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If you build it, will they come? A review of the evidence of barriers for active learning in university education

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Abstract

INTRODUCTION. Active learning has been demonstrated to lead to better learning outcomes for students within education, but within higher education institutions, there are still a wide range of barriers that prevent active learning from taking place.

METHOD. In this article, I discuss some of the key barriers, including the design of the teaching space, the use of new technologies (such as lecture capture), and challenges created by the COVID-19 pandemic.

RESULTS & DISCUSSION. Much of the literature suggests that, whilst there are structural barriers that discourage the use of active learning (such as the built environment), it is not sufficient to merely remove these barriers, but it is also important to create a demand from educators (and students) for newer, active pedagogies.

Keywords

Active learning, Barriers, Built environment, Flipping, Online education.

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Título (castellano)

Si las construyes, ¿vendrán? Una revisión de la evidencia de las barreras para el aprendizaje activo en la educación universitaria

Resumen

INTRODUCCIÓN. Se ha demostrado que el aprendizaje activo conduce a mejores resultados de aprendizaje para los estudiantes en el ámbito de la educación, pero dentro de las instituciones de educación superior todavía hay una amplia gama de barreras que impiden que se lleve a cabo el aprendizaje activo.

MÉTODO. En este artículo discuto algunas de las barreras clave, incluido el diseño del espacio de enseñanza, el uso de nuevas tecnologías (como la grabación de conferencias) y los desafíos creados por la pandemia de COVID-19.

RESULTADOS Y DISCUSIÓN. Gran parte de la literatura sugiere que, si bien existen barreras estructurales que desalientan el uso del aprendizaje activo (como el entorno construido), no es suficiente simplemente eliminar estas barreras, sino que también es importante crear una demanda del profesorado (y estudiantes) para pedagogías más nuevas y activas.

Palabras clave

Aprendizaje activo, Barreras, Entorno construido, Aula invertida, Educación en línea.

Títol (català)

Si les construïu, vindran? Una revisió de l'evidència de barreres per a l'aprenentatge actiu en l'educació universitària

Resum

INTRODUCCIÓ. S'ha demostrat que l'aprenentatge actiu condueix els estudiants a millors resultats d'aprenentatge en l'àmbit educatiu, però dins de les institucions d'educació superior encara hi ha un gran ventall de barreres que impedeixen aquest aprenentatge actiu.

MÈTODE. En aquest article comentem algunes de les barreres clau, com ara el disseny de l'espai docent, l'ús de noves tecnologies (com la gravació de conferències) i els reptes creats arran de la pandèmia de la covid-19.

RESULTATS I DISCUSSIÓ. Gran part de la literatura suggereix que, tot i que hi ha barreres estructurals que desincentiven l'ús de l'aprenentatge actiu (com ara l'entorn construït), no n'hi ha prou amb eliminar aquestes barreres, sinó que també és important que hi hagi una demanda per part del professorat (i de l'alumnat) de pedagogies noves i actives.

Paraules clau

Aprenentatge actiu, Barreres, Entorn construït, Aula invertida, Educació en línia.

1. Introduction

Institutes of higher education have existed for over a thousand years, yet despite changes to technology, and changes to understanding of how students learn, much of the overall structure of education has changed little over that time period, with practices becoming entrenched, and reinforced by structures that are built around the dominant paradigm. Mazur (1997) argues that many educators will default to the methods through which they were taught, which could lead to teaching practice which is not beneficial to all students propagating through generations of students.

In the context of the early Universities, Bologna University was founded in 1088, over 350 years before the development of the printing press (invented by Johannes Gutenberg in 1440). This meant that knowledge, in the form of books was scarce, and one of the few ways of transmitting knowledge to a wider range of students was through a delivery-based lecture. This form of students listening and transcribing what an informed lecturer says can lead to passive learning. To gain a deeper understanding, students would need to engage with the material, discuss, and challenge these ideas (Bonwell & Eison, 1991). Overall, the structures and the spaces used for education in the 2020s looks very similar to the structures seen at the advent of University education, with the major changes merely one of scale.

This reflects the dominant paradigm of higher education teaching was related to instruction of students (Barr & Tagg, 1995), which leads to the viewpoint of students as vessels into which knowledge can be transmitted, but this paradigm was being challenged by a range of educators (Barr & Tagg, 1995; Mazur, 1997).

However, even with greater access to technology throughout the last millennium, the dominant form of teaching has remained largely unchanged, with lectures, and “chalk and talk” methodologies still dominating, even in 2020 (Asarta et al., 2021).

1.1. Active learning

One of the simplest forms of active learning that students can engage with in a classroom is in active note-taking. Crawford (1925) demonstrates that, whilst note-takers may have lower short-term recall for material seen in lectures than those who passively listen, students who take notes during the lecture perform better with long-term recall, in part because the notes act as a storage device. However, note taking also presents an opportunity to encode ideas, with modest benefits demonstrated from note taking, even when no opportunities are presented to review the notes before testing (Kobayashi, 2005).

The growth of technology produces both opportunities and threats to active learning. Traditional lectures, supported by PowerPoint slides—made available to students prior to lectures—may have the impact of encouraging students to focus on listening to the material, rather than note-taking. A number of studies (Kim, 2018; León & García-Martínez, 2021) have demonstrated that PowerPoint slides, made available prior to the lecture are associated with students making fewer notes, and worse performance in assessments.

Of course, active learning goes much further than simply encouraging students to take notes within lectures. Modern forms of active learning include gamification, e.g. Holt (1996), student-to-student discussions, and think pair share methodologies e.g. Maier et al. (2010), problem-based learning e.g. Gijselaers (1995), and more.

Whilst there are clear benefits to active learning strategies, sometimes these strategies are undermined by physical, digital, or motivational barriers that make it more difficult to adopt active learning strategies. In this

article, I provide an overview of some of the key barriers to active learning, focussing on the built environment, teaching design, and challenges in recent years in the light of online teaching following COVID-19. However, even removing these barriers may not be sufficient to ensure that pedagogy transitions to an active footing, as even with digital and physical facilities, unless an educator is willing to engage in active learning, passive practices can still win out.

2. The built environment – A Field of Dreams?

One of the most fundamental barriers to active learning pedagogies in education is the structure of the built space. Woolner et al. (2012) argue that within schools, the design of teaching spaces either act to maintain inertia in teaching styles, or alternatively actively prevent new pedagogies from being developed. Whilst "Space does not change practice; people do" (Bøjer, 2019, p.2), the built environment can act as a barrier to adopting new teaching practices. This is emphasised by (Van Merriënboer et al., 2017), in that, in order to be effective, the pedagogy needs to be matched to the teaching space, and vice versa. Where a teaching space is designed with students facing forward, with a lecturer at the focal point, the space itself can guide the pedagogy towards delivery of material from the front, rather than engaging students with active learning.

There are a number of key drivers for how teaching space will be designed, of which I will discuss three; firstly, teaching space may be designed in such a way that enables cost-effective teaching of students, secondly, teaching space may be designed in such a way to reflect the stated preferences of students, and finally, teaching space may be designed in such a way to reflect the teaching practices of academics, and the stated preferences of both students and teachers may be influenced by the pedagogy that both students and educators have experienced (Jessop et al., 2012; Mazur, 1997).

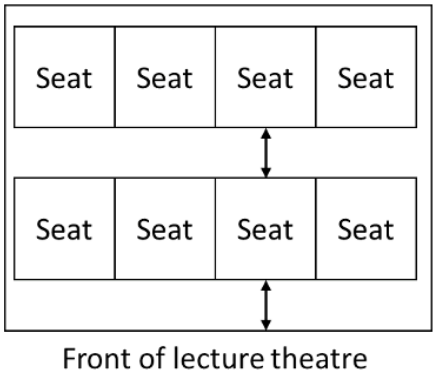
The dominant delivery method in economics education is, as for many centuries, lectures, in the form of chalk and talk delivery (Asarta et al., 2021), and the design of lecture theatres reflects this form of delivery. Lecture theatres look alike across many institutions worldwide, with rows of fixed seating, arranged in tiers (Ogilvie, 2008). One of the reasons for this dominance of both practice, and design of space is related to cost-effectiveness. Goffe & Kauper (2014), based on a survey of 275 Economic Principles teachers in the US, found that, whilst believing that lectures were not the best form of delivery or student learning, 28% saw lectures as a cost-effective way of delivering teaching.

Within lectures, elements of active learning can be developed, ranging from interactive games, (Holt, 1996) discussion between students, (Roach, 2014) and more. Enabling discussion can, however, be difficult in classes where students are arranged in rows with fixed seating; discussion may be possible with a direct neighbour, but can be difficult with more than one peer. Since 2010, there has been a big increase in the use of student-to-student discussion in economics principles education (Asarta et al., 2021), but only to a median of about 50%.

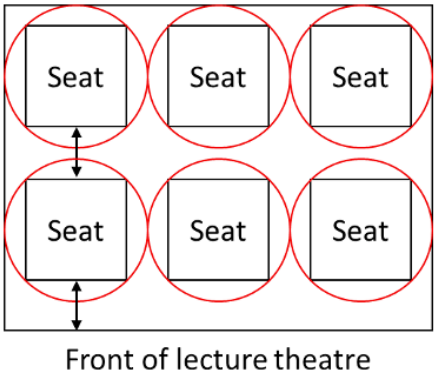
An alternative to the use of fixed seating is through the use of "swivel" seating, e.g. Ogilvie (2008), to allow for active engagement with peers during the class. However, the use of swivel seating requires more space per student (e.g. Figure 1) to allow for the seats to rotate. It is trivial to show that, *ceteris paribus*, a (square) seat that rotates from its centre will normally need at least $\sqrt{2}$ times as much space between seats than an equivalent seat. This can be marginally reduced by using rounded corners to a chair, but by adding a swivel, the space required increases, and as such, even relatively small changes to teaching space to enable active learning can lead to the space being *more expensive* when it comes to the built environment than traditional delivery methods, but in an institution where a range of pedagogies are employed, a flexible teaching space can allow for wider usage, and require fewer specialist spaces (Henshaw et al., 2011).

Figure 1

Illustration of space use with fixed and swivel seating



Use of space with fixed seating.



Use of space with "swivel" seating. The circle represents the space required to allow for the seats to rotate.

Note: In both layouts, the rows are set out with the same distance between seats, with seats the same shape and dimensions. In this example, a space that could occupy 8 seats in a "fixed-seat" structure, but only 6 seats with swivel-seating. Arrows represent equivalent leg-room for students when seating faced forward.

Ogilvie (2008) uses experimental methods to assess the introduction of *swivel-seating* in physics lectures (against the control of fixed seating), and finds that students who attended lectures in the swivel seating classroom performed significantly better in the final examination than those in traditional lectures, albeit with a relatively modest effect size. Similarly Henshaw et al. (2011) go further, and introduce swivel-desks in a flexible classroom space, which led to increases in student engagement with each other, and rapid transitions between teaching modes, reducing disruption to teaching.

Even in smaller spaces, teaching can default to "chalk-and-talk", with material being *delivered* to students, rather than students actively engaging with the material, and their peers to develop higher learning. Park and Choi (2014) argue that traditional classrooms, arranged in rows, produce differential outcomes, depending on where students are located in the classroom, with desks close to the front being part of a "golden zone", where it is easy to ask questions, and a "shadow zone", close to the back, where it is easy to hide. Park and Choi (2014), and a range of other authors (Bennett, 2021; Chiu & Cheng, 2017) have discussed the introduction of an "active learning classroom". A growing number of institutions, including NCSU, MIT, McGill, University of Minnesota and others are adopting "active learning" spaces (Park & Choi, 2014), where, by design, students are grouped together, often around tables facing each other through the teaching. These classrooms make it easier to engage with active and group-based learning, as students are automatically grouped together, and face each other during the sessions. In addition, in these active learning spaces, sight-lines developed to ensure that students can engage with both their group-members and the class leader.

Park and Choi (2014) demonstrate that by introducing an "active learning classroom", they find an improvement in students' perceptions relating to interaction, and with sharing ideas between students, and with the instructor. Similarly, Chiu and Cheng (2017) find evidence that active learning classrooms improve higher learning activities, such as innovation and creativity, for students across the ability range. Bennett (2021) highlights the impact that teaching within an active, or traditional, space, forces educators to change their approach within teaching. However, as with "swivel chairs" in lecture theatres, the grouping of students around desks leads to the potential

for a less efficient use of space within the room, leading to fewer students being seated in the same space. As such, there is a trade-off between better learning experiences, and the opportunity to develop higher levels of learning, and the cost of providing the space to enable that learning.

Finkelstein et al. (2016) provide an excellent guide to designing learning spaces with a number of key principles, including equipping students with access to appropriate technology to enable the possibility of active learning, allow for engagement with peers, and engagement with faculty.

Of course, even in a space designed for *active-learning*, it is possible that teachers could deliver a traditional, chalk-and-talk lecture. A unilateral change to the built environment may not lead to significant changes in pedagogy. Woolner et al. (2007) further argue that it is insufficient to merely build teaching spaces with a particular pedagogy in mind, and, citing Rivlin and Rothenberg (1976) find evidence that, in schools, within open-plan classrooms, designed with active-learning in mind, some teachers remained in their comfort zone, and simply delivered teaching from the front through a traditional lesson. This is further emphasised by Bøjer (2019), through a comprehensive review of the extant literature, who finds little evidence of a direct causal mechanism between the type of space and student learning outcomes, but instead it is the adoption of that space by educators that makes the difference to practice. That is, it is not the space that makes the difference, but the use of space that makes the difference to students' outcomes. However, the space itself can help facilitate different types of education, and can certainly act as barrier to different forms of education.

So far, we have talked about the structure of teaching space as being an influence on the type of teaching that takes place, but inevitably, the adopted method of teaching will have an influence on the type of teaching space that is developed. Goffe and Kauper (2014) illustrate that one-third of Principles of Economics teachers believe that students learn best from lectures, whilst a minority (albeit 39%) believe that alternatives are better, and more cost-effective, than lectures for developing learning amongst students, with non-tenure-track academics much more likely to value other forms of education than lectures.

The stated preferences towards lectures might not be a surprise, as methods which an instructor has found successful for their own learning are likely to be employed with the belief that they will be successful for others' learning (Mazur, 1997). Because most academics in economics have been trained in an environment where chalk-and-talk in lectures is a successful route to learning, this creates a feedback loop, whereby chalk-and-talk begets more chalk and talk. Similarly, it is also possible that the stated preferences of educators reflects the availability of appropriate spaces; if all lecture theatres are designed with a chalk-and-talk teaching structure in mind, then this will normalise the chalk and talk delivery method for educators.

However, this creates a potential negative externality. If a large proportion of educators are using chalk-and talk based delivery lectures, and since active learning spaces are *relatively* more expensive to provide (due to less intensive use of space), there may be no incentive for central planners to provide learning spaces designed to facilitate more active learning activities. Whilst active learning spaces do not act to ensure that active learning takes place, traditional spaces can act as a significant barrier to prevent active learning taking place.

A further barrier to the development of innovative spaces, designed around innovative pedagogies may be the preferences of students. Students' experience of teaching spaces influence what they value from teaching spaces, with students' stated preferences being towards elements of functionality, with the lecturer as a "deliverer of knowledge" (Jessop et al., 2012). However, these stated preferences may not be fixed preferences; Casanova et al. (2018) examine a redesign of teaching spaces, where student and teacher representatives were given the opportunity to influence the development of teaching spaces. However, student preferences seem to still be focussed around interaction between lecturer and student, with preferences focussed on functionality, including

audibility and visibility of slides. Whilst students do favour flexibility of learning spaces for *informal learning*, and the ability to engage remotely (Valtonen et al., 2021), the literature does suggest a level of conservatism amongst students towards spaces designed around active learning spaces, which in part may be influenced by the preferences of academics, particularly in Economics, towards traditional "efficient" methods such as chalk and talk lectures (Goffe & Kauper, 2014).

As we have seen, converting traditional lecture theatres and teaching spaces into active learning spaces can lead to a less "efficient" use of space, and as per Bøjer (2019), it is not sufficient to simply build active learning space, it is also necessary to encourage faculty to make use of the space in an active manner. Rather than "If you build it, they will come", with active learning spaces, if you don't build it, you place barriers in the way of active learning, but even if you build it, they will only come if the educators are willing! As such, educators and students also need to appreciate the benefits of active learning pedagogies, to create virtuous cycles, with active learning teaching leading to the development of more active learning spaces.

3. Online Space

For the past 25 years, institutions have made an increasing use of the online space, as either complements, or substitutes for live, in-person, teaching. Initially, virtual learning environments were largely used as repositories of materials to support teaching (such as lecture slides, problem sets), but the use of the online space has increased over time, to include the availability of lecture recordings, bespoke video content to prime students (ahead of a flipped classroom), and even learning activities, designed to support student knowledge, understanding, and develop higher levels of learning. In the previous section, the barriers that were created were in the form of barriers for educators to use active learning, the digital space creates opportunities for students to potentially disengage from the active learning elements.

3.1. Lecture capture and beyond

In the past 10 years, there has been growth in the use of *lecture-capture* software, initially to make available recordings of what happens within the lecture, and increasingly to also live-stream lectures. The introduction of lecture capture, and a move towards more *online-delivery* of material has created potential new barriers for active learning.

Whilst students have a preference for on-campus spaces for group work, where students have individual learning activities, their preference is to engage with these at home (Beckers et al., 2016). Reflecting on student preferences, this creates a cost to *in-person* lectures on campus; if a student's day consists of some individual study, and some time spent in lectures, the cost of attending a lecture is either the loss of time that could be spent on individual study, or alternatively the need to engage in individual study in a learning environment that is not their ideal space.

Prior to lecture capture being introduced, there was a very high cost of not attending lectures, as this was often the only way to engage with the lecture material; however, by introducing lecture capture, this cost is significantly reduced. The cost of not attending would be to miss out on active learning elements—such as discussion, games, and direct support—that students in the "live" session would experience.

Lecture capture technology provides students with the opportunity to review and revise concepts they have seen in lectures (and want to revise in more detail). The opportunity to revisit lectures is particularly valued by students from non-English-speaking backgrounds, and students with learning difficulties, such as dyslexia (Leadbeater et

al., 2013). Students are also strategic in when they view videos, with a spike in viewings just prior to assessment (Elliott & Neal, 2016), and students stated preferences are that they are strategic, using videos as an aide to revisit particular concepts, rather than as a complete substitute to lecture attendance (Birdi & Proud, 2015).

Early evidence suggested that lecture capture had little impact on student attendance at lectures (Pursel & Fang, 2012), but there is a growing literature that suggests that the net effect has been to significantly reduce overall attendance (Edwards & Clinton, 2019; Leadbeater et al., 2013). Students who choose not to attend lectures, and rely on lecture capture instead perform worse in assessment, which can be attributed to non-attendance, with the recordings only acting as an imperfect substitute for attendance at the live lecture (Edwards & Clinton, 2019).

Where we place active learning elements within live, large group teaching (such as lectures), lecture capture software creates the potential risk that students engage with the material, without necessarily engaging in the active learning elements. Because students are making a trade-off between attending the lecture, or not attending (and catching up with the video), then one strategy to incentivise students to attend the *live session* is to increase the value of the in-person elements—which cannot be captured by lecture capture—potentially by increasing the active elements of the live session. However, the impact of changing the value of the in-person elements will depend on the individual students discount rates, and the relative timing of other elements, such as assessments in other units.

Alongside the use of lecture capture to provide a record of what happened within a live lecture, a growing literature is developing, examining the use of purely online teaching in place of in-person lectures. On average, students perform worse in *online-only* courses (Alpert et al., 2016; Figlio et al., 2013), with effects particularly large for male and Hispanic students (Figlio et al., 2013).

There are a number of reasons why engaging with lectures via videos, rather than in-person may lead to lower performance, but one of these is likely to be that when watching lectures on a screen, rather than in person, may lead to more passive engagement (Witton, 2017), and the availability of easy distractions, such as social media may lead to less active engagement with the content (Hollis & Was, 2016). These results are backed up by Risko et al. (2012), who find evidence of students experiencing periods of mind-wandering during a 1 hour (online) lecture, with recall of content higher in the first half (71%) compared with the first half of a lecture (57%). However, by designing in active learning elements, in the form of short memory quizzes, embedded within the online videos, Szpunar et al. (2013) illustrated that students performed better in assessments than those without the active-learning elements.

Similar results can be seen when we look at student engagement with other online resources, such as message boards. Proud (2018) demonstrates that students who passively sign up for online course discussion boards, and merely read questions and answers on the site, perform significantly worse than other students, whereas students who actively engaged with the material by asking, or answering questions perform significantly better.

Effectively, all of the online material we have discussed thus far, are examples of *asynchronous* engagement with material. Student engagement with lecture recordings, online videos, and message boards can be carried out in their own time, and does not require engagement with other students. However, the key theme that comes out is that students tend to perform worse with passive engagement with these resources, and as such, it is important to develop frameworks to ensure that students engage, actively with the material. Witton (2017) recommends that the technology behind lecture capture should be used to create material that develops student learning, and not simply to provide a record of what took place in a live lecture.

3.2. Barriers that emerge within Flipped learning

In a traditional, lecture-based, course, students might be introduced to concepts and basic ideas, which they are then expected to work on to develop. In the traditional structure, effectively lectures allow students to develop lower levels of learning, such as "understanding", and "remembering" of concepts (Anderson & Krathwohl, 2001), but higher levels of learning, such as "creativity", "analysis" and "synthesis" may only be developed through problem solving.

However, as noted by Mazur (2009), this may lead to rote-learning, focussing on the material seen in the lecture, rather than genuinely developing learning. As such, an alternative to the traditional form of lecture is to *flip* the classroom, whereby students develop the foundational material through reading, or watching videos, or engaging in a foundational activity, and then in class students engage in active elements, designed to help develop higher levels of learning, with the support of an academic (Mazur, 2009). There's a large and growing literature showing that flipped classrooms may be preferred by students (Becker & Proud, 2018), although the higher workload associated with a fully flipped classroom can lower student satisfaction (Lombardini et al., 2018), and may lead to significantly better outcomes, on average, for students (Calimeris & Sauer, 2015; Lombardini et al., 2018; Olitsky & Cosgrove, 2016).

As with asynchronous lecture videos, one risk with flipping a classroom is that students do not, actively, engage with the preparation material; because the material in class builds upon the preparation material, the flipped classroom is only effective if students have properly, and fully engaged with the preparation material, and this also corresponds with student satisfaction with the flipped classroom (Becker & Proud, 2018).

For this reason, it is unlikely that the benefits of a flipped classroom are homogenous. Balaban et al. (2016) demonstrate that high attaining students (top 25% of distribution) gain more than lower attaining students (bottom 25% of the distribution), whilst Hispanic students gained less than white students, but that no groups were disadvantaged by the flipped classroom format. Similarly, Chen et al. (2019) find evidence of heterogeneity in effects of a flipped classroom based on cognitive styles.

As with the built environment, introducing a flipped classroom is not a guarantee of success, and does require enthusiasm and engagement from academic staff. For example Buhl-Wiggers et al. (2021) find evidence of positive—but insignificant—effects of a flipped classroom, but with significant heterogeneity between teachers. Further, it may be the case that there is nothing *special* about flipping the classroom, and the gains that are observed may simply be the benefits that would be observed from engaging an active learning pedagogy (Jensen et al., 2015).

3.3. COVID-19 and live streaming

Following the onset of the COVID-19 pandemic, teaching moved purely online across a wide range of institutions, and even in 2022, many institutions have some elements of teaching online. The move out of the classroom, and into cyberspace, which again creates potential hurdles for active learning.

As above, the use of asynchronous material creates a potential barrier, which can be overcome with appropriately designed activities for student engagement. Similarly, in *live lectures*, there can be challenges to adopting active learning strategies.

Student performance in online classes is less good than in-person classes (Bettinger et al., 2017), but this may be due to a reduction in feeling connected to peers and instructors (Kofoed et al., 2021). Similarly, when moved into

online teaching, students may be reluctant to turn cameras on within classes, and this is associated with—at best—passive engagement with the learning material, and low overall satisfaction with engagement with peers (Peimani & Kamalipour, 2021).

The move to online streaming carries further risks, as it further reduces the cost of *not-attending* a lecture in person. When making the decision to engage with a live-streamed lecture, rather than the in-person equivalent, students may not take into account the full cost of that decision. Low performing students perform worse if they attend live-streaming sessions as opposed to live, in-person lectures, although high-performing students perform better when compared with the in-person lectures. However, student preferences may still be towards in-person events (Cacault et al., 2021).

4. Conclusions

The dominant method of teaching in Economics is still the lecture, supported by chalk-and-talk methodologies (Asarta et al., 2021), in part due to preferences of academics (Goffe & Kauper, 2014), and in part due to a range of hurdles, which make more inventive active learning pedagogies more difficult.

However, there is a wealth of evidence that by introducing active learning strategies, such as flipping the classroom, there are significant benefits to student outcomes, albeit with heterogeneous effects. Active learning has the possibility of improving outcomes, but we need to consider where barriers will be for active learning, and actively work to remove these hurdles.

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