

# Chapter 2

## Design Considerations

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**Abstract** The quality of student learning depends largely on how well we design our curriculum and the pedagogies we use within this curriculum. A successful Flipped Classroom (FC) is no exception: to engage students and ensure learning requires carefully considered design and implementation. This chapter teases out, and more closely examines, the key critical success factors from the perspective of the changes that are required in both student and facilitator expectations and roles. In addition, a model for designing a FC provides a structured approach that emphasises a ‘context-first’ strategy.

**Keywords** Curriculum design · Transforming learning · Student-centred learning · Classroom design · Evaluation · Learning resources

### 2.1 Introduction

To design an effective Flipped Classroom (FC) we can begin with a methods-based approach requiring an understanding of the inputs (what we do to students) and outputs (what students can do at the end) supplemented by the all-important connecting factors between these two end points: how and what students learn. As

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the FC reverses the traditional order of learning by replacing the lecture as the first point of contact between the student and their learning with online ‘Pre-Learning’ followed by a ‘Facilitated Active Learning Session’, we must understand the mechanisms needed to ensure learning in this context (Pawson and Tilley 1997). This means we must focus on the combinations of activities and experiences that the students are to be involved in, and on the learning and developmental processes that are occurring within the students while engaged in these activities.

This ability to merge understanding with activity forms the basis of ‘active learning’ which is an umbrella term (Barkley 2009) used for a range of methods such as Experiential Learning (Kolb 1984), Situated Cognition (Brown et al. 1989; Resnick 1988; Schoenfield 2014), Situated Learning (Lave and Wenger 1999), Inquiry-Based Learning (Prince and Vigeant 2006), and Collaborative Learning (White and Fredrickson 1998). While there is much overlap in these learning theories, they all share a common component of ‘cognitive apprenticeship’ (Collins et al. 1989) where students learn to do authentic tasks by emulation (i.e. watching others, then doing the tasks themselves), in the context of guidance, feedback from, and collaboration with the facilitator and/or their peers, who then pass onto, or co-construct with the student, the cognitive and practical tools of the discipline. The notion of authentic learning (Lombardi 2007) is important in designing a FC as it intentionally brings into play multiple disciplines, perspectives, ways of working, habits of mind, and community.

Community underpins our understanding that learning is predominantly collaborative: much of the tacit and pragmatic understanding is gained interpersonally from peers and others within a community of practice (Toulmin 1972; Lave and Lave 1991; Wenger 1998). The FC should be designed to use and maximise the benefits of collaborative learning and thus requires the creation of an environment of active and engaged learning, the conditions for increasing the student cohort’s ownership of learning, and the development of higher-level thinking skills in the individual. This is important whether the FC is being designed to address students’ conceptual understandings or, at the other end of the spectrum, attempting to reconceive curriculum by increasing active learning in order to develop, and move towards the assessment of, student competencies.

All active learning methods specify both active and conceptual components. Activity is required because without hands-on experiences ‘*classroom instruction in a discipline is like studying recipes without ever cooking anything*’ (Greeno 1991, p. 117), and conceptual learning is required, as general principles need to be extracted from the experience so that they may be transferred to other contexts (Anderson et al. 1996; Bereiter 1997; Wineburg 1989; Blumenfeld et al. 1991). For example, students do not learn science from activity alone; the understanding of concepts and principles needs to be added in a structured way (Puntambekar and Kolodner 2005; Penner et al. 1998; Schnittka and Bell 2011).

The FC therefore needs to be designed such that students learn by applying their cognitive understanding to authentic problem-solving contexts, and where the facilitator, the learning environment, their peers, and the community of practice all provide multiple sources of knowledge and assistance to help them achieve their goals.

This first requirement that students must be able to apply their cognitive understanding moves towards another pillar of the FC, that of the student owning their learning.

We should emphasise here that the FC is not a panacea, nor are we advocating that all classes must be flipped. If the existing delivery achieves the desired learning outcomes and students are happily engaged in their learning, then there are likely better things to do with your time. Under no circumstances should a class be flipped solely because of institutional (or similar non-learning) drivers. Specifying a FC should be based on a need to:

- help students master a particular concept or knowledge that is tricky and not being adequately mastered through a current delivery method;
- engage students with material that may have been deemed ‘boring’ or ‘irrelevant’ by past cohorts; and/or
- facilitate the development of skills that use the new knowledge or concepts.

Partial flips may also be considered; it is not necessary to flip an entire course.

This chapter addresses the need to change the practices of all stakeholders (Sect. 2.2), and the considerations and elements that need to be brought together in a FC design (Sect. 2.3). The design elements include evaluation of the FC, for either course improvement or research and dissemination purposes, as we believe this is an important consideration for any teaching innovation. Finally, the chapter provides a checklist that can be used to evaluate a design (Sect. 2.4).

## 2.2 Changing Practices

### 2.2.1 *Transforming Your Practice*

It has often been said that flipping the classroom requires academics to flip their practice (Bruton 2012) and this indeed is fundamental to the success of flipping. What might not be apparent until you actually make the decision to flip is the extra amount of energy required to keep students engaged, enquiring, and learning and to ensure that their learning outcomes are the ones that you intend in comparison with traditional ‘chalk and talk’ pedagogy. Your role as an educator must be rethought, and none of your strongly held beliefs about what you think you know about teaching and learning can go unexamined. Moving from the role of lecturer (‘Sage on the stage’) to facilitator (‘Guide on the side’) requires not only that we also become learners, but that we explicitly define learning as mutually constructed meaning (Baxter Magolda 2012).

By its very definition the FC is constructivist: we require students to become actively involved in their learning rather than passively recipients of information. The focus is therefore switched from the teacher to the learner, and the challenge inherent in this should not be underestimated. Stepping out from behind the lectern is a daunting proposition both figuratively and literally and also one that students may not readily accept. One of the difficulties in co-construction can be the

**Table 2.1** Elements of constructivist learning design

Stage	Element (Gagnon and Collay 2006)	FC consideration
1	Develop a <i>situation</i> for students to explain—include what you expect them to do and how they will construct their meaning	Pre-learning activity
2	Decide on <i>groupings</i> of materials and/or students to facilitate cooperative learning	Facilitated session planning
3	Build a <i>bridge</i> between what students already know and what they need to learn	Overall FC design
4	Anticipate <i>questions</i> to ask and answer that facilitate learning; use Bloom’s taxonomy to elicit higher-level thinking	Facilitated session planning
5	Encourage students to <i>exhibit</i> a record of their thinking by sharing it with others; this should also demonstrate student learning	Facilitated session activity or post-facilitated session activity
6	Solicit student <i>reflections</i> about their learning and thus encourage them to cognitively acknowledge what they have learnt	Post-facilitated session activity

epistemological development of younger (17–20 years old) students. They tend to be low on Perry’s taxonomical scale (Perry 1970), suggesting that they do not see knowledge as constructed but rather as immutable and received. Establishing trust is therefore critical and should be made an explicit element in the narrative to ensure consistency of word and action (integrity).

The facilitator’s role in the FC can be explained using elements from the Constructivist Learning Design proposed by Gagnon and Collay (2006) that are ‘designed to provoke’ thinking about student learning processes, and these elements used to plan the FC (Table 2.1).

The work of Baxter Magolda and King (2004) around assessing learning goals and learner capacities can also help in understanding what is required of a FC facilitator. They suggest that successful constructivist learning requires a Learning Partnership to be created between students and the facilitator in which students take ownership of their learning. This ownership is a central pillar without which the FC will fail and so forming a Learning Partnership must be an aim of the facilitator. Note that the Learning Partnership does not need to be made explicit and named as such, but it should be reinforced wherever possible. The principles (Baxter Magolda 2012) behind this partnership and their links to constructivist learning (Table 2.1) are that:

1. Knowledge is socially constructed (Stages 2 and 5),
2. We have to respect and validate what learners know (Stages 1 and 3),
3. Learning has to be situated in learners’ experiences (all stages),
4. Meaning is mutually constructed (Stages 4 and 5).

The first principle, that learners need to share ideas and work through their implications with others to make sense of content, means that we have to make

sure our strategies for allowing this to happen actively support the process and that we don't just expect it to happen 'naturally'. The FC emphasis on fostering self-directed, peer-to-peer collaboration provides a good starting point, and the rest of the principles give us guidance on how to bring it about.

In describing the second principle, validating learners' capacity to know, Baxter Magolda suggests methods such as 'solicit learner perspectives', 'trust their judgement', and 'respect their beliefs'. Most project-based courses generally require students to refine their understanding of a problem and its solutions using such techniques. The difference in the FC is that this validation of the learners' capacity to know happens continually at every level of activity, in every session.

The third principle, drawing on learners' experience, requires attention to well-established curriculum design principles for effective learning which include considerations of scaffolding as well as constructive alignment (Biggs 1999) to ensure that new knowledge is meaningfully and appropriately connected to old knowledge (Stage 3, Table 2.1). In the FC, freeing up class time provides an opportunity to explore options for 'experiential learning' where meaning is obtained through direct experience. The FC does not generally allow either for 'passive learning' or for 'passive teaching', but we acknowledge that there may be a demand for the occasional inspirational event such as an iconic guest speaker.

The final principle, that meaning is mutually constructed, is not possible unless the facilitator makes learning meaningful and focuses on the development of the student. It requires the facilitator to enter into the learning process with the learners, help them to discover meaning, and in the process, challenge and reorganise their own thinking as well. As previously mentioned, this relaxation of intellectual authority may be difficult for some teachers and it also clashes with the expectations of many students. In actuality, the FC may have several sources of authority including a MOOC component, external information sources, teaching staff, and unfortunately, cultural barriers to change which can appear to be an unreasoned insistence on the familiar resulting in a resistance to anything that does not resemble traditional learning processes.

As a facilitator, you need to examine the ways in which these principles are evident in your practice and how they might underpin the design of your FC.

### ***2.2.2 Transforming the Student's Practice***

One of the first questions we get asked when we run workshops for academics on FC design is '*What do students make of the FC?*'. Then we get asked about the completion rate of Pre-Learning and what happens if students don't do it. Leaving aside the second question, as this is addressed in Sect. 2.3, the first is fundamental to transforming each student's practice.

Our experience, and that of others, is that some students will push back when asked to own their learning and engage actively in the FC. Just as it is difficult for us to transition to becoming facilitators, it is difficult for students to transition to

making the running when it comes to learning, especially if they have come from a more traditional system of lectures, tutorials, and practicals. We have learnt to confine this pushback to a minor fraction of the cohort through a number of strategies.

Firstly, as a fully FC will not have a lecture stream to provide direction and orchestrate continuity between modules and topics, it is important to ensure that these functions are satisfied in some other way. One approach is to consider the use of **a narrative with explicitly stated learning aims and objectives**. A narrative is the story that unfolds within a course allowing students the opportunity to personally identify with the course and its learning objectives in some way. The narrative as ‘story’ can be further defined as a representational structure consisting of a mix of meaningful and interrelated elements threaded together in sequence (Eng et al. 2008). This narrative as structure is essential in establishing and reinforcing a shared understanding with students on what is relevant and consequently fundamental to achieving the intended course learning objectives. The narrative is firmly based on constructivist theory that requires the negotiation of meaning. Without a narrative, students can be overwhelmed, frustrated, and quite unhappy with their first experience meeting the FC requirement to construct their own learning from online materials prior to arriving on campus. Different types of learning activities carried out in disparate settings can easily seem incoherent. The issue can be compounded as the facilitator is usually primarily concerned with helping learners deepen their understanding of the online content rather than addressing the narrative. A narrative therefore should be incorporated in the FC design.

As an example in the use of narrative as ‘story’ and as ‘structure’, let’s consider The University of Queensland course ENGG1200: Engineering Modelling and Problem Solving (see Chap. 7). This course was designed to introduce first-year engineering students to structured problem-solving. In its first iteration, students were given the following narrative story to describe the importance of what the course was about and how it would be run:

Engineers design, manufacture and test artefacts using materials in a structured process of thinking, acting and doing. We use models to represent an engineering problem and its solution such that we can make economic decisions and accurate predictions of the behaviour of a built artefact.

As will become clear below, the narrative did not resonate with students as evidenced by their negative feedback to the relevance of both course content and course organisation.

The course required students to learn about engineering materials as well as problem-solving in order to design and manufacture a functionally predictable prototype for the final week of the course. This prerequisite knowledge was delivered in the first six weeks of the 13-week course: engineering materials through online modules and quizzes followed by hands-on collaborative workshops applying these concepts, and problem-solving through team-based workshops. Students were assessed on their understanding of this knowledge in a traditional mid-term

examination. In the first iteration of the course, prominent and engaging guest speakers from research and industry presented state of the art work in areas that were aligned to the weekly concepts through a one hour lecture. Part of this lecture was used to facilitate the narrative development and provide feedback to the students, in other words to provide a narrative structure.

However after the second week, over 50% of the students stopped attending the lecture. When asked why, more than one student explained that despite the quality of the lecturers, the activities were perceived as not relevant. In addition, course evaluations indicated that the students were dissatisfied with the structure of the course. So what had gone wrong?

As a response to this failure, the lectures were replaced with 10-min podcasts and followed by integrated learning workshops that were preludes to major assessment activities, team organisational activities, and through which a shared understanding of the course narrative could be developed. There was a significant positive change in terms of students' perceptions of both course organisation and the clarity of course details. In addition, observation of the workshops and analysis of open-ended comments concerning the course showed that students had constructed their own narrative and thus managed to make sense of what they were learning. As course content, content delivery, and assessment were not changed, these findings can be attributed to the introduction of the workshops (Kavanagh and Reidsema 2014) and with them the development of narrative through negotiation of meaning and connection of activities.

We have also had success in reinforcing the narrative through the use of a custom-built system, integrated with our institutional learning management system (Blackboard) that clearly shows students what they 'Need to know' and what they 'Need to do' in any particular week (Fig. 2.1). This tool has been called the Learning Pathway and is discussed in more detail in Chap. 3 (Technology).

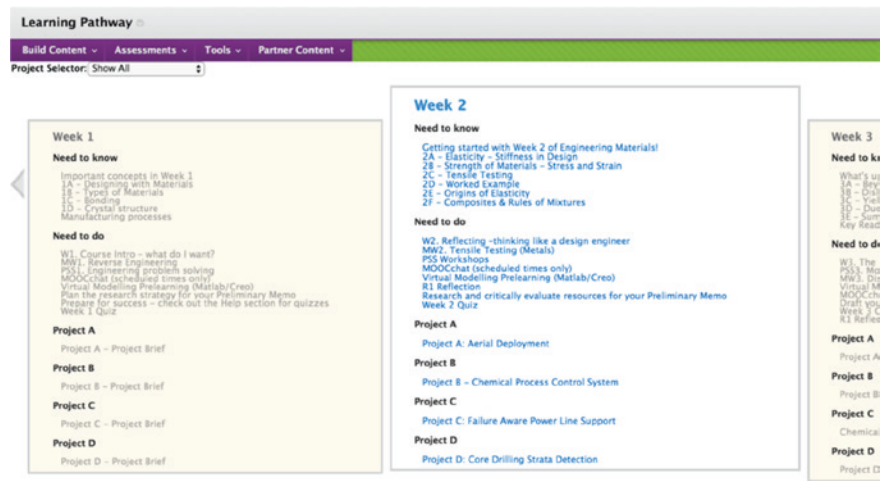


Fig. 2.1 Learning pathway tool



Secondly, it is important to *make the process of the FC explicit*. Students respond well to being given meta-level explanations of the delivery methods of a particular course and, if invited to be a ‘true’ participant in the process, can be a very valuable source of feedback and evaluation. This ‘true’ participation in the process resonates with the tenets of Learning Partnerships that a facilitator should nurture as part of developing their FC. It means that the facilitator should always be ready to listen to, and act on, the voice of the students, and hence, we recommend that opportunities for the student voice to be heard be deliberately designed for. These opportunities could range from the simple use of a Minute Paper (Angelo and Cross 1993) to a focus group session.

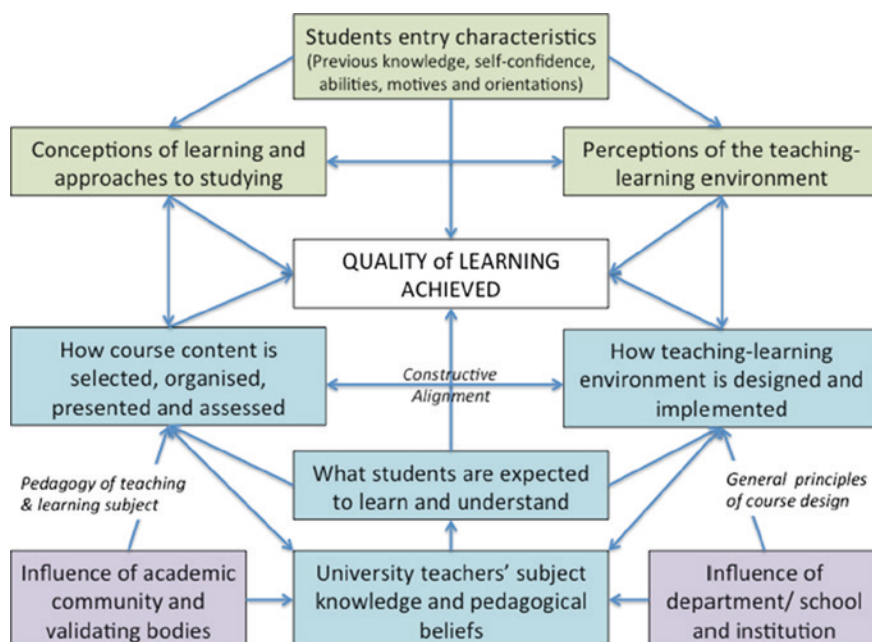
Lastly, students need to be *transitioned into the practice of the FC*. The first FC our students experience is one that is taken in their very first semester of university. In this course, we begin the semester with a few lectures that run in parallel with the flipped mode. The follow-up course in second semester has no lectures and is totally flipped. We find that the initial pushback from students towards the required ownership of learning is lessened by this gradual approach, and external evaluators have observed that both the preparation for and level of active collaboration of students within the Facilitated Session increases with exposure and experience. It should also be noted that the majority of our students take these flipped courses in conjunction with three other courses per semester that use a more familiar lecture/tutorial/practical delivery method and thus are not similarly challenged in every course. They often tell us that they enjoy the FC but are glad that not all their courses are so demanding.

### 2.2.3 Changing the Learning Environment

As discussed above, we need to change behaviours of both the teacher and the student and in the process develop a Learning Partnership. Entwistle and Peterson (2004) propose a conceptual model that is useful here (Fig. 2.2). It illustrates the links between teachers’ (boxes below the Quality box) and students’ (top 3 boxes) conceptions of what it is to be a learner and the influential contextual factors (Influence of academic community and Influence of department boxes) in terms of the quality of learning. In many cases, the facilitator (teacher) and course designer will be the same person but in the eventuality that it is not, both people will need to understand what is required in terms of change in practices.

The model highlights the fact that changing student and teacher practices requires a change in the learning environment. The elements of the figure are covered in more detail in the following sections.





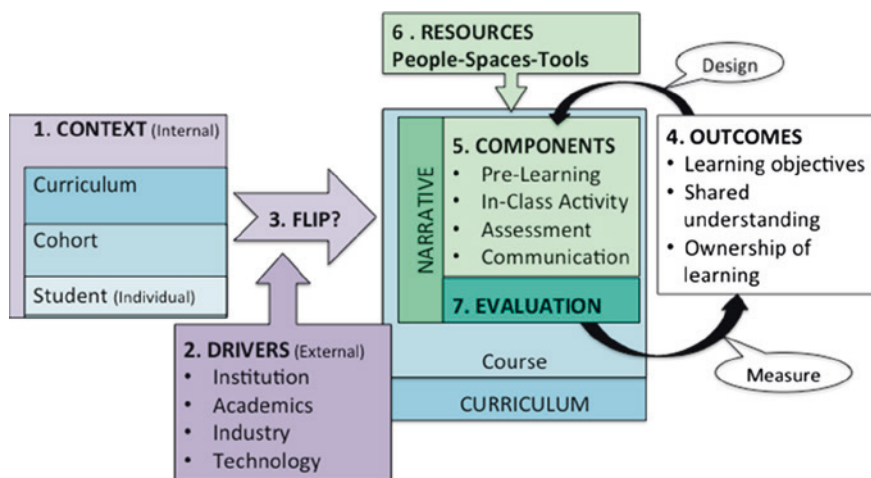
**Fig. 2.2** Teacher, student, and learning environment connection (Reprinted from Entwistle and Peterson 2004, with permission from Elsevier)

## 2.3 Flipped Classroom Design Considerations

### 2.3.1 A Design Process

Creating successful active learning activities is not straightforward as the goal is for students both to be willingly engaged in the activity and to learn the required concepts and their applications (Blumenfeld et al. 1991). To be successful therefore, a FC approach will necessarily involve careful educational design to ensure that course structure and activities (both contact and non-contact) are constructively aligned to create the desired integration of learning with doing. As described in the introduction to this book, the emphasis here is not on the testing of a new method for learning or engagement, but rather on practical considerations for designing a successful FC course.

Focusing on the design process for creating a course helps us conceive of the eventual product (a FC) in terms of a prototype. Prototypes allow us to make the invisible visible, communicating the course architecture, along with the content and processes whose function is to produce the required knowledge and skills in students. Prototypes are also useful in communicating our design intent to all stakeholders including senior administrators, and colleagues as well as students, thus building in purposeful feedback. As with any curriculum innovation, the product evolution is not complete after the first iteration and thinking in terms of prototypes is a good reminder of this.



**Fig. 2.3** FC design elements

To aid with the design of the FC, we have split the considerations into a number of design elements; these are discussed in the following sections and their interconnections shown in Fig. 2.3.

The numbering of each element in Fig. 2.3 is primarily for identification and not to be interpreted as requiring a mandatory or linear sequencing. The ordering of the design elements does, however, emphasise the importance of focusing on both the Context and Drivers as the basis for deciding on the merit or feasibility of flip-ping or not. In our own particular experience (Chap. 9), the situational analysis of the Context and the Drivers occurred concurrently with a set of outcomes that we intended to deliver. As with any design process diagram, iteration is a fundamental characteristic, even more so after the decision to flip (Element 3) has been made.

It is also worth noting that looking at Context (Element 1) will most probably occur in conjunction with a rough knowledge of the course outcomes (Element 4). There should also be a continual comparative analysis happening with regard to the differences between current and best practice. For example, with our own first-year engineering design and build course, we looked at what Olin College of Engineering and Purdue University were doing and found opportunities to incorporate elements of their practices in our FC. In addition, our Executive Dean wanted a focus on authentic learning, and hence, our FC design began with all these elements in tandem.

### 2.3.2 Element 1: Context

It is important to understand the full context in which the FC will be offered. A fundamental precept of design is that a good solution requires an excellent understanding of the problem and therefore context is everything. While the second

element, ‘Drivers’, is concerned with external factors, Element 1 considers the internal context in which the FC is to be offered which includes the curriculum, the cohort, and the individual students themselves.

You may not have too much influence on the context in which the course is offered, but it will certainly influence the design of your FC. For example, the following questions can be asked of the context in terms of:

- the curriculum:
  - How is the course integrated into the curriculum?
  - Does the course cover fundamentals that are to be developed later in a degree programme?
  - Are learning objectives to be built on previous courses/knowledge/skills?
- the cohort:
  - How many students do you have in the cohort?
  - What percentage are international and/or non-native English speakers?
  - What year level are they: first year, undergraduate, postgraduate, etc.?
  - Do they have any previous experience with the FC?
  - What is their mode of study: on-campus, distance, or mixed?

We must drill further in terms of students and identify the learning mechanisms employed by students in context in order to specify the mechanisms that need to occur within the learning environment that will support their learning.

The general mechanisms that we need within students have been specified within the literature on how people learn. Cognitive psychology describes how effective learning eventually produces experts with the required knowledge and skills, processes, strategies, principles, heuristics, schema, and mental models required for their discipline (Bransford et al. 1999). A FC design must support these mechanisms and account for the likely learning capacities of students. We should think about:

- the underlying assumptions about knowledge, self and working relationships students hold;
- the way that students are used to constructing knowledge and the difference between this and the methods we will employ in the FC;
- their expectations of how we will deliver knowledge and aid their development; and
- the value they place on peer learning and collaboration.

If the gap between where we will be operating and where the students expect to be working is too large, bridging activities will need to be provided that, as per Sect. 2.2, involve students in the process of learning, and can transition them to the FC. For example, an activity that asks students to produce a creative model of the course and its delivery can engage students in cognitively understanding the expectations of the course. In the past we have had engineering students write music, rap, and haiku, draw mind maps, and produce various diagrams or analogies through this activity. We always showcase the best models, and reward with prizes, thus bringing a competitive gaming element to the activity.

### 2.3.3 *Element 2: Drivers*

Such things as institutional support or lack thereof, student experience with the mode of delivery, and the availability of technology and tools, can aid or constrain the design of the FC. The facilitator will need to identify these drivers and capitalise on the positive and ameliorate the negative. As an opening, the following questions might be asked of:

- the institution:
  - Does it support FCs? (Are there spaces available?)
  - Is it actively trying to enrich the on-campus student experience? (Is there funding available?)
  - Is teaching innovation recognised? (What's in it for you?)
- your colleagues:
  - Are they flipping? (Can they provide you with advice and support?)
  - Will your move towards flipping affect their courses? (What do they need to know about what you're doing? What would they like to see developed in the students?)
- industry:
  - Do they want to input into the process? (Is the course of interest to them?)
  - Can they help with authenticity? (This will depend on your aims, expectations, and learning objectives.)
- technology:
  - What do you have available?
  - What can you use from elsewhere?
- best practice:
  - What does the discipline educational literature say?
  - What are other institutions doing?
  - What do external evaluations (accreditation bodies) say?
  - Horizon scanning? Where is your institution heading in relation to the big picture globally? Can you align your design to leverage this?

### 2.3.4 *Element 3: Flip?*

The main question to ask here is whether a flip is warranted or whether more traditional and/or existing methods are suitable to achieve the intended learning outcomes. If you determine that a flip will be beneficial, the level of flipping should be determined; for example, would a partial flip work? Perhaps you flip only those classes within a course that delivers tricky or difficult knowledge to a disengaged cohort and/or there is a need to transition learning outcomes from content comprehension to practical application.

Secondly, the various methods available for successfully facilitating active learning that are applicable for FC design should be considered. We hope that the following list will give you some ideas to cherry pick and the epistemology for further research.

- **Project-based learning (PBL):** PBL uses a complex, real-world project to engage students in collaborative problem-solving overseen by facilitators and sometimes experts. Knowledge and skills are acquired just in time, or previously acquired and built on. PBL is more focused on application of knowledge than acquisition of knowledge and uses more real-world applications than problem-based learning (Mills and Treagust 2003). The method enacts situated cognition (Blumenfeld et al. 1991) and thus promotes learning mechanisms that are well aligned to those of a successful FC. In a FC, projects could be used within a particular class to develop a specific learning objective, or as a vehicle to allow application of learning throughout the course. We often give open-ended design and build projects (e.g. an automated black box detection craft that will locate and retrieve a metallic item from a small pool, a deployable bridge that can be constructed by others and support a nominal weight, and a greywater treatment unit for a third world community) to student teams at the beginning of semester, and require them to apply course content progressively in order to deliver a finalised solution at the end of semester.
- **Situated learning** is a model of learning in a community of practice (Lave and Wenger 1991) connected to PBL. The term recognises that learning takes place in context, so the classroom and/or task should strive to be authentic, and as part of a social process. As with collaborative learning below, situated learning comes about from constructing meaning and knowledge with the help of others.
- **Collaborative learning (or Team-based learning):** Collaborative learning was mentioned in the introduction to this chapter, and we think it so important to the success of the FC that we mention it here again. In collaborative learning, students working together share experiences and knowledge and therefore create meaning and achieve learning that is not possible with an individual task (Chiu 2000). We set student teams tasks that require more than one individual to solve; they range from projects lasting a number of weeks to smaller problems that may only take an hour. These tasks facilitate the process of students asking each other questions, evaluating their answers, and synergising responses. For example, the automated black box detection craft, mentioned above as an open-ended design project, required software engineering students to develop code for an Arduino board and a search strategy, mechanical engineering students to design a watercraft and propulsion system, and electrical engineering students to connect sensors, power, and circuits. In order to produce a working prototype, the students needed to collaboratively learn and apply engineering design, communication and project management principles. Explicitly setting up collaborative learning moves both teacher and student to the change in practices outlined in Sect. 2.2.

- **SCALE-UP** (Student-Centered Active Learning Environment with Upside-down Pedagogies) is a collaborative learning method (Beichner and Saul 2005) that facilitates purposeful interactions between students by setting short, thought-provoking tasks. It is a FC approach, content is delivered outside formal class time and students given the responsibility for self-directed learning, that specifies round tables of nine students, thus providing flexibility as smaller groups of three may interact as necessary. SCALE-UP was initiated for physics courses where it was shown to improve students' ability to solve problems, reduce failure rates through increased conceptual understanding, and generally increase student satisfaction (Beichner et al. 2007).
- **Technology assisted:** Technology can assist teachers with providing content information (Blumenfield et al. 1991). The Internet has made many different types of delivery possible: text, videos, podcasts, and interactive tools for students to do their own research and learning or to annotate provided content. It is possible to use technology to enable the sharing of information and collaboration (Stahl et al. 2006), thus facilitating collaborative learning. If your cohort is not physically on-campus then designing for online collaboration will be essential. The opportunities that technology provides are discussed in more detail in Chap. 4 (Technology and Tools).
- **Distributed scaffolding:** Puntambekar and Kolodner (2005) coined the term *distributed scaffolding* as an approach to support hands-on inquiry learning in a classroom in a distributed, multi-agent way. They found that providing students with multiple forms of support and multiple learning opportunities was able to help them to learn science from design activities. Support can be from people such as facilitators or peers, software, learning environments, and other resources. We include this method as a prompt for the FC design to consider the various ways that learning can be facilitated.

A specific type of *distributed scaffolding* is **Blended learning**: the combination of 'face-to-face instruction with computer mediated instruction' (Bonk and Graham 2006) using digital or online media. Besides the advantage of scale (i.e. many more people can access online content) the method allows students to choose when and where they will access the online instruction. The FC, where Pre-Learning is delivered via a podcast or similar, is blended by nature.

The Case Studies in Part 2 (Practices) of this book may also provide initial ideas about pedagogies that may be used in your FC.

### 2.3.5 Element 4: Outcomes

Now that the internal and external contexts have been considered and an informed decision to flip has been made, it is important to clarify the desired outcomes of the class, as these are what the FC must achieve. If outcomes are not made explicit

then it is not possible to measure success (Element 7). These outcomes can be categorised by three key elements:

1. **Learning Objectives:** Learning objectives focus on the purpose of the course and are often best phrased by considering the assessment that will be set to measure the things that the students should be able to do as a result of the class. These objectives should take into consideration the level at which the student is working (i.e. novice, expert) and therefore fit into the curriculum as relevant;
2. **A Shared Understanding:** As previously mentioned, the FC necessitates a Learning Partnership be established in order to allow meaning to be mutually constructed. The facilitator must therefore understand what students already know and facilitate the connection to the new knowledge. If we return to Table 2.1 (Elements of Constructivist Learning Design), the need for developing a shared understanding can be factored into Stages 3 and 4 where the connection is established and questions are asked and answered. In this way, the knowledge gap between students and the facilitator should be minimised; and
3. **Ownership of Learning:** Ownership of learning can be simply explained as a conscious decision on the part of the student to participate fully in the FC; this means that they engage with pre-learning to a degree that allows them to take full advantage of the following flipped activity. In such a way, students can situate their learning in terms of what they need to know, and what they need to do, and achieve the necessary learning objectives. In the longer term, students associate value in what they are learning because they have taken responsibility for, and control over their learning.

Note that here we recognise not only immediate learning outcomes (i) but also outcomes that result from the FC process (Elements 2 and 3).

### 2.3.6 Element 5: Components

The FC design solution uses the understanding provided by elements 1–4 and combines activities and learning components to create an overall *architecture* for a learning environment. Remember that the learning activities should be related and that there should be an activity, tool, and/or resource that reminds the students how the FC components work together to achieve learning outcomes (i.e. a narrative). It is also useful here to refer back to Table 2.1 as a reminder of the flow of FC events as planned by the facilitator.

The design of the components should also recognise any distinctive challenges to learning the content. If there are cognitive problems, i.e. difficult or threshold concepts, the need for prior technical or contextual knowledge should be addressed. If there are likely to be individual problems with the content, then students will need to be able to identify what they know and their level of knowledge so that they can proceed with mutually constructing meaning and receive appropriate support from the facilitator or their peers.



Armed with the knowledge that we need to integrate the FC components and that students have specific needs, we can begin with considering *Pre-Learning* and ask the following questions:

- What information do the students need within the specific course/curriculum? How will you address them (e.g. podcasts, lesson templates, readings)?
- What resources will you need to be able to compile the Pre-Learning?
- Can students generate their own resources? Could this form part of the assessment?
- How will the students access the Pre-Learning?
- Is it imperative that the students complete the Pre-Learning? If it is imperative, then how will you ensure that this is done (e.g. online quiz, assessment or peer pressure in the active session)?
- Is there any preparation that is essential for the Facilitated Session? Does it matter if students complete the Pre-Learning before the Facilitated Session or could they access it afterwards?
- Should Pre-Learning be independent/individual or could it be collaborative?

Having designed the Pre-Learning, the *Facilitated Session*, either on-campus or virtual depending on your cohort, can be addressed. Considerations include:

- What does your Facilitated Session need to achieve? This could be the application of content from the Pre-Learning module, exploration of the common misconceptions around tricky/difficult knowledge, or development of competencies such as graduate attributes (e.g. teamwork, communication, critical thinking). You should always include the need to foster a shared understanding and student ownership of learning in the design of this session.
- What kind of activities will develop the required student learning (e.g. collaborative work in laboratories, prototyping, case study discussion, project-based problem-solving, SCALE-UP activities (Beichner and Saul 2005))? Can the students direct the session themselves and thus increase their ownership?
- If there is a possibility that some students have not completed the Pre-Learning, how will you bring them up to speed? In many cases we find that an initial exercise that directly addresses knowledge of the Pre-Learning helps these students and deepens understanding in those students who have to explain what has gone before.
- What resources will you need? For example, will students need a template to complete or will blank butchers paper be sufficient? Will you need microphones to take comments from the floor or perhaps squares of orange and blue cardboard so that the cohort can indicate answers to particular questions by holding one aloft? You might need to be a little creative; we've seen Lego used to help with chemistry concepts, creative model building, reflection on a situation, and technical drawing.
- How will you foster intra-class communication (e.g. using a whiteboard to keep track of student questions and comments, demonstrating student work using a document visualiser, passing around a microphone)? Perhaps this is not so

important, but a sense of community and a shared understanding can be fostered through an awareness of general cohort opinions, queries, and/or solutions.

- What is the driver for students to participate in the session?
- How will students demonstrate their learning? Is some form of assessment necessary? If assessment is required, will you conduct during the session or after?

### ***2.3.7 Element 6: Resources***

Resources are defined here as: manpower, technology/tool access, and spaces. Considerations include:

- Who will you have in your teaching team? Who will you have in your administrative and/or technical support team? Who could be empowered to contribute to the innovation?
- What access do you have to technology? What access will students need to technology?
- What do you already have in terms of tools to help deliver content, enable communication, aid assessment, etc.? What can you borrow and what will you need to create? Can you get funding to help you create necessary tools?
- What sorts of teaching spaces are available? Quite often, flat floor spaces equipped with furniture that allows collaboration between students is all that is required. If you cannot find the space you need, can you utilise other spaces?

It will be rare to find that you have the people, tools, and spaces that fit perfectly with your FC design. More often you will need to find workaround solutions or adapt what you have planned to what is available. We have repurposed gym halls, used open-source software, held classes outside, successfully lobbied industry for funds, and enlisted postgraduate students to help facilitate learning and the development of resources within our FCs.

One strong recommendation that has emerged from our experience is that you should communicate your passion and vision for the FC to your teaching team and then empower them to fill perceived gaps in the offering. Then, tutors become motivated to put together YouTube videos of FAQs, people with software skills develop tools to help with communication, and everyone brings back valuable information about what is working and what is not, provided an opportunity is created to receive this feedback.

You could also consider your students as resources. Asking your students to do things such as develop resources, peer-review work, or take charge of a session satisfies all three required FC outcomes (Element 4): learning objectives, shared understanding, and ownership of learning.

One final suggestion is to recognise when ‘near enough is good enough’. For example, there is no need to produce a Hollywood-standard podcast. Students do not expect this level of polish, and there is little to be gained in terms of learning outcomes. Similarly, resources can easily be developed on the fly as needs dictate.

It is almost impossible to anticipate all student needs, but if you maintain lines of communication with the cohort, it is a fairly easy thing to coordinate an Adobe Connect meeting or prepare a 5-min podcast in answer to a gap in resources.

### ***2.3.8 Element 7: Evaluation***

All teaching should be evaluated to ascertain the quality of learning outcomes and from there to determine where improvements could be made. Evaluation also provides an opportunity for academics to embed research approaches within the design of the course and enhance the scholarship of teaching and learning. This latter consideration may be important if you are innovating and need recognition in terms of research quantum.

The first step is to decide what will count as evidence of success and this might include shorter-term outputs or longer-term outcomes. Some examples that we have used are:

- **Outputs:**
  - levels of attendance,
  - online activity (frequency and duration),
  - assessment results,
  - artefacts created, and
  - student retention.
- **Outcomes:**
  - change in student attitudes,
  - development of skills,
  - application of learning in other courses, and
  - cognitive recognition of learning.

The next step is to decide how you will measure these items. While outputs are fairly easy to measure through things such as learning analytics, assessment marking, and head counts, outcomes will require considered measurement through things such as observations, interviews, focus groups, and surveys. The use of scaffolded reflection within a course can also provide evidence of both outputs and outcomes. Of course, if the evaluation is for anything other than course improvement, ethical clearance will be required to gather and use the data.

Planning for evaluation should refer back to how you will use any evidence gathered and what will actually count as success for you. Perhaps you could ask:

- How appropriate was the FC for your context?
- To what extent were short- to medium-term goals achieved?
- What were the consequences of the change in content delivery?

- Could the outcomes have been achieved with less effort and expense? (And are there areas where similar outcomes can be achieved?)
- What needs to be done to ensure that the change can be embedded in normal practice?

## 2.4 Conclusion: Finalising Your Design

If you have followed through Sects. 2.2 and 2.3 and designed a FC, we offer a checklist of the essential components to promote the mechanisms required for successful active learning in any discipline (Table 2.2). Components 1–5 have come from the work of Shoenfield (2014) who has looked at what constitutes a ‘powerful classroom’, component 6 is recommended by Darling-Hammond and Youngs (2002), and component 7 is underpinned by the work of Hadgraft and Dane (2014). Some of the items in Table 2.2 have not been explicitly covered in the

**Table 2.2** Checklist for FC design

<i>Part 1: knowledge and skills</i>	
<input type="checkbox"/>	Concepts are connected with procedures and contexts. Knowledge and skills include facts, procedures, frameworks, models, principles, and contextualised heuristics and strategies
<input type="checkbox"/>	Problem-solving uses real-world practices
<input type="checkbox"/>	Discipline specific habits of mind are fostered
<i>Part 2: cognitive demand</i>	
<input type="checkbox"/>	Activities create and maintain a productive level of intellectual challenge
<input type="checkbox"/>	Sufficient instruction is given that students are facilitated but not directed
<i>Part 3: access to content</i>	
<input type="checkbox"/>	Activities invite and support engagement with discipline content
<input type="checkbox"/>	All students are involved in the core concepts being explored
<i>Part 4: agency, authority, identity</i>	
<input type="checkbox"/>	Collaborative group activities facilitate presenting and debating ideas and building on one another’s ideas as equal contributors (including the facilitator)
<input type="checkbox"/>	Recognition for solid contributions is given
<input type="checkbox"/>	These are used together to build a sense of identity as a practitioner
<i>Part 5: use of assessment</i>	
<input type="checkbox"/>	Tests reveal current thinking
<input type="checkbox"/>	Feedback is given that builds on understanding or addresses misunderstandings
<input type="checkbox"/>	Opportunities to move forward are given
<i>Part 6: facilitator experience</i>	
<input type="checkbox"/>	Facilitators have good knowledge of the subject matter and its application
<i>Part 7: collaborative spaces</i>	
<input type="checkbox"/>	The Facilitated Session is conducted in a physical or virtual space that affords collaborative interactions

preceding text as they underpin all good teaching not just FC teaching. They have been included here for completeness, and the reader is referred to the appropriate reference for more detail.

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