Curriculum drift: A multi-dimensional perspective

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Structured Abstract

CONTEXT
Higher education institutions produce some form of curriculum documentation that is made available, usually via a publicly accessible website, to the public, and current and prospective students. Such documentation is important for an institution as it effectively forms a compact with students and society more generally. For any given program of study or individual course, this documentation specifies the topics to which students will be introduced and the outcomes they are expected to demonstrate by the end of their period of study. Frequently these documents also form part of the accreditation of education programs by professional or government bodies. Such documents are the result of considerable effort on the part of individual academics and their institution and the formal curriculum they represent usually has been crafted carefully to reflect the requirements and goals set by accrediting bodies and institutions.

PURPOSE OR GOAL
The research reported in this paper describes how academics use this documentation when they are designing and developing their courses.

APPROACH
Data was collected from 22 academics from three universities in Australia using a mixture of one-to-one and small focus group interviews. Qualitative analysis was conducted using Charmaz' (2006) approach to grounded theory.

ACTUAL OR ANTICIPATED OUTCOMES
Academics spend considerable time creating official curriculum documents so it was expected that they would make use of them to guide their development of course material for use with teaching. The data, however, shows that although they produce what participants described as a "designed object", they make little real use of it when developing and implementing their courses. Ignoring the formal or written curriculum causes the delivered curriculum to "drift", i.e. to move away from its original design, causing it to move out of alignment and to lose cohesion and coherence within a very short period of time. The research did not attempt to look at changes in student learning as a curriculum drifts. Based on existing research, however, it is likely that curriculum drift leads to actual learning outcomes that do not always meet intended outcomes. It is likely also that graduates experience greater difficulty in transferring their learning to the workplace.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY
Curriculum for a program of study in a higher educational institution can be likened to a complex piece of software. Thus curriculum drift can be equated to Parnas' (1994) concept of software aging where, over time the original design is lost sight of and the software becomes fragmented and both harder to maintain and delivers less and less of the original purpose. To control curriculum drift I suggest an approach which helps academics visualise and understand the complex, multi-dimensional relationships between the elements of a curriculum. This will facilitate the development and maintenance of a coherent, cohesive and aligned curriculum which in turn, will lead to improved student outcomes (Biggs, 1996, 2002, 2009; Cohen, 1987; Tyler, 1949).

KEYWORDS
Curriculum design; Multi-dimensional Curriculum; Curriculum Coherence; Curriculum Cohesion; Alignment; Curriculum drift

Introduction

The education of the next generation of young engineers and computer scientists will play an important role in determining the future of Australia. Educational outcomes must not only meet today's needs, but also anticipate the conditions graduates will face within a short time after graduation. A higher education institution's ability to meet this requirement is determined in the large by the curriculum it offers its students.

Higher education institutions produce some form of curriculum documentation for both programs and courses. This documentation is generally made available to current and prospective students via a publicly accessible website. These documents are important for institutions as they form a compact with society at large, industry, and students about the topics to which students will be introduced and the skills students will gain as part of a specific program of study or individual course.

Documentation may include details of teaching mode (e.g. face-to-face, blended or on-line), activities, assessment and intended student learning outcomes. Considerable time and effort on the part of the institution and individual academics is expended creating these documents and the curriculum they represent has usually been carefully crafted to reflect accreditation, department or school, and institutional goals. Such documents frequently form the basis of accreditation by professional bodies, such as Engineers Australia (EA), the Australian Computer Society (ACS), or government ones, such as the Australian Tertiary Education Quality and Standards Agency (TEQSA).

This paper begins with a brief description of the context of the study followed by a brief explanation of the commonly accepted concepts underpinning curriculum and three approaches to achieving design of quality curricula. I continue by presenting one aspect of the findings from a small qualitative study looking at how academics conceive of curriculum and how they actually use it. I conclude with reflections on the implications of the findings, especially those related to the concept of "curriculum drift" noted by participants in the study.

Context

Because they have the potential to both determine and drive outcomes, curriculum documents are some of the most important artefacts that an institution produces (Barnett, Parry, & Coate, 2001). In spite of this, the most notable outcome of a "review of the literature on curriculum in higher education in the UK, the USA and Australia … is the dearth of writing on the subject" (Hicks, 2007). Literature addressing curricula in higher education targets curriculum related issues such as inclusive curriculum, learner-centered curriculum, internationalization of the curriculum, or focuses on the design of individual courses – that is, single units of study (Barnett et al., 2001). Furthermore, university academics are largely unfamiliar with the concept of curriculum (Candy, Crebert, & O'Leary, 1994) and with its importance in determining student outcomes. Instead they develop and teach courses which reflect their own, frequently research-driven, interests and pay little heed to the need for program coherence or even to identifying the aims and objectives of their course (Felder & Brent, 2004).

Despite the lack of research into curriculum in higher education, there has been significant research into curriculum itself and into what makes a good curriculum: one that enhances learning. Since Tyler (1949) proposed his "objectives based" approach to education in schools there has been more or less focus on achieving successful educational outcomes using curriculum design. The best known approaches are Bloom's (1956) taxonomy which classified cognitive outcomes for learning (Coates, 2000) and the more recent concept of constructive alignment proposed by Biggs (1996). An aligned curriculum is one where the learning activities and the assessments are both aligned with the curricular goals (Cohen, 1987). Biggs' concept of constructive alignment is generally applied to individual courses rather than to a whole degree program.

The alignment of a degree program's generic attributes with the outcomes from individual courses is often verified using curriculum mapping. Curriculum mapping is "the process of indexing or diagraming a curriculum to identify and address academic gaps, redundancies, and misalignments for purposes of improving the overall coherence of a course of study and, by extension, its effectiveness" (Great Schools Partnership). Curriculum mapping is also associated with quality assurance and accreditation processes (Bath, Smith, Stein, & Swann, 2004). Despite documented successes more challenges than successes are usually reported (Oliver, Ferns, Whelan, & Lilley, 2010). According to Willett (2008) "the greatest challenges appear to concern demand for time and human resources".

When considering the quality of program curricula, the concept of coherence is also sometimes used. "By coherence we usually understand a property of a number of propositions: namely hanging together, overlapping, or somehow mutually supporting each other" (Angere, 2008, p. 1). A coherent curriculum is built on a set of "content standards" that have "evolved from particulars … to deeper structures inherent in the discipline" and this "evolution from particulars to deeper structures … occur[s] over the school year … as the student progresses" (Schmidt, Houang, & Cogan, 2002, p. 19). Thus a coherent curriculum can be described as one that is logical and consistent, that forms a united whole rather than being composed of a collection of unconnected or only loosely connected courses. Knight (2001, p. 369) argues, however, that "curriculum coherence is not widespread". Gardiner (1966) (cited in Diamond, 2008, p. 85) takes the argument further stating that "most curricula are unfocused … [with] a notable absence of structure and coherence".

Another concept encountered when considering the quality of program curricula, is that of cohesion. A cohesive curriculum is one that exhibits coherence, provides synthesizing experiences, allows students ongoing practice of skills and provides systematically created opportunities to develop increasing sophistication and apply what is learned (Allen, 2004). Thus a cohesive curriculum can be described as one where the pieces, i.e. the courses, fit together without unnecessary overlap or gaps, just as with a jigsaw.

For the purposes of this paper, and for the study itself, the definition of curriculum that I am using is:

> the published, planned curriculum: "what organisations develop for the learners in their educational systems and what should be taught by teachers in that system" (Print, 1993, p. 4) which includes high level descriptions of content and learning outcomes and is expressed "in a form that can be communicated to those associated with the learning institution ... [and which is] open to critique, and ... able to be readily transformed into practice" (Prideaux, 2003).

This definition applies to whole programs of study, but also incorporates the building blocks – courses, units, modules, majors – that make up that program. The focus of this paper is the formal or official curriculum, which is frequently made available through an institution's public web sites.

Method

This paper reports on one aspect of a small, qualitative study involving engineering, software engineering, computer science and information systems academics at three Australian universities. In total 22 academics have participated. Of the 22, six are women and seven have formal educational qualifications: five hold a Graduate Certificate in Higher Education; one a Bachelor degree in Adult Education and another, a Graduate Diploma of Education in Secondary Mathematics. Participants' period of time involved with curriculum design and development in higher education ranged from 6 months through to more than 30 years.

Data was collected via six in-depth, semi-structured, one-to-one interviews, followed by five small focus group interviews. Originally, it was intended to collect all the data through one-to-one interviews. It soon became clear, however, that participants were not used to thinking about curriculum in the way I was asking them to and there was significant perceived

potential for me to influence responses. I decided therefore to complete data collection using small focus group interviews as focus group interviews have been shown to assist participants to "explore and clarify their views" (Kitzinger, 1995) in a way not readily achievable in one-to-one interviews. Interviews lasted between half and one hour, and focus groups were between one and one half and two hours long. Participants were asked to describe their concept of curriculum – focus group participants created a model of their concepts using a white board and magnetic tags. They were also asked to describe what they did when they inherited a course that someone else had taught before them; what they did when they were required to teach a course that had not been taught at their institution previously; and what they did when teaching the same course over a period of years.

Data was analysed following Charmaz' (2006) approach to grounded theory. Key themes were identified based on the four areas of investigation: participants' concept of curriculum; developing a new course; inheriting an existing course; and what they did year on year when teaching the same course multiple times.

Curriculum: in the words of participants

Before presenting my findings I tell their story using participants' words only. Headings have been inserted to emphasise the themes and to clarify the flow of the story; they are not, however, quotes from the data. Comments on opposite sides of the text indicate the conversational element of data collection.

Curriculum – what they think it is

Curriculum is just content

*What's **in** the curriculum, what's the shape, what are the building blocks*

The sequence of courses

The sequence of lectures and all the topics and all the exercises and the flow of the assignments

You come up with the degree program and then that becomes the individual degree courses

And these just get repeated … the objectives and goals at the course level down here. It's a program and a course. I guess that's hierarchical

A guideline, a specification of sorts

It is a designed object

The aims, the objectives, and the goals infer the learning outcomes. You start with the aims and objectives. And then there's certain constraints

Constraints play a fairly significant role

If you can't achieve the goals there's not much point in fantasising about it

There is a process around the formation of curriculum and that has the aims and the objectives and it also has the evaluation and then the teaching activities and so on

Curriculum – how they use it

I know what the course is called and I will print on the course my understanding of what that topic is

Much of what you do is constrained by the actual topic. So if you tell me I'm going to teach third-year algorithms. I pretty much know already what's going to be in there

I guess the other thing that sort of informs curriculum is like your experience in curriculum, like what you did at university when you went to university

That also informs, quite strongly, how you implement courses and what goes into it. And maybe even things like that, shape stuff more than what the goals are

So you come up with a curriculum and then you think, well what were we intending to do anyway? So maybe goals aren't a big driver anyway

Often I've taken one thing out. They would accumulate over time so if you change one thing in the course each year, or one entry, then the course will change over time

I make sure [my course] is professionally and academically valid, whatever it is, but it's not my problem if that doesn't logically fit into a program, that's somebody else's problem.

Implications and Reflections

Many of the findings from this study support those previously reported in the literature. My data accords with a US study by Stark, Lowther, Sharp and Arnold (1997) which found that academics focus their attention on course level curriculum rather than program level; don't frequently discuss their ideas and proposed changes with their peers; and don't have a coherent view of the program curriculum. My study also confirms Stark's (2000) US study which found that academics did not explicitly follow any specific approach to curriculum design. Rather participants seemed to use various design mechanisms that they followed unconsciously, perhaps reflecting their training, experience, and background. My research also appears to support Barnett's (2000) argument that "curricula in higher education are to a large degree hidden curricula, being lived by rather than being determined. They have an elusive quality about them. Their actual dimensions and elements are tacit. They take on certain patterns and relationships but those patterns and relationships will be hidden from all concerned, except as they are experienced by the students".

During discussion of curriculum design, participants indicated they thought it was "like designing software. You've got to work out who the customer is, what they're trying to achieve and what resources you've got". Supporting their claims that curriculum was a designed object, participants said that when designing the curriculum "you'd normally start with goals" and then you'd factor in the constraints because "any design problem has constraints. You don't have infinite time, you don't have infinite people to throw at it … it's not just resources, its people: do you have people with the appropriate skills? If you don't then that limits your possibilities". Finally, the graduate or student "outcomes, goals et cetera are the guiding goals" that the designer sets out to achieve.

Despite acknowledging that the official curriculum could "be seen as a guideline, a specification of sorts" and that "the goals should be the main drivers", when inheriting a course or making changes between one iteration and the next, participants frequently did not review the official curriculum for the course, let alone the program. Instead individuals "just focused on my knowledge" because, for example, "when I'm given Business Intelligence, then it's up to me to think about well what would I include in Business Intelligence". Furthermore, rather than following the guidance offered by the official curriculum, participants looked "at other universities teaching other similar sorts of courses [to] see what content they have". They also looked at "text books and see what content is in those and that would help shape what you'd want to … what curriculum you'd want to stick in that course, what you'd want to teach in that course".

Moreover, participants acknowledged they often implemented "smaller, minor changes" each year to avoid dealing with the administrative overhead surrounding more significant curriculum change. Changes were often made without discussion with their peers, and frequently without changing or even checking the official curriculum as represented by their institution's formal, public curriculum documentation. Participants did not see it as their

responsibility to ensure that their course, its content and outcomes, fitted into the program so that it "added up to a whole". They acknowledged that small changes "would accumulate over time, so if you change one thing in the course each year, or one entry, then the course will change over time". Thus, a series of small changes in only a few courses was likely to cause significant curriculum drift, as explained by one participant:

> "Well that happens a lot and that's something that… and it's amazing, I've had this discussion with the Associate Director (Education) and others, about the degradation and integrity of our degrees by that process. You know, there's all these forces degrading, changing, evolving, not necessarily getting bad or good within themselves, but they're drifting away from that picture of everything being in balance… So the integrity of the degree … degrades, because everythings's drifting off and I think that's a natural thing. If you're given a course, especially some people will say, 'OK, I've been given this course to teach I've never taught before, I'm not going to be teaching much in the future', 'it's the last time it's run' or whatever it happens to be. You fiddle around with it to make it comfortable for yourself and maybe hopefully improve your [student evaluation] results; maybe fiddle around with the assessment a little bit, if you can get away with it and you don't think about this [program integrity] at all. You know what happens in reality? … I don't know if it's the right word, but you know, coherence or whatever, you know, satisfaction of this, over time it dwindles then someone says, 'oh shit, redesign the curriculum'. I think the other thing that happens … is that we, I suspect unconsciously, we rely on accreditations… to maintain the integrity of this and to say look, cool we've done that, but the ACS is cool, Engineers Australia say it's cool.

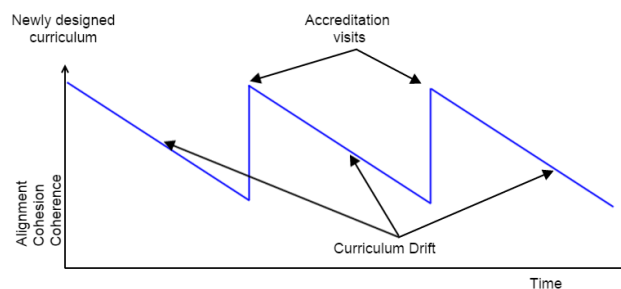Figure 1, drawn as the participant provided the description above, describes visually the notion of curriculum drift.

Figure 1 – Curriculum Drift

While it was acknowledged that 'curriculum drift' affected the overall quality of a degree program if it was not carefully monitored and controlled, it was seen as necessary because it was the "natural way of exploring change". Drift enables a curriculum to respond to changes in its environment wrought by changes in technology, required skills, content, society and those teaching the program.

Curriculum Drift

Although current, widely accepted and adopted approaches to developing and maintaining quality program curricula identify different aspects of a curriculum they do not take a holistic or systems view. Instead, they take a reductionist view and deal with each aspect as if it exists in isolation from the others. I believe this is one reason that although "outcomes-led rational curriculum planning offers one way of creating coherent curricula, … it is argued that, despite its appeal, it is a poor approach to adopt" (Knight, 2001).

I suggest each is an aspect of the complex adaptive system represented by curriculum. I argue therefore that these three aspects of a quality curriculum do not exist in isolation. Rather, between each there exist strong relationships, which mean when one aspect is changed it affects and brings about change in the other two aspects. Identifying the relationships between these three aspects of a quality curriculum enables the creation of a 3-dimensional view of the curriculum as shown in Figure 2. In 2006 O'Leary et al presented a similar 3D model. Their model used Biggs' concept of constructive alignment for one axis,

and instead of using coherence and cohesion they named their other two axes vertical and horizontal alignment respectively.
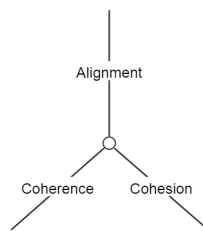

Figure 2 - The multiple dimensions of curriculum

Taking a holistic or systems view of a program curriculum, reminds one that to attempt to deal with one aspect in isolation will not necessarily deliver the intended outcomes. Furthermore, this understanding of the multi-faceted nature of a curriculum helps to explain its rapid movement out of balance or alignment.

Figure 3 provides a visual representation of what happens to a curriculum as it drifts. The faces of the cube can be considered to represent coherence, cohesion, and alignment. Each of the squares represents a single course. The cube itself represents the designed object: the official curriculum. The first image shows all the squares on a single face with the same colour and each row perfectly aligned. This image represents an aligned curriculum. After only a short period, perhaps within a single semester, it begins to change. Initially the change may be minimal, as indicated in the second image. At this stage, the original intent is still relatively clear and change is minor. The movement out of alignment of the first row is indicative of some of the cohesion weakening.
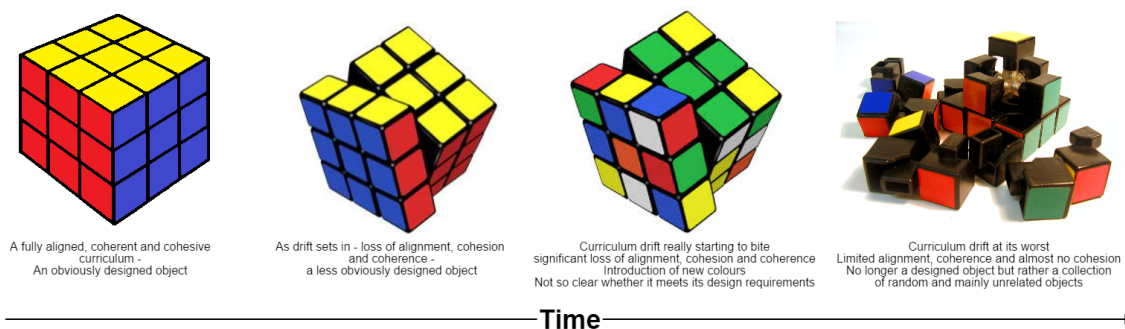

Figure 3 - A visual representation of uncontrolled curriculum drift

As time passes and curriculum drift continues unchecked, represented by the third image, the facets are no longer cohesive and there is a lack of coherence in the courses and in the overall program. Furthermore, the program curriculum is beginning to move away from its original shape, no longer obviously a "designed object" instead beginning to appear to be a number of random cubes that someone has placed together. By the final image, the shape – or purpose – of the original curriculum is completely lost. No longer can one tell easily that its origins were a cube. By the time it reaches this state, I argue that a curriculum is unlikely to deliver all, and may deliver none of its original aims and purpose. Over a period, perhaps as short as five years, I suggest this is what happens to our curricula with a consequent impact on the quality of the intended student outcomes it can deliver.

I believe that the curriculum for a degree program can be likened to a complex suite of software. Complex software is composed of many modules, not all of which are required all of the time. Depending on the purpose for using the software only a certain subset of the modules are required. So it is with curriculum for a degree program. While a program contains many courses, a student is not required to undertake every course available within a degree program. They choose those courses that meet their purpose.

Complex software is also subject to drift, known as "software aging" (Parnas, 1994). According to Parnas

changes … made by people who do not understand the original design concept almost always cause the structure of the program to degrade. Under those circumstances, changes will be inconsistent with the original concept; in fact, they will invalidate the original concept. Sometimes the damage is small, but often it is quite severe … as the software is maintained errors are introduced … If software has been maintained for some time without much concern … a marked deterioration will be observed … If we want to prevent, or at least slow down, software aging, we have to recognise it as a problem and plan for it. The earlier we plan for old age, the more we can do (Parnas, 1994).

I argue this is what happens with curriculum when academics develop and deliver courses without being guided by the official curriculum.

The difficulty academics have in understanding the complex connections between the overall outcomes of a program and how they mapped down onto the individual courses, because "it's hard for anybody to keep that in their head", was identified as a significant problem especially when trying to maintain program cohesion and coherence. This mapping was made more difficult when a course was shared across programs and even more so when those programs were in different faculties.

Participants suggested also that some form of visual representation of a curriculum and the relationships between the various elements, especially learning outcomes and content was needed. It was suggested that "software that defines all the links, like some electrical circuit software" would assist individual academics when designing, developing, delivering and maintaining their courses. Furthermore such software would provide real assistance to a program convener with responsibility for ensuring that a program meets an accrediting body's requirements. Thus when an academic goes "into the system and you want to change the learning outcomes" then a "link breaks … or something wobbles in the middle" alerting the academic to the impact of the proposed changes. Despite these suggestions for a tool, participants pointed out that however good the tool, "a tool is just tool" and what is important is the "process behind the tool". Moreover, it was suggested that "with the right tool you could save a lot of time. Instead of arguing about things that aren't all that relevant, it could direct you to argue about the right things, because some things we have to argue about. At the moment it's a fairly random process, it seems to me."

Conclusion

I contend that these issues are analogous with those that software developers have been contending and dealing with when managing and delaying software aging. To help manage and control curriculum drift I suggest that we adopt similar software engineering approaches that will help academics visualise and understand the complex, multi-dimensional relationships between the elements of a curriculum. As suggested by participants, software to facilitate this could be developed. Such software could extend upon the work already done, for example, at the University of Queensland (Cameron & Birkett, 2012) and at Curtin University (Oliver et al., 2010) to develop and enhance the holistic nature of the model.

Further research might also be undertaken to understand why academics describe the abstract process of curriculum development as a design process but then don't apply the principles of design to their own curriculum development tasks. Yet another approach may be to develop a tool that would measure drift and help program convenors moderate and control necessary drift to enable innovation to happen within the curriculum while still ensuring that the curriculum met the overall needs of the accrediting or government body.

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