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DEVELOPMENT ARTICLE

The process of designing for learning: understanding university teachers' design work

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Abstract Interest in how to support the design work of university teachers has led to research and development initiatives that include technology-based design-support tools, online repositories, and technical specifications. Despite these initiatives, remarkably little is known about the design work that university teachers actually do. This paper presents findings from a qualitative study that investigated the design processes of 30 teachers from 16 Australian universities. The results show design as a top-down iterative process, beginning with a broad framework to which detail is added through cycles of elaboration. Design extends over the period before, while, and after a unit is taught, demonstrating the dynamic nature of design and highlighting the importance of reflection in teachers' design practice. We present a descriptive model of the design process, which we relate to conceptualizations of higher education teaching and learning, and compare with the characteristics of general design and instructional design. We also suggest directions for future research and development.

Keywords Educational design · Design process · Design support · Higher education · Teacher design · University teaching

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Introduction

Although planning and preparation have long been recognized as fundamental to university teaching, interest in teachers' design work has been limited to educational design, particularly educational technology (Conole 2013; Kirschner 2015; Laurillard 2012). Existing research in higher education teaching tends to include design as a minor component, with a greater emphasis on conceptions of and approaches to teaching, particularly face-to-face teaching which is conceptualized as acts of lecturing, tutoring or assessing student work. Few studies have specifically investigated teachers' design practices—that is, how they go about designing learning experiences for their students. This is surprising given that educational design is an integral part of the work all teachers perform (Goodyear 2015). It is also problematic given the growing interest in teacher design as a driver for the innovation needed to address four pressures on contemporary university teaching: a more diverse student population; increasing expectations of graduate quality; intensifying pressures on teaching staff; and rapid technological change (Goodyear 2015). Building design capacity by better equipping teachers with design skills and knowledge is critical to making this shift sustainable (Goodyear 2015). Such a strategy would complement the existing types of initiatives universities already adopt to enhance the quality of teaching, such as employing instructional designers, providing professional development and developing institutional policies and procedures. A first step in building teacher design capacity, though, is to understand teachers' current design practice.

Strategies and tools to support teachers' design work have emerged over the past decade as a significant line of research and development in educational technology. These include tools to document designs, online repositories to share design ideas, and technical specifications and authoring tools to support delivery (e.g., Cross et al. 2008; Laurillard et al. 2013; Littlejohn 2004; Masterman and Manton 2011). From a review of this literature, we identified three principles that underpin this work:

- designs can be represented in a systematic way that can describe all pedagogic forms, across sectors and disciplines;
- designs can be shared in forms that encourage reuse and adaptation, and include pedagogical advice; and
- technology tools can be created to support representation, adaptation, sharing, and implementation.

Despite these efforts, the teacher design processes and practices these technologies seek to integrate with and enhance are not yet well understood. We argue that tools to support teachers' design work are more likely to be adopted if they first seek to connect with teachers' existing practices. This reasoning follows similar arguments that technologies that align well with immediate need and address familiar problems are more likely to be adopted (e.g., Ertmer 2005). Once adopted, technologies can seek to enhance and extend teachers' design practice. To achieve this, however, more empirical research is needed into the fundamentals of the design work teachers do.

At present, there is limited empirical work into university teachers' existing design practices that can drive advances in teacher design. By contrast, there is a long tradition of research into how school teachers plan and prepare (e.g., Clark and Yinger 1977; Elbaz 1991; McCutcheon 1980), which has extended to more contemporary design practices and training needs (e.g., Boschman et al. 2014; Ertmer 2005; Hoogveld et al. 2002). In the higher education literature, a significant body of studies has explored teaching (e.g., Biggs

2003; Laurillard 2013; McKeachie 1990; Prosser and Trigwell 1997; Ramsden 2003). This body of work has identified personal and contextual factors that influence the teachers' conceptions of and approaches to teaching, and the effects these approaches have on student learning and outcomes. Disciplinary background and departmental cultures, for example, have been found to be strong influences, shaping preferences for particular pedagogical approaches. This research highlights the key role teachers have in influencing student outcomes through their design of learning experiences.

Findings from the small number of design-oriented studies of higher education reveal that university teachers often have high levels of autonomy in deciding what and how to teach; student- and teacher-focused approaches are identifiable even at the planning stages; disciplinary and institutional cultures and perceptions of student cohorts are significant influences; and close colleagues are a key source of inspiration and informal support (Bennett et al. 2011; Postareff and Lindblom-Ylänne 2008; Stark 2000). Specifically, results from an Australian study revealed that academics have significant autonomy in design, even when the curriculum is set by accreditation requirements; and that unit design is often an individual responsibility, even in environments where there is collegial planning at a program level (Bennett et al. 2011). In terms of the design process, an interview study of Finnish university teachers (Postareff and Lindblom-Ylänne 2008) characterized two approaches to planning. A student/learning-focused approach considered student needs and prior knowledge as a starting point for design, involved students in the design process if possible, and resulted in an adaptable design that was not overly specified prior to the teaching session. By contrast, a teacher/content-focused approach started from the teachers' own interests, was solely designed by the teacher to suit his/her own interests, and was fully prescribed to leave little space for adaptation. These findings provide an important empirical base on which to build, but there is still much to discover; notably, the process university teachers go through when they design. This suggests that design approach is linked to teaching conception and approach, but Postareff and Lindblom-Ylänne did not investigate the actual processes teachers followed. From a questionnaire study of college teachers in the United States, Stark (2000) found disciplinary differences in course goals, student characteristics and teaching practices that led to different design outcomes. Process-oriented items about how they began their design process and which steps they included found that a majority of respondents began by determining the content, and identified variation in the steps respondents included and emphasized according to discipline. Respondents also described a cyclic but non-systematic process in which decisions about the ultimate design of the unit[1] were made in almost any order as suited the teacher's style and depending on whether the design was for an entirely new unit or revisions to an existing unit. The author notes, however, that the study was not able to account for the sequence in which design decisions were made. While these studies are important foundations for building our understanding of teachers' design processes, they leave many questions unanswered. For instance, while earlier research has indicated that teachers from different disciplines tend to adopt particular pedagogical approaches that result in different designs, it has not been clearly established that these differences lead to differences in the design processes teaches adopt. All three studies provided insights into how colleagues are a source of ideas through informal discussions (Bennett et al. 2011; Postareff and Lindblom-Ylänne 2008; Stark 2000).

[1] The generic term "unit" is used throughout this paper to refer to a component of a program of study (e.g. a degree) that a teacher designs for students. Depending on the institutional and national context, this may be variously termed unit, course, subject, or module.

Another possible source of relevant research comes from studies of other design fields. The work of instructional designers is particularly relevant. Research has sought to understand the nature of instructional design problems, how instructional designers conduct their work, and specific approaches that can best prepare them for and support them in their design role (for a recent review see Kali et al. 2011). The differences between the work of an instructional designer and a teacher raise questions about how directly relevant this research is (McKenney et al. 2015a, b). For example, teachers usually create a design for themselves to teach, whereas instructional designers may be involved in implementation but rarely undertake actual teaching. As yet little is known about the extent to which such differences give rise to differences in design practice. Findings from studies of designers outside education, such as architects, engineers, and industrial designers, could also inform us about the extent to which teachers' design work reflects more generic characteristics of design (see Razzouk and Shute 2012 for a recent review). Until there is empirical evidence to allow a comparison, we can only speculate about how we might draw on these ideas.

This paper reports on research that sought to advance our understanding of how university teachers design. Focusing on the processes by which teachers design, we present findings about the nature of design work conducted by university teachers, including how they start, how they proceed, and their sequence of activities. We use our results to derive a descriptive model of teachers' design process and discuss its alignment with conceptualizations of higher education teaching, as well as the extent to which it reflects design characteristics identified in the broader design literature and in instructional design research. We close with considerations for further research.

Method

The research study reported on in this paper was one component of a large multi-stage research and development project funded by a national research scheme. The study was guided by one overarching research question: How do university teachers design learning experiences for their students? The purpose of the study was to characterize university teachers' existing design practices as a basis for understanding how they might be better supported by technology-enhanced design support tools and institutional initiatives. The conceptual framing for this research drew on the higher education teaching literature; specifically the 3P model of teaching and learning processes (Biggs 1993) and the Approaches to Teaching framework (Prosser and Trigwell 1997) that draws on it. The 3P model (presage–process–product) conceptualizes the factors and interactions before, during, and as a result of teaching. Presage factors encompass the context set by the teaching and institution, including characteristics of the teacher and the course. These factors influence the teaching experience facilitated by the teacher and experienced by the student, and lead to the outcomes for both learner and teacher. The Approaches to Teaching framework conceptualizes the relations between teachers' ideas of teaching and learning, their perceptions of the teaching environment, and their approaches to teaching. This conceptual framing highlights the role of the teacher in interpreting the complexity of the teaching environment to make decisions about the design of a unit throughout the presage, process, and product stages. Together these two well-established models of higher education teaching helped us to conceptualize the nature of teachers' design work and informed the design of our data collection and analysis.

A qualitative approach was chosen for this study because the phenomenon under investigation (teacher design) is relatively unexplored, meaning that there is little empirical evidence that can support theorization. The conceptual framing highlights teaching (and therefore teacher design) as a complex, situated practice. The nature of the research problem, therefore, suggests that to begin to build an understanding of teacher design we need detailed data from first-hand experiences. These types of exploratory studies are well suited to qualitative approaches (e.g., Creswell 2012; Denzin and Lincoln 2011). This was an interview study that adopted a phenomenological stance; this approach seeks to capture participants' own accounts to provide insights into their experiences (Brinkmann 2013; Seidman 2013). We chose this method because it aligned with our research aim, which was to understand university teachers' experiences and perceptions of design as a means to begin exploring existing practice. Although multiple data sources are often preferred in qualitative research (Patton 2014), we could not observe participants' design experiences because they were in the recent past and official unit documentation provided little insight into the design process.

Our data collection strategy was to conduct semi-structured interviews with at least 30 university teachers from a range of different institutions, asking participants to describe their recent experiences of design. This approach would generate a rich dataset that would capture some of the diversity across the sector, while ensuring that the project remained manageable. To minimize the burden on participants, we chose to conduct a single interview of on average 1 h by phone or in person depending on the participants' location. The scope of the study was limited to Australia, in part because of the focus of the funding scheme, but also because the research team has extensive experience in Australian higher education that would aid interpretation of the data.[2] All protocols were approved by the authors' institutional Human Research Ethics Committee before recruitment commenced.

Potential participants were contacted through the mailing lists of four Australian professional academic bodies, and asked to complete a brief survey about their discipline and the nature of their teaching responsibilities. The 30 participants were purposively sampled from the pool of volunteers according to four criteria: discipline and discipline grouping; year level(s) of students taught; years of teaching experience in higher education; and years of experience in online teaching. We drew on Becher and Trowler's (2001) conceptualisation of disciplinary cultures, Shulman's (2005) notion of signature pedagogies, and the Australian Bureau of Statistics' Higher Education Discipline Groups codes to select participants from across difference disciplines and within the broader discipline groupings of arts, sciences, and professions. All participants held teaching and research positions, as is most common for Australian university teachers. Academics who did not routinely engage in teaching, such as those in support and research-only positions, were not included in this study. Participants were selected from a range of institutions, resulting in representation from 16 of Australia's 39 universities. We had a sufficiently large pool of volunteers to ensure that no more than four participants came from a single institution and that there was no overlap in discipline from within the same institution.

This approach provided broad representation across different teaching contexts (e.g., large and small classes; lectures, tutorials, and practical classes; face-to-face, blended, and online; undergraduate and postgraduate), teaching backgrounds (discipline, years/types of experience), and institutional contexts (research intensive, teaching and research, distance

[2] We have subsequently begun to replicate the study internationally in collaboration with local partner investigators to assist with recruitment and interpretation. These studies are underway and will generate comparative datasets.

education; metropolitan and regional). Table 1 provides an overview of participants' teaching profiles.

The interview protocol was informed by the conceptual framework (Biggs 1993; Prosser and Trigwell 1997) and relevant empirical literature (particularly Bennett et al. 2011; Postareff and Lindblom-Ylänne 2008; Stark 2000). A semi-structured approach was used, consisting of a series of open-ended questions that invited participants to share their perspectives. Interviewers used probes to elicit further detail, specific examples, and explanations. Participants were asked generally about their approaches to teaching, their teaching context, influences on their design practices, and supports used during their design process. A further series of questions asked participants to recall details about their processes and decisions during specific recent experiences of design. Two scenarios were suggested: (1) the design of a new unit, and (2) the redesign of an existing unit. Each series of questions began with an open-ended stem to begin the discussion. For example, when asking participants about how they designed a new unit, we asked them to choose a specific recent example and simply asked, "Where did you start?", followed by further prompts, such as "And what did you do next?" Generic prompts, such as "Could you tell me more about that?", were used to elicit further detail about each stage of a participant's process. Further probes were used only when aspects of the process were not clear; for example, "How do you decide on the assessment?" and "How do you work out what resources you will include?". Interviewers were careful to adjust their prompts to clarify and use the terminology adopted by the participant. This approach provided rich, contextualized descriptions. A weakness in any one-off interview strategy is the lack of complementary data to undertake triangulation. To improve the quality of the data collected through the interview, participants were asked about general and specific design experiences, and probes were used to elicit multiple examples. This measure was intended to reduce the possible bias caused by a participant focusing on a single experience.

The duration of the interviews ranged between 50 and 90 min. Five participants were interviewed face-to-face and 25 interviews were conducted by telephone. In general, participants were not known to the researchers, but care was taken to ensure that participants were not interviewed by a team member they knew personally. The researchers each maintained notes in which they reflected on the interviews they conducted and emerging issues related to the study. These were discussed at weekly team meetings to guide data collection and were drawn on in later analyses where relevant. Interviews were audio-recorded and transcribed. Using member checking, we gave participants the opportunity to review the transcript and offer amendments or clarifications if they wished.

A preliminary analysis framework was developed inductively from the data through a process of reading and annotating each interview, identifying key issues across the dataset, developing codes to describe clusters of related issues, and arranging these codes into categories to create a hierarchical structure. The initial codes and categories were compared to the conceptual framework and further refined. For example, Biggs's 3P model (1993) was used to define teaching *presage* factors, and Prosser and Trigwell's (1997) framework to define conceptions and approaches to teaching. At the highest level of the hierarchy seven categories were created: *Context*, *Teaching Approach*, *Design Context*, *Online Learning*, *Process*, *Design Influences* and *Support*. These categories grouped related sub-categories and codes. For example, within the *Process* category sub-categories were created for *Designing a New Unit* and *Redesigning an Existing Unit*, and subsidiary codes were created within each of these (see Table 2).

Definitions were drafted for each code and example excerpts identified. A separate code was retained for emerging issues that would be reconciled later in the analysis process.

Table 1 Teaching profiles of the participants

Name[a]	Discipline (discipline grouping)[b]	Teaching	Teaching experience (years)	Delivery method
Heidi	Anthropology (Arts)	UG, PG	<5	F, O
Steve	Media and Communication (Arts)	UG, PG	5–10	F, O
Kerrie	Film and History (Arts)	UG	>10	F, O
Christine	Japanese Language and Literature) Arts	UG, PG	>10	F, O
Julie	Art History (Arts)	UG, PG	>10	F, O
Katrina	Human Geography (Arts)	UG, PG	>10	F, O
Kirk	Sociology (Arts)	UG, PG	>10	F, O
Shane	Sociology and Social Policy (Arts)	UG, PG	>10	F, O
Trent	Social Psychology (Arts)	UG, PG	>10	F, O
George	Graphic Design (Arts)	UG, PG	>10	F
Kathleen	Marketing (Professions)	UG	<5	F, O, D
Cameron	Information Systems (Professions)	UG, PG	5–10	F, O
Bill	Mental Health Nursing (Professions)	UG	>10	F, O
Joyce	Information Systems (Professions)	UG	>10	F, O
Lily	Physiotherapy (Professions)	UG	>10	F, O
Patricia	Management (Professions)	UG	>10	F, O
Paul	Teacher Education (Professions)	UG	>10	F, O
Craig	Mining Engineering (Professions)	UG, PG	>10	F, O
Michelle	Higher Education (Professions)	PG	>10	F, O
Sally	Nursing Science (Sciences)	UG, PG	<5	F, O
Darren	Anatomy and Physiology (Sciences)	UG	5–10	F, O
Debbie	Developmental Psychology (Sciences)	UG	5–10	F, O
Belinda	Pharmacology (Sciences)	UG	>10	F, O
Gloria	Chemistry (Sciences)	UG	>10	F, O
Richard	Chemistry (Sciences)	UG	>10	F, O
Nigel	Chemistry and Pharmacology (Sciences)	UG	>10	O, D
Terence	Geology and Climate Science (Sciences)	UG	>10	O, D
Deidre	Environmental Chemistry (Sciences)	UG, PG	>10	F, O
Kurt	Biology and Ecology (Sciences)	UG, PG	>10	F, O
Lola	Environmental Science (Sciences)	UG, PG	>10	F, O

UG Undergraduate, *PG* postgraduate, *F* face-to-face, *O* online, *D* distance

[a] Pseudonyms have been used

[b] Discipline groupings were determined by the degree program, faculty, and focus of subject teaching

Each interview was then coded separately by two researchers using the analysis framework. During this process each researcher kept journal notes about the definitions of the codes to enable further refinement of the framework. All six members of the research team met to resolve disparities in coding, examine emerging issues, and revise the

Table 2 Codes within the *Designing a New Unit* category

Code name	Brief definition
Prompts	Indicates what prompts the need for a new subject
Process	Describes how they go about designing a new subject
Content	Refers to the place of content in the planning process and how topics and foci are selected
Structure	Discusses learning activities and the sequence in which students undertake them
Assessment	Discusses assessment and its place in the design process; this may also be referred to when discussing institutional requirements and influences on decision-making
Resources	Refers to how, when, or why they choose the content and other resources they do
Technology	Indicates the place of considerations for technologies in the design process

analytical framework and coding until consensus was reached about the definitions and codes assigned. Care was taken in these discussions to explore and interrogate each researcher's interpretation of the data with reference to his/her subjectivities. Researchers' notes provided a supplementary data source where relevant.

While it is not an aim of qualitative research to eliminate bias, these discussions did raise instances when researchers' individual perceptions of the code definitions may have influenced the findings. We adopted two common strategies during data analysis to ensure the rigor of the study. First, we used a collaborative approach throughout the analysis that involved all six members of the research team in the process described below; this approach was further supported through weekly meetings. One of the strengths of the research team was its members' extensive and varied backgrounds, including experience in teaching across a range of disciplines, and experience as university teachers and in support roles and instructional design. The collaborative approach promoted a constant questioning of our interpretations to avoid a deficit view of higher education teaching, and instead give prominence to participants' perspectives on their teaching and design experiences as a means to understand current practices. Second, we maintained an audit trail throughout the study. This consisted of researcher notes, detailed meeting minutes, a joint data analysis journal, and logs from the qualitative data analysis software used. This provides a record that can be reviewed and scrutinized.

After coding had been finalized, multiple analyses were undertaken within and across codes to answer a series of fine-grained analytical questions that addressed the study's overall research question. We used the qualitative analysis software to create reports within and across codes, from which we developed summaries, tables, and diagrams to identify patterns and themes. This paper reports on one of these analyses, which focused on characterizing the processes by which university teachers conduct their design work. The aim of this analysis was to identify commonalities in the design processes described, thus determining whether there was a shared experience of design, despite the diversity of participants' situations. We were also interested in whether we could detect significant differences in design processes within the sample. To support this process we used matrix reports from the qualitative analysis software and developed summary tables to compare the participants' accounts of their processes and look for patterns within and across disciplines.

Research context

Before summarizing the themes that emerged from the data analysis process, we provide a brief overview of the Australian university sector in which this study was situated. Australia has 40[3] public universities, which receive the majority of their funding from the Australian federal government. The sector was significantly expanded in the early 1990s to integrate the advanced college system into a larger university sector. Since that time the sector has experienced a marked increase in student numbers, a more diverse student population, demands for more flexible offerings often over multiple sites, greater scrutiny of the quality of higher education teaching, significant changes to management structures and approaches within institutions, the integration of digital technologies, and shifts towards more student-centered pedagogies (Gale 2011; James et al. 2012; Krause et al. 2009; Ramsden 2003). These changes have brought significant pressure on educators to adopt new and innovative educational approaches within a relatively short time. Design-support services exist centrally or within the faculties of all Australian universities, but these are limited resources for which there is strong demand, leaving many university teachers to rely on their own skills. This is a particular challenge for discipline experts, who often have limited pedagogical training and are expected to balance teaching work with research, professional service, and administrative responsibilities.

Results

The presentation of results has been structured according to the three general characteristics that emerged from the participants' descriptions of their design processes. We integrate direct quotes from participants to illustrate these characteristics.

Of the 30 participants, 22 could recount a recent experience of designing a new unit. Two had no prior experience designing a new unit; two spoke about their design experience at the program/degree level rather than providing details of a specific unit; three spoke about their experience of new unit design in general terms and did not provide details of a specific unit; and one participant, while having experience in designing new units, was not able to recall a recent example. In terms of redesigning an existing unit, 23 participants explained how they redesigned a particular unit, while seven spoke about their process of redesign more generally without reference to a particular unit. When asked to describe teaching in their discipline area generally and teaching in the particular units they had designed or redesigned, our participants referred to both student/learning-focused and content/teacher-focused conceptions and approaches. Although differences in pedagogical approach were evident, with some describing more student-centered strategies than others, there were no stark differences according to discipline.

The starting point depended on the nature of the design problem

The reasons for undertaking the design work and the context of the unit itself influenced the starting point for the design process. Two distinct starting points emerged from descriptions of designing a new unit, while the starting points for redesigning were more varied.

[3] The number of universities in Australia has increased since this research was completed.

Of the 22 participants who had experienced designing a new unit, 12 (6 from arts, 4 from professions, 2 from sciences) began by thinking about the learning outcomes, and 10 (2 from arts, 3 from professions, 3 from sciences) by considering the content area the subject would cover.

The 12 participants who started by considering outcomes focused on what they wanted students to be able to do by the completion of the unit: "What was essential for our students to know…what are they going to use in practice?" (Bill, professions).

The ten participants who began with a content-area focus determined what scope of content and which topics to include in the unit: "You map out what you consider to be the content first and then think about how best students can learn some of this stuff" (Richard, sciences).

Whether participants started the design process of a new unit from a learning-outcomes or content-area focus depended on contextual factors, including the position of the unit within the overall degree program, the resources available, their own familiarity with the content area, and whether they would teach subsequent iterations of the unit. For example, Christine (arts) started with outcomes when designing a new foreign-language unit because she had to account for how the new unit's prerequisites fitted within the program of study: "It's all a flow-on effect…first year coming to second year, going to third year." Katrina (arts) began her new unit with outcomes first because she was familiar with the content area, then thought about "how I'm going to structure that and get that content in terms of objectives, and making sure that those generic and specific unit skills are in place".

In contrast to Katrina, Terence (sciences) started the design of a new unit from a content-area focus because there were no content resources available: "I wasn't handed any notes…. When you teach a new subject you have to become familiar with the content [area]. So there is a large amount of time invested in finding and preparing the content [resources]." Kirk (arts) started designing his new unit from a content-area focus purely for pragmatic reasons. He talked about being in "survival" mode, as he would only teach the unit once, and focused on organizing content into weekly topics: "[Because it's] a one-off, you have a lot less investment. So, really, you start from how many weeks do you have to fill up…then you're working out how many topics…11 topics, 11 weeks."

The situation was quite different when redesigning an existing unit. For the purposes of this study, redesign was considered as going beyond the mechanistic changes that are needed every time a unit is taught (for example, to update dates or contact details). We were interested in more significant modifications such as the need for content topics to be updated, or changes in delivery mechanisms. When an existing unit is redesigned, its objectives or intended learning outcomes usually do not change: "whatever you've got to do, you've just got to look that you're still achieving the objectives" (Kathleen, professions).

The starting point for redesigning depended on what had prompted the revisions. These prompts tended to be context-driven. Seventeen of the 30 participants mentioned more than one reason for redesigning. Overall, five key reasons surfaced for redesigning: addressing feedback from students and colleagues (12 participants); updating the content covered in a unit (10 participants); making changes to perceived problems identified during teaching the unit (8 participants); changing the way a unit is delivered to include online components (6 participants); and staff changes such as taking over from someone who had left (4 participants). Content-area changes were most significant when teaching an existing unit for the first time, particularly when the previous university teacher had not passed on the unit materials: "I'm going to revise [the unit], because the person who taught it has left" (Darren, science). With universities increasingly moving to more-flexible modes, some

teaching had shifted to partly or wholly online. This often required major revisions to teaching approaches and assessment strategies. For example, Julie (arts) explained that she redesigned an undergraduate unit "to respond to new possibilities using online teaching and learning modes". Joyce (professions) explained that when she was employed at her university her "first job was to take this unit and translate it into something that could be offered off campus".

Heidi's experiences are indicative of the differences in design processes for new and existing units. When designing a new undergraduate unit, she began from an outcomes focus: "With the concept…often I'll just think about an article I've written…and I'll think, 'What would somebody have to know in order to follow the sequence of the argument I made in that article?'" Yet, when redesigning an existing undergraduate unit that she had not taught before, she started her design process from a content-area perspective. She explained that she needed to change the content focus of the unit because it had been too closely aligned to the previous academic's research interest: "So I had to change it to make sure it was something that I could lecture on" (Heidi, arts).

Understanding where university teachers begin when designing a unit gives insight into how they initially conceptualize and engage with the design problem. The accounts provided by our participants suggest that design and redesign processes begin differently. When designing a new unit, participants began by focusing on either learning outcomes or content area, whereas when redesigning an existing unit, the starting point depended on the specific modifications required. The rationales for these starting points depended on how the teacher initially conceptualized the design problem (e.g., as needing to address particular outcomes or develop particular skills, being concerned about a lack of available content resources or lack of familiarity with a content area, or needing to improve an assessment task). Notably, there were no obvious differences in starting points for designing a new unit or redesigning an existing unit between the disciplines, delivery methods, or unit characteristics (e.g. undergraduate versus postgraduate).

Design moved from broad considerations to specific detail

Participants explained that in the early stages of the design process they needed to create or understand the unit's overarching framework. Only when this framework was established did they turn their attention to the specifics of the unit. This design process can be characterized as moving from broad to specific, or from macro to micro.

For a new unit, establishing the initial framework involved decisions about the learning outcomes, the scope of the content and assessments, and general ideas about learning activities. Of the 12 participants who began their broad design process from a learning-outcomes focus, 10 (4 arts, 4 professions, 2 science) thought about the content area (4 arts, 4 professions, 2 science) before considering learning activities and assessments, while 2 (George and Kerrie, both arts) focused on learning activities and assessment before considering the content focus. For example, Bill (professions) said, "Then what we did was…we aligned content with the objectives. What content would we have to put into meet those objectives?" Kerrie (arts) was one of those who turned to assessment and learning activities as her next consideration: "What do I need to do to create learning activities and assessment types that will help them [students] develop those skills and will demonstrate to them that they have developed them?"

Five of the 12 participants (3 arts, 2 professions) explicitly explained how they then worked from the outcomes to think about the other unit components—content topics, learning activities and assessment—to enable the achievement of those outcomes. For

example, Kerrie (arts) explained: "What specific skill will [students] think, 'I can now do this really well'; then I move backwards from that to what do I need to do…that will help them develop those skills". George (arts) said: "Outcomes, and then worked backwards…what are the learning objectives, what do I need them to know at the end? Then I would tend to go to developing a project that would allow them to do that, and then down to setting up the learning tasks…the exercises and the content for the lectures." Bill and Paul (both professions) explicitly mentioned aligning content topics, learning activities, and assessment with outcomes; for example: "We aligned content then with the objectives. What content would we have to put into meet those objectives?" (Bill, professions).

Of the 10 participants who started by determining the scope of the content, 4 participants (3 professions, 1 arts) explicitly stated they thought about how the learning outcomes would match with the content topics and then devised assessment tasks and/or learning activities to align with them. For example, Craig (professions) explained, "We would…nut out a…course outline that covers the topics…there are some learning outcomes…. Okay, now we need to match these up…with the appropriate assessment then to the learning outcomes." Six participants (three arts, three science) explained how they thought of assessment and learning activities next. For example: "I might map out usually the lectures…and then…design what I think will be interesting learning activities for students in tutorials" (Trent, arts). One participant said she thought of the content topics and assessment tasks concurrently: "When I'm developing the assessment tasks and the topics I'm also simultaneously thinking about how I'm going to use…the web and the online tasks to get them to learn something that's related to the subject itself. So, I sort of have to do those things simultaneously" (Julie, arts).

After the overarching unit framework had been established, attention turned to designing the specifics of the unit, such as selecting readings, creating content resources, developing specific learning activities to include in classes, and determining the timing and requirements of assessment tasks. While designing the specifics, participants described a process of continuously reflecting on both their broad and specific design decisions to ensure that all the unit components aligned: "To me that's the process in my own mind, the alignment of outcomes, content, and assessment" (Paul, professions). This reflective activity served as a self-monitoring mechanism during the design process:

> I keep a copy of the outcomes next to me…and I'm saying to myself, "Okay, how does this module I'm thinking about doing relate to these outcomes?"…. I'll look at assessment and make sure that…the various time slots are building towards that piece of assessment (Steve, arts).

Working iteratively was important for achieving this alignment, but the processes described did not involve a systematic or linear sequence. For example, there were no descriptions of planning chronologically week by week, or developing class activities before moving on to specifying content resources or technology supports. Instead, participants typically described working on whatever aspects of the design they deemed to be a priority at the time, while also checking new details against what they had already specified.

When participants redesigned an existing unit, two patterns emerged that were consistent with the strategy of designing from broad to specific. When participants had not taught the unit before, they undertook a process of *familiarization* to better understand the existing unit's structure and determine whether its existing design aligned with their teaching style and content expertise. Once familiar with the existing unit, they made decisions about specific aspects that required modification. This is analogous to designing

from broad to specific, as the process of familiarization was about understanding the unit's existing framework and involved critically evaluating it: "There's no assumption that when you come to a new institution that you'll simply take on another person's courses uncritically" (Heidi, arts).

When participants redesigned an existing unit that they had taught before, their redesign considerations mainly focused on the specific aspects of the unit they wanted to modify or improve, such as updating the scope of content, making modifications to address student feedback, making changes to issues identified during implementation, and making changes to how the unit would be delivered, such as incorporating online components. While they did not need to undertake the process of familiarization, as they had previously taught the unit, nine participants (five arts, one professions, three science) engaged in a broad-to-specific design strategy when undertaking their redesign. For example, Julie (arts) said, "Every time I teach it, I look at the design and consider ways of making it better based on the students' experience from the previous semester." Richard (science) stated, "What you do is you start by questioning everything that you're doing in the unit."

Overall, our participants described working early in their design process to establish the overarching framework of a unit or becoming familiar with the existing unit structure. Attention then turned to the specific detail, which involved working iteratively to achieve coherence across the many aspects of a unit. Creating or understanding the macro features provided a scaffold for more-detailed, micro-level design decisions. Participants explained this as a process of trying to achieve alignment among the outcomes, content, activities, and assessment, supported by their overall framework and driven by a desire to improve the unit's design.

Design occurred before, during, and after a unit's implementation

For our participants, design was an iterative process that occurs before, during, and after a unit's implementation. Before the teaching session,[4] participants developed their designs using the broad-to-specific pattern in iterations, moving recursively through the interrelated components of the unit. This was not a linear process with clearly defined steps.

The design process continued after the start of the teaching session, with participants engaged in designing the specific modules, weekly materials, or class and online activities. Many of these smaller components were planned for, but not fully prepared before the teaching session. For example, Terence (science) explained that he knew what topics he wanted to cover, but "I wrote the lectures as I went". He went on to say. "You may find that when delivering the subject you may be one lecture ahead of the students in terms of content preparation" (Terence, sciences). Adaptations might also have been needed "on the fly" as problems with a design became apparent or circumstances changed. In our participant accounts we found examples of this approach in both face-to-face and online/blended modes.

Even after the end of the teaching session, more than half of the participants described reflecting on how the unit could be improved for its next iteration. Participants who designed a new unit that they would teach again in the future also considered redesign issues during unit implementation. For example. Katrina (arts) spoke about recording

[4] The generic term "session" is used here to refer to the time period over which a unit is offered to students. Depending on the context, this may be variously termed session, semester, or term. It is distinct from "class", which refers to a lecture, tutorial, workshop, or practice class, usually face-to-face, scheduled during a teaching session.

adaptations required for the subsequent iteration of the unit while teaching the current iteration of the unit: "I develop a spreadsheet or almost a diary where after each lecture or each week I just make notes about the different issues that I want to change for next year or have to remember to develop." Shane (arts) viewed this as a pragmatic approach to design:

> I always take a kind of "Well, this is the first go and I don't have to do everything, it doesn't have to be a perfect unit this time" [view]. So I have a very kind of…pragmatic approach that we won't get it right the first time (Shane, arts).

Shane went on to explain how he constantly reflects on his teaching:

> I've gotten into a habit…of thinking constantly about teaching as I'm doing it, and usually I will try and then draw together that kind of reflection at the end of the unit and move things in a new direction if I think I can find one that works better (Shane, arts).

This demonstrates how some participants' design work extended to considering subsequent offerings of a unit when they knew they would be teaching it again.

Similarly, participants redesigning an existing unit that they had previously taught, and intended to continue to teach, described a process of ongoing review, even recording their ideas about what could be improved in the future. For example: "If I know something just really didn't work, I…leave some notes for myself…to review that" (Darren, sciences). "If I'm teaching something for a subsequent time I will look on my reflective notes—I keep notes as I'm teaching" (Michelle, professions). Eight participants (four arts, two professions, two science) described being committed to a continuous cycle of improvement: "If there's something I've taught and I still think it's good, and I think, well, how can I make it better…I usually set the bar pretty high for myself" (Belinda, sciences). Even redesigning a unit not previously taught was often seen as iterative, building on the work of others:

> For me to just walk into any unit and turn around and say, "Well, I'm just going to throw all of this away and start afresh" is kind of arrogant…. It's quite a different process because I'm not starting with a clean slate (Steve, arts).

In sum, when participants designed a new unit, there was a period of intensity to establish the unit framework and specify the detail to prepare the unit for implementation. Design work continued during implementation to finalize specific components that had been deliberately deferred (such as the weekly lecture content and tutorial activities). Reflection occurred before, during, and after unit implementation as teachers considered how to improve the unit in the future. This common pattern shows that design is not an activity conducted solely before the commencement of teaching, and that leaving a design incomplete is a strategy that allows adaptation in response to students as the teaching session unfolds. The iterative refinement of a unit over a period of time suggests it is continuously evolving and possibly never truly complete. The participants' accounts suggest that unit design can extend over multiple offerings, rather than being a more tightly defined "project".

Discussion

The purpose of this study was to better understand the process by which university teachers go about designing units for teaching. A high degree of commonality across the range of disciplines, institutions, and teacher backgrounds suggests there is a shared experience of

process, summarized in Fig. 1. As a descriptive process model drawn from accounts of practice, this adds to the very limited empirical literature that seeks to identify patterns across individual experiences and goes beyond anecdotal evidence. Similar approaches have been used to contribute descriptive models of instructional design (see Lee and Jang 2014).

As shown in Fig. 1, whether designing a new unit or redesigning an existing unit, our participants followed a top-down approach, beginning their design process with a broad framework. There was variation in which aspect of the framework they focused on first, but regardless of their starting point, they iteratively considered the learning outcomes, the scope of the content to be covered, their general ideas for learning activities, and their assessment strategy. With the broad framework in place, they moved on to specify the detail, at the same time checking against the broad framework and making adjustments if necessary. Like Stark (2000), we identified a non-systematic cyclic design process in the accounts of our participants and variation in the steps taken depending on whether they were designing a new unit or revising an existing unit. Unlike Stark, however, we identified a clear top-down process that was similar across participants and a high degree of similarity in the steps taken within each phase. For example, when establishing the broad framework, all participants reported considering the learning outcomes, the scope of the content, the assessment strategy, and ideas for learning activities. The order and emphasis on each varied among participants, but there was no clear disciplinary difference. Nor

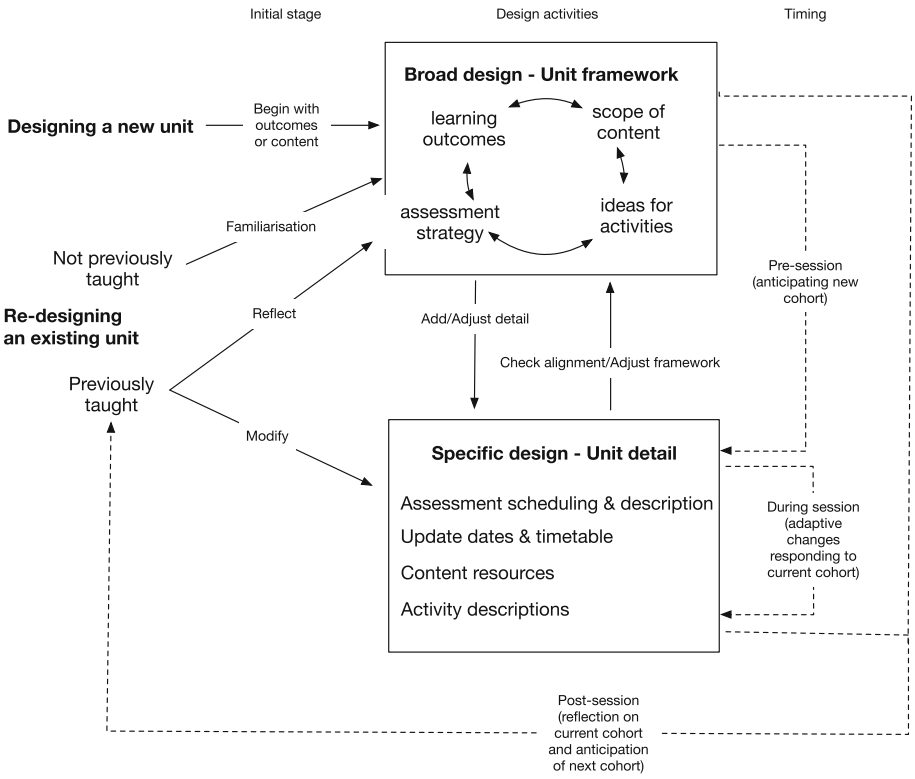

Fig. 1 A descriptive model of university teachers' design processes

could we identify differences in approach adopted by those participants who appeared to adopt more student-centered strategies. This suggests that there may be a similar general design process and leaves open the possibility that disciplinary and pedagogical differences are evident in more fine-grained decisions than either our study or Stark's could detect.

As might be expected, our results showed that much of a teacher's design work is completed prior to the teaching session, when a teacher creates or modifies a unit in anticipation of the new cohort. The considerations described by our participants reflect the *presage* factors in the 3P model (Biggs 1993), such as teachers' conceptions of students, and teacher and institutional factors. After teaching has begun, student responses may prompt the teacher to make adaptive changes to the design, mostly to the unit details. A teacher may also leave some of the unit detail unfinished until after the session has begun, with the intention of adapting the design to best suit the enrolled students. This reflects teachers engaging with both the *product* and *process* elements of Biggs's model. That is, they are enacting the design of the unit, in concert with the students, and acting on students' responses (informed by interactions in class or online, and student work submitted in activities or for assessment). The teacher reflects on the success of the design to identify future changes, feeding into another cycle of redesign. This usually occurs after the teaching session is complete, although teachers often make note of their ideas for changes during the teaching session. These activities contribute to developing teacher knowledge, which feeds back into the *presage* factors for future teaching. The findings of this study reveal how design work fits within the teaching and learning cycle as envisaged by Biggs (1993), adding new detail about teacher activity.

The results of this study can also be related to the concepts underpinning the Approaches to Teaching framework (Prosser and Trigwell 1997). Our participants referred to both student/learning-focused and teacher/content-focused as influences on their teaching; this was reflected in the design of the unit, particularly the instructional strategies they chose, but our results did not demonstrate distinct differences in the process they followed to arrive at their differing design outcomes. Put simply, regardless of whether participants described beginning with a learning-outcome or content-area focus, their subsequent processes followed a similar top-down process (Fig. 1). This finding does not reflect distinctions that Postareff and Lindblom-Ylänne (2008) made between student-centered and teacher/content-focused approaches to the planning of teaching. An explanation for this absence may lie in the nature of our participants. As explained by Postareff and Lindblom-Ylänne (2008), a student/learning-focused approach can be considered a more comprehensive approach to teaching that incorporates and extends beyond a teacher/content-focused approach. This means that teachers who adopt a more student/learning-focused approach, often because they are more experienced and are positively oriented to teaching, consider students and learning, as well as content and teaching. Our participants were mainly experienced teachers who were sufficiently interested in teaching to join (and be recruited from) a teacher-related professional organization. This suggests that they may be more likely to adopt a student/learning-centered approach, regardless of their discipline.

It is important to emphasize that the model we have outlined above is *descriptive* rather than *prescriptive*. It is based on what academics describe doing, rather than what they perhaps should do to be most effective. A noteworthy absence in the data is any reference to the use of models or frameworks to guide the design process. This is despite the prevalence of curriculum-planning approaches and practical guides to support university teachers. It may be that the use of these approaches and guides has been integrated into the tacit practices of higher education teachers, or it may reflect their limited adoption. Further

research is needed to resolve this question. Although this study helps to understand what teachers currently do, with the intention of informing future support strategies, there is clearly a related question of what teachers *should* do that also needs to be addressed as part of an overarching research agenda.

The design characteristics of teachers' design processes

The findings of this study also enable consideration of how the nature of university teachers' design processes compares with the characteristics of design processes adopted in other disciplines (such as architecture, engineering, and industrial design) and, in particular, to the more closely related field of instructional design.

The general design literature refers to design as an analytical, yet creative, process "that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign" (Razzouk and Shute 2012, p. 330). Findings from design studies suggest that design is an iterative endeavor, characterized by an evolving understanding of the problem and its context, drawing on precedent and experience to develop an appropriate solution, subject to constraints on resources (Cross 2006; Goldschmidt 1998). Key characteristics of design from this literature can be synthesized as: a top-down, breadth-first approach; iterative and responsive to new ideas; making design decisions; and reflecting on the design solution (Razzouk and Shute 2012). Our findings are consistent with these broad characteristics.

A top-down, breadth-first approach refers to starting with a general, potentially vague idea that becomes more detailed and specific. Participants in this study demonstrated this characteristic by establishing a broad framework for their design before determining the specific details. Similarly, expert instructional designers have been found to identify key features of the problem and a basic strategy before working on the details (Perez and Emery 1995). Our participants described working iteratively through different parts of their design, continuously modifying it in response to new ideas about the problem and context. This aligns with the notion of design as "cycles of mutual adjustment between specifications and solutions until a final solution is reached" (Razzouk and Shute 2012, p. 336). Similar processes have been identified in studies of expert instructional designers who work iteratively through aspects of the design while continuing to address the overall problem (Le Maistre 1998; Perez and Emery 1995). Cognitive processes of "strategic control" involving decisions about "which idea to elaborate or adapt next, which constraints to relax, how to set priorities" (Razzouk and Shute 2012, p. 337) were also evident in our participants' explanations of how they self-regulated and reflected throughout the design process to prioritize their activities and make judgments about the progress and quality of their design. This is similar to the self-monitoring demonstrated by expert instructional designers as they reflect on their progress to decide how best to proceed (Le Maistre 1998).

Despite these clear similarities between our participants' design processes and those described in the wider design literature, some differences and absences were apparent. The role of representations is significant in design documentation and in evaluation through reflection, dialogue, and self-critique (Do and Gross 2001; Nagai and Noguchi 2003). Although some of our participants mentioned making notes during their design process, none referred to using systematic representations to document their designs. Novice instructional designers have also been found to make limited use of representations (Kerr 1983), whereas expert instructional designers routinely document their designs (Kirschner et al. 2002). Expert designers also use design process and/or conceptual models to support

their work. For example, Ertmer et al. (2008) found that expert instructional designers had mental models of the design process in mind, often adapted from textbook models, but used heuristically rather than directly. In an earlier study, Rowland (1992) had observed that expert instructional designers drew on instructional design principles to check ideas they had generated. By contrast, there was no evidence that our participants drew on design models or principles as part of their process.

Overall, our findings suggest that there are aspects of teachers' design work that reflect key characteristics of design more generally, but unlike instructional designers, teachers do not consciously think of their work as "design", nor do they articulate or conceptualise what they do in design terms. This suggests that there is scope to do much more to develop the notion and practice of teachers as designers. Previous findings suggest that, while design training may be useful, teachers' design work differs from that of instructional designers such that approaches sensitive to teachers' particular design work may be needed (e.g., Hoogveld et al. 2002; McKenney et al. 2015a, b). For example, the autonomous nature of teachers' design work (Bennett et al. 2011) means that supports must be voluntarily adopted by teachers, rather than mandated, and adaptable to different routines. Further, given that colleagues have already been identified as important sources of design ideas (Bennett et al. 2011; Postareff and Lindblom-Ylänne 2008; Stark 2000), their input might also be harnessed to support the process of design as well. Our findings support the contention that there is a shortage of relevant practical and conceptual tools to support teacher design (Mor and Craft 2012; Goodyear 2015).

Limitations and further work

It is important to acknowledge the limitations of our study and consider what further work is needed. Our participants were very particular to our study. All were engaged enough in teaching and learning to join one of the professional organizations from which we recruited, and to volunteer their participation. Three-quarters had more than 10 years' teaching experience. It is therefore not surprising that they demonstrated the top-down, breadth-first approach to design common to experts (Razzouk and Shute 2012). Further research is needed to explore the design process of early-career academics to compare the findings. With a more limited knowledge base, novices follow different thinking processes, tending to focus on more-superficial aspects of a design problem rather than identifying an underlying logic (Cross 2006). Further studies could investigate whether less experienced teachers do indeed follow different processes when designing. Our participants also came from the Australian university sector, which, though similar to other higher education contexts internationally, is likely to have particular characteristics that may influence design processes. The effects of context should also be explored through similar studies in sectors within post-secondary education.

A further limitation of this study is its reliance on one-off interviews asking participants to recall particular experiences of design. Accurate recall of actual activities is difficult, and further research could use interviews that are more contemporaneous with the design process, participants' own records of their design activities, and observations of design in naturalistic or simulated settings. This could include methodologies that track design over a period of time (e.g., Jones et al. 2011) or protocol studies of the kind used in other design research (e.g., Cross 2006). Such studies could identify specific design decision patterns that may reveal disciplinary differences and add detail to the design process model. For example, an analysis of the language used by teachers to describe their design processes will be helpful in identifying and understanding the tacit models that teachers draw on. The

use of particular terms and concepts will reveal more about the ideas that shape teachers' design approaches and possibly their process. Such studies could also use quantitative analysis techniques to identify correlations, for example, between the various characteristics of design problems and the design processes adopted by teachers.

There is significant scope for further research and practical application in this area. We are only beginning to understand teachers' design work. While exploring actual practice is an important starting point, a further step would be to investigate the effectiveness of particular design processes by collecting data about a design's implementation and the resulting student outcomes. It is too soon to suggest how teachers *should* design, but this must be addressed in the future to ensure that improvements to practice can be realized.

Conclusion

This study examined how university teachers undertake the process of designing new units and redesigning the existing units that they teach. While the factors that influence university teachers to adopt particular approaches are well known, these are rarely considered within the context of design more generally, and few studies have been conducted into teachers' design processes specifically. We have derived a descriptive model of the design process that university teachers across disciplines adopt. This model extends Stark's (2000) early findings by identifying a breadth-first, top-down, iterative approach that reflects the processes adopted by effective designers, including instructional designers. This common approach challenges earlier indications that teachers from different disciplines follow design approaches that reflect their different pedagogical approaches. This does not preclude more-subtle differences in design decisions at a more micro level than we could detect. Further research is needed to explore this possibility. Participants in this study also demonstrated self-monitoring of their process, similar to that of other designers. These findings suggest that university teachers do undertake design in ways similar to other designers, but important differences were also found. Specifically, the university teachers in this study did not appear to draw on design models to guide their process, nor did they create representations of their designs. If teacher design is to drive innovation in higher education, as has been suggested, appropriate training and supports will be needed and will need to be adopted much more widely. While our findings contribute to the sparse literature about how university teachers engage in design, significant research and practical applications are needed to advance design thinking and practice in higher education.

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