you know, doing stuff. Like lack of labs, the lack of interaction. you know. I mean I'm more of a ‘learn by doing’ person, so not having labs, or not having the you know, the interaction, you know doing stuff.. and **I tend to get lazier at home**.”

However, for a small number of participants, the isolation from others suited them. The preference for studying alone was typically expressed as an ‘escape from distraction’, as the following example extract from a Y3 student shows:

> "For myself, I learn better alone than with people around me. **So, when I'm alone I can concentrate and get the material easier in my head than I would with other people around me, distracting me**."

**"Difficulties adapting to the change in learning approach"**

Several students reported finding it hard adapting to the weekly asynchronous-synchronous learning cycle. Those in Y2 and Y3 in particular, said that they felt they were working harder than before, as this snippet from a Y2 student illustrates:

> "I don't know why, but it feels like the workload's been increased somehow. I mean even if it is just me, or if it actually did increase, I [don't know]. But I mean, you know, that's a feeling that I definitely have, that I've been working much more, so it feels much more."

This might have been anticipated by those more used to traditional non-flipped approaches to learning. However, on further questioning, it emerged that the lockdowns and enforced learning from home were significant factors. Distractions at home often emerged as an important reason for problems, as for example in this exchange with an F3 learner who shared a house with nine other students:

> Interviewer: "Are you saying that there's just too many distractions at home?"
>
> Response: "Yes, if someone's always around doing something, yeah. So, I go down to make lunch and I'll get into a long conversation and it'll take, it'll be on whatever, and my break ends up being a lot longer than it was meant to be."

The enforcement of studying at home opened students not only to distractions, but also disrupted personal study habits, sometimes in significant ways, as exemplified in this exchange with an F1 learner:

> Interviewer: "The expectation is that you watch the asynchronous material before you attend the synchronous session. Are you able to do that? Doesn't that require quite a lot of self-discipline, to do that week in week out?"
>
> Response: "Yeah. I find it's a case of having to force myself into quite a strict timetable of doing so, um, but I do find it's doable. It's

> typically you know, ‘read this section of notes’ and ‘watch the videos’, and then there's formative quizzes, um but, yeah, I do find that to be quite manageable, yeah. But at the same time, it's putting aside so much more time because I'm more distracted at home. **Ordinarily, if I were to study in my free time, I'd, you know, I'd put myself in a library either by myself or with some friends**.”

This exchange illustrates how this learner, who was used to studying in the library, was further stressed in attempting to adapt to the new learning model. Although it is difficult to say that all students felt like this, it gives some insight into why so many complained that study felt harder under the conditions prevailing at the time.

**Tension Categories 3-6**

With the exception of one participant (an ‘F1’ learner), all the others admitted that when coursework submission deadlines approached they postponed engagement with one or more other modules. Although this led them to fall behind, they relied on podcasts of synchronous sessions to catch up. However, it was not always clear that the reasons for postponement could be linked to tensions that could be assigned unambiguously to either systemic contradiction alone.

Timetabling issues were sometimes cited as a cause of tension. For some students, synchronous sessions were scheduled for two adjacent days in the week. This meant that for modules for which the synchronous sessions were deemed to be of lower value, these learners cited fatigue and opted to not attend, and caught up by watching the recordings.

Technical difficulties using online software were experienced by some participants. Overseas students living in time zones eight or nine hours ahead of, or behind the UK experienced problems due to fatigue (either late at night or early morning). Many also reported tensions due to financial stress, and frustration with inconsistent modes of communication.

## Section Summary

Adapting to a new learning paradigm was undoubtedly stressful for some learners.

However, perhaps the most significant of the categories here -at least as far as flipped teaching is concerned- were those associated with pressures to complete their coursework. In almost all cases this was the most commonly-given reason for disengaging with weekly asynchronous-synchronous learning cycles, and this is discussed further in a later section *(6.4.5)*.

### 6.3.5 Tension Categories Related to Teacher Experiences.

Although my colleagues were not a primary focus for the research, I felt it important to interview them to gain an insight into flipped teaching from *their* perspective. Furthermore, their inclusion can be justified on AT grounds, since, by facilitating learning, their Object/motive coincides with that of the students, whose desire to acquire the necessary knowledge and skills in order to graduate meets the collective, societal purpose of producing graduate engineers. In terms of Engestrom's activity diagrams, this implies that the 'Subject' includes both learners *and* teachers.

By interviewing teachers, I aimed to inquire into learning activities within their respective modules from their viewpoint, and identify the tensions that they experienced. Between the end of teaching in the first semester and its resumption in the second, six members of academic teaching staff in EEE were interviewed. These staff members had by then each taught at least one module, and some of them would go on to teach modules in the remainder of the academic year. Note that the interviews were not accompanied by Q Sorts, and therefore no quantitative data is available.

I began each interview by asking them to explain what they saw as their teaching objectives. The objectives mentioned by interviewees were as follows:

1. To equip students with specific skills and knowledge that matched the module's published learning outcomes.
2. To enhance their students' 'value' (as they saw it) in the eyes of prospective employers.

3. To support the students in becoming more self-reliant and able to think independently using the skills and knowledge gained.
4. To help students become confident, ethically minded and critical-thinking people.
5. To successfully ‘deliver’ the module by meeting Institutional expectations and requirements (for both Faculty and Department).
6. To assess students by writing (and marking) exam papers and coursework.
7. To meet accreditation requirements from professional bodies.
8. To keep the module content fresh and up-to-date.

In AT terms, objectives 1-4 correspond to the Object of activity, which, broadly speaking, is to produce competent graduate electrical/electronic engineers. This coincides with the learners’ viewpoint of the Object, who collectively desire to become graduate engineers (see Section 2.3.1.1, p.37). As mentioned previously, the Object/motive is to satisfy the societal need for graduate electrical/electronic engineers. Thus, learners and teachers share a collective motive for the activity. As will be discussed later (Section 6.5), it is for this reason that I include teachers in the Subject node in the analysis.

Objectives 5-8 correspond to goals that each teacher strives to achieve in the activity of teaching within their own modules.

As before, the tensions identified were analysed and placed into categories according to similarity. The majority of tensions were ones associated with items 5 and 6 in the above list. The categories are presented in Table 6.4 and listed in descending order of frequency of occurrence.

| (no.) | **Category** |
|---|---|
| 1 | Assessment. |
| 2 | Synchronous sessions. |
| 3 | Pressure to conform to the imposed teaching model. |
| 4 | Dissatisfaction with imposed measures of teaching quality. |

Table 6.4. Tensions Reported by Academic members of Teaching Staff.

As before, each of these tension categories will be discussed in turn, with supporting extracts.

**Assessment**

Unsurprisingly, tensions associated with student assessment -including coursework and exams- were mentioned several times by interviewees.  These were exacerbated by the additional exams that were held in mid-semester 1, which were then immediately followed by multiple coursework submission deadlines. The teaching model adopted by faculty was intended to encourage learner-centred activities, and this applied equally to coursework. However, this did not always succeed in promoting full student participation and engagement. In one case, a lecturer set coursework that required additional learning beyond that provided by the course materials alone. To his dismay however, he found that students appeared unenthusiastic and did it only half-heartedly. As a result, the assessment marks for the coursework were quite poor overall, and he told me he was very disappointed. When asked for an explanation for their apparent lack of enthusiasm and engagement he responded by saying that students were accustomed to the idea that there is a set of course notes that contains “everything they need to know”; and that they know they will be examined on material in these notes, and they won’t necessarily do very much more:

> “They’re used to [having] a set of course notes that they can read and that gives them all the answers, um because they're quite used to that and that implies there's this specific number of things you need to know [and nothing more]. As an example, the Intellectual Property section, which I think is one of the more important ones *[topics]*, there's some really good stuff [available externally] and so I give them uh, an hour's lecture on it. And then [I expected them to] go to that website, play around, look around and explore these features. [But] I think I can guarantee [that] **virtually no one did this**. This idea of going out and reading, [say] getting a few textbooks and reading them, I don't think our students are used to that anymore. It makes me sound really old and old-fashioned, but I think giving them notes and not asking them to go and explore textbooks to find things is a big negative in them becoming self-learners and their expectations.”

This particular case signals that learner-centred learning doesn't necessarily automatically occur ("**virtually no one did this**") despite the encouragement and best intentions of teachers.

The problems associated with facilitating independent learning under flipped teaching - particularly in the synchronous sessions- was discussed separately with another lecturer, who said:

> "..**in a flipped model the focus is so much reduced on presenting material.** So a lot of the discussions we've been having..because if you're used to presenting information and responding to little bits of feedback from students, well they've got material [that] they can study on their own..and students don't want you to repeat material that's recorded in the videos, understandably. [And] if you do completely different stuff there's [possibly] too much material. [And] um, if you're wanting to respond to feedback, well, you're only really answering individuals' questions! **There's been complaints about almost everything that was done in those [synchronous] sessions**..[but] I think this is a changing role of what it is to be a lecturer, from information presenter to facilitator."

The highlighted text confirms that teachers/lecturers were well aware of the expectations of teachers in flipped teaching; they were clearly also aware of the complaints made by students' regarding the synchronous sessions, in particular. The same lecturer revealed that despite faculty's advice to teachers on how the adopted learning model should be implemented, there still seemed to be some uncertainty among colleagues as to how much support should be offered to learners:

> "[Should it be] '**I've given you enough so that you should be able to do it yourself**', or is it '**I'm going to do whatever's needed to ensure that everyone does learn, even if that is holding people's hand and dragging them through it!**' "

This extract highlights important questions facing teachers using the flipped approach: by how much and to what extent should you provide students with support, while still promoting learner-centred activities? This question is directly implicated in the teacher-led vs learner-centred contradiction that is hypothesised in this thesis. The extracts also tie in with a major source of tension raised in interviews with students, i.e., their experiences in/with the synchronous sessions. However, as pointed out by this particular interviewee, teachers have the potential to reduce tensions experienced by students by intervening to facilitate learning in a more active way. Of course, choosing to do so is likely to introduce more tensions for teachers!

But it is not only with students, that tensions associated with assessment are generated; it can happen with departmental and faculty staff too (i.e., the ‘Community’, in AT terms). Although such tensions can’t be tied uniquely to flipped teaching, having to account for, and explain, why the results did not fit departmental or faculty expectations and norms also generates tension and stress.

**Synchronous sessions**

Although the majority of interviewees expressed support for flipped teaching, all voiced concerns about poor levels of attendance in synchronous sessions, which I experienced myself in my own modules. Superficially, it may suggest that many students had chosen to adopt a minimum-effort approach to their learning. However, this could be misleading, and in fact I found little, if any evidence for it in my student interviews. It might have *appeared* that they exhibited minimal effort, when instead they were devoting a greater effort in accomplishing academic goals in other areas of the curriculum. One lecturer suggested that we shouldn’t necessarily stress about poor attendance, nor any other behaviour that lecturers might perceive as ‘minimalist’, especially given the availability of session recordings. He further argued that *not* going to a synchronous session could even be seen as rational, normal behaviour, and should therefore be accepted:

> “It's a strategy that happens in real life. It happens in your job, in your career sometimes you know, **so why try to prevent that?**”

The viewpoint that teaching staff should accept that students sometimes see attendance at synchronous sessions as optional was actually shared by a majority of the interviewees. One thought that instead of worrying about poor attendance, efforts should instead be directed towards issues that students found difficult. He said he had added further asynchronous content to his module to address specific concepts that he anticipated students would struggle with. Such actions do, of course, seek to reduce tensions that students might otherwise experience. This use of the asynchronous component as a source of additional information that goes beyond the basic replacement of lectures should, of course, be viewed as supportive of learner-centred learning.

As per the students, interviewees reported mixed experiences with online synchronous teaching. One lecturer expressed a strong desire to return to face-to-face teaching, while another reported that he had received good feedback from students. While these differences surfaced, the experience of online teaching was felt by some to be exhausting (as I found to a certain extent myself).

**Pressure to conform to the adopted teaching model**

Conforming to the adopted teaching model required module leaders to convert existing materials to meet the requirements of the weekly asynchronous-synchronous cycle. This often meant long hours learning how to create videos from lecture notes, and creating or (in some cases) repurposing online quizzes to accompany them. A further challenge was in creating synchronous sessions that engaged and enthused learners. These challenges were not trivial, and required many teachers to learn new skills in video creation and editing, which took a lot of time and effort. However, one module leader questioned the need to create videos, and expressed his concerns as follows:

> ”There is absolutely no evidence to suggest that making videos for students improves their learning um, and in fact I read an article by the director of learning at MIT Distance Learning who said that there is no evidence to suggest that any of our online tools are any better than um, a good textbook, which is shocking um, because you know, I have spent three months of my life making videos and they [the students] already have extensive notes which are interactive actually. And I think a lot of **the prescription that we're given is not founded on any empirical studies**. It's founded on opinion, and that really irritates me deeply!”

While his opinion that “**the prescription that we're given is not founded on any empirical studies**” might be regarded by faculty as unfair, he also expressed doubt that videos can be used for effective learning. According to him they are a “**passive form of learning**”:

> ”**For me, watching a video is a passive form of learning and it's never as strong as something which is reinforced through active effort**. So if you have the notes and, uh, included with the notes are problems which forces you to be active, then [that] I think, that reinforces the learning. I know that we have the quizzes after each video but they're multiple choice quizzes, and again, the knowledge that they test is superficial.”

The same interviewee expressed disagreement with the flipped teaching approach of using classroom time to practise problems. In his view, synchronous sessions should not be used as tutorial sessions; instead they should be used to discuss additional material. He also expressed strong opinions about traditional lectures, and reflecting on his recent experiences said:

> “We now know that lectures actually work, because students have the chance to interact with each other. They can get answers by serendipity apart from anything else, you know, after the lecture the students come up to the lecture and they ask questions. They gather around the desk [and] I chat to them during the break and that's part of the learning process, and I think that is uniquely absent in this online environment where you can't have you know, casual questions asked to the lecturer as he or she is leaving the room. Um, and I think that's all part of what they pay for, actually.”

This support for traditional forms of teacher-led instruction was echoed in some student interviews, and will be discussed shortly again. However, before leaving this, it should be said that this particular lecturer is highly regarded by his peers and the student cohort generally, consistently scoring highly in Unit Evaluation Questionnaires (UEQ) results. UEQs are briefly discussed in the next section.

**Dissatisfaction with Institutional measures of teaching quality**

For several years Faculty have used UEQs to establish a measure of teaching ‘quality’ on a module by module basis. A UEQ is essentially a survey tool to obtain evaluations from students on their experiences of teaching, assessment, feedback, etc. Some questions are answered by selecting a score from a Likert-like scale, while others are open-ended requiring a comment or a more discursive response. Historically, UEQs in EEE are completed by relatively small numbers of students

(typically 10-15%), however the comments are especially valuable as they can be seen as representative of wider issues or problems with the module.
The use of UEQs as a measure of ‘quality’ is widely regarded as dubious by many EEE teaching staff, and those interviewed indicated they were expecting more than the usual amount of negative feedback from students this year. Some added that they already felt overstretched and under pressure. As one put it when asked about how he would respond to pressure to improve his teaching in the face of poor UEQ results:

> “We know that teaching is the ‘bread and butter’ of this university [and] I believe that that's probably the case from a purely financial point of view, but then of course what do I do? Do I steal from my research time, or do I start doing my administration in a way that's disgusting and induce the wrath of students in another way?”

Two of the interviewees mentioned negative feedback as a perennial source of tension. “It hurts!” said one.

**Other Tensions mentioned**

Other tensions mentioned were related to the Institution’s Virtual Learning Environment (Blackboard). Its ‘single-click and select’ user interface can be a drag on productivity, especially when using it to perform a ‘heavyweight’ operation such as creating a new module. As a tool, the Blackboard system is well-known for being a source of tension, not only for students and teaching staff but also other academic-related members of the community.

## Section Summary

From the interviews with teachers, it is apparent that many of the tensions mentioned as being significant were those associated with the synchronous sessions. It is clear that there was some variability in how teachers implemented them, and this is mirrored in the interview data with students. That some teachers accept that attendance at synchronous sessions is optional, would appear to undermine flipped teaching, which views classroom teaching as an opportunity to use collaborative, active-learning techniques. Unfortunately, several students also see these sessions as optional. Some teachers appear to hold different views on how to implement flipped teaching, with some embracing and supporting the role change from presenters to facilitators of learning, but others resisting it. These different viewpoints led to tensions that can be linked with the teacher-led vs learner-centred contradiction. Finally, it was noticeable that tensions and problems associated with individual vs collaborative learning were not raised as particular concerns.

## 6.4 Discussion

In this section I draw together some of what I consider to be among the more important points from the preceding sections, and add further observations gleaned from the interviews. I begin by first making some remarks about the most significant contextual factors that affected the study. I then present some student responses to questions about flipped teaching in general, and whether or not interviewees thought that it should be retained in the future. I finish by briefly discussing what is arguably the most serious factor that potentially undermines flipped teaching: when learners do not engage with, or undertake, the asynchronous tasks and activities.

### 6.4.1 Uneven Implementation of Flipped Teaching

As noted in Chapter 1, the Faculty's response to the pandemic was to instruct teaching staff to replace face-to-face teaching with a fully online Blended Learning model that incorporated flipped teaching. This resulted in the synchronous sessions and asynchronous content becoming the core structural components of each taught module.

However, inconsistent and varying implementations resulted in a varied experience for learners. With the synchronous sessions, it appears that while some teachers actively provided opportunities for collaborative working, others did not. Those students who did not attend synchronous sessions relied on podcasts and on the asynchronous materials, resulting in (for them) a largely individual, rather than collaborative, learning experience.

In sum, the lack of opportunities for collaborative learning may explain in part why tensions associated with the ‘Individual vs Collaborative learning’ contradiction surfaced only marginally. Thus, flipped teaching and learning largely meant primarily an individual, and not a collaborative learning experience for most students.

### 6.4.2 Online Teaching Masking Flipped Teaching and Learning

In the interviews, several tensions were uncovered that were arguably due more to problems associated with online learning in general, rather than flipped teaching in particular. These had the effect of ‘masking’ and/or further accentuating tensions that, from a reading of FC literature, might be anticipated with a flipped approach alone. For example, some student participants struggled in their attempts to fully utilise formal collaborative learning opportunities, few as they were. A complaint made by these student interviewees in this respect was the inability to quickly turn to a classmate and discuss or ask about aspects of the material being discussed by a module leader. In pre-pandemic times, this was deemed by some to be especially valuable during, and/or immediately following live lectures. By contrast, the online experience was judged to be inferior, with the online chat facility felt by many to be a poor substitute. The inability to quickly visually check if students were engaged was frustrating for some teachers, as one put it:

> “The chat function works reasonably well but you know if you get 10 people chatting, uh textually, then that feels like quite a good response. But in fact it means 190 people might be asleep and because most of them don't have their videos on..”

For their part, some students reported feeling reticent in directing questions to the lecturer in an online environment. As one put it:

> "Zoom is a kind of format where if there's 100 people and one person speaks, it's very hard to give your input without looking as if you're **interrupting** them."

On the other hand, the interview data occasionally contained counterexamples where the online format suited other students very well. For example:

> "For me, I found that the, the um, **synchronous sessions this year have been so good**, like above and beyond what a lecture can ever provide. Because you're not in a room full of 100, 200 people you know, even 10 people, you know, and you've got this sort of anonymity and isolation where you can ask questions. And not really feel like you're perturbing the class and I think it's only helped."

For new students, for whom this was the first year attending University, responses to questions about their experiences with flipped teaching sometimes appeared to be conflated with online learning. In other words, to them, flipped teaching *was* online learning. Arguably, this shouldn't be surprising given that they had no prior university learning experience with which to compare against. Responses from students who had begun their academic study one or two years before, were, understandably, better able to distinguish and compare their contemporary experiences with earlier, pre-pandemic ones.

### 6.4.3 Recordings of Synchronous Sessions

As discussed below, several reasons were given by participants as to why they did not attend synchronous sessions. This might have been expected to disrupt the weekly learning cycles, leading to students falling behind. Teachers, for their part, recorded sessions and made them quickly accessible, cognisant that absentee learners would use them to catch up. The disruption to learning that might ordinarily have occurred was mitigated by the availability of the recordings, and many students relied on these to catch up. Arguably, their provision 'saved' the blended learning model adopted by the Faculty.

## 6.4.4 Retaining the Flipped Approach

Students were also asked about the idea of retaining the flipped approach but converting the synchronous sessions to face-to-face ones. While some thought it a good idea and were supportive, several more said they prefer the traditional approach. When asked why, these students said that one of the advantages was the opportunity to question the teacher while he/she was introducing material. The following is an example exchange:

> Interviewer: "Looking forward, um it might well be that students in year two now, and who will be going into year three in September, may find that the year three asynchronous videos are retained, i.e., that they will be expected to watch the asynchronous videos and then follow up with the synchronous sessions, which will of course then be face-to-face, and not online. Do you think it could work?"
>
> Student: "Um, I'd say I wouldn't prefer that, um that's a personal opinion and the reason I choose to justify that is because um, the asynchronous videos essentially explain the material to you. And the synchronous sessions are kind of tutorial questions. Um, I feel like it would reduce almost all the face-to-face interaction to tutorial sessions and that sometimes takes away, I think, **the joy of actually attending a lecture** and engaging with the lecturer while he's explaining a concept to you. So that's something that I thoroughly enjoyed, like when a lecturer was explaining something someone would randomly raise a hand and say "Oh wait! I didn't understand that!", and then it would instantaneously be corrected or explained. Sometimes you might not have thought [about] it in that particular way [that] the other student thought. Or just the fact that you're interacting and it's sort of like a community, study experience, [rather] than just a one-on-one. I think that that really adds to the experience, that sense of um, being in the community, and **hearing somebody else ask a question that you might not have thought of, which might be very relevant**, [is] very important."

The "**joy of actually attending a lecture**", and "**hearing somebody else ask a question that you might not have thought of, which might be very relevant**", are striking arguments in favour of 'traditional' lectures, and against the core concept of using classroom time mainly for collaborative problem-solving activities, which is a hallmark of the flipped approach. This extract corroborates and complements similar contributions made by other study participants. Put another way, it is an example of voiced support for traditional teacher-led instruction, and it is significant for the FC because flipped teaching intentionally reduces opportunities like this.

### 6.4.5 Undermining Flipped Teaching and Learning: Non-Attendance at Synchronous Sessions

As discussed before, non-attendance at synchronous sessions potentially undermines the claimed advantages of flipped teaching and learning. In fact, non-attendance at one or more sessions was admitted by all participants. While this would seem to be a serious failing, the simple availability of session recordings mitigated its impact, and as already mentioned, this likely 'saved' the adopted teaching model. There were several reasons given for non-attendance by students, as discussed earlier.

Non-attendance at synchronous sessions did not necessarily result in complete abandonment of the weekly asynchronous-synchronous learning 'cycle'. However, abandonment often did occur, albeit temporarily, and students cited the pressure of deadlines as the main reason. In fact, almost all respondents explained that when more pressing demands approached -typically credit-bearing coursework deadlines and mid-semester exams- weekly cycles were postponed. Students were specifically asked about their reasons for non-attendance. The following extract is typical of many responses:

> "It's uh, when the deadline approaches, all you can think about is "I gotta get this work done!", you know, and um, the idea of wasting mental energy trying to learn something else is um, [I don't know if] 'scary' is the right word, but it's worrying. It's a difficult thing to be like "Okay, I'm gonna pile more work on myself now, I'm gonna make **my life even harder**" you know, [instead] you can just say "No, I'm just gonna do this work [now] and get it done by the deadline and then I can come back and do this [at] another time."

The argument for temporary postponement of the weekly learning cycle to avoid making "**my life even harder**", is entirely reasonable, and (as was mentioned earlier) accepted as normal behaviour by some teachers. However, one of the most important advantages touted by proponents of flipped teaching is the use of classroom time for active learning techniques, i.e. ones that involve the active participation of learners. Simply stated, by not attending synchronous sessions, students are missing out and potentially disadvantaged. While this may be true in principle, the evidence suggests such techniques were not used consistently, or *were* used, but not always to good effect (except in a small number of cases, i.e., the two year-1 modules mentioned in section 6.3.2). Where they were not used, relying on session recordings for catching up would seem reasonable. However, where they *were* used, and given the observation made earlier that watching videos is arguably a passive experience, it could be said that session recordings do not provide an effective mitigation strategy. This would appear to be a fundamental dilemma for the FC.

### Section Summary

The pandemic and the consequential wholesale transition from classroom-based to online learning forced the introduction of a blended teaching model, at the heart of which were flipped teaching methods. At the same time, the restrictions imposed by online learning and the uneven implementation of the model obscured many of the potential advantages advocated for these methods. It is also clear that the FC can be undermined by other factors, as outlined in the previous section. Irrespective of these, and the pandemic overall, it may yet be possible to implement flipped teaching in a way that retains its most readily identifiable features and satisfies all learners. This will be discussed later.

## 6.5 Analysis

In this section I analyse the findings using the framework of AT and Engestrom's activity diagrams. The goal is to develop an analytic understanding of how flipped teaching mediates learners' subjectivity and motivation, and thereby address my main research question.

I begin by considering how the activity of learning electrical/electronic engineering is represented in an activity diagram. I then show how each systemic contradiction identified by the research is depicted. Then, taking each systemic contradiction in turn, I discuss the associated tensions and findings using supportive interview extracts where appropriate. I also include a discussion of how the tensions might be alleviated.

### 6.5.1 Recap: AT Model

As explained in Chapter 2, my analysis uses the AT model due to Engestrom, which is reprised in Figure 6.1.

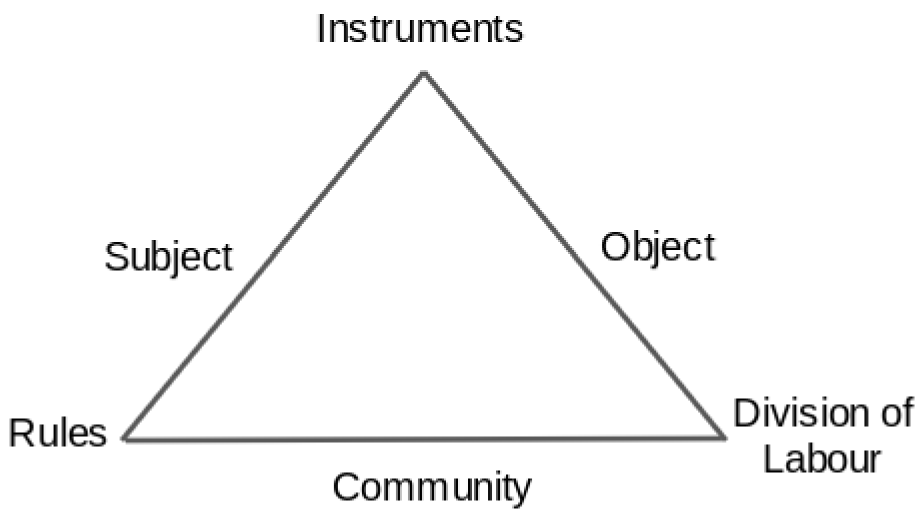


Figure 6.1. Activity System diagram (due to Engestrom).

To recap, the nodes of the model are as follows:

- In general, in AT educational analysis, ‘Subject’ is usually taken to mean the module’s cohort of learners, or a subgroup of them. However, here I also include teachers/lecturers, on the grounds that their Object/motive essentially corresponds to that of the students.
- ‘Object‘ means the collective motive of the activity from the viewpoint of both the learners and teachers/lecturers. As discussed in Chapter 2, the ‘Object’ is distinguished from objectives or goals which typically relate to specific learning outcomes. Therefore, ‘write a program in C’, ‘complete the Digital Systems coursework', 'pass the Circuit Analysis exam’, 'pass the Electronic

Materials module', etc, are all examples of goals at which actions are directed. The ‘identity’ of the Object is discussed shortly.

- ‘Instruments’ are the tools and resources that Subjects use in learning, for example the materials that constitute both the synchronous and asynchronous components of modules.
- ‘Rules’ shape and determine patterns/norms of relations between Subject and the other nodes within the Activity System. The most important rules are those associated with the norms and protocols of flipped teaching, which, in this study, are subsumed by the blended learning model adopted by faculty.
- The ‘Community’ consists of categories of people that have a direct interest in the outcome of the activity. This includes academic staff, (both support and teaching), administrative staff, and the communities that the Subject belongs to (including family).
- ‘Division of Labour’ represents roles within the activity, for example the roles played by students in the activity, and also those played by teachers/lecturers and their assistants.

In AT analysis it is important to clarify the Object in the activity under consideration and avoid any ambiguity in regard to its identity. From the learners’ perspective, the goal/Object might be articulated as “become a graduate engineer”, or “graduate with a good degree”, or similar. Teachers’ perspectives on the Object of activity are aligned with this, as was reported earlier in section 6.3.5.

Having identified the Object/motive, the following sections examine the Subject’s activity mediated by their relationships with the Instruments, Rules, Community and Division of Labour. A particular focus is placed on the tensions that were identified earlier, and which arise in these relationships on multiple levels, i.e., within and between nodes of the Activity System, and between other Activity Systems. I begin by showing how each systemic/dialectical contradiction identified by the research is represented using activity diagrams.

### 6.5.2 ‘Teacher-led vs. Learner-centred’ Learning

Taking tensions associated with ‘Teacher-led vs. Learner-centred’ learning first, I interpret these as manifestations of a dialectical contradiction between the goal-directed activities of teachers and learners, as reflected in the Division of Labour within the activity, overall. This is depicted in Figure 6.2.

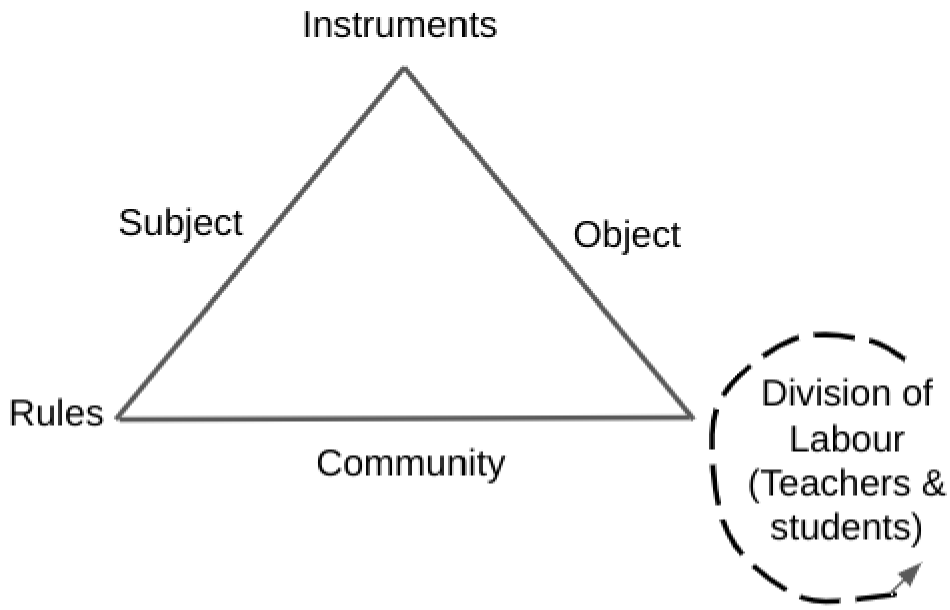


Figure 6.2. Activity System Depicting Systemic Contradiction ‘Teacher-led vs Learner-centred’ Learning.

Note that this mirrors the conclusion reached by Fredriksen and Hadjerrouit in their study of a flipped mathematics classroom, who stated that “that both [teachers and learners] need to constantly balance their practices in the teaching-learning interaction process in a dialectical and reciprocal manner [26].“ *(Fredriksen & Hadjerrouit, 2020, p. 16)*.

As already discussed, the FC imposes role changes for both teachers and learners with regard to learning subject matter content: teachers are expected to act more as facilitators of learning through its application, while learners are expected to assume more responsibility for its attainment. Evidence was presented in earlier sections of both teachers and students who either resisted these role changes or accepted and (in some cases) embraced it. As was reported, some teachers debated the extent to which they should go in supporting learners, while still promoting learner-centred activities.

Amongst learners, the tensions explained by this contradiction might be expected to be more acute amongst those who expect the teacher to use directed-teaching methods *("tell me what I need to know")*, and who resist the shift towards more learner-centred methods *("help me find out for myself")* which are intentionally emphasised by flipped teaching. The quantitative analysis in Chapter 5 identified learners associated with factor F3 as being those most resistant, even though they represented a minority of study participants. One of these learners was quite explicit in expressing her need for instructional guidance:

> "**I find it a lot easier to do things when you tell me what to do as opposed to doing them sort of by myself**. I need guidance rather than just throwing stuff at me, so [saying] 'Here, get on with that, and learn that and that!', yeah, [its] not my style."

The tensions generated by this contradiction, as experienced by learners, manifested themselves between Subject and the other activity diagram nodes, and these are discussed next.

**Tensions between Subject and Rules**

A majority of learners did appear to tacitly accept the idea that a greater responsibility for learning would fall on their shoulders. That they found it difficult, requiring in some cases dramatic changes in personal study routines and increased self-discipline (for example in ignoring distractions, etc), may also explain why so many students felt it was hard work. As discussed earlier, the associated tensions can be partly blamed on enforced isolation during lockdowns, etc, and not flipped teaching alone. As also noted, a small minority saw it differently, and despite being cut off from social contacts, responded positively and found it easier to acclimatise themselves to the changed conditions and expectations demanded.

**Tensions between Subject and Instruments**

In order to successfully orient themselves to the adopted teaching model, learners relied on access to good quality asynchronous content and supportive teacher-led activities in synchronous sessions. Tensions naturally arose where these weren't evident and/or failed to meet expectations. The interview data showed that there was a significant number of complaints under 'Dissatisfaction with the teacher-led activities in the synchronous sessions' and 'Difficulties experienced in learning from the asynchronous materials'. In activity diagram terms, these types of complaint appear as tensions between Subject and Instruments, even though their origins can be traced to the systemic contradiction depicted in Figure 6.2. The use of Zoom software within synchronous sessions introduced new stresses for teachers and learners alike, struggling to use features such as the 'chat box'. This is an example of the introduction of a new instrument into an Activity System, causing new tensions and affecting, in consequence, the evolution of the system.

The ways in which students responded to the tensions varied. Interviews revealed that dissatisfaction with the activities in synchronous sessions would often disincentivize them, leading to some opting not to attend and rely mainly on asynchronous content instead. In some cases this appears to have resulted in a shift of focus away from striving for deeper learning (e.g., a mastery approach) and towards obtaining a passing grade (e.g., a performance approach). Interview data frequently showed students also looking for other, external (Internet) sources of help, for example YouTube or their fellow classmates, when experiencing difficulties.

**Tensions between Subject and Community**

The work of faculty staff, such as those involved in academic support, is often unseen by students. It can, nevertheless, impact significantly on their academic learning. This was particularly the case for timetabling, which is a faculty responsibility. The scheduling of activities, particularly synchronous sessions and coursework deadlines, were behind many of the complaints made by students. Some study participants revealed that they habitually missed certain synchronous sessions because they were scheduled at the end of a full day, following several other activities. And as already mentioned, most learners tended to temporarily disengage from the weekly learning cycle, especially when coursework deadlines approached. This was most acute later in the semester, when several were due at the same time.

**Alleviating the Tensions**

The first approach one might think of to reduce the tensions between Subject and Rules and Subject and Instruments, would be for teachers to devote more effort and energy in supporting active learning in the classroom. Of course, this is easier to say than to do, but it was undertaken by some teaching staff, as reported. As noted earlier, student's motivations are linked to judgements regarding teachers' attitudes, dispositions and perceived enthusiasm. Unfortunately, there were only two modules in which students reported higher levels of engagement and activity.

Teachers could also improve the quality of asynchronous materials where this was deemed to be deficient in some manner. In fact some teachers did respond in this way, by providing additional weekly 'drop-in surgery' sessions to students, as well as additional asynchronous materials.

Perhaps surprisingly, alleviating tensions caused by timetabling issues, may actually be harder to achieve. Although timetabling might appear a mundane task, with cohorts of nearly 300 students this is already extremely challenging. Similarly, avoiding the 'bunching' together of coursework submission deadline dates has always been problematic, unless deadlines could be delayed until the end of the semester, or later.

## 6.5.3 'Individual v Collaborative Learning'

The second systemic contradiction, 'Individual v Collaborative learning', arises as a further consequence of flipped classrooms. In activity diagram terms, I interpret the associated tensions as manifestations of a dialectical contradiction within the Subject node (i.e., between individuals and their classmates). This is illustrated in Figure 6.3.

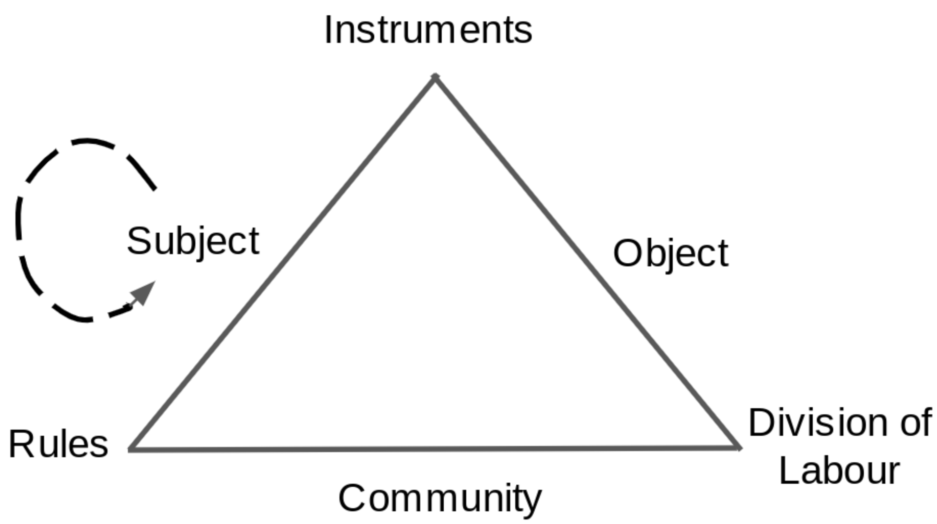


Figure 6.3. Activity System Depicting Systemic Contradiction
'Individual v Collaborative Learning'.

In principle, tensions associated with this contradiction are accentuated when collaborative forms of learning are desired (by learners) but are absent; or, *are* provided, but in ways that are restricted or limited. Collaborative learning might also be thwarted or resisted by those learners that for personal reasons do not wish to participate and/or prefer independent/solitary study. The interview data contained examples of each of these cases.

**Tensions between Subject and Rules**

As several students indicated, the ability to discuss learning topics and cross-check understanding with their peers is highly valued, especially because it can sometimes lead to deeper insights and understanding. As discussed, implementations of the adopted teaching model often limited such opportunities, especially real-time ones. Some students simply stated that they missed learning with others, citing experiences in pre-pandemic times. Overall, a majority expressed a preference to learn with others, although as noted, there were also a few learners who prefer individual/solo study.

When teachers did provide collaborative learning opportunities, typically in the synchronous sessions, they sometimes failed to work in the ways expected. Although the limitations of online participation clearly contributed to disappointing outcomes, there was also evidence of a reluctance to participate on the part of some learners. I experienced this in my own teaching, including in pre-pandemic times.

Arguably the highest risk to the success of formal types of collaborative learning in general, is students' failure to complete the required preparatory out-of-class learning (essentially, the asynchronous activities). The interview data contained several examples of when students failed to attend synchronous sessions for this reason.

**Tensions and Competition Between Individuals**

Regardless of whether formal opportunities for learners to work together are provided or not, it is apparent that some learners prefer to learn individually and resist collaborative learning. As noted earlier, this was manifested in one module, where some students reported difficulties with other team members.

The desire amongst students for social forms of learning -formal or informal- appears to be stronger than any sense of competition between them. High levels of competition between individuals engaged in the same activity in, say, a workplace environment, might result in a reduction in the help offered to others. This might be due perhaps, to feelings of enmity, or because of a sense of not wanting to give others a perceived advantage. As mentioned earlier, the interview data revealed that although students were aware of their position (in terms of marks) in the class, feelings of enmity do not appear to have surfaced, as the following extract further illustrates:

> “I'm not hugely bothered by being competitive like at this stage, you know. Being a student, I feel like there's not particularly room to be competitive. I’d rather help other people, and other people help me. Yeah, a bit of community spirit! Because it's a trade-off, because I'm asking them questions and they're asking me questions back.“

**Alleviating the Tensions**

Given that individuals often have different learning preferences, reconciling and alleviating these tensions to satisfy all learners is likely to be very challenging. The interview data shows that while most desire collaborative learning, some still prefer to work in solitude. But for teachers, this is not a simple, binary question: some students desire/require different amounts of help, some more than others. Furthermore, the particular approach needed will be different for modules whose character is more 'theory' than 'hands-on'. As Barab et al concluded in their study, careful consideration is required in setting up flipped classrooms to tailor them to learners' specific needs *(Barab et al, 2002, p. 40)*. Of course, with class sizes of 300 or more, the challenge of alleviating tensions and fully meeting learners' needs might prove difficult to achieve.

## 6.5.4 External Factors

The interview data also revealed tensions that affected learners sometimes had an external origin. These took the form of pressure from family, and/or the demands of a part-time job or commitments to other, non-academic pursuits. These sources can be modelled using AT by considering that individuals participate in multiple, interconnected Activity Systems, reflecting the connectedness of his or her life. An example representation is shown in Figure 6.4.

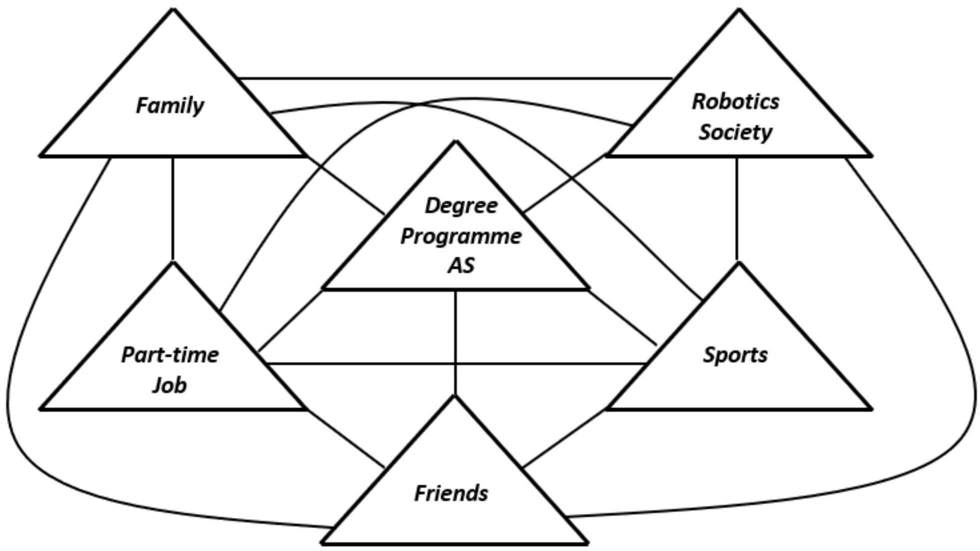


Figure 6.4. Interacting Activity Systems

Figure 6.4 depicts a set of interconnected Activity Systems (ASs) for a hypothetical learner who has a family, friends, a part-time job, and interests in sports and robotics. Note that the interconnections shown do not distinguish between nodes within each AS. An important inference is that a temporarily leading goal in one AS can affect activity in significant ways in the others, including, of course, the postponement of weekly learning cycles demanded by flipped teaching. Figure 6.4 offers a visual explanation of why nearly all learners appear to occasionally (temporarily) disengage from the weekly asynchronous-synchronous learning cycle. Thus, when the pressure of deadlines in one AS increases significantly, learning in the others may suffer in this respect.

## 6.6 Limitations

Before concluding this chapter, I draw attention to arguably the most important factors that influenced the analysis. This includes the choice of interview extracts selected to support discussion points and draw conclusions, and the use of AT diagrams as a visual aid in discussing tensions and contradictions. The discussion here centres mainly on students' interview data, rather than on teachers' interviews which by comparison tended to be more open-ended in character.

### Interview Data

As discussed in Chapter 4, with interview analysis the researcher must remain aware of potential methodological risks and problems, such as the power relationship between interviewer and interviewee, the projection of the self, and the truth and authenticity of the accounts given *(Nunkoosing, 2005)*. These and other issues are legitimate concerns in qualitative research, and are no different here. In attempting to mitigate these concerns, my objective was to build an *enabling* relationship with each interviewee. Essentially I wanted to have conversations with them that were equitable and allowed for the exploration of their given answers, when required. This required sensitivity to the speed and pace of the answers given to questions, while at the same time acknowledging the limits and boundaries of what he/she wanted to reveal during questioning.

The student interviews were semi-structured in nature, such that the content and direction of the questions was guided largely by their responses to the Q-Sorts. All the interviews were conducted online, and only commenced after a brief recap of the purpose and expectations, and the Consent Form had been signed. At the start of each interview, participants were reminded of the voluntary nature of participation and their freedom to withdraw at any time *(Participant Information Sheet; Consent Form)*. Despite this, there would be no guarantee, of course, that interviews would be free from the methodological issues mentioned. Students were aware that my goal was to seek an understanding of the tensions experienced by them, and the connection with their personal motivation. As such, I have selectively used extracts from student accounts that provided evidence to support the theoretical connections that were hypothesised to exist. Regarding the authenticity of accounts, it was possible in some cases to corroborate the accounts given by students with (anonymous) others, and with other sources, for example the EEE departmental mid-year undergraduate survey *(EEE Survey 2020-21)*.

## AT Diagrams

As discussed in Chapter 2, the AT diagrams used to model activity are limited in certain respects. Although they are helpful in identifying the structural contradictions within and between nodes in activity, by being 'static' diagrams, they hide much of the dynamic and micro-scale actions that occur as goal-directed activities are undertaken. Nor do they show the trajectory and evolution of the activity system, or the nested activities within it. Furthermore, also missing from the diagrams are elements of what Roth has termed the "agentive dimensions of activity, including identity, emotion, ethics and morality, or derivative concepts, such as motivation, identification, responsibility, and solidarity" *(Roth, 2009, p. 53)*. The practical effect of relying solely on the diagrams for analysis, thus limits the extent to which an understanding of the regulatory effects of subjectivity and motivation can be built. At the end, one can say that their value in the analysis was limited to providing a visual way to examine and contemplate the hypothesised systemic contradictions and their relationship to tensions experienced by learners.

## 6.7 Summary and Conclusions

An AT framework has been used to explore the mediation of academic subjectivities and motivation by flipped learning, through the prism of the tensions that learners experienced and reported. These tensions were categorised and grouped appropriately with each of the two hypothesised systemic/dialectical contradictions. This enabled a structured approach with which to examine and analyse learners' views, opinions, dispositions and motivations in their goal-directed activities. Approaches to the alleviation of the various tensions have been considered.

There is no doubt that tensions were exacerbated in part, due to the restricted learning conditions caused by the pandemic, i.e., by lockdowns, enforced learning at home and social distancing. Tensions were also exacerbated due to the varied ways in which teachers implemented flipped teaching. Interviews with teachers confirmed that the most frequently mentioned tensions were those associated with the synchronous sessions; those interviews also confirmed reports (by learners) of the variability in their implementation by teachers. Learners regulated their actions and activities through their capacity to adapt to the conditions, and through self-discipline.

The interview data can only be said to provide *some* support for the existence of the three collective subjectivities that were identified as factors in Chapter 5 (i.e., F1, F2 and F3). It is difficult to conclude with certainty that flipped learning impacted one factor more than another. This was because the association of these three factors with individual tension categories was only signalled weakly in the data. For example, although F3 learners would be expected to be more resistant to flipped learning than F1 or F2 learners, this appeared to be true, but only marginally so.

Regardless of which factor they loaded on, perceptions of teacher's attitudes, energy and enthusiasm (or lack thereof), particularly in synchronous sessions, clearly impacted on some learners' beliefs and, in turn, on the direction and intensity of effort they expended in goal-directed activities. Synchronous sessions that succeeded in enthusing and engaging learners the most, appeared to be ones that used genuinely collaborative, active learning techniques, coupled with enthusiastic teachers. Those that did not, were ones that held less value for students, who in many cases chose not to attend and relied instead on recordings to catch up. However, irrespective of how well (in students' eyes) flipped teaching was implemented, the risk remains that students might disengage with the weekly learning cycle, for whatever reason. This is a dilemma for teachers for which there does not appear to be a straightforward solution.

The impact on learners' motivation of the tensions associated with the Teacher-led vs Learner-centred learning contradiction, was examined. For many, the result was partial disengagement with the weekly learning cycle, in particular attendance at synchronous sessions. For some, this was accompanied by a diminished intrinsic interest in the subject. However, for tensions associated with the 'Individual v Collaborative learning' contradiction, the corresponding impact on motivation was less discernible and inconclusive.

Finally, the restrictive conditions also hampered the many ways that learners engage in social forms of learning outside of formal contexts. As discussed in the next chapter, a potential fruitful area of future research would be to investigate how these informal forms of learning might be exploited by implementations of flipped teaching.

# Chapter 7 Conclusions

In this chapter I discuss how the research results help to furnish answers to my main research question, which is reprised below:

**How are engineering students' academic motivations and subjectivity mediated by flipped teaching?**

Here, I draw conclusions and consider the broader picture and the implications for further work and exploration. First, in section 7.1, I present a brief recap of the purpose of the research. Then in section 7.2, I summarise the findings in terms of the effects that flipped teaching had in mediating student subjectivities. In section 7.3 the mediation of student academic motivation is considered. Then in section 7.4, I provide a summary and discuss the study’s contribution to knowledge. I also discuss its limitations. Finally, in section 7.5, I provide some personal reflections and suggestions for future research into the use of flipped teaching within undergraduate engineering programmes in Higher Education.

## 7.1 Recap of the Research

This research took a case study approach to investigating the role of undergraduate engineering flipped teaching in mediating student academic motivation and subjectivity. In outlining my theoretical approach in Chapter 2, I contended that theories of motivation are more helpful in understanding human behaviour if they also draw on the social and cultural context, rather than focussing exclusively at the level of individual cognition. In the flipped classroom, in which collaborative and social forms of learning are intentionally encouraged and promoted, I argued that a sociocultural approach was therefore also needed, and this led me to AT. A consequence of adopting such an approach is that learners’ subjectivities are foregrounded. These subjectivities were captured operantly, using Q methodology.

My literature review revealed that although AT has been used in educational studies in HE, its use in analyses of FCs are rare, and appeared to be non-existent for engineering FCs. This is a gap which this case study has sought partly to address, within the overall aim of contributing to a better theoretical understanding of FCs, generally, and thereby improving their design and implementation.

Within an AT analytical framework, tensions and contradictions are a natural focus of inquiry, and it was hypothesised that flipped teaching would accentuate two contradictions in particular: ‘Teacher-led vs Learner-centred’ learning, and ‘Individual vs Collaborative’ learning. As noted in my literature review in Chapter 3, these two contradictions were also identified separately in a small number of studies of FCs that also used AT. Those studies involved single course modules, whose focus was on using the identified contradictions to explain the dynamics of the activity systems under analysis. In the research presented here, I have gone further and attempted to link the contradictions to learners’ academic subjectivities and motivations in order to examine their mediatory effect. A further difference is that the data used is based on the experience of learners in FCs in multiple modules, from across an entire curriculum. This research has also examined the reasons why learners did not complete/engage with some of the expected preparatory pre-class learning activities, a problem that appears to be common in most FCs.

The tensions reported by learners were categorised and analysed according to which of the two aforementioned contradictions they were associated with. The unfortunate intervention of the pandemic, and the subsequent adoption of an exclusively online learning model, exacerbated these tensions, as I documented earlier.

As stated in the introduction to the thesis, the original plan was to collect data from a single year-1 module taught using flipped teaching. It was envisaged that an ethnographic approach would be used, involving both classroom and laboratory sessions, but this had to be abandoned. This was a pity, as it would have enabled close observation of the moment-to-moment details that are often lost by relying on recollections and memories alone. It would likely have provided a means to examine the subjective experience of learning in a FC, in fine-grained detail. As the pandemic recedes and the restrictions on learning are lifted, this is a potential near-future study that could commence, as originally conceived.

The pandemic was a major new condition, which also became an opportunity. Students had to quickly accustom themselves to a largely new and unfamiliar learning paradigm. On the one hand, this introduced additional tensions to those caused by flipped teaching alone expected in normal times. But on the other hand, it had the effect of providing the research with data from a wider range of sources than originally envisaged. The result was a research study whose scope of inquiry was a much broader landscape of flipped teaching, spanning across all undergraduate years, and which in turn produced a rich set of data.

In the next section I summarise the results in terms of the impact of flipped teaching and learning, beginning with student subjectivity.

## 7.2 The Impact of the FC on Students' Academic Subjectivities: Summary and Discussion

The quantitative analysis of the data, reported on in Chapter 5, uncovered three different, collective subjectivities (or factors), that I labelled F1, F2 and F3. There, I profiled their differences and similarities in detail, and later found evidence to support their characteristics in the follow-up interviews. While these profiles were informative, and reflective of the tensions experienced by learners, many of the identified characteristics are quite general in character and are not focussed on flipped teaching and learning alone. This was partly because they reflected the broad range of statements that the Q-Set itself was composed of. Thus, it was found that only F1 and F3 learners appear to value the understanding of taught material and the passing of each module, as being of equal importance. It was also shown that F2 learners appeared to be more focussed on passing modules, without necessarily acquiring a good understanding of the subject material; they adopted a correspondingly more ‘strategic’ approach to learning, at least compared to F1 or F3 learners. There were further differences between each of the three ‘types’ in their apparent level of self-confidence, with F1 learners appearing to be more confident than their F2 or F3 peers. General attitudes and dispositions towards flipped teaching specifically, also showed differences: F1 and F2 learners were more agreeable with the notion that flipped teaching made subject material easier to learn, compared to their F3 peers. It should be remembered, of course, that these characteristics are ideal in the sense that they represent what might be termed '100% pure loaders' on each factor. In practice, the majority of students 'loaded' on more than one factor, thus blurring the data to a certain extent.

Regarding specific aspects of flipped teaching, there was widespread dissatisfaction with the teacher-led activities in synchronous sessions/lectures. As discussed in Chapter 6, the tensions reported by learners were mostly identifiable as being related to the first of the hypothesised systemic contradictions, i.e., 'Teacher-led vs Learner-centred' learning. Each learner, regardless of category, voiced disappointment or dissatisfaction with the majority of the synchronous sessions. All study participants reported considerable variability in the way in which they were structured and conducted. Repetition of asynchronous material and a lack of problem-solving activities were frequent complaints, which tended to drive down their perceived overall value. Although teachers received advice from faculty on how to design and host synchronous sessions, there were sound pedagogical reasons why their content and pace sometimes varied. Therefore, it would seem unlikely that such complaints could ever be avoided, despite teachers' best intentions.

A further aspect, and one that is arguably more insidious for flipped teaching generally, is that almost all the study participants sometimes temporarily suspended their engagement with the weekly asynchronous-synchronous learning cycle. As I pointed out earlier, there is no formal definition for what a flipped classroom actually is, or a 'recipe' for how to implement one. All one can say is that flipped teaching has certain features and distinguishing characteristics that mark it out as a particular teaching model. The weekly learning cycle is one of those distinguishing features, and its abandonment -even temporary- is an action that undermines the very premise of flipped teaching and its claimed advantages. The evidence here corroborates one of the findings of my literature review (Chapter 3), i.e., that several FC studies reported that high proportions of learners undertook little or no preparation before class.

The most frequently given explanation for not preparing for synchronous sessions was the prioritising of other activities such as coursework deadlines or exam preparations. In prioritising other activities, individuals were responding to more immediate demands associated with other goals/modules, deemed to be more important in the short-term. AT diagrams provide a visual means to appreciate why learners sometimes disengage with the weekly asynchronous-synchronous cycle imposed by FCs, which, in the end, would appear to be largely unavoidable.

Furthermore, temporary disengagement with any particular flipped classroom is not always ‘temporary’. There were further reasons, beyond prioritising other work, why individuals will sometimes choose to participate selectively, say by engaging with the asynchronous materials, but ignoring the bulk of the synchronous sessions. Reasons ranged from disenchantment with synchronous sessions to simply lacking a basic interest in a module.

To some extent, the pitfalls of disengaging from the weekly cycle were mitigated by a) the continuous availability of asynchronous materials, and b) recordings of the synchronous sessions. Proponents of flipped teaching would naturally decry recordings as a poor substitute for participation in a “classroom” that should be engaging and interactive. But as noted, many synchronous sessions were not arenas for high levels of engagement or interaction, anyway. Of course, one does not need a flipped classroom to provide interactivity and engagement: these things are not exclusive to flipped teaching. The interview data shows clearly that they are appreciated by learners whatever pedagogical approach is used. The ability to question the lecturer on the spur of the moment is also highly valued; as one study participant explained, a question might be asked that you had not thought of, for which the answer is “highly-valued”. A lesson here is that for flipped classrooms to be successful, they should be constructed to promote opportunities for this.

As reported in Chapter 6, the second hypothesised systemic contradiction, i.e. ‘Individual vs Collaborative learning’ generated fewer tensions than anticipated. Opportunities for collaborative learning tended to be absent from most asynchronous activities and were fairly low in most synchronous sessions. With only a few exceptions, teachers encouraged little in the way of collective/collaborative learning, despite the majority of study participants expressing generally positive dispositions towards it. There was ample evidence in the interview data that most students value collective forms of learning, whether formal or otherwise. Some interviewees were explicit in asserting that the ability to compare views and opinions of taught material with their peers often led to a deeper understanding of it. Interview extracts revealed the sometimes unseen (by teachers) informal ways in which cross checks of understanding occur within classrooms. This sharing and exchange of individual subjectivity (i.e., intersubjectivity) in the common interest of learning occurs, of course, outside the classroom too; it is all part of the social practice of learning. In Activity Theory terms, this might be interpreted as learners using their peers as a resource in transforming the object through activity. Furthermore, through their relational agency, individual students are themselves, in turn, transformed by developing the ability to help and support others *(Edwards and D'Arcy, 2004)*. This insight (which is not new, of course) has implications for the construction of flipped classrooms. It suggests that teachers should worry less about learning outcomes and 'delivering the curriculum', and instead look for opportunities to promote and utilise students' disposition towards learning together with their peers. In other words, teachers should give greater attention to the social practices of the classroom, both formal and informal ones. As Edwards and D'Arcy put it:

> "Teaching therefore includes the production and management of social processes geared at enhancing the dispositions of learners to participate knowledgeably in the practices of a curriculum subject." *(Ibid., p.148)*.

Unfortunately, the restrictive conditions, coupled with limited genuine collective/collaborative learning opportunities in general, acted to undermine intersubjectivity and the development of mutual understanding.

Edwards' point regarding relational agency also connects with the expectation that learners are expected to increasingly self-regulate their learning, particularly in HE. As noted by Zimmerman,

> "Self-regulated students focus on how they activate, alter, and sustain specific learning practices in social as well as solitary contexts." *(Zimmerman, B.J., 2002, p.70)*.

The points made by both Edwards and Zimmerman are pertinent to both the asynchronous and synchronous components of flipped learning. They suggest that, in designing and implementing successful FCs, close attention should be paid to supporting learner self-regulation; arguably more so, than in comparative, non-flipped classrooms.

### 7.2.1 Subjectivity: Mediator of, or Outcome of, Activity? Or Both?

The three collective subjectivities (i.e. F1, F2 and F3) can be thought of as a reflection of learners' experiences under flipped teaching in this study. They were produced from a specific set of Q statements, and evidence for them was supported by the follow-up interviews. However, one might question whether *all* of the views, opinions and dispositions that they represent, should be interpreted as outcomes of the pedagogy of flipped teaching. The point here is that it would be expected that at least *some* of the views and dispositions identified would have been established previously, i.e., prior to the experience of flipped teaching. These attitudes will have been produced by, and pre-conditioned socially and culturally by, individual learners' personal backgrounds. For example, consider the 'strategic' F2 learner; it is likely that she was already 'strategic' *before* experiencing the FC. Similarly, F3 learners' preference for collective/collaborative learning is unlikely to have emerged 'just because' of flipped learning. Together, flipped teaching and the pandemic combined to confront, challenge and expose such pre-existing attitudes, resulting in tensions which this study has documented in detail.

But then, this raises the question "What is a tension, exactly?" The tensions modelled in the AT diagrams presented in Chapters 2 and 6 represented tensions within and between nodes, which, it was argued, are manifestations of underlying contradictions. It was claimed that some were also manifestations of dilemmas, paradoxes, and personal conflicts and clashes, and the interview data contained examples of each. However, regardless of their origin, as mentioned earlier, one might argue that tensions are experienced when learners' subjectivities are activated. This is most likely to occur when their expectations, beliefs, opinions and dispositions are challenged. This was arguably the case here, given the 'step-change' in the learning environment due to the transition to flipped teaching and the imposition of restrictive learning conditions.

The discussion in this section has admittedly been rather speculative, however it leads, in turn, to further questions about the role that subjectivities play in determining learning behaviours in FCs. Seen through the lens of AT, subjectivity and, for that matter, motivation, may be viewed as *mediators* of activity. In this view, subjectivity and motivation can be regarded as psychological tools that are mobilised in learning, both consciously and subconsciously (by both students and teachers). Therefore, one might legitimately pose an alternative question, one that is, essentially, an inversion of my main research question, i.e., “What are the mediating roles of subjectivity and motivation in the activity of flipped learning?” This is a complex question to which answers may be provided by future research. It would be equally interesting to see the results of a longitudinal study that would aim to establish collective subjectivities and motivations before and after flipped teaching.

## 7.3 The impact of Flipped Teaching and Learning on Students' Academic Motivation: Summary and Discussion

As Ryan and Deci have suggested, motivation can be thought of as the “energy for action” *(Ryan & Deci, 2017)*. This energy arises from underlying motives connected to beliefs that sustain activity. Tensions that arise in goal-directed behaviour can either reinforce beliefs and motivation, or act to oppose and degrade them. The interview data contained several examples of both.

In considering motivation through the lens of AT, it is useful to distinguish between the fundamental Object/motive of activity, and the motivation associated with pursuing specific goals. In the following, I use the term 'motivation' to represent a measure of the willingness to expend effort in the pursuit of goals. While there was no indication in the data that learners had lost their fundamental motives for wanting to learn electrical/electronic engineering (i.e., the Object/motive), there were illustrations of how tensions were connected to increases or decreases in motivation in their goal-directed activities. As reported in Chapter 6, this was clearest in relation to those caused by the ‘Teacher-led vs Learner-centred learning’ contradiction. In many cases these were linked to teachers’ actions, or inactions, in synchronous sessions.

All learners indicated that their motivation to study was more sensitive to their teacher’s communicative approach and attitudes, than to the attitudes of their fellow students. The synchronous sessions are particularly pertinent here, because a teacher’s approach and attitudes are highly visible to students. When the lecturer’s approach was perceived as conveying excitement and enthusiasm, learners reported feeling energised and more likely to experience higher levels of engagement and effort. They were more likely to fully engage with the weekly learning cycle for that subject, i.e., they were more likely to attend the synchronous sessions in addition to undertaking the corresponding preparatory asynchronous tasks. In contrast, when the lecturer’s attitude was perceived to be indifferent, or lacking in enthusiasm, students' responses indicated that there was likely to be a diminution in their effort and desire to engage. They were then more likely to cease attending future synchronous sessions for that module and rely instead on podcasts.

One potential way to reduce these tensions -and, by implication, improve motivation- would be to work harder to provide for more interaction and engagement. The experiences reported by learners -especially with regard to the lack of interaction- might imply that teachers did not do enough to encourage the learner ’side’ of the ‘Teacher-led vs Learner-centred’ contradiction axis. However, that may be unfair. Amongst teaching staff, there was a wide acknowledgement that considerable amounts of time and work were necessary in preparing for the transition to online teaching. Faculty provided advice to help achieve two broad objectives: how to teach each module while ensuring that learning outcomes are met, while, at the same time, ensuring that the learning experience for students met levels of satisfaction (as measured by surveys) that were similar to those in pre-pandemic times. There was no specific focus on motivation, per se. It appears from survey results that on the whole, teachers succeeded in meeting faculty’s first objective, but did so only partially with the second *(EEE Survey 2020-21)*. The reasons for this are complex but were due in part to the switch to online teaching, something for which a large majority of teachers had little prior experience of. The challenges in transitioning from the classroom to an online teaching environment are not insignificant, and have been documented by multiple researchers *(Wang et al, 2021; Sword, 2012; Esani, 2010).* My own experience taught me that providing high quality active learning experiences for learners in online synchronous sessions is far from easy.

But a teacher's attitude and enthusiasm are just two factors that are 'implicated' in students' academic motivation. Other factors play a role, such as having a basic interest in the subject, or factors such as self-confidence, external expectations, general beliefs, and personal goals. No matter how well synchronous sessions are constructed, there will always be, it seems, some subjects for which learners will engage with the weekly learning cycle only partially. This is not to say they are demotivated, but instead are reacting to demands in other areas of academic study.

The discussion so far has centred on the connections between tensions and motivation. The links between teachers' enthusiasm, or lack thereof, and students' willingness to engage have been documented. However, motivation is a complex phenomenon, and its connection to tensions experienced in goal-directed behaviour is not necessarily a simple and direct one. Attempts to improve learner motivation by acting to relieve tensions alone won't necessarily succeed for reasons already discussed. Furthermore, an analysis predicated on an examination of tensions alone, cannot, by itself reveal the nuanced way in which motivational goals are internalised.

Historically, motivational processes have been thought of as individual, cognitive phenomena that spring from a desire to satisfy one or more needs *(Maslow, 1943)*. However, as discussed in Chapter 2, sociocultural perspectives of motivation view motivation as possessing a social origin, in which motivational goals and beliefs stem from cultural practices. These goals and beliefs are internalised "through collaborative engagement" *(Walker et al, 2004)*. To explain this, Walker and colleagues utilise the concept of 'transformative internalisation and externalisation' suggesting, and following Valsiner, that "social practices are transformatively internalised by the individual, then subsequently externalised in the same or other social contexts *(Ibid. p. 246)*. Thus, individual motivation arises from social contexts, while externalisation explains how individuals “contribute to new social practices” *(Ibid, p. 246).* I will return to these concepts shortly, but it is useful at this point to consider and contrast an alternative theory which, although predicated on the basis of individual psychological needs, contains a highly developed concept of internalisation.

As also discussed in Chapter 2, Self-determination Theory (SDT) doesn't see motivation as a unitary concept, but instead as a differentiated phenomenon. Associated with the theory is a scale of motivational ‘regulations’, which its founders have labelled a ‘motivation continuum’ *(Ryan & Deci, 2017, p.193)*. Viewed from left to right, the scale describes an ascendency from amotivated behaviour, through to behaviour that is fully self-determined and autonomous. Although one might take issue with the use of the term ‘continuum’ as a descriptive moniker, the scale has been successfully used to identify the different ways in which individuals internalise the values associated with activities. I was able to confirm this in an earlier study *(Rubner, 2018).* One use of the scale is to investigate whether a particular teaching intervention results in making learners’ motivation more volitional and autonomous. Speculating, the aforementioned concept of ‘transformative internalisation’ may be useful in developing a similar scale in a future study that uses a Vygotskian sociocultural approach.

As mentioned in Chapter 2, some authors have claimed that SDT contains concepts that may be useful for understanding motivation in flipped classrooms, *(Abeysekera & Dawson, 2015).* As also mentioned, the theory conceives motivation to be predicated on the following psychological needs: to have good, supportive relations with others, to develop competency, and to develop a sense of autonomy (volition). According to SDT, when these needs are met, an individual is likely to experience behaviour with a greater sense of autonomy and self-determination. A teacher wanting to improve learners’ motivation is advised to provide what is called “autonomy support” *(Ryan & Deci, Ibid.)*. To see what this means, it is worth briefly considering each of these needs in turn in the context of this study.

Considering first, the need for supportive relations, it was clearly evident from the data that most learners desire good, working relationships with their fellow students. Indeed, all the study participants indicated that they reach out to their peers for help from time to time. Furthermore, some learners explicitly stated that they missed collective learning experiences -for example lab sessions- with their classmates. Therefore, the promotion of collective/collaborative activities, especially in the classroom, is something that would be approved of, in SDT 'terms'. Of course, this aspect would be expected in flipped classrooms; however, as the data also showed, a few learners were surprisingly reluctant to engage in some forms of (formal) collective learning.

The need to develop competency through academic learning was mentioned multiple times, often expressed by study participants as a desire for deeper learning through, for example, more practice at problem-solving. However, again, the data showed that this wasn't shared by all, as some would 'trade' deeper learning for an exam pass (F2 learners). Despite this, the promotion of competency through collaborative learning activities would also be expected of flipped classrooms.

Although the function of autonomy was not probed specifically in the interviews, it could be tested as part of a future study of flipped teaching. However, it is possible to foresee that a flipped classroom might not work for all learners, no matter how well it is constructed. For example, for some learners, the imposition of the weekly asynchronous-synchronous cycle clearly did not align with their accustomed learning style. A handful of study participants expressed a strong desire to return to the pre-pandemic learning model. One may infer then, that for some, flipped teaching might work instead to *undermine* autonomy and their sense of self-determination.

I should point out here that I'm not advocating a synthesis of SDT and sociocultural theories of motivation. Each approach, after all, conceptualises motivated behaviour in very different and largely incompatible ways. However, there are concepts in SDT which, when coupled with the concept of 'transformative internalisation', may be useful in the future construction of a more complete Vykotskian sociocultural theory of motivation. For example, speculatively, teaching interventions designed to satisfy the three psychological needs at the centre of the conception of motivation within

SDT (i.e., to have supportive relations, to develop competency, to have autonomy support), might find application limited to the goal-level within AT (i.e., below the Object/motive level).

Finally, and to summarise, there are limits to how much one can infer about learners' academic motivation from this case study. The statements used in the Q-Set were such that only broad conclusions could be made. They were not focussed sufficiently to permit deductions about the detailed nuances of their goal-driven behaviour.

A more complete picture of the impact of flipped teaching on motivation would also need to consider related qualities, for example its longitudinal and stability aspects *(Lantolf & Genung, 2002).* These would require data of a higher 'granularity', such as that provided by for example, a study that included ethnographic methods.

## 7.4 Summary, Recommendations, Contribution to Knowledge and Study Limitations

### Summary

This study, which was conducted under the conditions of a global pandemic, aimed to examine the mediation and impact of flipped teaching on undergraduate engineering students' academic motivations and subjectivities. Engestrom's version of Activity Theory was used as an analytical framework. Evidence was presented to support the hypothesis underlying the research: that flipped teaching accentuates two systemic contradictions: Teacher-centred vs Learner-centred learning, and Independent vs Collaborative learning. Q Methodology was used to comprehend the learner's subjectivities. The Q data revealed, through factor analysis, that learner subjectivities fell into three categories, each characterised by different views, attitudes and dispositions to learning. In some areas these differences were only marginal; in others they were much greater. These findings were supported by analysis of the follow-up interviews. Learners' subjectivities were examined in relation to the tensions connected to systemic contradictions that were hypothesised, using AT.

It is clear that, while most study participants liked and approved of flipped learning in general, a smaller number did not. A small number also expressed neutral or negative attitudes towards formal types of collective/collaborative learning. It would thus appear that no matter how hard teachers work to implement flipped classrooms, there is a chance that some learners will resist them.

The tensions caused by, and accompanying each systemic contradiction, were documented and categorised. They were exacerbated by the extreme learning conditions endured by students during the pandemic. On closer examination, it was clear that a large number of them stemmed from learner's experiences with online synchronous sessions in particular. These sessions did not meet the expectations for many study participants. In several cases, links were identified between the tensions experienced and learners' motivation. These were often manifested as a reduced intrinsic interest in a subject/module, accompanied by a drop in intensity in their efforts to accomplish the associated goals. However, detailed, nuanced effects on motivation were less discernible. Learners also reported experiencing difficulties with some of the asynchronous materials. Overall, fewer tensions related to independent vs collaborative learning were reported, reflecting possibly a lack of attention (by study participants' teachers) in providing collaborative learning experiences.

In sum, the problems experienced by learners were caused by implementations of flipped classrooms that in most cases only partially met the objectives set out by the Faculty. More serious for flipped classrooms, however, is that almost all learners will, at one time or another, disengage from the weekly learning cycle, and rely on session recordings to catch up. One way of providing compensation for missed sessions, could be by repeating them on a weekly basis. While such duplication might work for small cohort numbers, it is difficult to envisage it working for large cohorts consisting of hundreds of students.

## Recommendations

At the time of writing, another academic year is nearing completion, and the synchronised components of some modules have been replaced with face-to-face teaching. The removal of online synchronised learning might be expected to de-amplify tensions, but this may not turn out to be the case and cannot be assumed. The return to face-to-face learning is likely to expose flipped classrooms to even greater scrutiny by students. Poor implementations will continue to accentuate tensions, which, as the evidence suggests, have a negative impact on their subjectivity and motivation. Simply stated, for flipped teaching approaches to work, teachers must provide genuine active collective/collaborative learning opportunities, particularly in the synchronous components. It may also be fruitful to encourage collaborative learning (formal or informal) in the asynchronous components, where possible. Where appropriate, activities should be structured to tap into students' natural curiosity and to promote their relational agency and intersubjectivity. Essentially this requires a full commitment to a role change; from a subject matter expert who 'delivers' content knowledge and information, to that of a facilitator of learning. This is no easy task, and one that teachers are likely to need support in achieving. It also requires students to "buy-in" to the pedagogic approach by setting appropriate expectations. It is likely that there will always be some who resist collaborative learning, and those that struggle in adapting to the weekly asynchronous-synchronous learning cycle.

## Contribution to Knowledge

The goal of the research has been to obtain deeper insights into how an engineering FC works in HE, within the context of this case study. The data was drawn from study participants who experienced flipped teaching across their entire programme of study (which was due of course, to the exceptional circumstances of the global pandemic). In this respect it is unusual, and stands in contrast to the majority of FC studies that were conducted in normal times and which only compared a single module configured as a FC, with an equivalent non-flipped classroom.

Specifically, the study has sought to understand the mediation of flipped teaching on learners' academic subjectivities and motivation using AT and Q Methodology. In this respect, it has made both theoretical and methodological contributions.

As reported in Chapter 4, the use of Q in FC studies appears to be rare. As far as is known, this research represents the first time that Q methodology has been used to examine subjectivities within engineering FCs. The use of both Q and AT here, has led to the identification and interpretation of three different viewpoints/subjectivities.

With regard to AT, its use as a theoretical framework to study FCs in HE is also rare, and appears to be non-existent as far as engineering programmes are concerned. As far as is known, this research appears to be unique in this respect. Furthermore, in previous such studies, the goals were limited largely to the identification and characterisation of the systemic/structural contradictions. This study, which was conducted during abnormal circumstances (i.e., the pandemic), has gone further and investigated how learners' academic subjectivities and motivation are linked to the pedagogic tensions associated with two such contradictions, i.e., 'Teacher-led vs Learner-centred Learning' and 'Independent vs Collaborative learning'. Although the data was blurred to some extent by the exceptional learning conditions, the research has attempted to explore these links in detail, and resulted in a number of insights.

First, regarding relationships between pedagogic tensions and academic subjectivity, although it was signalled relatively weakly in the data, it was possible to differentiate the effect of the tensions reported by learners in terms of the three types of subjectivity found by this study, i.e., F1, F2 and F3. The least enthusiasm for flipped teaching was expressed by learners whose subjectivities align with factor F3. Tensions reported by this group appeared to be at raised levels compared to their peers. They tended to express a general preference for collective/collaborative learning that was largely absent in the flipped classrooms that they experienced. Speculatively, such learners are likely to be impacted by FC pedagogy more strongly (positively or negatively) than those whose subjectivities align with factors F1 or F2, who appear to hold neutral opinions with regard to collective/collaborative learning and flipped teaching in general.

Second, with regard to motivation, for many learners it appears that their intrinsic interest in a subject is strongly affected by perceptions of teachers' actions in the synchronous components of FCs. In this respect, it was not possible to distinguish between F1, F2 and F3, however this finding corroborates the results from the literature, i.e., that FCs that provide genuinely active, engaging synchronous/classroom activities, appear to be valued more highly by learners. This case study has shown that this conclusion appears to be true for learners across multiple FCs, not just single FCs in isolation. It would therefore appear that the tensions experienced in synchronous components of FCs are the most influential for learners' academic motivation. In terms of an activity diagram, the tensions between Subject and Rules and between Subject and Instruments, are therefore particularly significant.

A further contribution to knowledge made by this study relates to the nature and origins of the two dialectical contradictions that I claimed are accentuated by flipped teaching. It was shown that tensions associated with the 'Teacher-led vs Learner-centred' and the 'Independent vs Collaborative' contradictions can be traced in large part to the role changes imposed by FC pedagogy. These role changes impact the goal-directed actions of learners and teachers in significant ways, and drive their transformation and development. Using AT, the 'Teacher-led vs Learner-centred' contradiction is represented in an activity system diagram as a dialectical contradiction within the 'Division of Labour' node (in agreement with the conclusion of Fredriksen and Hadjerrouit). The 'Independent vs Collaborative' contradiction can be represented as a dialectical contradiction within the 'Subject' node. For the latter, tensions surface when individuals choose to resist collaborative/collective learning, or when their preference for (and ability to engage in) collaborative/collective learning is inhibited.

At the end, therefore, the analysis suggests that in seeking to improve flipped teaching, particular attention should be given to careful management of the role changes that FCs impose. This clearly requires the engagement of students in teachers' pedagogic motives. That said, however, the study also corroborated reports in the literature of the sometimes large numbers of learners who disengage temporarily from the weekly synchronous-asynchronous learning cycle. While it appears that this phenomenon is unavoidable, the use of AT diagrams provides a visual explanation of why this sometimes happens.

Finally, and speculatively, AT provides a lens through which subjectivity and motivation might also be understood as psychological tools in the mediation of learning within FCs. This poses an alternative question to the one that this research has attempted to answer, but nonetheless would likely make a fascinating potential future study.

In summary, this study has contributed to knowledge in the following ways:

- The research has investigated links between particular pedagogic tensions associated with the Flipped Classroom and academic motivation and subjectivities. The results support the hypothesis that flipped teaching accentuates two particular systemic contradictions, which appear to be responsible for a large proportion of the tensions. It appears that learners experience most tensions when the synchronous components of flipped classrooms are perceived to be poorly implemented. The sources of these tensions and contradictions can, in turn, be traced to the role changes that are required in flipped teaching pedagogy.
- Q Methodology has been used to operantly capture and analyse learner subjectivities in an undergraduate engineering programme using flipped teaching. As far as is known, this is the first time Q has been used in a study involving the Flipped Classroom in engineering education in Higher Education. Three different types of subjectivity were uncovered that reflected different, but sometimes overlapping sets, of opinions, views and dispositions to flipped teaching. One type -labelled F3 in the study- were particularly sensitive to the implementation of Flipped Classrooms in regard to their expectations. F3 learners appear to express a particular preference for collective/collaborative learning, and are therefore more likely to be impacted by tensions arising from implementations of flipped classrooms where their relational agency is limited.
- Learners' academic motivation -understood as a measure of willingness to exert effort in goal-related tasks- appears to be affected mostly (positively or negatively) by their experiences within the synchronous components of flipped classrooms.
- The use of Activity Theory has supported the view that academic subjectivities and motivation might be seen as both mediators *and* objects/outcomes of activity.
- A case study into flipped teaching conducted under severe learning restrictions, due to the global pandemic, conducted across an entire curriculum. This was shown to exacerbate the tensions expected from flipped classrooms under normal conditions (as previously reported), and introduced additional ones.

## Study Limitations

The limitations of the study were as follows:

- **Sample Size** The study was limited to a small sample of undergraduates enrolled on degree programmes in electrical/electronic engineering. Conclusions cannot easily be widened to other engineering programmes even within the same institution. However, in cases such as this, and where conditions afford, similar contradictions and associated tensions might be expected to surface.
- **Q Methodology** The semi-structured interviews were guided in part by the choice of Q-Set statements. It was acknowledged that these statements are not necessarily comprehensive enough to cover the whole field/subject under study. The results of this research could be used to inform a future study that would no doubt use a different set of statements. Although three factors/viewpoints were identified, they were shown to be not entirely orthogonal, given the evidence of correlations between them, particularly so between one pair (F1 and F3).
- **Activity Theory** As discussed in Chapter 2, the particular version of Activity Theory that I used (due to Engestrom) has received criticism from some quarters. This includes criticisms of the triangular diagrammatic representations of activity systems, limited as they are in revealing the regulating effects of subjectivity, motivation, emotions or feelings.
- **Pandemic** The pandemic was a major disruption. Originally (i.e., in pre-pandemic times), the plan was to use an ethnographic approach and observe and collect data both during laboratory work, and from flipped classroom sessions. This had to be abandoned, and the study conducted entirely online.
- **Motivation** The study was only able to observe surface connections between tensions and motivation. As explained the latter was interpreted in terms of volition, or willingness to expend effort to undertake goals. To achieve a more detailed and nuanced understanding of motivation requires further research.

Such research would, ideally, use a sociocultural approach, but currently there appears to be no widespread agreement on what form that should take.

- **Identity** The consideration of identity and of identity-related processes, was not a focus for this study. However, there are compelling arguments that a study of motivation and subjectivity should also consider identity. As scholars have pointed out, teaching engineering is not only about turning students into problem-solvers; it is also about producing a particular type of person -in this case, someone who will also contribute to the good of society and humanity *(Middleton et al, 2018)*. The word 'identity' is a very broad notion, however, and a future study might begin with the related sociocultural concept of 'desire for recognition'. This concept is linked, in turn, to learners' self-beliefs and expectations, particularly in comparisons with perceived abilities of classmates. The data produced by this study contained several examples of students wanting to know their performance and abilities in comparison to their peers.

## 7.5 Personal Reflections and Suggestions for Further Research

As the world learns to live with Covid-19, it is clear to see the impact that the pandemic had on education, at all levels. Higher Education, for which this case study was the context, is no less affected. Since 2020, online learning has become widespread and is likely to continue to occupy a major role in the UK. Within engineering education, teaching approaches like the flipped classroom have acquired far greater awareness. However, the experience for students and teachers was far from enjoyable. This research presented in this thesis has highlighted several problems with flipped learning, which might be addressed in future. The following is a suggested list of issues that would benefit from further research:

- Learners will tend to disengage at some point from the weekly asynchronous-synchronous learning cycle. How could this be mitigated?

- The reported effectiveness of FCs may be due in large part to the use of active learning techniques in the classroom. More evidence is needed, however, to determine if this is generally true.
- How can teachers leverage the informal learning communities that learners build for themselves, to improve learner-centred learning and learners' self-regulation in FCs?
- How do previously established subjectivities and motivations that were established in non-flipped teaching affect learning behaviours in FCs? A longitudinal study to track collective subjectivities and motivations before and after flipped teaching, would help to answer this question.
- As originally conceived, this study had planned to use ethnographic techniques in data collection. Such a methodological approach (which would now be possible) would permit a closer examination of the subjective experience of learning in a FC, in fine-grained detail, and inform the potential future studies listed here.

# Chapter 8 Appendices

## 8.1 Appendix 1 Q Concourse

A University degree is expected of me.
Academic malpractice rules sometimes make me frustrated.
An important reason that I do my work is to please my lecturers.
At any given time, I work equally hard on all my modules.
Being competent at engineering is the most important thing.
Completing the coursework in a module is less important than passing the exam.
Fear of performing poorly in the course is what motivates me the most.
Flipped teaching makes it easier for me to learn.
Getting good grades is the most important thing to me.
I am afraid of getting a low mark in the course.
I am afraid that I will not learn everything in the course.
I am anxious that I may not master all that is supposed to learn in the course.
I am expected to do well in my degree.
I am more motivated by my fellow students than by my lecturers.

I am often concerned that I may not learn all that there is to learn in the course.
I am striving to do well compared to other students.
I avoid doing more work than is necessary.
I believe that lecturers shouldn’t expect students to spend significant amounts of time studying material everyone knows won’t be examined.
I can get by in most assessments by memorising key sections rather than trying to understand them.
I do all of the asynchronous activities each week.
I do not find my course very interesting so I keep my work to the minimum.
I don't always fully complete the coursework in modules.
I don't expect to do well in my degree.
I don't like flipped teaching and prefer traditional ways of learning.
I don't really know why I go to university and, frankly, I care very little.
I don’t want to stand out too much because it will make my classmates feel we are not the same.
I enjoy helping others on the course.
I experience a good feeling while studying engineering.
I experience satisfaction while studying my subject.
I feel annoyed when I am required to make an effort.
I feel guilty if I do not learn everything perfectly in this course.
I feel happiest when I can do a task with little effort in this course.
I feel happiest when I learn new things in this course.
I feel happiest when people see me succeed.
I feel satisfaction when achieving difficult academic tasks.
I feel satisfied when I do better than others in this course.
I feel satisfied when I learn as much as possible in this course.
I feel unhappy when a task takes too much time in this course.
I feel unhappy when I fail to develop my abilities in this course.
I feel unhappy when people see me fail in this course.
I find it hard keeping up with the course.
I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.
I find most new topics interesting and often spend extra time trying to obtain more information about them.
I find that at times studying this course gives me a feeling of deep personal satisfaction.
I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.
I find that studying academic topics in this course is exciting.
I find the best way to pass examinations is to try to remember answers to likely questions.
I generally restrict my learning to what is specifically set, as I think it is unnecessary to do anything extra.
I have perfected my personal approach to academic study.
I learn academic material by myself, regardless of others, including teachers.
I learn better in this course when I can collaborate with others.
I like the flipped style of teaching.
I love my subject.
I make a point of looking at most of the suggested readings that go with the lectures.
My aim is to pass the course while doing as little work as possible.

I must prove to myself that I can complete my degree.
I need a very deep understanding of material in order to pass the exams.
I never look for help outside of the course materials (e.g YouTube).
I never miss any of the asynchronous activities given each week.
I never rely on fellow students when completing coursework.
I often feel bored by the course.
I once had good reasons for going to University but now I wonder whether I should continue.
I only do some of the asynchronous activities each week.
I only seriously study what's given out in class or in the course assignments.
I prefer course material that really challenges me so I can learn more.
I prefer learning with my fellow students.
I prefer material that arouses my curiosity, even if it is hard to learn.
I prefer someone else teaching me rather than having to learn by myself.
I prefer to learn by interacting with my peers in this course.
I prefer to learn things by myself.
I prefer working with others in this course.
I see engineering as part of my identity.
I see no point in learning material which is not likely to be in the examination.
I sometimes look for help outside of the course materials.
I sometimes seek help from other students, e.g., using social media.
I struggle to understand what I learn at University.
I study engineering for the satisfaction I feel when accomplishing difficult academic tasks.
I study engineering in order to have a better salary in the future.
I study engineering in order to obtain a more prestigious job later on.
I study my course to prove to myself that I am an intelligent person.
I study my subject to learn interesting things, not just to pass exams.
I tend to be passive when working in teams.
I tend to take a more active role when working in a team.
I try to determine the way I study according to the course requirements and the lecturer's teaching style.
I want to become an engineer mainly to have a good career and life.
I want to become an engineer mainly to help fix the world's problems.
I want to learn as much as possible.
I want to prove to others that I can succeed in my studies.
I was motivated to study engineering by one or more inspirational people.
I will sometimes skip lectures if I'm less interested in the subject.
I will sometimes skip lectures when close to submitting coursework.
I work hard at my studies because I find the course material interesting.
I work hard because I want to live up to expectations.
I work hard because understanding this content is important for becoming the person I want to be.
I work hard so that my family will be proud of me.
I worry that I may not learn all that I possibly could while studying.
I worry about not learning as much as I am capable of.
If I could choose how material is taught, I would do it differently.
In the course, my goal is always to avoid a low mark.
In the course, my goal is always to get a high mark.
In the course, my goal is to get by with the least amount of work.

In the course, my goal is to learn as much as possible.
It is important for me to do better than others.
It is important that people do not see me fail in the course.
It is my own fault if I don't learn the material in the course.
It is very important for me to get better grades than other students.
It matters a lot if I don't learn everything in a module.
It's not my fault if I don't learn the material in the course.
It’s very important for me that I don’t look stupid.
I'm confident I can learn the most complex material in the course.
I'm not really sure why I'm studying my subject.
I'm not sure that I want to study my subject anymore.
I'm not very clear about my overall academic objectives.
I'm studying the subject because I was told to.
Learning new things is important to me in the course.
Learning with other students is mostly a pain.
My aim is to avoid doing worse than other students.
My aim is to completely master all the material taught to me.
My aim is to completely master the material taught to me.
My approach to study has not changed since starting the course.
My attitudes to learning are strongly affected by what my fellow students say.
My goal is to avoid performing poorly compared to others.
My goal is to learn as much as possible.
My goal is to perform better than the other students.
My strategy is to learn just enough to pass each module.
My strategy is to learn just enough to pass.
My studies allow me to continue learning many things that interest me.
My subject is interesting, but my main goal is to pass exams.
No one really cares what I think or feel while I'm studying.
One of my main goals is to avoid looking like I can’t do my work.
Passing each module is always the most important thing.
Regardless of results, working hard makes me feel less guilty.
Sometimes I’m afraid that I may not understand the content of this class as thoroughly as I’d like.
Studying my subject makes me feel good.
Synchronous lectures don't have much value for me.
The attitude of my lecturers has a big effect on my motivation to study.
There is generally not enough support available to help me with academic work.
To do well, I must have good relationships with my fellow students.
Understanding everything in the course is very important to me.
Understanding the taught material is always the most important thing.
University education will help me prepare for my chosen career.
Working in a team does not motivate me to want to learn more.
Working in a team motivates me to want to learn more.
You can pass the exams just by practising the past papers.

## 8.2 Appendix 2 Q Participant Information Sheet

**Participant Information Sheet (PIS) 2020-21** *version 1.2, 03/08/2020*

This PIS should be read in conjunction with The University privacy notice.

You are being invited to take part in a research study as part of a project to understand the relationship between motivation and learning among electrical engineering students at the University as part of doctoral research in engineering education. Before you decide whether to take part, it is important for you to understand why the research is being conducted and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for taking the time to read this.

**Who will conduct the research?**

Geoff Rubner, Department of EEE, University of Manchester

**What is the purpose of the research?**

I am hoping to acquire an insight into the factors that affect and link motivation and learning among students undertaking an electrical engineering degree. This particular study aims to capture individual dispositions to study. The ultimate purpose is to design interventions that seek to improve motivation and the overall student experience. It is intended that the outputs of the research will be used in a thesis and possibly journal papers.

**Why have I been chosen?**

Because you are an undergraduate engineering student (in EEE). The study aims to target up to twenty students.

**What would I be asked to do if I took part?**

With your consent, you would be observed during either an on-campus or online laboratory and then later asked to participate in an online interview to explore your responses to questions asked about your learning experiences. Prior to the interview you would be asked to sort a series of statements on a grid (also provided online), the purpose of which is to help guide and inform the interview questions. Only the researcher (Geoff Rubner) and you will share the information. It is expected that the interview will last no longer than 1 hour. All data collected will be pseudonymised to protect your personal information.

**What will happen to my personal information?**

In order to undertake the research project I will need to collect the following personal information/data about you:

Your background and choice of degree programme.

Motivational factors related to your study, for example:

- Your views about your chosen degree programme.
- Your experiences in a flipped teaching environment.
- Whether or not you plan to continue in engineering after completing the degree.

An audio recorder will be used to capture your responses to the interview questions. No video recordings would be made. The audio recordings will be pseudonymised, transcribed, and encrypted. As part of the pseudonymization of your personal data, a participant id will be assigned, known only to the researcher and the research team (see below). The pseudonymised transcriptions will be used to extract factors (a process called "factor analysis") relating to educational theories.

Only the research team (consisting of the researcher Geoff Rubner, and Professor Julian Williams of the School of Environment, Education and Development, University of Manchester), will have access to this information. Professor Williams will have access only to the pseudonymised transcriptions, the participant ids, and the factor analysis data. He will not have access to your personal data.

We are collecting and storing this personal information in accordance with the General Data Protection Regulation (GDPR) and Data Protection Act 2018 which legislate to protect your personal information. The legal basis upon which we are using your personal information is “public interest task” and “for research purposes” if sensitive information is collected. For more information about the way we process your personal information and comply with data protection law please see our Privacy Notice for Research Participants.

The University of Manchester, as Data Controller for this project, takes responsibility for the protection of the personal information that this study is collecting about you. In order to comply with the legal obligations to protect your personal data the University has safeguards in place such as policies and procedures. All researchers are appropriately trained and your data will be looked after in the following way:

- Only the researcher Geoff Rubner will have access to your Personal Identifiable Information (PII). PII is data which could identify you, but it will be anonymised as soon as is practicable (this is expected to be within four weeks following its collection).
- Your PII will not be shared with any other organisation, nor used in any future studies.

- Your pseudonymised data may be used in future studies, but only with your consent.
- Your pseudonymised data will be retained for a maximum period defined by University (currently 5 years).
- Your consent form and contact details will be retained until completion of the doctoral programme (expected to be 2022); this information will be scanned and stored electronically on a University of Manchester computer.

**Will my participation in the study be confidential?**

Your participation in the study will be kept confidential to the research team as listed above.

- The audio recordings will be transcribed by the researcher alone (Geoff Rubner).
- Your PII will be removed in the final transcript.
- The audio recording will be transferred and kept securely on a University of Manchester computer.
- The copies of the recording on the audio recorder and on the computer will, within four weeks of completion of the transcription, be deleted.

You have a number of rights under data protection law regarding your personal information. For example you can request a copy of the information we hold about you, including audio recordings (until they are deleted). This is known as a Subject Access Request. If you would like to know more about your different rights, please consult our privacy notice for research and if you wish to contact us about your data protection rights, please email dataprotection@manchester.ac.uk or write to The Information Governance Office, Christie Building, University of Manchester, Oxford Road, M13 9PL. at the University and we will guide you through the process of exercising your rights.

You also have a right to complain to the Information Commissioner's Office, Tel 0303 123 1113.

**What happens if I do not want to take part or if I change my mind?**

It is up to you to decide whether or not to take part. If you decide not to participate there will be no detrimental impact on your studies, and it will not affect your academic standing or progress. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time without giving a reason, again without detriment to yourself and without affecting your academic standing or progress. However, it will not be possible to remove your data from the project once it has been anonymised although we will not be able to identify your specific data. This does not affect your data protection rights.

Although an audio recording is a necessary part of the study, you are free to decline its use. As a participant it is essential that you are comfortable with the recording process at all times and are free to request that the recording be stopped at any time.

**Will my data be used for future research?**

When you agree to take part in a research study, the information about your health and care may be provided to researchers running other research studies in this organisation. The future research should not be incompatible with this research project and will concern studies of motivation among engineering students. These organisations may be universities, NHS organisations or companies involved in health and care research in this country or abroad. Your information will only be used by organisations and researchers to conduct research in accordance with the UK Policy Framework for Health and Social Care Research. This information will not identify you and will not be combined with other information in a way that could identify you. The information will only be used for the purpose of health and care research and cannot be used to contact you regarding any other matter or to affect your care. It will not be used to make decisions about future services available to you.

**What is the duration of the research?**

The entire data collection (i.e. observations and interviews) phase of the research will be conducted during the entire teaching semester. This includes transcription and factor analysis of each interview.

**Where will the research be conducted?**

The research will be conducted entirely online.

**Will the outcomes of the research be published?**

It is anticipated that the research will culminate in a thesis and possibly one or more journal papers. Participants will be informed of the results and outcomes upon request.

**Disclosure and Barring Service (DBS) Check (if applicable)**

Not applicable.

**Who has reviewed the research project?**

The research project has been reviewed by the Ethics Committee of the School of Environment, Education and Development, University of Manchester.

**What if I want to make a complaint?**

Minor complaints If you have a minor complaint then you need to contact the researcher in the first instance: GEOFF RUBNER, SACKVILLE/B33, SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING. Tel. 0161 306 4715, email g.rubner@manchester.ac.uk.

**Formal Complaints**

**If you wish to make a formal complaint or if you are not satisfied with the response you have gained from the researchers in the first instance then please contact**

The Research Governance and Integrity Manager, Research Office, Christie Building, University of Manchester, Oxford Road, Manchester, M13 9PL, by emailing: research.complaints@manchester.ac.uk or by telephoning 0161 275 2674.

**What Do I Do Now?**

If you have any queries about the study or if you are interested in taking part then please contact the researcher: GEOFF RUBNER, SACKVILLE/B33, SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING. Tel. 0161 306 4715, email g.rubner@manchester.ac.uk.

**This Project Has Been Approved by the University of Manchester's Research Ethics Committee.**

## 8.3 Appendix 3 Q Participant Consent Form

**CONSENT FORM – 2020-21, Semester 2** *version 1.2*

Dear Participant,

You are invited to take part in a research study carried out by Geoff Rubner in the Manchester Institute of Education and the Department of EEE, at the University of Manchester. The study aims to:

- Understand links between motivation and learning in engineering students at the University.
- To develop and pilot methods to capture their dispositions to study.

- To develop a better understanding of the learning experiences of students and progression in Higher Education.

If you are happy to participate please complete and sign the consent form below:

**Consent Form**

If you are happy to participate please complete (by initialling each activity) and sign the consent form below.

| | Activities | Initials |
|---|---|---|
| 1 | I confirm that I have read the attached information sheet (Version 1.2, Date 03/08/2020) for the above study and have had the opportunity to consider the information and ask questions and had these answered satisfactorily. | |
| 2 | I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving a reason and without detriment to myself. I understand that it will not be possible to remove my data from the project once it has been anonymised and forms part of the data set.<br><br>I agree to take part on this basis. | |
| 3 | I agree to the interviews being audio recorded. | |
| 5 | I agree that any data collected may be published in anonymous form in academic books, reports or journals. | |
| 6 | I understand that data collected during the study may be looked at by individuals from The University of Manchester or regulatory authorities, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data. | |
| 7 | I agree that any anonymised data collected may be shared with researchers/researchers at other institutions. | |
| 9 | I agree that the researcher may retain my contact details in order to provide me with a summary of the findings for this study. | |

10 I understand that there may be instances where during the course of the interview/focus group information is revealed which means that the researcher will be obliged to break confidentiality and this has been explained in more detail in the information sheet.

11 I agree to take part in this study.

**Data Protection**

The personal information we collect and use to conduct this research will be processed in accordance with data protection law as explained in the Participant Information Sheet and the [Privacy Notice for Research Participants](#).

________________________ ________________________

Name of Participant Signature Date

Geoff Rubner

________________________ ________________________

Name of the person taking consent Signature Date

[1 copy for the participant, 1 copy for the research team (original)]

## 8.4 Appendix 4 Study "1" Selected Factor Analysis Data

The tables shown below were extracted from the .lis file produced by PQ Method in each case. As explained, Study "2" was the main study on which the analysis was conducted. Since Study "1" was not discussed in depth, only a selected subset of the results are included here for reference.

**Correlation Matrix Between Sorts:**

| SORTS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 26 | 40 | 46 | 10 | 28 | 55 | 44 | 25 | 38 | 29 | 12 | 27 | 34 | 30 | 36 | 40 | 38 | 57 |
| 2 | 26 | 100 | 19 | 20 | 20 | 48 | 34 | 43 | 14 | 21 | 38 | 27 | 39 | 38 | 49 | 41 | 55 | 12 | 23 |
| 3 | 40 | 19 | 100 | 41 | 11 | 23 | 38 | 46 | 31 | 32 | 37 | 22 | 31 | 38 | 19 | 37 | 31 | 47 | 40 |
| 4 | 46 | 20 | 41 | 100 | 28 | 12 | 28 | 40 | 56 | 63 | 39 | -1 | 40 | 55 | 17 | 20 | 61 | 43 | 50 |
| 5 | 10 | 20 | 11 | 28 | 100 | 22 | -5 | 29 | 25 | 28 | 43 | 14 | 36 | 25 | 35 | 25 | 20 | 41 | 34 |
| 6 | 28 | 48 | 23 | 12 | 22 | 100 | 50 | 31 | 17 | 25 | 36 | -3 | 51 | 29 | 14 | 26 | 35 | -9 | 21 |
| 7 | 55 | 34 | 38 | 28 | -5 | 50 | 100 | 31 | 35 | 24 | 31 | 9 | 36 | 34 | 29 | 49 | 37 | 5 | 28 |
| 8 | 44 | 43 | 46 | 40 | 29 | 31 | 31 | 100 | 27 | 34 | 38 | 23 | 50 | 47 | 15 | 40 | 44 | 34 | 41 |
| 9 | 25 | 14 | 31 | 56 | 25 | 17 | 35 | 27 | 100 | 59 | 23 | -7 | 37 | 54 | 15 | 22 | 56 | 25 | 39 |
| 10 | 38 | 21 | 32 | 63 | 28 | 25 | 24 | 34 | 59 | 100 | 31 | 17 | 44 | 50 | 15 | 25 | 53 | 28 | 31 |
| 11 | 29 | 38 | 37 | 39 | 43 | 36 | 31 | 38 | 23 | 31 | 100 | 31 | 45 | 51 | 46 | 37 | 46 | 46 | 49 |
| 12 | 12 | 27 | 22 | -1 | 14 | -3 | 9 | 23 | -7 | 17 | 31 | 100 | 13 | 19 | 22 | 40 | 7 | 14 | -8 |
| 13 | 27 | 39 | 31 | 40 | 36 | 51 | 36 | 50 | 37 | 44 | 45 | 13 | 100 | 64 | 19 | 47 | 55 | 28 | 46 |
| 14 | 34 | 38 | 38 | 55 | 25 | 29 | 34 | 47 | 54 | 50 | 51 | 19 | 64 | 100 | 10 | 47 | 64 | 35 | 54 |
| 15 | 30 | 49 | 19 | 17 | 35 | 14 | 29 | 15 | 15 | 15 | 46 | 22 | 19 | 10 | 100 | 35 | 31 | 32 | 31 |
| 16 | 36 | 41 | 37 | 20 | 25 | 26 | 49 | 40 | 22 | 25 | 37 | 40 | 47 | 47 | 35 | 100 | 37 | 20 | 23 |
| 17 | 40 | 55 | 31 | 61 | 20 | 35 | 37 | 44 | 56 | 53 | 46 | 7 | 55 | 64 | 31 | 37 | 100 | 20 | 41 |
| 18 | 38 | 12 | 47 | 43 | 41 | -9 | 5 | 34 | 25 | 28 | 46 | 14 | 28 | 35 | 32 | 20 | 20 | 100 | 47 |
| 19 | 57 | 23 | 40 | 50 | 34 | 21 | 28 | 41 | 39 | 31 | 49 | -8 | 46 | 54 | 31 | 23 | 41 | 47 | 100 |

**Table A.4.1 Correlation Matrix Between Sorts.**

**Factor Matrix with an X Indicating a Defining Sort:**

| | Loadings | | |
|---|---|---|---|
| QSORT | 1 | 2 | 3 |
| 1 | 0.5122X | 0.2158 | 0.2655 |

| | | | |
|---|---|---|---|
| 2 | 0.0527 | 0.2921 | 0.6878X |
| 3 | 0.4765X | 0.3014 | 0.1857 |
| 4 | 0.7822X | 0.0726 | 0.1231 |
| 5 | 0.2721 | 0.3904X | 0.1105 |
| 6 | 0.1319 | 0.0716 | 0.5641X |
| 7 | 0.2833 | 0.0797 | 0.5414X |
| 8 | 0.4497X | 0.3408 | 0.3202 |
| 9 | 0.6198X | -0.1297 | 0.2912 |
| 10 | 0.6174X | 0.0468 | 0.2797 |
| 11 | 0.3572 | 0.5130 | 0.3722 |
| 12 | -0.1087 | 0.5689X | 0.1033 |
| 13 | 0.4345 | 0.2160 | 0.5363 |
| 14 | 0.5769 | 0.1636 | 0.4763 |
| 15 | 0.1442 | 0.5294X | 0.1984 |
| 16 | 0.1740 | 0.3957 | 0.5304X |
| 17 | 0.5231 | 0.0808 | 0.5820 |
| 18 | 0.5735 | 0.4952 | -0.2331 |
| 19 | 0.6319X | 0.2475 | 0.1537 |

**Table A.4.2 Factor Matrix with an X Indicating a Defining Sort**

**Correlations Between Factor Scores:**

| | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1.0000 | 0.2891 | 0.4421 |
| 2 | 0.2891 | 1.0000 | 0.4433 |
| 3 | 0.4421 | 0.4433 | 1.0000 |

**Table A.4.3 Correlations Between Factor Scores**

**Factor Characteristics:**

| | Factors | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| No. of Defining Variables | 7 | 3 | 4 |
| Average Rel. Coef. | 0.800 | 0.800 | 0.800 |
| Composite Reliability | 0.966 | 0.923 | 0.941 |
| S.E. of Factor Z-Scores | 0.186 | 0.277 | 0.243 |

**Table A.4.4 Factor Characteristics**

# 8.5 Appendix 5 Q-Sets

## 8.5.1 Q-Set 1

1 A university degree is expected of me.

2 I must prove to myself that I am capable of completing my degree.

3 A University education will help me better prepare for my career.

4 I experience pleasure and satisfaction while studying engineering.

5 Actually, I did have my reasons for studying engineering but now I'm not sure.

6 I don't really know why I'm studying my subject.

7 I feel great satisfaction when accomplishing difficult academic topics.

8 I see engineering as part of my identity.

9 I study my subject to learn fascinating things, not just to pass exams.

10 I want to prove to others that I can succeed in my studies.

11 I believe that a few additional years of education will improve my career.

12 I'm studying the subject because I was told to do so.

13 I'm in love with my subject.

14 I was motivated to study engineering by one or more inspirational people.

15 I want to help solve the world's problems, and becoming an engineer will help.

16 I feel like I can be myself when studying the subject.

17 If I could choose how material is taught, I would do it differently.

18 To do well I must have good, positive relationships with my classmates.

19 The attitude of my lecturers has a big effect on my motivation.

20 Regarding my motivation to study, the relationships that I have with my classmates are important.

21 At university, no one really cares what I think or feel while I'm studying.

22 My aim is to completely master the material taught to me.

23 My goal is to learn as much as possible.

24 I am striving to do well compared to other students.

25 My goal is to perform better than the other students.

26 My approach to study means it is likely that I will learn more.

27 My strategy is to learn just enough to pass.

28 My goal is to avoid performing poorly compared to others.

29 My aim is to avoid doing worse than other students.

30 I prefer course material that really challenges me so I can learn more.

31 I prefer course material that arouses my curiosity, even if it is difficult.

32 Getting good grades is the most important thing to me.

33 It is most important for me to get better grades than other students.

34 I am very interested in all the content of my course.

35 Understanding all the subject matter of each course is very important.

36 It is my own fault if I don't learn the material in this course.

37 If I don't understand the course material, it is my fault.

38 I'm confident I can understand the most complex material presented to me.

39 I expect to do well in my degree.

40 I don't like flipped teaching and prefer more traditional styles.

41 I prefer someone else teaching me rather than having to learn by myself.

42 I sometimes seek help from other students, e.g. using social media.

43 I prefer to learn things by myself.

44 I prefer learning with my fellow students.

45 I tend to be passive when working in teams.

46 I tend to take a more active role when working in a team.

47 Working in a team motivates me to want to learn more.

48 Learning with other students is mostly a pain.

49 I find it hard keeping up with the course.

50 I do all of the asynchronous activities each week.

### 8.5.2 Q-Set 2

From the Study 1 interviews, it was clear that participants' views and attitudes were significantly influenced by the weekly synchronous/asynchronous learning cycle. Many complained that the new teaching method felt 'harder work' compared to their earlier experiences, and had clearly decided to adopt a 'strategic' approach to where they directed their energy and effort. For example, I noticed that they would interrupt the weekly learning cycle due to the imminence of coursework deadlines. Therefore, I added some statements that would facilitate an exploration of their actions in participating in the weekly learning cycle.

I removed statements asking whether they "loved" their subject, and if they felt it "defined" them, i.e., ones which could loosely be described as 'identity-related'. I also removed some statements related to their fundamental motives to want to study engineering and become engineers. Instead, I wanted to explore their actions in participating in the weekly learning cycle. I retained questions pertaining to teamwork as I wanted to explore their attitudes towards group/collaborative working.

Some statements were refined to establish clarity and remove ambiguity . In some cases this simply meant shortening the sentence and using different words.

Of the statements used in Study 1, 32 were retained, either without alteration, or with slight changes to the wording. The new Q Set therefore contained 18 new statements, in addition to these 32, and is reproduced in full below:

1 Passing each module is always the most important thing.

2 I will sometimes skip lectures if I'm less interested in the subject.

3 It matters a lot if I don't learn everything in a module.

4 I tend to be passive when working in teams.

5 My aim is to completely master all the material taught to me.

6 I never look for help outside of the course materials (e.g. YouTube).

7 I never miss any of the asynchronous activities given each week.

8 The attitude of my lecturers has a big effect on my motivation to study.

9 I'm not very clear about my overall academic objectives.

10 I learn academic material by myself, regardless of others, including teachers.

11 I find it hard keeping up with the course.

12 If I could choose how material is taught, I would do it differently.

13 I don't expect to do well in my degree.

14 Flipped teaching makes it easier for me to learn.

15 Learning with other students is mostly a pain.

16 I prefer learning with my fellow students.

17 My attitudes to learning are strongly affected by what my fellow students say.

18 To do well I must have good relationships with my fellow students.

19 I want to prove to others that I can succeed in my studies.

20 I am more motivated by my fellow students than by my

21 I am striving to do well compared to other students.

22 Synchronous lectures don't have much value for me.

23 I sometimes seek help from other students, e.g. using social media.

24 My goal is to avoid performing poorly compared to others.

25 I was motivated to study engineering by one or more inspirational people

26 Understanding the taught material is always the most important thing.

27 Completing the coursework in a module is less important than passing the exam.

28 I don't always fully complete the coursework in modules.

29 I will sometimes skip lectures when close to submitting coursework.

30 I prefer course material that really challenges me so I can learn more.

31 My goal is to perform better than the other students.

32 Getting good grades is the most important thing to me.

33 I need a very deep understanding of material in order to pass the exams.

34 Academic malpractice rules sometimes make me frustrated.

35 My strategy is to learn just enough to pass each module.

36 My subject is interesting, but my main goal is to pass the exams.

37 Working in a team does not motivate me to want to learn more.

38 I never rely on fellow students when completing coursework.

39 I don't like flipped teaching and prefer traditional ways of learning.

40 Its not my fault if I don't learn the material in the course.

41 There's generally not enough support available to help me with academic work.

42 At any given time, I work equally hard on all my modules.

43 You can pass the exams just by practising the past papers.

44 I have perfected my personal approach to academic study.

45 I prefer someone else teaching me rather than having to learn by myself

46 My approach to study has not changed since starting the course.

47 I'm confident I can learn the most complex material in the course.

48 I want to become an engineer mainly to help fix the world’s problems.

49 I want to become an engineer mainly to have a good career and life.

50 It is very important for me to get better grades than other students.

# 8.6 Appendix 6 Study “2” Factor Analysis Data

The tables shown below were extracted from the .lis file produced by PQ Method in each case.

## Study 2 Data *(the main study)*

### Correlation Matrix Between Sorts:

| SORTS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 43 | 22 | 59 | 40 | 31 | 67 | 67 | 22 | 55 | 51 | 41 | 28 | 46 | 14 | 8 | 43 | 15 | 54 | 23 | 41 |
| 2 | 43 | 100 | 23 | 26 | 34 | 14 | 50 | 37 | 5 | 56 | 28 | 25 | 29 | 35 | 18 | -3 | 37 | -31 | 45 | -4 | 33 |
| 3 | 22 | 23 | 100 | 34 | 20 | 38 | 35 | 38 | -9 | 28 | 26 | 7 | 37 | 46 | 7 | -26 | 25 | -1 | 50 | 2 | 28 |
| 4 | 59 | 26 | 34 | 100 | 27 | 43 | 46 | 47 | 20 | 24 | 32 | 12 | 8 | 34 | 15 | -5 | 22 | 14 | 40 | 31 | 23 |
| 5 | 40 | 34 | 20 | 27 | 100 | 2 | 32 | 34 | 43 | 31 | 20 | -5 | 17 | 43 | 28 | -23 | 41 | 5 | 16 | -5 | 28 |
| 6 | 31 | 14 | 38 | 43 | 2 | 100 | 26 | 26 | -5 | 9 | 34 | 12 | 31 | 23 | -1 | 0 | 25 | 14 | 49 | 21 | -11 |
| 7 | 67 | 50 | 35 | 46 | 32 | 26 | 100 | 62 | 25 | 55 | 39 | 34 | 20 | 66 | 0 | -8 | 31 | -1 | 59 | 21 | 56 |
| 8 | 67 | 37 | 38 | 47 | 34 | 26 | 62 | 100 | 26 | 52 | 42 | 46 | 14 | 68 | -3 | -1 | 42 | 12 | 53 | 25 | 49 |
| 9 | 22 | 5 | -9 | 20 | 43 | -5 | 25 | 26 | 100 | 35 | -9 | -3 | -8 | 25 | 25 | 0 | -3 | 14 | -12 | 18 | 31 |
| 10 | 55 | 56 | 28 | 24 | 31 | 9 | 55 | 52 | 35 | 100 | 51 | 21 | 31 | 49 | 11 | 8 | 28 | -19 | 38 | 14 | 61 |
| 11 | 51 | 28 | 26 | 32 | 20 | 34 | 39 | 42 | -9 | 51 | 100 | 39 | 44 | 43 | -3 | 28 | 37 | 5 | 50 | 7 | 33 |
| 12 | 41 | 25 | 7 | 12 | -5 | 12 | 34 | 46 | -3 | 21 | 39 | 100 | 24 | 31 | -5 | 16 | 28 | 9 | 37 | 3 | 23 |
| 13 | 28 | 29 | 37 | 8 | 17 | 31 | 20 | 14 | -8 | 31 | 44 | 24 | 100 | 15 | 15 | 15 | 21 | 9 | 35 | -18 | 31 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 46 | 35 | 46 | 34 | 43 | 23 | 66 | 68 | 25 | 49 | 43 | 31 | 15 | 100 | -5 | -7 | 40 | 3 | 54 | 17 | 49 |
| 15 | 14 | 18 | 7 | 15 | 28 | -1 | 0 | -3 | 25 | 11 | -3 | -5 | 15 | -5 | 100 | 15 | 3 | 28 | -17 | 3 | 24 |
| 16 | 8 | -3 | -26 | -5 | -23 | 0 | -8 | -1 | 0 | 8 | 28 | 16 | 15 | -7 | 15 | 100 | -14 | 32 | 3 | 15 | 1 |
| 17 | 43 | 37 | 25 | 22 | 41 | 25 | 31 | 42 | -3 | 28 | 37 | 28 | 21 | 40 | 3 | -14 | 100 | 8 | 21 | 3 | 33 |
| 18 | 15 | -31 | -1 | 14 | 5 | 14 | -1 | 12 | 14 | -19 | 5 | 9 | 9 | 3 | 28 | 32 | 8 | 100 | -1 | 32 | -5 |
| 19 | 54 | 45 | 50 | 40 | 16 | 49 | 59 | 53 | -12 | 38 | 50 | 37 | 35 | 54 | -17 | 3 | 21 | -1 | 100 | 18 | 15 |
| 20 | 23 | -4 | 2 | 31 | -5 | 21 | 21 | 25 | 18 | 14 | 7 | 3 | -18 | 17 | 3 | 15 | 3 | 32 | 18 | 100 | 7 |
| 21 | 41 | 33 | 28 | 23 | 28 | -11 | 56 | 49 | 31 | 61 | 33 | 23 | 31 | 49 | 24 | 1 | 33 | -5 | 15 | 7 | 100 |

**Table A.6.1 Correlation Matrix Between Sorts.**

## Factor Scores with Corresponding Ranks:

| | | | Factors | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. | Statement | No. | 1 | | 2 | | 3 | |
| 1 | Passing each module is always the most important thing | 1 | 1.67 | 3 | 0.89 | 12 | 1.72 | 2 |
| 2 | I will sometimes skip lectures if I'm less interested in | 2 | -0.21 | 32 | 1.06 | 6 | 0.34 | 21 |
| 3 | It matters a lot if I don't learn everything in a module | 3 | 1.01 | 8 | -0.42 | 34 | 0.50 | 17 |
| 4 | I tend to be passive when working in teams. | 4 | -1.25 | 45 | 0.98 | 10 | -1.63 | 46 |
| 5 | My aim is to completely master all the material taught | 5 | 1.49 | 5 | -0.67 | 35 | 1.17 | 5 |
| 6 | I never look for help outside of the course materials | 6 | -0.81 | 40 | -0.84 | 39 | -2.11 | 50 |
| 7 | I never miss any of the asynchronous activities given | 7 | 0.57 | 16 | -0.32 | 31 | -0.96 | 43 |
| 8 | The attitude of my lecturers has a big effect on my mo | 8 | 0.79 | 12 | -0.18 | 27 | 0.46 | 20 |
| 9 | I'm not very clear about my overall academic objective | 9 | -1.41 | 47 | 0.77 | 16 | -0.54 | 37 |
| 10 | I learn academic material by myself, regardless of oth | 10 | 0.45 | 17 | 1.03 | 9 | -0.29 | 32 |
| 11 | I find it hard keeping up with the course. | 11 | -0.89 | 41 | 1.03 | 8 | 0.96 | 11 |
| 12 | If I could choose how material is taught, I would do it | 12 | 0.17 | 21 | 1.76 | 2 | 0.46 | 19 |
| 13 | I don't expect to do well in my degree. | 13 | -2.13 | 49 | 0.52 | 18 | -1.33 | 44 |
| 14 | Flipped teaching makes it easier for me to learn | 14 | 0.89 | 9 | 1.37 | 5 | 0.03 | 25 |
| 15 | Learning with other students is mostly a pain | 15 | -0.22 | 33 | 0.34 | 23 | -1.35 | 45 |
| 16 | I prefer learning with my fellow students | 16 | -0.18 | 30 | -0.81 | 38 | 0.96 | 9 |
| 17 | My attitudes to learning are strongly affected by what | 17 | -1.19 | 44 | -1.65 | 48 | -0.91 | 42 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 18 | To do well I must have good relationships with my fell | 18 | -0.70 | 38 | -1.59 | 47 | 1.14 | 6 |
| 19 | I want to prove to others that I can succeed in my stu | 19 | 0.70 | 13 | -0.72 | 37 | -0.26 | 31 |
| 20 | I am more motivated by my fellow students than by my | 20 | -0.56 | 36 | -1.02 | 41 | -0.41 | 35 |
| 21 | I am striving to do well compared to other students. | 21 | 1.17 | 7 | -1.23 | 43 | -0.13 | 28 |
| 22 | Synchronous lectures don't have much value for me. | 22 | -0.02 | 25 | 0.46 | 22 | -0.57 | 38 |
| 23 | I sometimes seek help from other students, e.g. using | 23 | 0.37 | 18 | 0.47 | 20 | 0.74 | 12 |
| 24 | My goal is to avoid performing poorly compared to other | 24 | 0.83 | 11 | -0.16 | 26 | 0.52 | 14 |
| 25 | I was motivated to study engineering by one or more in | 25 | -0.55 | 35 | -1.08 | 42 | 1.51 | 3 |
| 26 | Understanding the taught material is always the most | 26 | 2.00 | 1 | 0.81 | 15 | 2.22 | 1 |
| 27 | Completing the coursework in a module is less important | 27 | -1.08 | 43 | -0.14 | 25 | 0.28 | 22 |

| | | | Factors | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. | Statement | No. | 1 | | 2 | | 3 | |
| 28 | I don't always fully complete the coursework in module | 28 | -2.17 | 50 | -0.19 | 28 | -0.46 | 36 |
| 29 | I will sometimes skip lectures when close to submitting | 29 | -0.23 | 34 | 0.67 | 17 | 0.96 | 10 |
| 30 | I prefer course material that really challenges me so | 30 | 1.20 | 6 | -0.06 | 24 | 0.66 | 13 |
| 31 | My goal is to perform better than the other students. | 31 | 0.00 | 24 | -1.70 | 49 | -0.20 | 30 |
| 32 | Getting good grades is the most important thing to me | 32 | 1.56 | 4 | -0.35 | 32 | -0.31 | 33 |
| 33 | I need a very deep understanding of material in order | 33 | 0.17 | 22 | -1.28 | 45 | 0.50 | 16 |
| 34 | Academic malpractice rules sometimes make me frustrate | 34 | -0.79 | 39 | -1.24 | 44 | -2.09 | 49 |
| 35 | My strategy is to learn just enough to pass each module | 35 | -1.97 | 48 | -0.31 | 29 | -0.80 | 41 |
| 36 | My subject is interesting, but my main goal is to pass | 36 | -0.56 | 37 | 1.40 | 4 | 0.04 | 24 |
| 37 | Working in a team does not motivate me to want to learn | 37 | -0.05 | 27 | 0.87 | 13 | -1.78 | 47 |
| 38 | I never rely on fellow students when completing course | 38 | -0.10 | 28 | 0.82 | 14 | 0.51 | 15 |
| 39 | I don't like flipped teaching and prefer traditional | 39 | -0.91 | 42 | -1.01 | 40 | 0.47 | 18 |
| 40 | Its not my fault if I don't learn the material in the | 40 | -1.29 | 46 | -0.32 | 31 | -1.81 | 48 |
| 41 | There's generally not enough support available to help | 41 | -0.21 | 31 | -0.36 | 33 | -0.33 | 34 |
| 42 | At any given time, I work equally hard on all my module | 42 | 0.62 | 15 | -1.34 | 46 | 0.08 | 23 |
| 43 | You can pass the exams just by practising the past pap | 43 | -0.02 | 26 | 1.03 | 8 | -0.69 | 4 |
| 44 | I have perfected my personal approach to academic stud | 44 | 0.69 | 14 | -0.72 | 37 | -0.58 | 39 |
| 45 | I prefer someone else teaching me rather than having | 45 | 0.34 | 19 | 1.86 | 1 | -0.04 | 26 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 46 | My approach to study has not changed since starting | 46 | -0.14 | 29 | 0.96 | 11 | -0.15 | 29 |
| 47 | I'm confident I can learn the most complex material in | 47 | 0.31 | 20 | 1.51 | 3 | 1.07 | 8 |
| 48 | I want to become an engineer mainly to help fix the | 48 | 0.84 | 10 | 0.46 | 22 | 1.10 | 7 |
| 49 | I want to become an engineer mainly to have a good | 49 | 1.77 | 2 | 0.50 | 19 | 1.42 | 4 |
| 50 | It is very important for me to get better grades than | 50 | 0.04 | 23 | -1.86 | 50 | -0.06 | 27 |

**Table A.6.2 Factor Scores with Corresponding Ranks**

## Distinguishing Statements for Factor 1:

(p < .05 ; asterisk (*) Indicates significance at p < .01).

Both the factor Q-Sort value (Q-SV) and the z-score (Z-SCR) are shown.

| | | | Factors | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | | 2 | | 3 | |
| No. | Statement | No. | Q-SV | Z-SCR | Q-SV | Z-SCR | Q-SV | Z-SCR |
| 32 | Getting good grades is the most important thing to me | 32 | 3 | 1.56* | -1 | -0.35 | -1 | -0.31 |
| 21 | I am striving to do well compared to other students | 21 | 2 | 1.17* | -2 | -1.23 | 0 | -0.13 |
| 19 | I want to prove to others that I can succeed in my studies | 19 | 1 | 0.70* | -1 | -0.72 | -1 | -0.26 |
| 44 | I have perfected my personal approach to academic study | 44 | 1 | 0.69* | -1 | -0.72 | -2 | -0.58 |
| 7 | I never miss any of the asynchronous activities given each | 7 | 1 | 0.57* | -1 | -0.32 | -2 | -0.96 |
| 47 | I'm confident I can learn the most complex material in the | 47 | 1 | 0.31* | 3 | 1.51 | 2 | 1.07 |
| 43 | You can pass the exams just by practising the past papers | 43 | 0 | -0.02 | 2 | 1.03 | -2 | -0.69 |
| 37 | Working in a team does not motivate me to want to learn | 37 | 0 | -0.05* | 1 | 0.87 | -3 | -1.78 |
| 38 | I never rely on fellow students when completing coursework | 38 | 0 | -0.10 | 1 | 0.82 | 1 | 0.51 |
| 16 | I prefer learning with my fellow students. | 16 | 0 | -0.18 | -1 | -0.81 | 2 | 0.96 |
| 2 | I will sometimes skip lectures if I'm less interested in the | 2 | -1 | -0.21 | 3 | 1.06 | 0 | 0.34 |
| 29 | I will sometimes skip lectures when close to submitting | 29 | -1 | -0.23* | 1 | 0.67 | 2 | 0.96 |
| 36 | My subject is interesting, but my main goal is to pass exams | 36 | -1 | -0.56 | 3 | 1.40 | 0 | 0.04 |
| 18 | To do well I must have good relationships with my fellow | 18 | -1 | -0.70* | -3 | -1.59 | 3 | 1.14 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11 I find it hard keeping up with the course. | 11 | -2 | -0.89* | 2 | 1.03 | 2 | 0.96 |
| 27 Completing the coursework in a module is less important | 27 | -2 | -1.08* | 0 | -0.14 | 0 | 0.28 |
| 9 I'm not very clear about my overall academic objectives. | 9 | -3 | -1.41* | 1 | 0.77 | -1 | -0.54 |
| 35 My strategy is to learn just enough to pass each module | 35 | -3 | -1.97* | 0 | -0.31 | -2 | -0.80 |
| 13 I don't expect to do well in my degree. | 13 | -4 | -2.13* | 1 | 0.52 | -2 | -1.33 |
| 28 I don't always fully complete the coursework in modules | 28 | -4 | -2.17* | 0 | -0.19 | -1 | -0.46 |

**Table A.6.3 Distinguishing Statements for Factor 1**

## Distinguishing Statements for Factor 2:

(p < .05 ; asterisk (*) Indicates significance at p < .01).

Both the factor Q-Sort value (Q-SV) and the z-score (Z-SCR) are shown.

| | | Factors | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | | 2 | | 3 | |
| No. Statement | No. | Q-SV | Z-SCR | Q-SV | Z-SCR | Q-SV | Z-SCR |
| 45 I prefer someone else teaching me rather than having to | 45 | 1 | 0.34 | 4 | 1.86* | 0 | -0.04 |
| 12 If I could choose how material is taught, I would do it | 12 | 0 | 0.17 | 4 | 1.76* | 1 | 0.46 |
| 36 My subject is interesting, but my main goal is to pass exams | 36 | -1 | -0.56 | 3 | 1.40* | 0 | 0.04 |
| 43 You can pass the exams just by practising the past papers | 43 | 0 | -0.02 | 2 | 1.03* | -2 | -0.69 |
| 4 I tend to be passive when working in teams | 4 | -3 | -1.25 | 2 | 0.98* | -3 | -1.63 |
| 46 My approach to study has not changed since starting the | 46 | 0 | -0.14 | 2 | 0.96* | 0 | -0.15 |
| 1 Passing each module is always the most important thing | 1 | 3 | 1.67 | 2 | 0.89 | 4 | 1.72 |
| 37 Working in a team does not motivate me to want to learn | 37 | 0 | -0.05 | 1 | 0.87* | -3 | -1.78 |
| 26 Understanding the taught material is always the most | 26 | 4 | 2.00 | 1 | 0.81* | 4 | 2.22 |
| 9 I’m not very clear about my overall academic objectives | 9 | -3 | -1.41 | 1 | 0.77* | -1 | -0.54 |
| 13 I don't expect to do well in my degree | 13 | -4 | -2.13 | 1 | 0.52* | -2 | -1.33 |
| 49 I want to become an engineer mainly to have a good career | 49 | 4 | 1.77 | 1 | 0.50 | 3 | 1.42 |
| 40 Its not my fault if I don't learn the material in the course | 40 | -3 | -1.29 | -1 | -0.32* | -3 | -1.81 |
| 3 It matters a lot if I don't learn everything in a module | 3 | 2 | 1.01 | -1 | -0.42 | 1 | 0.50 |
| 5 My aim is to completely master all the material taught to me | 5 | 3 | 1.49 | -1 | -0.67* | 3 | 1.17 |
| 16 I prefer learning with my fellow students | 16 | 0 | -0.18 | -1 | -0.81 | 2 | 0.96 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21 I am striving to do well compared to other students | 21 | 2 | 1.17 | -2 | -1.23* | 0 | -0.13 |
| 33 I need a very deep understanding of material in order to pas | 33 | 0 | 0.17 | -3 | -1.28* | 1 | 0.50 |
| 42 At any given time, I work equally hard on all my modules | 42 | 1 | 0.62 | -3 | -1.34* | 0 | 0.08 |
| 18 To do well I must have good relationships with my fellow stu | 18 | -1 | -0.70 | -3 | -1.59* | 3 | 1.14 |
| 31 My goal is to perform better than the other students | 31 | 0 | 0.00 | -4 | -1.70* | 0 | -0.20 |
| 50 It is very important for me to get better grades than other | 50 | 0 | 0.04 | -4 | -1.86* | 0 | -0.06 |

**Table A.6.4 Distinguishing Statements for Factor 2**

## Distinguishing Statements for Factor 3:

(p < .05 ; asterisk (*) Indicates significance at p < .01).

Both the factor Q-Sort value (Q-SV) and the z-score (Z-SCR) are shown.

| | | Factors | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | | 2 | | 3 | |
| No. Statement | No. | Q-SV | Z-SCR | Q-SV | Z-SCR | Q-SV | Z-SCR |
| 25 I was motivated to study engineering by one or more | 25 | -1 | -0.55 | -2 | -1.08 | 3 | 1.51* |
| 18 To do well I must have good relationships with my fellow stu | 18 | -1 | -0.70 | -3 | -1.59 | 3 | 1.14* |
| 16 I prefer learning with my fellow students. | 16 | 0 | -0.18 | -1 | -0.81 | 2 | 0.96* |
| 39 I don't like flipped teaching and prefer traditional ways of | 39 | -2 | -0.91 | -2 | -1.01 | 1 | 0.47* |
| 36 My subject is interesting, but my main goal is to pass exams | 36 | -1 | -0.56 | 3 | 1.40 | 0 | 0.04 |
| 14 Flipped teaching makes it easier for me to learn. | 14 | 2 | 0.89 | 3 | 1.37 | 0 | 0.03* |
| 21 I am striving to do well compared to other students. | 21 | 2 | 1.17 | -2 | -1.23 | 0 | -0.13* |
| 10 I learn academic material by myself, regardless of others in | 10 | 1 | 0.45 | 2 | 1.03 | -1 | -0.29* |
| 9 I'm not very clear about my overall academic objectives. | 9 | -3 | -1.41 | 1 | 0.77 | -1 | -0.54* |
| 22 Synchronous lectures don't have much value for me. | 22 | 0 | -0.02 | 0 | 0.46 | -1 | -0.57 |
| 43 You can pass the exams just by practising the past papers. | 43 | 0 | -0.02 | 2 | 1.03 | -2 | -0.69 |
| 13 I don't expect to do well in my degree. | 13 | -4 | -2.13 | 1 | 0.52 | -2 | -1.33* |
| 15 Learning with other students is mostly a pain. | 15 | -1 | -0.22 | 0 | 0.34 | -3 | -1.35* |
| 37 Working in a team does not motivate me to want to learn | 37 | 0 | -0.05 | 1 | 0.87 | -3 | -1.78* |
| 34 Academic malpractice rules sometimes make me frustrated | 34 | -2 | -0.79 | -2 | -1.24 | -4 | -2.09 |
| 6 I never look for help outside of the course materials | 6 | -2 | -0.81 | -2 | -0.84 | -4 | -2.11* |

## Table A.6.5 Distinguishing Statements for Factor 3

### Descending Array of Differences Between Factors 1 and 2:

| No. | Statement | No. | Type 1 | Type 2 | Difference |
|---|---|---|---|---|---|
| 21 | I am striving to do well compared to other students. | 21 | 1.170 | -1.227 | 2.397 |
| 5 | My aim is to completely master all the material taught to me | 5 | 1.487 | -0.669 | 2.157 |
| 42 | At any given time, I work equally hard on all my modules. | 42 | 0.621 | -1.339 | 1.960 |
| 32 | Getting good grades is the most important thing to me. | 32 | 1.563 | -0.351 | 1.914 |
| No. | Statement | No. | Type 1 | Type 2 | Difference |
| 50 | It is very important for me to get better grades than other | 50 | 0.038 | -1.856 | 1.894 |
| 31 | My goal is to perform better than the other students | 31 | 0.000 | -1.697 | 1.697 |
| 33 | I need a very deep understanding of material in order to | 33 | 0.167 | -1.282 | 1.449 |
| 3 | It matters a lot if I don't learn everything in a module | 3 | 1.014 | -0.423 | 1.437 |
| 19 | I want to prove to others that I can succeed in my studies | 19 | 0.704 | -0.717 | 1.421 |
| 44 | I have perfected my personal approach to academic study | 44 | 0.692 | -0.717 | 1.409 |
| 49 | I want to become an engineer mainly to have a good career | 49 | 1.771 | 0.503 | 1.268 |
| 30 | I prefer course material that really challenges me so I can | 30 | 1.199 | -0.062 | 1.261 |
| 26 | Understanding the taught material is always the most | 26 | 1.997 | 0.807 | 1.191 |
| 24 | My goal is to avoid performing poorly compared to others | 24 | 0.826 | -0.159 | 0.985 |
| 8 | The attitude of my lecturers has a big effect on my motivation | 8 | 0.792 | -0.178 | 0.970 |
| 7 | I never miss any of the asynchronous activities given each | 7 | 0.574 | -0.318 | 0.892 |
| 18 | To do well I must have good relationships with my fellow | 18 | -0.696 | -1.585 | 0.890 |
| 1 | Passing each module is always the most important thing. | 1 | 1.665 | 0.890 | 0.775 |
| 16 | I prefer learning with my fellow students | 16 | -0.181 | -0.807 | 0.626 |
| 25 | I was motivated to study engineering by one or more | 25 | -0.552 | -1.082 | 0.531 |
| 20 | I am more motivated by my fellow students than by my | 20 | -0.557 | -1.020 | 0.464 |
| 17 | My attitudes to learning are strongly affected by what my | 17 | -1.190 | -1.650 | 0.460 |
| 34 | Academic malpractice rules sometimes make me frustrated | 34 | -0.794 | -1.244 | 0.450 |

| | | | | | |
|---|---|---|---|---|---|
| 48 | I want to become an engineer mainly to help fix the world’s | 48 | 0.835 | 0.456 | 0.380 |
| 41 | There's generally not enough support available to help me | 41 | -0.209 | -0.358 | 0.149 |
| 39 | I don't like flipped teaching and prefer traditional ways | 39 | -0.911 | -1.013 | 0.103 |
| 6 | I never look for help outside of the course materials | 6 | -0.810 | -0.843 | 0.033 |
| 23 | I sometimes seek help from other students, e.g. using | 23 | 0.365 | 0.470 | -0.105 |
| 22 | Synchronous lectures don't have much value for me | 22 | -0.015 | 0.456 | -0.471 |
| 14 | Flipped teaching makes it easier for me to learn | 14 | 0.895 | 1.372 | -0.477 |
| 15 | Learning with other students is mostly a pain | 15 | -0.225 | 0.344 | -0.568 |
| 10 | I learn academic material by myself, regardless of others in | 10 | 0.446 | 1.028 | -0.582 |
| 29 | I will sometimes skip lectures when close to submitting | 29 | -0.231 | 0.669 | -0.901 |
| No. | Statement | No. | Type 1 | Type 2 | Difference |
| 38 | I never rely on fellow students when completing coursework | 38 | -0.098 | 0.821 | -0.920 |
| 37 | Working in a team does not motivate me to want to learn | 37 | -0.053 | 0.869 | -0.921 |
| 27 | Completing the coursework in a module is less important | 27 | -1.081 | -0.137 | -0.944 |
| 40 | Its not my fault if I don't learn the material in the course | 40 | -1.291 | -0.318 | -0.973 |
| 43 | You can pass the exams just by practising the past papers | 43 | -0.016 | 1.035 | -1.051 |
| 46 | My approach to study has not changed since starting the | 46 | -0.138 | 0.956 | -1.095 |
| 47 | I'm confident I can learn the most complex material in the | 47 | 0.309 | 1.505 | -1.196 |
| 2 | I will sometimes skip lectures if I'm less interested in the | 2 | -0.210 | 1.061 | -1.270 |
| 45 | I prefer someone else teaching me rather than having to | 45 | 0.338 | 1.856 | -1.519 |
| 12 | If I could choose how material is taught, I would do it | 12 | 0.173 | 1.759 | -1.586 |
| 35 | My strategy is to learn just enough to pass each module. | 35 | -1.971 | -0.311 | -1.660 |
| 11 | I find it hard keeping up with the course. | 11 | -0.895 | 1.035 | -1.930 |
| 36 | My subject is interesting, but my main goal is to pass exams | 36 | -0.563 | 1.401 | -1.963 |
| 28 | I don't always fully complete the coursework in modules. | 28 | -2.172 | -0.192 | -1.980 |
| 9 | I'm not very clear about my overall academic objectives | 9 | -1.406 | 0.767 | -2.173 |
| 4 | I tend to be passive when working in teams | 4 | -1.246 | 0.980 | -2.227 |
| 13 | I don't expect to do well in my degree | 13 | -2.130 | 0.517 | -2.648 |

**Table A.6.6 Descending Array of Differences Between Factors 1 and 2**

## Descending Array of Differences Between Factors 1 and 3:

| No. | Statement | No. | Type 1 | Type 3 | Difference |
|---|---|---|---|---|---|
| 32 | Getting good grades is the most important thing to me | 32 | 1.563 | -0.311 | 1.874 |
| 37 | Working in a team does not motivate me to want to learn | 37 | -0.053 | -1.781 | 1.728 |
| 7 | I never miss any of the asynchronous activities given each | 7 | 0.574 | -0.958 | 1.532 |
| 21 | I am striving to do well compared to other students | 21 | 1.170 | -0.131 | 1.301 |
| 6 | I never look for help outside of the course materials | 6 | -0.810 | -2.109 | 1.299 |

No. Statement No. Type 1 Type 3 Difference

| No. | Statement | No. | Type 1 | Type 3 | Difference |
|---|---|---|---|---|---|
| 34 | Academic malpractice rules sometimes make me | 34 | -0.794 | -2.089 | 1.295 |
| 44 | I have perfected my personal approach to academic | 44 | 0.692 | -0.582 | 1.275 |
| 15 | Learning with other students is mostly a pain. | 15 | -0.225 | -1.351 | 1.127 |
| 19 | I want to prove to others that I can succeed in my studies | 19 | 0.704 | -0.259 | 0.964 |
| 14 | Flipped teaching makes it easier for me to learn. | 14 | 0.895 | 0.029 | 0.866 |
| 10 | I learn academic material by myself, regardless of others in | 10 | 0.446 | -0.294 | 0.739 |
| 43 | You can pass the exams just by practising the past papers | 43 | -0.016 | -0.691 | 0.675 |
| 22 | Synchronous lectures don't have much value for me. | 22 | -0.015 | -0.568 | 0.553 |
| 30 | I prefer course material that really challenges me so I can | 30 | 1.199 | 0.656 | 0.543 |
| 42 | At any given time, I work equally hard on all my modules. | 42 | 0.621 | 0.084 | 0.538 |
| 40 | Its not my fault if I don't learn the material in the course | 40 | -1.291 | -1.811 | 0.519 |
| 3 | It matters a lot if I don't learn everything in a module | 3 | 1.014 | 0.495 | 0.519 |
| 4 | I tend to be passive when working in teams | 4 | -1.246 | -1.634 | 0.387 |
| 45 | I prefer someone else teaching me rather than having to | 45 | 0.338 | -0.038 | 0.376 |
| 49 | I want to become an engineer mainly to have a good | 49 | 1.771 | 1.419 | 0.352 |
| 8 | The attitude of my lecturers has a big effect on my motivation | 8 | 0.792 | 0.456 | 0.336 |
| 5 | My aim is to completely master all the material taught to me | 5 | 1.487 | 1.170 | 0.317 |
| 24 | My goal is to avoid performing poorly compared to others | 24 | 0.826 | 0.520 | 0.306 |
| 31 | My goal is to perform better than the other students. | 31 | 0.000 | -0.195 | 0.195 |
| 41 | There's generally not enough support available to help | 41 | -0.209 | -0.329 | 0.119 |

| | | | | | |
|---|---|---|---|---|---|
| 50 | It is very important for me to get better grades than other | 50 | 0.038 | -0.064 | 0.101 |
| 46 | My approach to study has not changed since starting the | 46 | -0.138 | -0.152 | 0.013 |
| 1 | Passing each module is always the most important thing. | 1 | 1.665 | 1.718 | -0.053 |
| 20 | I am more motivated by my fellow students than by my | 20 | -0.557 | -0.411 | -0.145 |
| 26 | Understanding the taught material is always the most | 26 | 1.997 | 2.222 | -0.225 |
| 48 | I want to become an engineer mainly to help fix the | 48 | 0.835 | 1.100 | -0.264 |
| 17 | My attitudes to learning are strongly affected by what | 17 | -1.190 | -0.910 | -0.280 |
| 12 | If I could choose how material is taught, I would do it | 12 | 0.173 | 0.459 | -0.286 |
| 33 | I need a very deep understanding of material in order to | 33 | 0.167 | 0.504 | -0.337 |
| No. | Statement | No. | Type 1 | Type 3 | Difference |
| 23 | I sometimes seek help from other students, e.g. using | 23 | 0.365 | 0.743 | -0.378 |
| 2 | I will sometimes skip lectures if I'm less interested in the | 2 | -0.210 | 0.343 | -0.552 |
| 36 | My subject is interesting, but my main goal is to pass exams | 36 | -0.563 | 0.039 | -0.602 |
| 38 | I never rely on fellow students when completing coursework | 38 | -0.098 | 0.515 | -0.613 |
| 47 | I'm confident I can learn the most complex material in the | 47 | 0.309 | 1.067 | -0.758 |
| 13 | I don't expect to do well in my degree. | 13 | -2.130 | -1.331 | -0.799 |
| 9 | I'm not very clear about my overall academic objectives. | 9 | -1.406 | -0.544 | -0.862 |
| 16 | I prefer learning with my fellow students. | 16 | -0.181 | 0.964 | -1.145 |
| 35 | My strategy is to learn just enough to pass each module. | 35 | -1.971 | -0.804 | -1.167 |
| 29 | I will sometimes skip lectures when close to submitting | 29 | -0.231 | 0.958 | -1.190 |
| 27 | Completing the coursework in a module is less important | 27 | -1.081 | 0.278 | -1.359 |
| 39 | I don't like flipped teaching and prefer traditional ways of | 39 | -0.911 | 0.467 | -1.377 |
| 28 | I don't always fully complete the coursework in modules. | 28 | -2.172 | -0.461 | -1.712 |
| 18 | To do well I must have good relationships with my fellow | 18 | -0.696 | 1.135 | -1.831 |
| 11 | I find it hard keeping up with the course. | 11 | -0.895 | 0.958 | -1.853 |
| 25 | I was motivated to study engineering by one or more | 25 | -0.552 | 1.511 | -2.063 |

**Table A.6.7 Descending Array of Differences Between Factors 1 and 3**

## Descending Array of Differences Between Factors 2 and 3:

| No. | Statement | No. | Type 2 | Type 3 | Difference |
|---|---|---|---|---|---|
| 37 | Working in a team does not motivate me to want to learn | 37 | 0.869 | -1.781 | 2.650 |
| 4 | I tend to be passive when working in teams. | 4 | 0.980 | -1.634 | 2.614 |
| 45 | I prefer someone else teaching me rather than having to | 45 | 1.856 | -0.038 | 1.894 |
| 13 | I don't expect to do well in my degree. | 13 | 0.517 | -1.331 | 1.849 |
| 43 | You can pass the exams just by practising the past papers | 43 | 1.035 | -0.691 | 1.726 |
| 15 | Learning with other students is mostly a pain. | 15 | 0.344 | -1.351 | 1.695 |

| No. | Statement | No. | Type 2 | Type 3 | Difference |
|---|---|---|---|---|---|
| 40 | Its not my fault if I don't learn the material in the course | 40 | -0.318 | -1.811 | 1.493 |
| 36 | My subject is interesting, but my main goal is to pass | 36 | 1.401 | 0.039 | 1.362 |
| 14 | Flipped teaching makes it easier for me to learn. | 14 | 1.372 | 0.029 | 1.343 |
| 10 | I learn academic material by myself, regardless of others in | 10 | 1.028 | -0.294 | 1.321 |
| 9 | I'm not very clear about my overall academic objectives. | 9 | 0.767 | -0.544 | 1.310 |
| 12 | If I could choose how material is taught, I would do it diff | 12 | 1.759 | 0.459 | 1.300 |
| 6 | I never look for help outside of the course materials | 6 | -0.843 | -2.109 | 1.266 |
| 46 | My approach to study has not changed since starting the | 46 | 0.956 | -0.152 | 1.108 |
| 22 | Synchronous lectures don't have much value for me. | 22 | 0.456 | -0.568 | 1.024 |
| 34 | Academic malpractice rules sometimes make me frustrated | 34 | -1.244 | -2.089 | 0.846 |
| 2 | I will sometimes skip lectures if I'm less interested in the | 2 | 1.061 | 0.343 | 0.718 |
| 7 | I never miss any of the asynchronous activities given each | 7 | -0.318 | -0.958 | 0.640 |
| 35 | My strategy is to learn just enough to pass each module. | 35 | -0.311 | -0.804 | 0.493 |
| 47 | I'm confident I can learn the most complex material in the | 47 | 1.505 | 1.067 | 0.438 |
| 38 | I never rely on fellow students when completing coursework | 38 | 0.821 | 0.515 | 0.306 |
| 28 | I don't always fully complete the coursework in modules. | 28 | -0.192 | -0.461 | 0.269 |
| 11 | I find it hard keeping up with the course. | 11 | 1.035 | 0.958 | 0.077 |
| 41 | There's generally not enough support available to help | 41 | -0.358 | -0.329 | -0.030 |
| 32 | Getting good grades is the most important thing to me | 32 | -0.351 | -0.311 | -0.040 |
| 44 | I have perfected my personal approach to academic study | 44 | -0.717 | -0.582 | -0.134 |
| 23 | I sometimes seek help from other students, e.g. using | 23 | 0.470 | 0.743 | -0.273 |

| | | | | | |
|---|---|---|---|---|---|
| 29 | I will sometimes skip lectures when close to submitting | 29 | 0.669 | 0.958 | -0.289 |
| 27 | Completing the coursework in a module is less important | 27 | -0.137 | 0.278 | -0.415 |
| 19 | I want to prove to others that I can succeed in my studies | 19 | -0.717 | -0.259 | -0.457 |
| 20 | I am more motivated by my fellow students than by my | 20 | -1.020 | -0.411 | -0.609 |
| 8 | The attitude of my lecturers has a big effect on my motivation | 8 | -0.178 | 0.456 | -0.634 |
| 48 | I want to become an engineer mainly to help fix the world's | 48 | 0.456 | 1.100 | -0.644 |
| 24 | My goal is to avoid performing poorly compared to others. | 24 | -0.159 | 0.520 | -0.679 |
| 30 | I prefer course material that really challenges me so I can | 30 | -0.062 | 0.656 | -0.718 |
| No. | Statement | No. | Type 2 | Type 3 | Difference |
| 17 | My attitudes to learning are strongly affected by what my fe | 17 | -1.650 | -0.910 | -0.740 |
| 1 | Passing each module is always the most important thing. | 1 | 0.890 | 1.718 | -0.828 |
| 49 | I want to become an engineer mainly to have a good | 49 | 0.503 | 1.419 | -0.916 |
| 3 | It matters a lot if I don't learn everything in a module | 3 | -0.423 | 0.495 | -0.918 |
| 21 | I am striving to do well compared to other students | 21 | -1.227 | -0.131 | -1.096 |
| 26 | Understanding the taught material is always the most | 26 | 0.807 | 2.222 | -1.415 |
| 42 | At any given time, I work equally hard on all my modules. | 42 | -1.339 | 0.084 | -1.423 |
| 39 | I don't like flipped teaching and prefer traditional ways of | 39 | -1.013 | 0.467 | -1.480 |
| 31 | My goal is to perform better than the other students. | 31 | -1.697 | -0.195 | -1.502 |
| 16 | I prefer learning with my fellow students. | 16 | -0.807 | 0.964 | -1.771 |
| 33 | I need a very deep understanding of material in order to | 33 | -1.282 | 0.504 | -1.786 |
| 50 | It is very important for me to get better grades than other | 50 | -1.856 | -0.064 | -1.793 |
| 5 | My aim is to completely master all the material taught to me | 5 | -0.669 | 1.170 | -1.839 |
| 25 | I was motivated to study engineering by one or more | 25 | -1.082 | 1.511 | -2.594 |
| 18 | To do well I must have good relationships with my fellow | 18 | -1.585 | 1.135 | -2.720 |

**Table A.6.8 Descending Array of Differences Between Factors 2 and 3**

## Factor Q-Sort Values for Each Statement:

| | | | Factor Arrays | | |
|---|---|---|---|---|---|
| No. | Statement | No. | 1 | 2 | 3 |
| 1 | Passing each module is always the most important thing | 1 | 3 | 2 | 4 |
| 2 | I will sometimes skip lectures if I'm less interested in the | 2 | -1 | 3 | 0 |
| 3 | It matters a lot if I don't learn everything in a module | 3 | 2 | -1 | 1 |
| 4 | I tend to be passive when working in teams. | 4 | -3 | 2 | -3 |
| 5 | My aim is to completely master all the material taught to me | 5 | 3 | -1 | 3 |
| 6 | I never look for help outside of the course materials (e.g YouTube) | 6 | -2 | -2 | -4 |

| | | | Factor Arrays | | |
|---|---|---|---|---|---|
| No. | Statement | No. | 1 | 2 | 3 |
| 7 | I never miss any of the asynchronous activities given each | 7 | 1 | -1 | -2 |
| 8 | The attitude of my lecturers has a big effect on my motivation | 8 | 2 | 0 | 1 |
| 9 | I'm not very clear about my overall academic objectives. | 9 | -3 | 1 | -1 |
| 10 | I learn academic material by myself, regardless of others in | 10 | 1 | 2 | -1 |
| 11 | I find it hard keeping up with the course. | 11 | -2 | 2 | 2 |
| 12 | If I could choose how material is taught, I would do it diff | 12 | 0 | 4 | 1 |
| 13 | I don't expect to do well in my degree. | 13 | -4 | 1 | -2 |
| 14 | Flipped teaching makes it easier for me to learn. | 14 | 2 | 3 | 0 |
| 15 | Learning with other students is mostly a pain. | 15 | -1 | 0 | -3 |
| 16 | I prefer learning with my fellow students. | 16 | 0 | -1 | 2 |
| 17 | My attitudes to learning are strongly affected by what my fe | 17 | -2 | -3 | -2 |
| 18 | To do well I must have good relationships with my fellow stu | 18 | -1 | -3 | 3 |
| 19 | I want to prove to others that I can succeed in my studies. | 19 | 1 | -1 | -1 |
| 20 | I am more motivated by my fellow students than by my lecture | 20 | -1 | -2 | -1 |
| 21 | I am striving to do well compared to other students. | 21 | 2 | -2 | 0 |
| 22 | Synchronous lectures don't have much value for me. | 22 | 0 | 0 | -1 |
| 23 | I sometimes seek help from other students, e.g. using social | 23 | 1 | 1 | 2 |
| 24 | My goal is to avoid performing poorly compared to others. | 24 | 2 | 0 | 1 |
| 25 | I was motivated to study engineering by one or more | 25 | -1 | -2 | 3 |
| 26 | Understanding the taught material is always the most | 26 | 4 | 1 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| 27 | Completing the coursework in a module is less important than | 27 | -2 | 0 | 0 |
| 28 | I don't always fully complete the coursework in modules. | 28 | -4 | 0 | -1 |
| 29 | I will sometimes skip lectures when close to submitting cour | 29 | -1 | 1 | 2 |
| 30 | I prefer course material that really challenges me so I can | 30 | 3 | 0 | 1 |
| 31 | My goal is to perform better than the other students. | 31 | 0 | -4 | 0 |
| 32 | Getting good grades is the most important thing to me. | 32 | 3 | -1 | -1 |
| 33 | I need a very deep understanding of material in order to pas | 33 | 0 | -3 | 1 |
| 34 | Academic malpractice rules sometimes make me frustrated. | 34 | -2 | -2 | -4 |

| | | | Factor Arrays | | |
|---|---|---|---|---|---|
| No. | Statement | No. | 1 | 2 | 3 |
| 35 | My strategy is to learn just enough to pass each module. | 35 | -3 | 0 | -2 |
| 36 | My subject is interesting, but my main goal is to pass exams | 36 | -1 | 3 | 0 |
| 37 | Working in a team does not motivate me to want to learn more | 37 | 0 | 1 | -3 |
| 38 | I never rely on fellow students when completing coursework. | 38 | 0 | 1 | 1 |
| 39 | I don't like flipped teaching and prefer traditional ways of | 39 | -2 | -2 | 1 |
| 40 | It's not my fault if I don't learn the material in the course | 40 | -3 | -1 | -3 |
| 41 | There's generally not enough support available to help me wi | 41 | -1 | -1 | -1 |
| 42 | At any given time, I work equally hard on all my modules. | 42 | 1 | -3 | 0 |
| 43 | You can pass the exams just by practising the past papers. | 43 | 0 | 2 | -2 |
| 44 | I have perfected my personal approach to academic study. | 44 | 1 | -1 | -2 |
| 45 | I prefer someone else teaching me rather than having to lear | 45 | 1 | 4 | 0 |
| 46 | My approach to study has not changed since starting the cour | 46 | 0 | 2 | 0 |
| 47 | I'm confident I can learn the most complex material in the c | 47 | 1 | 3 | 2 |
| 48 | I want to become an engineer mainly to help fix the world’s | 48 | 2 | 0 | 2 |
| 49 | I want to become an engineer mainly to have a good career an | 49 | 4 | 1 | 3 |
| 50 | It is very important for me to get better grades than other | 50 | 0 | -4 | 0 |

**Table A.6.9 Factor Q-Sort Values for Each Statement**

## Unrotated Factor Loadings:

Unrotated Factor Matrix

| SORTS | Factors 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1 | 0.8272 | 0.1017 | 0.1099 | 0.0102 | -0.0329 | 0.0008 | 0.0263 |
| 2 | 0.5218 | -0.2476 | -0.2297 | 0.0750 | -0.2112 | 0.0425 | -0.0553 |
| 3 | 0.4445 | -0.0143 | -0.3413 | 0.0830 | 0.2933 | 0.0912 | -0.3494 |
| 4 | 0.5788 | 0.0844 | 0.1691 | 0.0156 | 0.2690 | 0.0758 | -0.0749 |
| 5 | 0.4418 | -0.4780 | 0.1819 | 0.1544 | 0.0058 | 0.0001 | -0.2757 |
| 6 | 0.3913 | 0.3959 | -0.0899 | 0.1083 | 0.2769 | 0.0806 | -0.3014 |
| 7 | 0.7617 | -0.1182 | -0.0948 | 0.0157 | 0.1273 | 0.0165 | 0.1947 |
| 8 | 0.7873 | -0.0340 | -0.0153 | 0.0011 | 0.1577 | 0.0253 | 0.2086 |
| 9 | 0.2456 | -0.3196 | 0.4846 | 0.1975 | 0.0586 | 0.0038 | 0.2085 |
| 10 | 0.6739 | -0.2729 | -0.0873 | 0.0495 | -0.2413 | 0.0565 | 0.2420 |
| 11 | 0.6303 | 0.2759 | -0.2321 | 0.0901 | -0.2452 | 0.0585 | 0.0070 |
| 12 | 0.4063 | 0.1563 | -0.2175 | 0.0518 | -0.1528 | 0.0215 | 0.2081 |
| 13 | 0.4105 | 0.0728 | -0.2191 | 0.0399 | -0.2858 | 0.0816 | -0.3091 |
| 14 | 0.7156 | -0.2356 | -0.1529 | 0.0503 | 0.2925 | 0.0907 | 0.1586 |
| 15 | 0.1731 | -0.0497 | 0.4274 | 0.0971 | -0.2414 | 0.0566 | -0.3500 |
| 16 | 0.0535 | 0.4401 | 0.1145 | 0.1286 | -0.3677 | 0.1443 | 0.2496 |
| 17 | 0.4874 | -0.0705 | -0.1179 | 0.0145 | -0.0104 | 0.0000 | -0.1949 |
| 18 | 0.1420 | 0.3368 | 0.5115 | 0.2326 | 0.0454 | 0.0026 | -0.0178 |
| 19 | 0.6393 | 0.2350 | -0.4000 | 0.1537 | 0.2589 | 0.0699 | 0.0020 |
| 20 | 0.2347 | 0.1635 | 0.2659 | 0.0498 | 0.2597 | 0.0703 | 0.2187 |
| 21 | 0.5749 | -0.4364 | -0.0070 | 0.1140 | -0.2635 | 0.0684 | 0.1617 |
| Eigenvalues | 5.8798 | 1.4042 | 1.3774 | 0.2244 | 0.9338 | 0.0838 | 0.9428 |
| % expl.Var. | \| 28 | 7 | 7 | 1 | 3 | 0 | 4 |

**Table A.6.10 Unrotated Factor Loadings**

**Factor Loadings after Varimax Rotation:**

Loadings

| QSORT | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 0.6513 | 0.4128 | 0.3350 |
| 2 | 0.4682 | -0.1297 | 0.3878 |
| 3 | 0.5286 | -0.1389 | 0.1248 |
| 4 | 0.4138 | 0.3707 | 0.2492 |
| 5 | 0.1310 | 0.0747 | 0.6588 |
| 6 | 0.4802 | 0.2401 | -0.1724 |
| 7 | 0.6351 | 0.1209 | 0.4304 |
| 8 | 0.6411 | 0.2338 | 0.3944 |
| 9 | -0.1334 | 0.3314 | 0.5193 |
| 10 | 0.5143 | 0.0261 | 0.5206 |
| 11 | 0.7111 | 0.1472 | 0.0003 |
| 12 | 0.4857 | 0.0291 | -0.0009 |
| 13 | 0.4656 | -0.0095 | 0.0705 |
| 14 | 0.5919 | 0.0034 | 0.4905 |
| 15 | -0.0853 | 0.3854 | 0.2433 |
| 16 | 0.1155 | 0.3159 | -0.3106 |
| 17 | 0.4363 | 0.0328 | 0.2549 |
| 18 | -0.0395 | 0.6234 | -0.0707 |
| 19 | 0.7898 | -0.0066 | -0.0085 |
| 20 | 0.1076 | 0.3722 | 0.0486 |
| 21 | 0.3458 | -0.0167 | 0.6334 |
| % expl.Var. | 22 | 7 | 12 |

**Table A.6.11 Factor Loadings after Varimax Rotation**

**Factor Loadings *(after rotation)*:**

| Q Sort | F1 | F2 | F3 | Comments |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 19 | **0.7898** | -0.0066 | -0.0085 | |
| 11 | **0.7111** | 0.1472 | 0.0003 | |
| 1 | 0.6513 | 0.4128 | 0.3350 | *confounded* |
| 8 | 0.6412 | 0.2338 | 0.3944 | *confounded* |
| 7 | 0.6531 | 0.1210 | 0.4304 | *confounded* |
| 14 | 0.5919 | 0.0034 | 0.4905 | *confounded* |
| 3 | **0.5286** | -0.1389 | 0.1249 | |
| 12 | **0.4857** | 0.0291 | -0.0009 | |
| 6 | **0.4802** | 0.2401 | -0.1724 | |
| 2 | 0.4682 | -0.1297 | 0.3878 | *confounded* |
| 13 | **0.4656** | -0.0095 | 0.0705 | |
| 17 | **0.4363** | 0.0328 | 0.2549 | |
| 4 | 0.4138 | 0.3707 | 0.2493 | *confounded* |
| 18 | -0.395 | **0.6234** | -0.0707 | |
| 15 | -0.0853 | **0.3854** | 0.2433 | |
| 20 | 0.1076 | **0.3722** | 0.0486 | |
| 16 | 0.1156 | 0.3159 | -0.3106 | - |
| 5 | 0.1310 | 0.0747 | **0.6588** | |
| 21 | 0.3458 | -0.0167 | **0.6334** | |
| 10 | 0.5143 | 0.0261 | 0.5206 | *confounded* |
| 9 | -0.1334 | 0.3314 | **0.5193** | |
| **Totals** | **7** | **3** | **3** | **7** |

**Table A.6.12. Factor Loadings *(after rotation).***
***Factor-exemplifying Q Sorts are highlighted.***

## Factor Score Correlations:

| | F1 | F2 | F3 |
|---|---|---|---|
| **F1** | 1.0000 | 0.0888 | 0.5198 |
| **F2** | 0.0888 | 1.0000 | 0.1201 |
| **F3** | 0.5198 | 0.1201 | 1.0000 |

**Table A.6.13. Factor Score Correlations**

## Factor Arrays:

## Composite Q sort for Factor 1

| -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| I dont expect to do well in my degree. | I tend to be passive when working in teams. | Academic malpractice rules sometimes make me frustrated. | Theres generally not enough support available to help me with academic work. | If I could choose how material is taught, I would do it differently. | I want to prove to others that I can succeed in my studies. | I am striving to do well compared to other students. | Passing each module is always the most important thing. | Understanding the taught material is always the most important thing. |
| I don't always fully complete the coursework in modules. | Its not my fault if I don't learn the material in the course. | I never look for help outside of the course materials (e.g YouTube). | I will sometimes skip lectures if I'm less interested in the subject. | I need a very deep understanding of material in order to pass the exams. | I have perfected my personal approach to academic study. | It matters a lot if I don't learn everything in a module. | Getting good grades is the most important thing to me. | I want to become an engineer mainly to have a good career and life. |
| | Im not very clear about my overall academic objectives. | I find it hard keeping up with the course. | Learning with other students is mostly a pain. | It is very important for me to get better grades than other students. | At any given time, I work equally hard on all my modules. | Flipped teaching makes it easier for me to learn. | My aim is to completely master all the material taught to me. | |
| | My strategy is to learn just enough to pass each module. | I don't like flipped teaching and prefer traditional ways of learning. | I will sometimes skip lectures when close to submitting coursework. | My goal is to perform better than the other students. | I never miss any of the asynchronous activities given each week. | I want to become an engineer mainly to help fix the worlds problems. | I prefer course material that really challenges me so I can learn more. | |
| | | Completing the coursework in a module is less important than passing the exam. | I was motivated to study engineering by one or more inspirational people. | Synchronous lectures don't have much value for me. | I learn academic material by myself, regardless of others including lecturers. | My goal is to avoid performing poorly compared to others. | | |
| | | My attitudes to learning are strongly affected by what my fellow students say. | I am more motivated by my fellow students than by my lecturers. | You can pass the exams just by practising the past papers. | I sometimes seek help from other students, e.g. using social media. | The attitude of my lecturers has a big effect on my motivation to study. | | |
| | | | My subject is interesting, but my main goal is to pass exams. | Working in a team does not motivate me to want to learn more. | I prefer someone else teaching me rather than having to learn by myself. | | | |
| | | | To do well I must have good relationships with my fellow students. | I never rely on fellow students when completing coursework. | I'm confident I can learn the most complex material in the course. | | | |
| | | | | My approach to study has not changed since starting the course. | | | | |
| | | | | I prefer learning with my fellow students. | | | | |

**Figure A.6.1 Factor Array for Factor 1**

## Composite Q sort for Factor 2

| -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| My goal is to perform better than the other students. | I need a very deep understanding of material in order to pass the exams. | I never look for help outside of the course materials (e.g YouTube). | Its not my fault if I don't learn the material in the course. | Synchronous lectures don't have much value for me. | Working in a team does not motivate me to want to learn more. | I learn academic material by myself, regardless of others including teachers. | I'm confident I can learn the most complex material in the course. | I prefer someone else teaching me rather than having to learn by myself. |
| It is very important for me to get better grades than other students. | At any given time, I work equally hard on all my modules. | I don't like flipped teaching and prefer traditional ways of learning | Getting good grades is the most important thing to me. | I want to become an engineer mainly to help fix the worlds problems. | I never rely on fellow students when completing coursework. | I find it hard keeping up with the course. | My subject is interesting, but my main goal is to pass exams. | If I could choose how material is taught, I would do it differently. |
| | To do well I must have good relationships with my fellow students. | I am more motivated by my fellow students than by my lecturers. | Theres generally not enough support available to help me with academic work. | Learning with other students is mostly a pain. | Understanding the taught material is always the most important thing. | You can pass the exams just by practising the past papers. | Flipped teaching makes it easier for me to learn. | |
| | My attitudes to learning are strongly affected by what my fellow students say. | I was motivated to study engineering by one or more inspirational people. | It matters a lot if I don't learn everything in a module. | I prefer course material that really challenges me so I can learn more. | Im not very clear about my overall academic objectives. | I tend to be passive when working in teams. | I will sometimes skip lectures if I'm less interested in the subject. | |
| | | I am striving to do well compared to other students. | My aim is to completely master all the material taught to me. | Completing the coursework in a module is less important than passing the exam. | I will sometimes skip lectures when close to submitting coursework. | My approach to study has not changed since starting the course. | | |
| | | Academic malpractice rules sometimes make me frustrated. | I want to prove to others that I can succeed in my studies. | My goal is to avoid performing poorly compared to others. | I dont expect to do well in my degree. | Passing each module is always the most important thing. | | |
| | | | I have perfected my personal approach to academic study. | The attitude of my lecturers has a big effect on my motivation to study. | I want to become an engineer mainly to have a good career and life. | | | |
| | | | I prefer learning with my fellow students. | I don't always fully complete the coursework in modules. | I sometimes seek help from other students, e.g. using social media. | | | |
| | | | | My strategy is to learn just enough to pass each module. | | | | |
| | | | | I never miss any of the asynchronous activities given each week. | | | | |

**Figure A.6.2 Factor Array for Factor 2**

## Composite Q sort for Factor 3

| -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| Academic malpractice rules sometimes make me frustrated. | Learning with other students is mostly a pain. | I have perfected my personal approach to academic study. | I want to prove to others that I can succeed in my studies. | I will sometimes skip lectures if I'm less interested in the subject. | I prefer course material that really challenges me so I can learn more. | I want to become an engineer mainly to help fix the worlds problems. | I was motivated to study engineering by one or more inspirational people. | Understanding the taught material is always the most important thing. |
| I never look for help outside of the course materials (e.g YouTube). | I tend to be passive when working in teams. | You can pass the exams just by practising the past papers. | I learn academic material by myself, regardless of others including teachers. | Completing the coursework in a module is less important than passing the exam. | My goal is to avoid performing poorly compared to others. | I'm confident I can learn the most complex material in the course. | I want to become an engineer mainly to have a good career and life. | Passing each module is always the most important thing. |
| | Working in a team does not motivate me to want to learn more. | My strategy is to learn just enough to pass each module. | Getting good grades is the most important thing to me. | At any given time, I work equally hard on all my modules. | I never rely on fellow students when completing coursework. | I find it hard keeping up with the course. | My aim is to completely master all the material taught to me. | |
| | Its not my fault if I don't learn the material in the course. | My attitudes to learning are strongly affected by what my fellow students say. | Theres generally not enough support available to help me with academic work. | My subject is interesting, but my main goal is to pass exams. | It matters a lot if I don't learn everything in a module. | I prefer learning with my fellow students. | To do well I must have good relationships with my fellow students. | |
| | | I never miss any of the asynchronous activities given each week. | I am more motivated by my fellow students than by my lecturers. | Flipped teaching makes it easier for me to learn. | I need a very deep understanding of material in order to pass the exams. | I will sometimes skip lectures when close to submitting coursework. | | |
| | | I dont expect to do well in my degree. | I don't always fully complete the coursework in modules. | I prefer someone else teaching me rather than having to learn by myself. | I don't like flipped teaching and prefer traditional ways of learning. | I sometimes seek help from other students, e.g. using social media. | | |
| | | | Im not very clear about my overall academic objectives. | It is very important for me to get better grades than other students. | If I could choose how material is taught, I would do it differently. | | | |
| | | | Synchronous lectures don't have much value for me. | I am striving to do well compared to other students. | The attitude of my lecturers has a big effect on my motivation to study. | | | |
| | | | | My approach to study has not changed since starting the course. | | | | |
| | | | | My goal is to perform better than the other students. | | | | |

**Figure A.6.3 Factor Array for Factor 3**

## 8.7 Appendix 7 Tensions and Tension Categories

Sources of tension reported by study participants are listed below, under the appropriate systemic contradiction and tension category. Although there are similarities between some tension sources, they were retained because the underlying reasons given for each one were sufficient enough to differentiate them.

**<u>Systemic Contradiction 'Teacher-led v Learner-centred learning'</u>**

**Tension Categories:**

**"Dissatisfaction with the teacher-led activities in the synchronous sessions".**

Several synchronous sessions just repeated the asynchronous material; many sessions are boring and uninspiring; there's a sense that nothing useful is done for a large percentage of the time; sessions often do not enthuse, or engage attention; there are often little or no problem-solving activities; sessions are not as focussed compared to corresponding asynchronous materials; inability to quickly turn to a friend/classmate to discuss questions; inhibited to ask questions during sessions; the sessions are tiring; many sessions are often poorly structured; in some modules the lecturer just reads off the (Powerpoint) slides; some sessions are too fast; the sessions should have individual study plans; too much new information is given in some sessions; some lecturers have a poor presentation style; recordings of sessions are of variable quality; the teaching quality in sessions varies greatly module to module; some sessions use too much time answering questions from some students who didn't bother watching the asynchronous videos; sessions are not focussed enough on exam preparation; sessions should spaced out, with 5-10 minutes gap between each one; not enough time allowed in sessions for problem-solving; too much variability in the format of sessions.

**"Difficulties experienced in learning using the asynchronous materials".**

Some videos were too long; some contained too much content, requiring a lot of time spent in note-taking, rewinding and replaying to understand everything; the content was sometimes inadequate for independent learning; learning from videos felt to take longer than compared to traditional face-to-face teaching; some videos were of low production quality; sometimes, learning had to be supplemented by looking outside the module, e.g., YouTube; additional learning resources such as textbooks should be more often indicated; for some modules, the online quizzes do not show/have the answers/solutions; not being able to ask the lecturer a question at the time; having asynchronous materials makes the workload feel strenuous; not enough time allowed to fully comprehend the content; the online quizzes should be more challenging; not having enough time to keep up watching videos each week; not having notes/enough notes, supplied with videos; the quality of videos varied too much between one module and another; too many videos; some perceived as being too narrowly focussed.

**"Poor quality support in the use of tools mandated in learning."**
[For one module] little/no help in installing software needed for some learning activities; support was poor when there were problems in using online tools. ***2***

**"Passing the exam at the expense of acquiring a deeper understanding of the taught materials"**
Some asynchronous materials were better suited to passing exams, rather than helping to achieve a deep conceptual understanding of the material; unnecessary pressure to watch videos, when the module can be passed by learning the online notes and practising past exam papers.

**<u>Systemic Contradiction 'Individual v Collaborative learning'</u>**

**Tension Categories:**

**"Few opportunities for collaborative working."**
Unable to talk with and consult with classmates; missing the enjoyment of chatting with classmates informally while learning [in synchronous sessions]; problems are easier to solve with the help of friends; learning together using the chat facility in synchronous sessions is sometimes difficult; lack of peer support in labs; limited opportunities to hear classmates ask questions you had not thought of.

**“Poor or bad experiences working in teams.”**

[For one module in particular] difficult to resolve interpersonal differences; disagreements over timescales/work targets, including strategies and acceptable levels of performance.

**“Competition between learners.”**

Competition with others for the best grades; some classmates want too much help.

**<u>Other Student Tension Categories</u>**

**“Isolation and working from home.”**

Misses the excitement of attending lectures; feeling isolated; too much time at home, with too many distractions; disruption to normal study routines; not good at self-discipline/self-organisation; stresses due to daily routines like shopping/eating/drinking, etc; worries about mental health.

**“Difficulties in adapting to the change in learning approach.”**

Difficult to follow the weekly asynchronous-synchronous cycle consistently; everything feels hard work; there’s not enough time to complete everything; difficult to concentrate late at night/early morning, due to different time zones; worries about assessment; the coursework for a module appears to be disconnected with the core subject; unhappy with the [lack of] feedback received; sense of being micromanaged; difficult to stay consistently focused and motivated while studying; difficult to maintain a good work-life balance.

**“Pressure to meet coursework deadlines, prepare for exams, and timetabling issues.”**

When particular coursework deadlines approach, tend to work on those to the exclusion of others, and then have to work hard to catch up; timetabling concerns; applying for jobs/internships/postgraduate applications (Y3); additional pressures due to mid-semester exams.

**“Technical problems associated with online learning.”**

Computer and Internet technical issues; difficulties using online software.

**“Different and inconsistent modes of communication.”**

Inconsistent/varied modes of communication used by different lecturers.

**“Financial problems causing stress.”**

Financial worries due to lack of part-time job opportunities; family-related financial problems.

**<u>Teacher Tensions Categories and Tensions</u>**

**Tension Categories:**

**“Assessment.”**

New, mid-semester exams added to the workload; lack of engagement with coursework in one case in particular; sense that exams should be ‘dumbed-down’ due to the restrictive learning conditions; problems with Blackboard;

**"Synchronous sessions.“**

Attendance often poor; reacting/responding to complaints by students; unable to easily interact with students compared to normal times; students not completing asynchronous activities; perception that students inhibited to ask questions;

**“Pressure to conform to the imposed teaching model.”**

Time needed to produce online quizzes and narrated videos of lecture notes; workloads felt much greater; difficulties with the online software; uncertainty of how much additional support should be given students; lack of belief in flipped teaching; taking time away from administrative and research commitments.

**“Dissatisfaction with imposed measures of teaching quality.”**

Dissatisfaction with UEQs; lack of belief in faculty-imposed metrics; negative feedback from students.

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