

On a Mission: The Case for Sustainability and Embedding Values in a Changing Higher Education Landscape

Christine Lindstrøm^a, Dino Spagnoli^b, Matthew Pye^c, Juliey Beckman^d, and Andrew Kepert^e

Corresponding author: Dr Andrew Kepert (Andrew.Kepert@newcastle.edu.au)

^aSchool of Physics, University of New South Wales, Sydney NSW 2052, Australia

^bSchool of Molecular Sciences, The University of Western Australia, Perth, WA, 6009, Australia

^cSchool of Life and Environmental Sciences, The University of Sydney, Sydney NSW 2006, Australia

^dResearch School of Biology, College of Science, Australian National University, Canberra, ACT 2602, Australia

^eSchool of Information and Physical Sciences, College of Engineering, Science and Environment, University of Newcastle, Ourimbah NSW 2258, Australia

Abstract

Change in higher education creates many risks to the sustainability of teaching practices. In this paper, we review some perspectives and resources on change in higher education and examine strategies for educators to participate in sustainable change. Central to this is the role of local mission statements, formulated to consciously reflect common values and purpose within a team of colleagues, and used to guide decision making, particularly in times of change. This discussion considers changes in teaching practice, such as those required for active learning, informed by principles concerning general organisational change, and specific qualities of contemporary higher education in the sciences.

Introduction

The teaching landscape of higher education is going through irreversible changes. In recent years, discipline-based education research, a proliferation in digital tools, institutional pressures and the COVID-19 pandemic have pushed us, as educators, to continually engage with the challenges and opportunities this presents. To not lose our way or stay bounded by outmoded structures as we expand our vision far into the 21st century, we need to get back to basics and be explicit about why we are here, what we are trying to achieve, and how we can sustainably go about achieving this.

The broad goal of this paper is to take two steps back to look at the big picture of the current situation, with an aim to leverage the disruptive experience of the pandemic to establish a new and improved normal. To constrain the paper, the focus is on *one* change that is relevant to all Science, Technology, Engineering and Mathematics (STEM) disciplines and for which the research evidence is so abundant that it is no longer up for debate, namely the case for active learning. How does higher education sustainably shift to a different model of teaching? The recent experience of change during the pandemic included both acceleration of long-term developments and introduction of temporary changes. With both, the obvious risk is that these changes may be unsustainable, leaving academics exhausted and the student experience suffering.

After an introduction to active learning, the paper examines three areas with broadly sourced literature to outline elements necessary for a successful sustainable transformation of higher education: clarity of what one is trying to achieve on a local level, a structured approach for

implementing sustainable change, and the relevance of operating within and according to our values as we navigate the transformation.

From traditional lectures to active learning

The original role of universities was as the provider of hallowed information. The first universities were established in medieval times (high Middle Ages: 1000–1347) and include well known institutions such as the Universities of Bologna (est. 1088), Oxford (est. 1096–1167) and Cambridge (est. 1209). This was well before the invention of the printing press (ca. 1440), so the lecture was one of the few opportunities to access information, as handwritten books were both rare and expensive. After the proliferation of textbooks, traditional lectures still served an important purpose as a conduit for summarising, emphasising and elaborating on course material from the vantage point of the expert (French & Kennedy, 2017). However, since the advent of the Information Age—roughly coinciding with the new millennium—the democratization of information through the internet has completely changed the educational environment. Access to information of almost any type is no longer a limited resource; the world has changed from one of information scarcity to one of information abundance. Consequently, the challenge in 21st century society is how to maturely navigate and apply information rather than accessing and possessing it, which fundamentally changes the role of higher education.

Much research has been conducted into how to shift from a paradigm of information delivery to one where supporting students in processing, integrating and applying this information is the objective. This has been one of the dominant focus areas of the broader field of Discipline Based Education Research (DBER)—the collective term for education research in tertiary STEM disciplines—since the 1980s. The focus of research within DBER has been to foster student learning in “the most crucial topics, techniques, procedures and ways of knowing that define the particular discipline” (National Research Council, 2012, p. 9). The weight of evidence accumulated by DBER practitioners shows that involving students actively in the learning process compared with the instructional method of lecturing enhances student learning.

Physics Education Research pioneered the rigorous examination of the effectiveness of active learning methods vs. traditional methods, i.e., the lecture, in the 1980s. To be able to measure some relevant aspect of student learning, a valid and reliable instrument first had to be developed. Work by Halloun, Hestenes, Well and Schwackhamer in the 1980s and early 1990s (Halloun & Hestenes, 1985a, 1985b; Hestenes, 1987) resulted in one of the most widely used instruments of student conceptual understanding of Newtonian Mechanics: the Force Concept Inventory (FCI) (Hestenes, Wells, & Swackhamer, 1992). When the FCI was applied at the beginning (pre-test) and end (post-test) of a course, the change in knowledge—i.e., the learning—could be measured. Throughout the 1990s, the FCI was applied to a wide range of introductory physics courses across the US, ranging from high schools to Ivy League universities. In a seminal paper, Hake (1998) compiled the results from over 6000 students, plotting the learning gains according to whether the courses were taught using active learning methods (called ‘interactive engagement’ in the paper) or traditional passive lectures. The findings had a seismic impact on the community of physics educators connected to the research literature: courses taught using active learning methods resulted, on average, in twice the learning gain compared to courses taught according to traditional methods ((48±14)% vs. (23±4)%) (pp.65-66). Other science disciplines followed suit, and the research evidence in favour of the learning efficacy of active learning methods grew. Freeman et al. (2014) published a large meta-analysis of 225 studies across undergraduate STEM education,

concluding that “active learning leads to increases in examination performance that would raise average grades by a half a letter, and that failure rates under traditional lecturing increase by 55% over the rates observed under active learning” (p. 1). Furthermore, “active learning confers disproportionate benefits for STEM students from disadvantaged backgrounds and for female students in male-dominated fields” (p.4), emphasizing additional benefits of shifting towards more active learning.

What constitutes active learning spans a wide range, but they all require students to be actively engaged in the learning process. Hake’s (1998) original definition of the distinction between Interactive Engagement methods (now generally referred to as active learning) and Traditional methods has not changed notably: “‘Interactive Engagement’ (IE) methods [are] those *designed at least in part to promote conceptual understanding through interactive engagement of students in heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors (...)* [while] ‘Traditional’ (T) courses *make little or no use of IE methods, relying primarily on passive-student lectures, recipe labs, and algorithmic-problem exams*” (Hake, 1998, p. 65, emphasis original). To make room for active learning, a flipped classroom strategy (Bergmann & Sams, 2012) where students receive their first exposure to the content prior to coming to class is a widely used approach to free up class time to actively working on the material. To further refine what to focus on in class, a Just-in-Time Teaching approach (Novak, Patterson, Gavrin, & Christian, 1999) where students complete a formative assessment prior to class, enables the teacher to identify what students most need help from the teacher to learn. When the teacher is no longer required to fill class time with first exposure to material and armed with an understanding of what students are struggling with, a plethora of active learning methods can fill class time, including answering multiple choice questions via student response systems in large lecture theatres using Peer Instruction (Mazur, 1997), and solving problems together in groups in workshop tutorials (Sharma, Millar, & Seth, 1999).

The case for local mission statements

With the literature providing evidence for the effectiveness of a variety of methods and models for active learning, a transition to broad implementation, like any change, requires leadership. According to one definition “Management is doing things right; leadership is doing the right things” (attributed to both Peter Drucker and Warren Bennis, cited by Covey, 2004, p. 101). Without a clear focus on what the right things are, valuable resources—including people’s time and effort—may be wasted. As higher education finds itself in one of the most tumultuous times in recent history, resources need to be used wisely, which requires scrutiny of and clarity on direction and outcomes. A mission statement is such a clear expression of direction, based on consensus of what “the right things” are, which are often expressed as statements of visions and values. An effective mission statement serves as a guide in decision making, including where to direct limited resources (e.g., financial, human effort, and time), how to evaluate progress, and how to balance and prioritise competing interests (James & Huisman, 2009; Kosmützky & Krücken, 2015).

While most universities have mission statements for the institution at large (Flavin, Zhou Chen, & Quintero, 2020), these may not clearly or easily translate to local decisions. More valuable are local mission statements for teams or departments, which are more specific to their particular operation (Meacham & Gaff, 2006). Such local mission statements can and should be independently developed by the people expected to live by them to ensure relevance and buy-in. This has been the starting point for successful organisational change in several science departments in the US, as pioneered by Joel Corbo and colleagues in their work on

Departmental Action Teams (DATs) at the University of Colorado Boulder (Corbo et al., 2016; Reinholz, Pilgrim, Corbo, & Finkelstein, 2019).

When writing a mission statement, it should reflect the highest ideals of the team as well as the realities of their context (see D'Souza et al., 2011; Simerly, 1998 for examples). When applied to higher education, this means that mission statements should be created by the participants who are at the coalface of teaching and be consistent with the culture and values of the organisation (Simerly, 1998). Moreover, the values included in the mission statement guide everything the organisation does, affects decision making, and provide a direct measure of the organisation's daily actions (Blanchard & O' Connor, 1997).

Designing for sustainable change

Despite the abundance of methods and literature available on active learning, transforming higher education into using evidence-based teaching methods is slow. Research by Henderson, Dancy, and Niewiadomska-Bugaj (2012) surveyed 722 physics faculty across the US and found that 88% had knowledge of at least one research-based instructional strategy, but that of those who tried to use at least one, 1/3rd discontinued use. A significant reason for this was the lack of support during implementation. A review of the literature on "Facilitating change in undergraduate STEM instructional practices" (Henderson, Beach, & Finkelstein, 2011) further concluded that "[e]ffective change strategies: are aligned with or seek to change the beliefs of the individuals involved; involve long-term interventions, lasting at least one semester; require understanding a college or university as a complex system and designing a strategy that is compatible with this system" (p. 952). More recently, a book titled "Transforming institutions: Accelerating systemic change in higher education" (White et al., 2020) present the collective push from the DBER community, primarily in the US, to shift to evidence-based teaching methods. While shifting to active learning will better support our mission of educating independent thinkers and ethical problem solvers for the 21st century, the change process requires appropriate resourcing until a new steady-state is reached, noting that a significant resource is how academics' time is spent. Ultimately, the resourcing that reaches the academics at the coalface sets the pace for how fast change can happen.

As universities have grown increasingly more complex, the decision-making authorities have become ever more distant and socially isolated from where the decisions are implemented (Jones & Harvey, 2017; Tapanila, Siivonen, & Filander, 2020). At the same time, most academics at the coalface of education feel that they don't have the power to change this structure. Decision-making authority and resource allocation are both issues of management—of "doing things right"—and they are not unique challenges for universities. The military has a top-down command structure (Marquet, 2013), which is similar to universities. Retired US General Stanley McChrystal, who led the Joint Operations Task Force during the Iraq War, recounts in his book *Team of Teams* how organisational features led to ineffectiveness in the fight against Al Qaeda (McChrystal et al., 2015). Central to his solution was a change that was as simple as it was effective: as much as possible, shift the decision-making authority to where the information is. This required clarity of mission communicated throughout the personnel chain, capacity building at all levels, and the development of trust in the competency and integrity of the teams on the ground executing the organisation's mission. Applied to universities, this corresponds to a reversal of the centralisation process widespread in past years, returning significant decision-making authority and control to those closest to the implementation of educational change (Goulionis, 2013).

Change always comes at a cost, and efforts expended by a team to become more aligned with their stated mission statement is no exception. Whoever oversees resource allocation may find a common prioritisation technique in management called the ‘MoSCoW method’ useful. The starting point is clarity of what resources are available and what the overall goal or mission is. What follows is a strategy of listing the ‘Must-haves’, ‘Should-haves’, ‘Could-haves’ and ‘Won’t-haves’ (Clegg & Barker, 1994). This approach recognises the inherent unpredictability in the resources required to achieve a set of goals—a problem well-known to all academics—and has built-in clarity around what can be sacrificed, ensuring that it is not the human resources involved. Leadership expert Alicia McKay brings further clarity to how to think of what can be sacrificed. She borrows the term ‘frangible’ from road engineering to introduce a related concept into the leadership and management lexicon. In road engineering, “for something to be frangible, means that it (not you) must break if you hit it with your car” (McKay, 2021, p. 26). Translated into management, this means that “we all need to make sure that the right things are frangible. When we decide what we’re willing to let break, we make sure that the most important thing—you—is OK” (p. 27).

This triad of clarity of mission, overview of resources and classification of frangibility is central for wise prioritisation and the design of an effective and respectful workload allocation system. Workload schemes are an explicit requirement from many University Enterprise Agreements to ensure fair workload allocation among academics. Yet, many Schools do not have such workload schemes, or if they do, they are not fair or transparent, as recent acknowledgement of systemic underpayment of casual staff across universities in Australia has revealed (Linskill, 2019). Given the inherent flexibility and autonomy in academic positions and the nature of knowledge work in general, developing a system that is fair and sustainable is as challenging as it is important.

Workload schemes face three main challenges. Firstly, tasks included in the scheme tend to have optimistic accounting: it may allocate two hours of preparation for a lecture, but the reality of teaching is that quality is costly—even a very efficient lecturer requires a certain minimum amount of time to do a good job, and that may be significantly more than two hours (Burgess, 1996; Vardi, 2009). Secondly, academics are not identical replaceable units: an experienced experimental researcher may love working in the teaching laboratories and find preparation fun and easy, whereas a theoretician may feel completely drained doing the same task, reminded every week of why they steered well clear of laboratory research. Thirdly, workload schemes often only cover maintenance work (i.e., tasks that are the same year to year to ensure the place runs), ignoring change work and professional development (Kenny & Fluck, 2017). By rendering change efforts invisible, those who make the greatest contributions to innovation and development become the most disadvantaged.

If universities genuinely aspire to provide students with effective and novel teaching and learning practices and offer a vibrant university campus life—strategies aimed at improving the student experience—this needs to be explicitly built into the workload allocation schemes. Universities have an army of passionate, knowledgeable and innovative academics who want to contribute to this change, but they cannot—and should not!—be expected to do this work on a volunteer basis without enabling support.

In parallel with appropriately resourcing change that is aligned with the mission statement, we need to get better at identifying what not to spend time on—the ‘won’t haves’ in the MoSCoW method—captured by the business maxim “If it’s not worth doing, it’s not worth doing well”. The human penchant for solving problems through addition was the topic of a recent Nature

paper (Adams, Converse, Hales, & Klotz, 2021) and a subsequent follow up article in Scientific American (Kwon, 2021), In this article Kwon quotes Benjamin Converse (co-author of the Nature paper) and states: “[A]dditive solutions have sort of a privileged status—they tend to come to mind quickly and easily,” whereas “[s]ubtractive solutions are not necessarily harder to consider, but they take more effort to find” (online article, no page number). Of relevance to our situation, reviewing “an archive of ideas for improvement submitted to an incoming university president (...) only 11 percent of 651 proposals involved eliminating an existing regulation, practice or program” (Kwon, 2021, online article, no page number). Consequently, it is unsurprising that subtractive solutions that respect the limited resources of those expected to implement them are few and far between.

As an example, senior and middle management offer their contributions to tackle the challenges academics face, but their solutions are almost invariably additive: workshops and training on new approaches to teaching and learning; training to use additional technology; and increased expectations for professional practice, such as inclusivity and wellbeing. As standalone initiatives, these all have value, but they fail to address the problem that most academics do not have the capacity to engage with these activities, and it is rarely communicated clearly that these activities are frangible.

Educators in many cases have the power to advocate for subtractive solutions by changes being resource-reducing or, at least, resource-neutral for improved outcomes. As an example, assessment can be labour-intensive, but in shifting to more student-centred active learning, a clear understanding of values and purpose in each element of our teaching can help distil our time requirement down to only what’s most valuable. In a course with substantial class activity focused on developing, discussing and presenting ideas, it is natural for marking to be completed in class, whereas weekly low-stakes formative quizzes completed prior to class can be simply marked on participation (not correctness), making marking very efficient while the class challenges can be addressed in a collective manner in class. These strategies allow for highly valued feedback to be personalised and immediate (Dunlosky et al., 2013) while reducing after-class assessment work. Innovation does not have to come at a cost.

Metrics vs. Values—don't mistake the slave for the master

The mission statement that guides our change efforts should, in addition to a vision of the future we try to build, contain within it that clear expression of what we *value*. Stephen R. Covey writes in the classic *The 7 Habits of Highly Effective People*: “People can’t live with change if there’s not a changeless core inside them. The key to the ability to change is a changeless sense of who you are, what you are about and what you value” (Covey, 2004, p. 115).

Used wisely, metrics play an essential role in monitoring states and progress in academia: grades reflect student achievement in courses, citations indicate some aspects of the impact of papers, and student evaluations produce ‘overall satisfaction’ scores for courses. However, without wisdom, Goodhart’s law takes reign: “When a measure becomes a target, it ceases to be a good measure”. Mission statements—which should not contain metrics—serve as our anchor to ensure that we measure the things we value instead of valuing the things we measure. This includes alerting us to goals and values that may currently not be measured at all, thereby rendering them invisible.

Translating qualitative factors into valid and reliable quantitative measures is part of the bread and butter of DBER. Validity concerns whether the metric measures what it purports to measure, whereas reliability refers to whether the measure would return the same result if

applied at a different time. Our goal here is not to cover these concepts in any depth; instead, we point out five specific issues related to metrics that affect us in higher education.

First, we hardly ever measure learning. Summative assessments, such as final exams, may validly measure the state of a student's knowledge at the end of the course relative to the learning goals in a course. However, without knowing what the student knew when they started the course, what has actually been learned remains undetermined. Valid and reliable measures of learning are very demanding to develop, but they are routinely used by discipline specific education researchers. In physics, for example, a library of such measures, known as concept inventories, including the FCI mentioned earlier, can be found on PhysPort (*PhysPort: Supporting physics teaching with research-based resources*, 2022). However, due to the cost involved in their development, we cannot afford for them to be single use, and they are therefore strongly protected from broad release among students and not used as summative assessments. Concept inventories are to be reserved for educational research or internal course evaluation to assess the effectiveness of a course or an educational intervention. While concept inventories are the gold standard, regular summative assessments imperfectly measure the absolute state of knowledge of some more or less representative subset of the course learning goals. This is not necessarily a problem, but we must not fool ourselves into believing that they have either high validity or reliability, or that we can measure the qualitative knowledge a student possesses to an arbitrarily small degree of uncertainty.

Second, research makes it clear that, in aggregate, there is no correlation between student evaluation and learning gains (Uttl, White, & Gonzelez, 2017). In fact, pedagogical innovations and effective evidence-based teaching methods can result in reduced student evaluation scores (Deneen & Prosser, 2021). In a study of two different teaching modes in physics, students were separated into one active instruction and one passive instruction group (Deslauriers et al., 2019). Students in the active group demonstrated statistically significantly higher learning gains, but in all measures of students' *perceived* effectiveness of the teaching methods, the passive group scored higher. This result is well known within the DBER literature: i.e., active learning methods result in greater learning. However, because it is often a challenging and tiring process, students do not realise that it is more effective than traditional passive instruction where the lecturer articulates the subject. If metrics derived from student experience surveys are not interpreted correctly, and are not evidence-based, actions may be taken that stifle innovation and damage learning spaces, as well as the educators involved.

Third, if the student evaluations are to be of value, from a statistical perspective, response rates must be considered. These are often too low for the self-selected sample results to be representative of the population—the entire class or cohort—especially for large classes (Fan et al., 2019; MacNeill, Driscoll, & Hunt, 2015). While there are many aspects of such surveys that require nuance, in education and social science research, response rates below 70% are generally interpreted with caution, and rates below 50% cannot be treated as representative of the population at all (Gordon et al., 2002). Hence, while these surveys may contain individual feedback that is useful for course improvement, it is essential that they are not mistaken for being statistically representative of the population.

Fourth, if student evaluations are deemed to be of benefit, this must be weighed against the compounded costs of sampling (Simpson, 2018) and unconscious biases, openly discriminatory comments against women (Buckley, 2021; Wagner, Rieger, & Voorvelt, 2016), people of colour, and LGBTIQ+ staff members, all of which are well-documented and target the most vulnerable staff (Fan et al., 2019; Gelber, Brennan, Duriesmith, & Fenton, 2022). The

discipline of study can be impacted by low evaluation scores (Leach, 2016). The removal of anonymity in the surveys may help to lessen these cases of discrimination (Lakeman et al., 2021), but it is not a panacea. Consequently, the intent and purpose of the survey should be clearly defined by management and allow scope to experiment with curriculum and other changes, some of which may fail. As long as academic promotions and performance reviews are tied to the metrics in these surveys, scope for experimentation will be compromised, career progression will be inhibited, and novel education methods will be impeded.

Fifth, several aspects of teaching and learning are currently barely measured, if at all. These include attributes such as inclusivity, communication skills, team-work, and staff time. These should be articulated in a mission statement, even though there are challenges inherent in measuring and benchmarking them. For example, if we claim to respect people's time, but have no measure of how much time our colleagues and students are spending, how do we know what we should aim to change? In this case, creating a new metric could bring significant benefits.

By explicitly scrutinising the values of our metrics, educators can make the conscious choice to replace values at the heart of their work. A clear mission statement is a reminder that universities are all about people: helping students and staff gain knowledge through learning from others and developing it themselves. This is valued due to collective belief that knowledge has enormous potential to improve lives, but if metrics are elevated over people, the risk is 'Human sacrifice at the altar of the metric gods.'

Conclusion

Discussions about change are often confronting, with potential to divide colleagues and highlight conflicting views. However, most science educators in higher education have shared goals and values, such as commitment to an excellent education for their students, to sustaining their discipline area, and to furthering public understanding of the sciences. Mission statements that express these shared values provide clarity and purpose to determine what is essential to the discipline area and guide decisions concerning change. Shared values also support diversity, as they can be translated into practice within a variety of contexts, including different disciplines, different institutions and different times. The range of ways in which values can be embedded in these contexts prepares us for and guides us towards sustainable change, whether driven by crisis or opportunity. To emerge stronger from changes in the higher education landscape, the explicit values and principles captured in a mission statement thus provide the fixed foundations from which we can reimagine and grow our teaching practice.

Acknowledgement

The authors acknowledge the contribution made by the many ACSME2021 delegates who participated in the initial panel discussion that motivated this article. Particular thanks are extended to Bonnie McBain, Liam Phelan and Adam Micolich, who provided valuable feedback on draft versions.

References

- Adams, G. S., Converse, B. A., Hales, A. H., & Klotz, L. E. (2021). People systematically overlook subtractive changes. *Nature*, 592(7853), 258-261. <https://doi.org/10.1038/s41586-021-03380-y>
- Bergmann, J., & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*. Washington DC: International Society for Technology in Education
- Blanchard, K., & O' Connor, M. (1997). *Managing by Values*. Sam F. Berrett-Koehler Publishers.
- Buckley, A. (2021). Crisis? What crisis? Interpreting student feedback on assessment. *Assessment & Evaluation in Higher Education*, 46(7), 1008-1019. <https://doi.org/10.1080/02602938.2020.1846015>

- Burgess, T. F. (1996). Planning the academic's workload: different approaches to allocating work to university academics. *Higher Education*, 32(1), 63-75. <https://doi.org/10.1007/bf00139218>
- Clegg, D., & Barker, R. (1994). *Case Method Fast-Track: A Rad Approach*. Addison-Wesley Longman Publishing Co., Inc.
- Corbo, J. C., Reinholz, D. L., Dancy, M. H., Deetz, S., & Finkelstein, N. (2016). Framework for transforming departmental culture to support educational innovation. *Physical Review Physics Education Research*, 12(1), 010113. <https://doi.org/10.1103/PhysRevPhysEducRes.12.010113>
- National Research Council. (2012). *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*. The National Academies Press. <https://doi.org/doi:10.17226/13362>
- Covey, S. R. (2004). *The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change* (25th anniversary ed.). Simon & Schuster.
- D'Souza, D. E., Clower, T. L., Nimon, K. F., Oldmixon, E. A., & van Tassell, F. S. (2011). Developing a Mission Statement for a Faculty Senate. *Planning for Higher Education*, 39(2), 15-24.
- Deneen, C. C., & Prosser, M. (2021). Freedom to innovate. *Educational Philosophy and Theory*, 53(11), 1127-1135. <https://doi.org/10.1080/00131857.2020.1783244>
- Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*, 201821936. <https://doi.org/10.1073/pnas.1821936116> PMID - 31484770
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving Students' Learning With Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology. *Psychological Science in the Public Interest*, 14(1), 4-58. <https://doi.org/10.1177/1529100612453266>
- Fan, Y., Shepherd, L. J., Slavich, E., Waters, D., Stone, M., Abel, R., & Johnston, E. L. (2019). Gender and cultural bias in student evaluations: Why representation matters. *PLOS ONE*, 14(2), e0209749. <https://doi.org/10.1371/journal.pone.0209749>
- Flavin, M., Zhou Chen, T., & Quintero, V. (2020). Size matters: an analysis of UK higher education institution mission statements. *Journal of Higher Education Policy and Management*, 42(3), 285-299. <https://doi.org/10.1080/1360080X.2019.1658839>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410-8415. <https://doi.org/10.1073/pnas.1319030111> PMID - 24821756
- French, S., & Kennedy, G. (2017). Reassessing the value of university lectures. *Teaching in Higher Education*, 22(6), 639-654. <https://doi.org/10.1080/13562517.2016.1273213>
- Gelber, K., Brennan, K., Duriesmith, D., & Fenton, E. (2022). Gendered mundanities: gender bias in student evaluations of teaching in political science. *Australian Journal of Political Science*, 1-22. <https://doi.org/10.1080/10361146.2022.2043241>
- Gordon, N., Davidoff, F., Tamow, E., Reidenberg, M., & Endriss, K. (2002). A question of response rate. *Science*, 25(1), 25.
- Goulionis, Y. (2013). A critical approach and a statistical study to leadership in university education. *Educational Research and Reviews*, 8(4), 121-128.
- Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-74. <https://doi.org/10.1119/1.18809>
- Halloun, I. A., & Hestenes, D. (1985a). Common sense concepts about motion. *American Journal of Physics*, 53(11), 1056-1065. <https://doi.org/10.1119/1.14031>
- Halloun, I. A., & Hestenes, D. (1985b). The initial knowledge state of college physics students. *American Journal of Physics*, 53(11), 1043-1055. <https://doi.org/10.1119/1.14030>
- Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching*, 48(8), 952-984. <https://doi.org/10.1002/tea.20439>
- Henderson, C., Dancy, M., & Niewiadomska-Bugaj, M. (2012). Use of research-based instructional strategies in introductory physics: Where do faculty leave the innovation-decision process? *Physical Review Special Topics-Physics Education Research*, 8(2), 020104.
- Hestenes, D. (1987). Toward a modeling theory of physics instruction. *American Journal of Physics*, 55(5), 440-454. <https://doi.org/10.1119/1.15129>
- Hestenes, D., Wells, M., & Swackhamer, G. (1992). Force concept inventory. *The Physics Teacher*, 30(3), 141-158. <https://doi.org/10.1119/1.2343497>

- James, H., & Huisman, J. (2009). Missions statements in Wales: the impact of markets and policy on congruence between institutions. *Journal of Higher Education Policy and Management*, 31(1), 23-35. <https://doi.org/10.1080/13600800802559229>
- Jones, S., & Harvey, M. (2017). A distributed leadership change process model for higher education. *Journal of Higher Education Policy and Management*, 39(2), 126-139. <https://doi.org/10.1080/1360080X.2017.1276661>
- Kenny, J., & Fluck, A. E. (2017). Towards a methodology to determine standard time allocations for academic work. *Journal of Higher Education Policy and Management*, 39(5), 1-21. <https://doi.org/10.1080/1360080x.2017.1354773>
- Kosmützky, A., & Krücken, G. (2015). Sameness and Difference. *International Studies of Management & Organization*, 45(2), 137-149. <https://doi.org/10.1080/00208825.2015.1006013>
- Kwon, D. (2021). *Our Brain Typically Overlooks This Brilliant Problem-Solving Strategy*. <https://www.scientificamerican.com/article/our-brain-typically-overlooks-this-brilliant-problem-solving-strategy/> (accessed 16 February 2022)
- Lakeman, R., Coutts, R., Hutchinson, M., Lee, M., Massey, D., Nasrawi, D., & Fielden, J. (2021). Appearance, insults, allegations, blame and threats: an analysis of anonymous non-constructive student evaluation of teaching in Australia. *Assessment & Evaluation in Higher Education*, 1-14. <https://doi.org/10.1080/02602938.2021.2012643>
- Leach, L. (2016). Exploring discipline differences in student engagement in one institution. *Higher Education Research & Development*, 35(4), 772-786.
- Linskill, S. (2019). Union uncovers pay discrepancies for casual staff. *Advocate: Journal of the National Tertiary Education Union*, 26(3), 7.
- MacNell, L., Driscoll, A., & Hunt, A. N. (2015). What's in a Name: Exposing Gender Bias in Student Ratings of Teaching. *Innovative Higher Education*, 40(4), 291-303. <https://doi.org/10.1007/s10755-014-9313-4>
- Marquet, L. D. (2013). *Turn the ship around!: A true story of turning followers into leaders*. Penguin.
- Mazur, E. (1997). *Peer instruction: a user's manual*. Prentice Hall.
- McChrystal, S., Collins, T., Silverman, D., & Fussell, C. (2015). *Team of Teams: New Rules of Engagement for a Complex World*. Portfolio.
- McKay, A. (2021). *You Don't Need an MBA: leadership lessons that cut through the crap* (1st ed.). Major Street Publishing.
- Meacham, J., & Gaff, J. G. (2006). Learning Goals in Mission Statements: Implications for Educational Leadership. *Liberal Education*, 92(1), 6-13.
- Novak, G. M., Patterson, E. T., Gavrin, A. D., & Christian, W. (1999). *Just-in-Time Teaching: Blending active learning with web technology*. Prentice Hall.
- PhysPort: *Supporting physics teaching with research-based resources*. (2022). Retrieved 11 March 2022 from <https://www.physport.org/index.cfm?>
- Reinholz, D. L., Pilgrim, M. E., Corbo, J. C., & Finkelstein, N. (2019). Transforming Undergraduate Education From the Middle Out With Departmental Action Teams. *Change: The Magazine of Higher Learning*, 51(5), 64-70. <https://doi.org/10.1080/00091383.2019.1652078>
- Sharma, M. D., Millar, R., & Seth, S. (1999). Workshop tutorials: accommodating student-centred learning in large first year university physics courses. *International Journal of Science Education*, 21(8), 839-853. <https://doi.org/10.1080/095006999290327>
- Simerly, R. G. (1998). An Easy-to-Implement Strategic Long-Range Planning Model. *The Journal of Continuing Higher Education*, 46(1), 47-69. <https://doi.org/10.1080/07377366.1998.10400337>
- Simpson, A. (2018). The structure of surveys and the peril of panels. *Studies in Higher Education*, 43(8), 1334-1347. <https://doi.org/10.1080/03075079.2016.1252321>
- Tapanila, K., Siivonen, P., & Filander, K. (2020). Academics' social positioning towards the restructured management system in Finnish universities. *Studies in Higher Education*, 45(1), 117-128. <https://doi.org/10.1080/03075079.2018.1539957>
- Uttl, B., White, C. A., & Gonzalez, D. W. (2017). Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related. *Studies in Educational Evaluation*, 54, 22-42. <https://doi.org/10.1016/j.stueduc.2016.08.007>
- Vardi, I. (2009). The impacts of different types of workload allocation models on academic satisfaction and working life. *Higher Education*, 57(4), 499-508.
- Wagner, N., Rieger, M., & Voorvelt, K. (2016). Gender, ethnicity and teaching evaluations: Evidence from mixed teaching teams. *Economics of Education Review*, 54, 79-94.
- White, K., Beach, A., Finkelstein, N., Henderson, C., Simkins, S., Slakey, L., Stains, M., Weaver, G., & Whitehead, L. (2020). *Transforming Institutions: Accelerating Systemic Change in Higher Education*. In: Pressbooks. <http://openbooks.library.umass.edu/ascenti2020>.