Efficient learning design - concept, catalyst, and cases

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This paper presents the current approach to implementing educational technology with learning design at the Faculty of Science and Technology, Aarhus University, by introducing the concept of 'efficient learning design'. The underlying hypothesis is that implementing learning design is more than engaging educators in the design process and developing teaching and learning, it is a shift in educational practice that potentially requires a stakeholder analysis and ultimately a business model for the deployment. What is most important is to balance the institutional, educator, and student perspectives and to consider all these in conjunction in order to obtain a sustainable, efficient learning design. The approach to deploying learning design in terms of the concept of efficient learning design, the catalyst for educational development, i.e. the learning design model and how it is being used, and two cases of efficient learning design interventions are being presented.

Keywords: learning design, efficiency, science education, educational technology

From effectiveness to efficiency

Since the late 1980s educational technology has demonstrated its potential to enhance and transform higher education. Studies show how technology can be used to improve learning by providing higher flexibility in time, place, and pace, to motivate and engage students in a variety of ways, to support collaboration and reflection, improve assessment and feedback, and provide authentic and multi-modal learning (Blumenfeld et al., 1991; Conole, 2013; Conole & Dyke, 2004; Price & Kirkwood, 2011). However, such initiatives often require substantial budgets, expertise and assistance from educational developers and media producers, and exceptionally enthusiastic educators, and, unfortunately, this may at the same time be the reason why many initiatives turn out to be one-time wonders or make no significant difference (Earle, 2002; Romiszowski, 2004; Russell, 1999; Weller, 2002; Weller, 2011). A possible solution is to adopt a learning design approach and its inherent ideas of making technology interventions explicit and reusable and the design process sharable using resources such as learning design models, toolkits, pedagogical planners, and tools for visualising designs (Conole, 2013; Conole & Oliver, 2002). As a systematic, scalable, and more holistic alternative to ad hoc initiatives and technology interventions, learning design is currently gaining footing in a number of countries including the UK and Australia for 'devising new practices, plans of activity, resources and tools aimed at achieving educational aims' (Open University, 2014) and for providing support for reusability, reducing time spent on the development, and making effective use of educational technology (Britain, 2004; Conole & Fill, 2005; Cross et al., 2008; Oliver & Conole, 2000).

In principle, learning design has a broad focus and considers teaching development as a process involving various stakeholders such as educators, educational developers, students, and the institution and aims at developing pedagogically informed learning (Conole, 2013; Conole & Fill, 2005; Conole et al., 2004; Cross & Conole, 2009; Mor & Craft, 2012; Oliver & Conole, 2000). However, most reports and articles about learning design turn their attention to the educators, learning designers, and their development of materials, and to a minor degree the learning and the institutional context. Koper's review of 'current research in learning design' from 2006 (Koper, 2006) and the special issue of Journal of Interactive Media in Education (JIME) from 2005 on 'Advances in Learning Design' (Tattersall & Koper, 2005) illustrate how the research is highly concerned with educator and designer-oriented issues such as design patterns, authoring tools, and players for learning design without necessarily considering the big picture: e.g. how the design fits into the institution, whether it improves learning for the students and provide them with new possibilities, whether it is sustainable for the institution and helps actualise digital strategies, and whether it is operational to the educators. Recent learning design initiatives such as Jisc's Design Studio (2014a) and the Open University Learning Design Initiative (2014) have been incorporated into high-level institutional change processes and curriculum design projects together with business models, a design process, and have a declared focus on efficient curriculum development. Nevertheless, only four out of the 12 Design Studio projects have overall aims for efficiency and none of them report about *efficient* deployments in terms of cost-effectiveness for the institution, practicability for the educators, and impact on student learning at the same time (The Design Studio, 2014b; 2014c; 2014d; Jisc, 2014). In order to avoid the same pitfall it is important to move the focus from merely discussing *effective* learning design to an efficiency approach where at least three important stakeholders and their perspectives are taken into account.

Concept: efficient learning design

Implementing technology in higher education implies at least three important stakeholders: the institution which defines the context, budget, digital strategy, and support; the educators whose teaching will be transformed using technology; and the students whose learning will be affected by the technology. Furthermore, in some cases it is also relevant to make a distinction between the management and the educational developers of the institution as their agenda and interests may be inconsistent, e.g. when the management seeks to cut costs and the educational developers seek to improve quality at the same time. In order to make learning design *efficient* each of the three stakeholders' perspectives need to be clarified and substantiated and, ideally, the learning design should be in the intersection of all three perspectives. The stakeholders' perspectives, power, and interests vary between institutions and educational settings. Some interests and perspectives such as the institutional incentives for technology-enhanced learning are explicitly described in formal documents such as digital policies and e-learning strategies, while others are implicit and must be identified or defined according to students' and educators' needs and preferences. This article looks into the interests present at Aarhus University; however, many of these criteria and preferences may very well be pertinent also for other universities.

Aarhus University, like many other universities, has an official strategy for educational technology, here referred to as a 'Policy for educational IT' (Aarhus Universitet, 2011). The policy includes three main focus areas: the technological platform and services for technology-enhanced learning, development of educators' qualifications and teaching practice, and students' learning and competency development (ibid.). Furthermore, the policy lists as a benchmark that 60 % of the teachers should be offered development assistance for 'rethinking' (i.e. 'innovating') their teaching practice with educational technology by 2015. The policy is supported by funds to acquire and implement a university-wide learning management system (LMS) and no distinct funds to the educational units for educational development. As such the educational units are left with a minimal budget for a substantial task, which calls for a cost-effective approach. In addition to the institutional policy, the educational unit has a pedagogical focus on developing and providing 'active learning' in order to foster deep learning and higher-order thinking (cf. Centre for Science Education, 2013).

Some educators have reservations and are reluctant towards implementing technology in their teaching practice. The reluctance may be due to the absence of obvious benefits or justifications for using technology, or due to low enthusiasm or confidence with technology (Weller, 2002; Zhao & Cziko, 2001); however, it may also be due to the complexity and practicability in adopting the technology. A study from 2009 among European educators revealed that the practical aspects of the development and implementation of web-based media in their teaching practice such as easy access to existing materials, easy access to production and sharing facilities, and having the time to develop the materials were the most significant barriers for the uptake (Godsk, 2009).

The students as well as the institution are pressured by the study progress reform by the Danish Government (2013), which entails that the university must reduce the average degree-completion time in order to avoid cuts in funding. Students are, on the other hand, not solely interested in getting their degree, they are also interested in learning the curriculum and obtaining knowledge for their future role and work, getting good grades for the competitive job market, and to have a good learning experience (Brown & Duguid, 1996). Local surveys of how students perceived the utility of webcasts for online learning in two different modules revealed that 85-91 % of the students to a certain, large, or very large extent found them useful for learning the curriculum, 63-82 % for repetition during the module, 64-74 % for examination preparation, and 56-81% for providing perspective (cf. Godsk, 2014). In addition, the surveys also revealed that 63-70 % of the students preferred the technology-enhanced learning to traditional face-to-face lectures and that they appreciated the flexibility in time, place, and pace that the technology provided (ibid.).

Combining these three perspectives in a set diagram reveals a number of different intersections of interests and scenarios (cf. Figure 1). As Figure 1 suggests a narrow focus on improving teaching and learning may fail to address important institutional perspectives, just as a narrow focus on teacher training and teaching development may disregard the students' actual learning and a strategic initiative to improve students' learning may not be practical for the educators. An efficient design is located in the centre as a balance of all three perspectives.

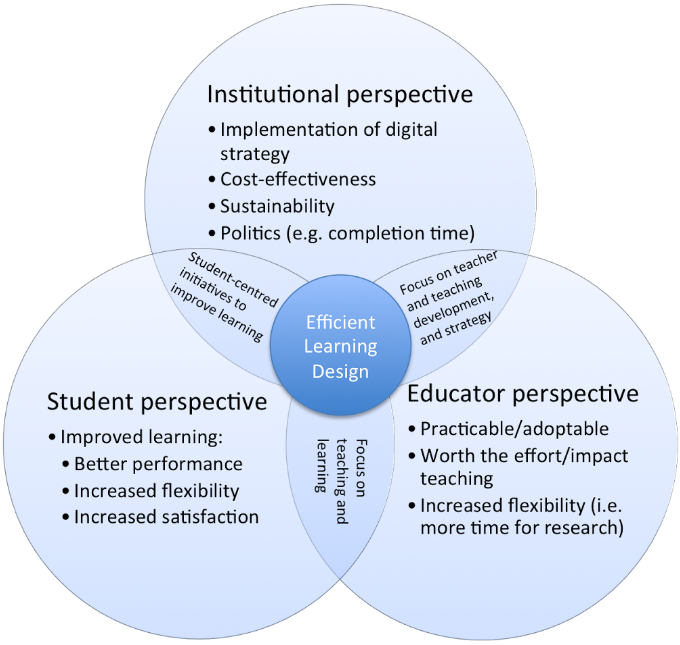

Figure 1: 'Efficient learning design' illustrated as the intersection of three perspectives: the institutional, the educator, and the student.

Seen from the institutional perspective an important parameter is the effectiveness of the learning design in terms of actualised level of enhancement or transformation of a module being developed. To classify the level Puentedura's 'Substitution Augmentation Modification Redefinition' (SAMR) model (2010) and its concepts of 'augmentation' to describe technology-enhanced learning where the technology 'acts as a direct tool substitute, with functional improvement' (ibid.; p. 3), 'modification' and 'redefinition' to describe transformed learning where the technology significantly changes practice, and 'substitution' to describe modules where technology brings no significant educational improvement were adopted and expanded (Figure 2). The original SAMR model focuses on how tools are being used on a task-level; however, as this initiative is concerned with the impact of technology on module-level the concepts have been expanded to cover the transformational level of an entire module according to the typical structure of science higher teaching with lectures, assignment work in smaller groups, laboratory and/or fieldwork, homework, and end-of-module examination (cf. Handelsman et al., 2004).

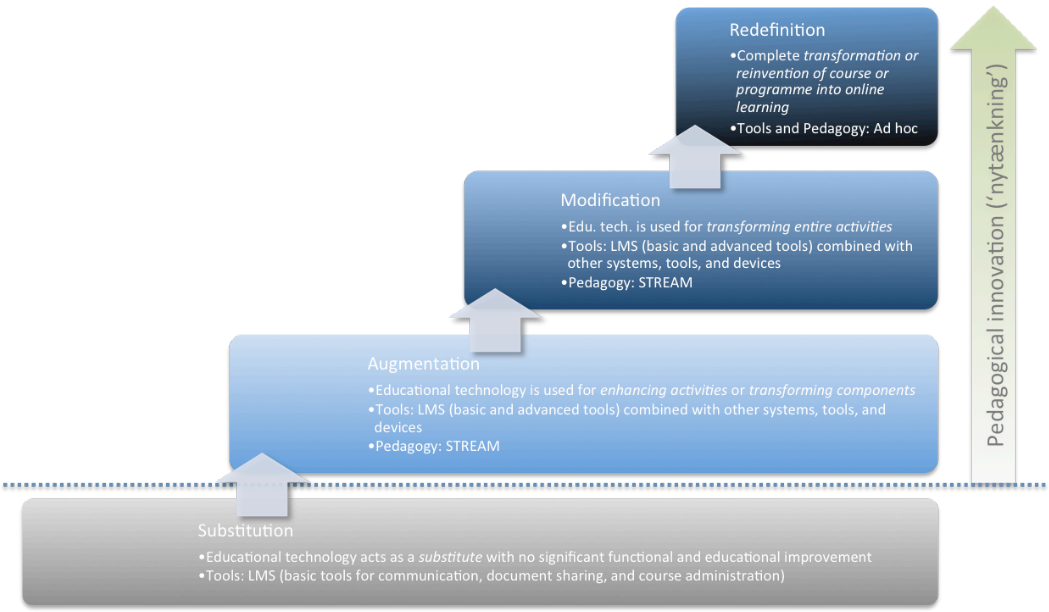

Figure 2: A revised version of the SAMR model for classifying the level of enhancement and transformation. Examples of supported tools and pedagogies are listed for each level.

In practice this means that a module is classified as 'augmented' when technology has been used to enhance an entire activity such as all lectures or exercises *or* to transform minor components into online learning, and as 'modified' when educational technology has been used to transform entire activities into online learning. As a consequence the cost-effectiveness of the intervention can be determined as the ratio of the costs for the intervention and the actualised level. In order to support the interventions in an efficiently way a learning design model ('The STREAM Model', cf. Godsk, 2013) has been developed to act as a catalyst.

Catalyst: The STREAM model

The catalyst for the educational development and implementation of 'efficient learning design' is a locally developed learning design model: 'STREAM' (Figure 3) (cf. Godsk, 2013). STREAM is an acronym for 'Science and Technology Rethinking education through Educational IT towards Augmentation and Modification' (Godsk, 2013; p. 723) and is designed as a flexible model that does not specify or prescribe the use of specific technologies and/or a precise pedagogical pattern but it does foreground the pedagogical strategies of active learning (Bonwell & Eison, 1991), Just-in-Time Teaching (JiTT) (Novak et al., 1999; Simkins & Maier, 2010), Flipped Classroom, and Peer Instruction (PI) (Mazur & Hilborn, 1997). The model provides suggestions of which tools to use, how out-of-class activities can be structured, and how these activities can provide feedback for in-class teaching activities and vice versa. The idea is that STREAM serves as an inspiration for educators on how to make good, active use of the technology as well as an implementation guideline for media producers and educational developers; however, educators are free to use and deviate from the model as they prefer.

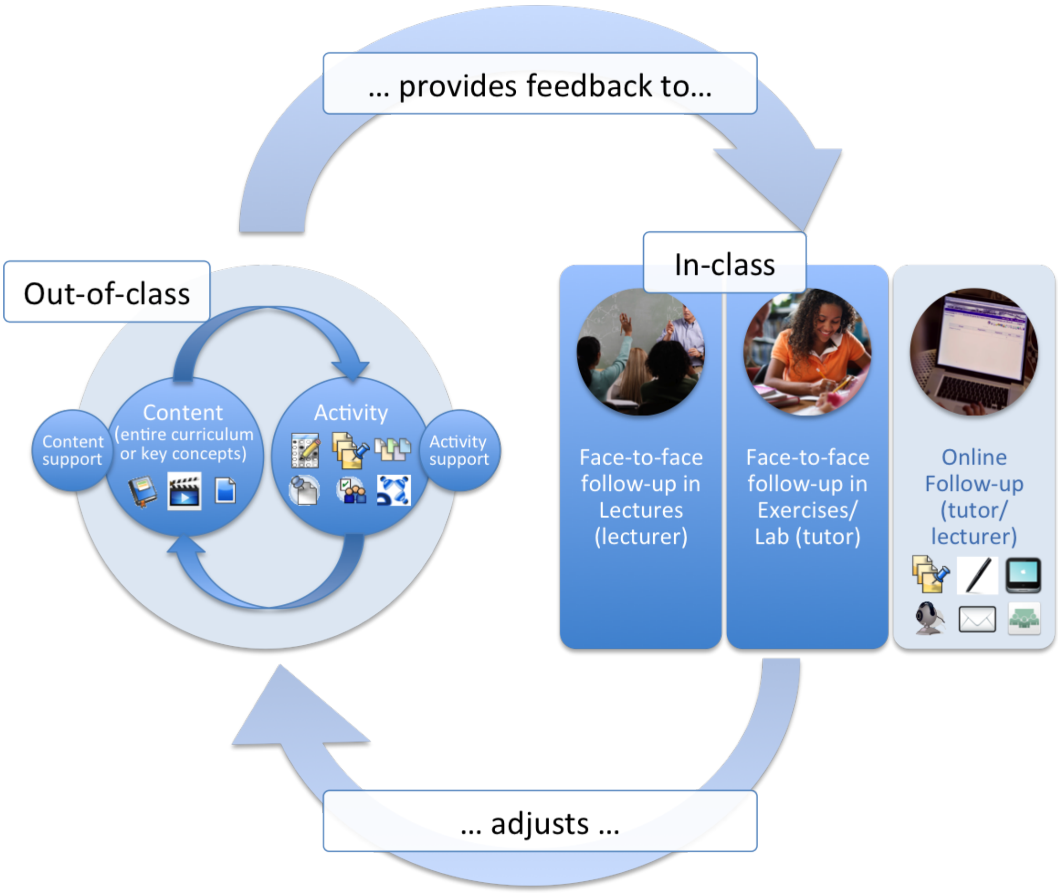

Figure 3: The STREAM Model.

The educators are typically being introduced to the model by an educational developer, the media lab, or through online materials and programmes as a systematic and supported alternative to ad hoc developments.

That is STREAM is not a ‘wizard’ or a step-by-step guide with exact specifications of learning activities but more of an open-ended model or framework for the ‘core feature’ of learning design, making educators make think about their use of technology and make pedagogically theory-informed decisions (cf. Agostinho, 2006; Conole, 2013; Conole & Oliver, 2002; Conole et al., 2004).

Cases

Due to external circumstances the 60 % ‘rethinking’ benchmark (cf. Aarhus Universitet, 2011) has been postponed for at least a year; however, a series of STREAM related initiatives have been launched and some with the intent of causing a ripple effect. The initiatives include: a website and a video about the model and its use (with approximately 30 views per month on average); a presentation of the model as part of a ‘road show’ to inspire educators to adopt educational technology; presentations at seminars and conferences; individual presentations to educators developing their modules with assistance from the educational unit and/or the media lab; and an introduction to the model as a compulsory part of the training programme for assistant professors aiming for tenure. In practice this means that entire year cohorts of new educators are familiar with STREAM and of the 2013 and 2014 cohorts respectively 83 % and 71 % responded in the programme evaluation that they found STREAM relevant to their own teaching. When it comes to the senior educators there is only limited data about the exact extent of the adoption, as they are highly self-governed in planning their teaching. Nevertheless, the educational unit and the media lab have been directly involved in 10 transformations over the past 12 months using STREAM; some of which some have been evaluated thoroughly through student surveys, interviews of educators, examination results, and web statistics form the video systems and LMS (cf. Godsk, 2014). In particular the transformations of a module on Astrophysics and another on Calculus were carefully evaluated as the educators had the intention to gradually increase the use of technology in their teaching practice or to engage in the transformation of an additional module (the case with Calculus), respectively, and thus needed solid evidence of the impact. Astrophysics was *augmented* using STREAM by supplementing face-to-face lectures with webcasts, reflection exercises, and multiple-choice quizzes for out-of-class preparation and feedback. The educator developed the webcasts, exercises, and quizzes with technical support from the media lab and pedagogical support from the educational unit. The module was subsequently evaluated through a web-based questionnaire sent so all students (n = 123) after their final examination and prior to the marking addressing their use and perception of the materials. 41 % of the students completed or partly completed the survey and, combined with web statistics about the use of the materials, a follow-up interview of the educator about his incentives, and the official policy for educational IT, it was possible to identify the institutional, educator, and student perspectives (cf. Table 1). Unlike Astrophysics Calculus 2 was *modified* guided by STREAM by completely replacing all face-to-face lectures with online learning in terms of learning paths with webcasts, multiple-choice quizzes, reflection exercises, and online feedback. The management of the department initiated this radical transformation with the ambition to, among others, completely discontinue face-to-face lectures in the long run. The educator was marked out to transform the module with support by the media lab and the educational unit using webcasts and online activities. Like Astrophysics the module was evaluated through a web-based questionnaire sent to all students (n = 1,184), of which 27 % fully or partly completed, through web statistics, and with follow-up interview of the educator. In this case an experimental research design was applied and thus the students were randomly divided into an online group and a face-to-face group. This made it possible to also compare examination results and student satisfaction in correlation with the use of technology and level of transformation (cf. Godsk, 2014). The results of both transformations and studies are summarised in Table 1 together with an assessment of the efficiency.

Table 1: The results of two modules transformed into blended and online learning with STREAM.

Module	**Astrophysics (2013)**	**Calculus 2 (2013)**
Level and credit	Undergraduate, 5 ECTS	Undergraduate, 5 ECTS
Institutional perspective	• Actualise the policy for educational IT • For the educational unit to provide effective and sustainable improvement of teaching and learning with qualified use of technology • Low costs	• Actualise the policy for educational IT • For the educational unit to provide effective and sustainable improvement of teaching and learning with qualified use of technology • For the department to modernise their teaching, completely discontinue face-to-face lectures, and rationalisation
Educator perspective	• Improve teaching by providing: o a larger degree of alignment between lectures, exercises, and examination o influence to the students of what is covered during lectures o a possibility for students to re-visit complicated material from lectures • A professional interest in working with educational technology and use the new LMS in practice	• Low technical effort/easy to transform teaching and implement technology • Support for media production and technical setup • Satisfied students and adequate/similar teaching quality • Increased flexibility in time and more consecutive time for research
Student perspective	• High student satisfaction (70 % preferred the enhanced format to traditional lectures) • Higher degree of flexibility in time, place, and pace (incl. support for repetition and examination preparation) (nearly all students made use of the possibility to use the materials at different locations, times, and paces) • More time for discussion during lectures. • Online, active learning for in-depth understanding (86 % of the students responded that they to a certain, large, or very large extent used the materials to understand the topics in-depth) • More effort for the students	• Higher grades and pass rates (an average of approx. one grade on the ECTS scale from C to B) • Higher student satisfaction (63 % preferred the transformed format to traditional lectures) • Higher degree of flexibility in time, place, and pace (incl. support for repetition and examination preparation). 84 % of the students were most frequently studying other places than on-campus, 61 % of the students were primarily studying in the evening, during the night, weekend, or vacations, and 84 % would stretch the completion of transformed lecture to at least a day or more. • Online, active learning
Efficiency of learning design	• Student learning improved in terms of higher student satisfaction, more flexibility, and more time for discussion during lectures at a very low cost, limited effort to the teacher, and some effort to the students. The positive experiences have encouraged the educator to develop the module even further with a larger degree of online activities and partly online assessment.	• Student learning improved significantly in terms of examination results, flexibility, and student satisfaction at a relative low cost. Furthermore, the positive experiences whetted the educator's appetite and have initiated the development of additional modules in concordance with the policy and the ambitions of the department.

Conclusion

Many educational development initiatives take the obvious and idealistic starting point in improving teaching practice and students' learning, and more and more institutions deploy a learning design approach in order to share practices and make effective use of educational technology. Unfortunately, many initiatives fail to take the context and other important perspectives into account and are in some cases being discontinued when funding has come to a halt and thus fail to provide a sustainable value to the institution. Looking at the context at Aarhus University, which most likely is comparable to many other university contexts, a basic stakeholder analysis reveals that important perspectives and interests influence the success of learning design. As a consequence learning design is currently being deployed at Aarhus University with respect to three main stakeholders: the institution, the educators, and the students using the STREAM model as catalyst. Two cases of transformed modules have briefly been presented as examples of how learning design may balance and satisfy the three perspectives at the same time and thus potentially qualify as efficient learning design. How much educational developers may prefer addressing the *effectiveness* of learning design and dislike to consider costs and policy, the key to a sustainable design may very well be to think in terms of stakeholders and 'efficient learning design'.

Future work includes further research on what actually characterises efficient learning design at Aarhus University and other universities, testing the underlying hypothesis, and a refinement of STREAM to meet these demands.

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