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Designing High Structure Renewable Assignments as Liberatory Open Education

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**Abstract**

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Open Education Practices (OEP) have been proposed as a way to increase both engagement in learning, and lower costs. Broadly, Open Educational Practices involve learners in creating, evaluating, remixing, or otherwise modifying Open Education Resources (OER). Aspirational descriptions of OEP frame them both as liberatory by engaging learners directly with the creation of knowledge which they and others can use to solve their problems (see Bali et al., 2020) and as truly authentic assessments, engaging learners in the types of knowledge creation they will engage in in knowledge careers (see DeRosa & Robison, 2017). One particular form of these assignments, as proposed by Wiley and Hilton, renewable assignments – assignments which can be continually used across semesters and cohorts, and in which learners iteratively improve upon the work of former learners (2018). In this way, both the assignment

and materials become ‘renewable’ – because they are reused or renewed continually, rather than being discarded at the end of a quarter.

Designing assignments which fulfill the liberatory aspirations of Renewable Assignments requires accounting for a variety of design factors, and integrates a number of theories into a living and technology-enabled practice. This dissertation describes three studies that use mixed methods design research to attempt creating guiding principles for the design of renewable assignments, and practices that center ethical open education. These principles are intended to function as a set of theoretical constructs accounting for key factors which can enable renewable assignments and other OEP to fulfill the high aspirations of maximizing their liberatory value.

Before describing the three design experiments involved in this dissertation, this dissertation briefly describes the problem space – difficulties in innovation within learning technologies which suggest that renewable assignments may be a viable innovation which, if well designed, holds potential to shift not only technology use, but power structures which limit the benefits of learning and learning technologies to learners.

Following this description, this dissertation describes the three design experiments which engage these ideas of renewable assignments as a design space. The first study is a user (learner)-centered mixed methods case study of an endocrinology course engaged in adopting high structured renewable assignments as an attempt to turn a course pack into a student-created open textbook. This research centers the perspective of learners and teachers in what practices are effective, as well as what practices they feel themselves engaging in most deeply. Finding the concepts of student voice and creating a conversation between student work and feedback as important theoretical points within this learning ecosystem, our research continues with a

theoretical inquiry into equity in student voice within open educational practices. We compare findings in high structure active learning design with José Medina's work *The Epistemology of Resistance* (Medina, 2013) to discuss the epistemological value of learning design in group learning in general, and open education practices specifically. In the final set of experiments, we engaged with learners and teachers in three different courses: one an honors course about the local ecosystem, a second, environmental science course about writing about ecological matters, and third a comparative history of ideas course about the literature of environmental justice. Using similar methods across all these courses, we evaluated student work created in response to assignment conditions with increased, and decreased, structure which our discussion of group epistemology suggested may impact the equity of student voice and feedback within assignments. We describe the new directions that the findings suggest in continued research into ethical, adoptable, and effective open educational practices and their supporting technologies.

We conclude with an evaluation of the ways in which these experiments further develop the liberatory potential of renewable assignments specifically and liberatory educational practices broadly. These evaluations suggest particular principles which can be broadly used by educators, groups of learners, and technology designers to create learning experiences which maximize the liberatory values and the learning effectiveness of renewable assignments. Finally, we suggest future research in the same line, including the similarities between design principles suggested by this research and the practices of agile software design, overlaps which reveal principles of structured renewable assignments that may be broadly applicable to various groups which seek to create or refine knowledge together.

## **Dedication**

To Chris, who nurtures connective epistemologies I had not imagined

## Acknowledgements

The following dissertation is about collaborative creation, but it does not address what I believe to be one of the biggest truths about collaborative creation – that all works are collaborative. Any book or dissertation is made up of a hundred or a hundred thousand phrases and words that were created and manipulated by others. Our language (with some exceptions) is an open text, and so are we – we are constantly in the process of writing and editing parts of ourselves, and collaboratively writing with others, whether they contribute a small phrase here or there, a paragraph, or a well-timed edit that we forget because it was, by nature, a deletion.

Some particular contributions I remember and want to recognize: Steve Kerr, for being a consistent presence and a remarkably engaging and encouraging intellect. Tomas for jumping readily into a late, emergent collaboration, and Jennifer White, Timothy Billo and Lubna Alzaroo for being so interested in the processes their learners had entrusted them to guide, and so ready to collaborate with me to explore those processes. Virginia (Ginger) Berninger, for being insistently and deeply caring, despite business and distance. Aveloc, for teaching and insisting on courage, and Kate, for teaching and insisting on the collaboration of our non-human relatives. My parents dug deep into time and effort to spend on my and my siblings' learning – and making sure we were actively engaged in it, and that the level of challenge was beneficial.

Collaborative writing and education systems have been present in many scholars, and more scholars than I reference here have influenced my perspective in ways I am very grateful, particularly indigenous scholars, Megan Bang and Robin Wall Kimmerer, white scholars, Michael Foucault, Robert Caro, Robin DeRosa, scholars who are the descendants of enslaved people, Angela Davis, Audre Lourde, Isabel Wilkerson, and Langston Hughes, scholars with recent immigration backgrounds, Rajiv Jhangiani and Sanjay Sarma; and many others with and

without academic credentials who have thought and worked on collaboration, learning, equity, and power. I now have a somewhat better understanding of what it took for them to lay out research and texts I could draw on.

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Writing acknowledgements feels incomplete, and I wish I could co-write them with a big group. If I've left out anyone, I hope you'll forgive me, and that you'll find a way of either editing these words or jogging my memory.

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## **Chapter 1: False Horizons: Problems and Dangers of Predicting and Creating Meaningful**

### **Educational Innovations**

#### **The Impact of the Problem**

Human visual perception is a marvelous scientific instrument. It requires nothing more than an unexpected burst of glitter to realize that the eye makes predictions, and these predictions can be falsified (for example, the eye so rarely predicts glitter). Every day, our eyes and brains make thousands of predictions, some true, some false, some checked against the facts. The eye is constantly predicting that there will be no movement right at the edge of vision, and we begin to predict that objects will be permanent at a very young age. Sometimes, these predictions are falsified. In the right contexts, like glitter, a delightful if messy surprise, in others, a sign of danger. Some incorrect predictions are far more damaging than others. A false horizon is a phenomenon that occurs when the pilot of an airplane mistakes a line of clouds or a line of ground lights for the horizon line – and orients their plane accordingly. Some pilots have been so thoroughly convinced by the argument of their eyes that they assume their instruments must be incorrect.

In fifteen years working in the field of educational technology, often as the person responsible for leading investigations into technologies which were sold to executives with promises to transform education, I bore regular witness to a kind of false horizon where rather than a line of lights or a set of clouds; marketing and predictions about the future of educational technology and educational innovation were the line mistaken for the horizon, and oriented towards. The relatively limited damage of this misperception was multiplied by a disregard for or lack of instruments. Decision-makers – sometimes administrators, sometimes faculty, sometimes presidents of colleges, and sometimes students, chose a line to orient themselves by, and then followed it while ignoring signals and theories of the success or failure of those innovations.

Perhaps more importantly, choosing not to test the hypothetical, but instead, attempting to implement it in a kind of continual choice.

Continually choosing wrong, while perhaps not as immediately and violently disastrous as the crash of an airplane, is a kind of slow-motion disaster. I have seen firsthand millions of dollars spent by students, schools, and educational technology companies, on technology which has done little to improve learning, and in some cases, for which students have suffered through inaccessible interfaces, capture and sale of their data, or simply having to pay for, and spend time learning, a tool that did nothing to improve learning in the subject they are paying a school to teach them.

The money I have directly seen spent, and participated in spending, looms large. Perhaps even greater waste than this pile of money is the waste of human time – whether the time of staff selecting, integrating, and implementing technologies, or that of faculty learning and using them, or that of students pressed into using, paying, (and sometimes giving their personal data to) technology systems oriented toward a false horizon. That has been my personal experience working in educational technology for the last fifteen years – multiply that by all the other experiences in colleges and universities, not to mention grade schools and lifelong learning opportunities around the world, and we can take a measure of the enormous impact of poor predictions of educational technology success – and the potential value of finding ways to predict and design effective, impactful educational innovation.

### **The Structure of this Dissertation**

The focus of this dissertation is on a particular line of innovation – Open Educational Resources (OER) – leveraging modern information technology to provide learners materials they can freely own, use, and modify, leading to Open Pedagogy - the practices of teaching that seek to maximize the value of OER in a teaching context, and what I am calling “High Structure

Renewable Assignments”, a particular form of Open Pedagogy that uses specific assignment design principles to maximize the value of Open Pedagogy. As I will cover in the literature review and conceptual framework parts of this dissertation, OER and Open Pedagogy are a form of educational innovation, and like most educational innovations, have struggled to justify their value to the learners they are meant to impact. Given the potential of educational innovations to create these slow-motion disasters, where money and time are wasted on much promise and little delivery, one of the aims of this dissertation is to lay out a conceptual framework for how the current innovations in discussion might break this trend.

In the first chapter, I describe in broad terms some failures of prediction in educational innovation and give examples. In the second chapter, I build on this description and review of a subset of the literature about the difficulties and dangers of predicting educational innovations by building a conceptual framework for how we might orient and measure progress toward ethical, effective, and adoptable educational innovations that avoid these pitfalls. It is important to state that these orientations are not meant as a final set of theories, but as a set of generative theories that are meant to create hypotheses about the types of innovations that might be resistant to these failures and provide us with design guidance we can use to create empirical tests that give us evidence for or against these hypotheses. I will argue that it is in continual testing and refinement that both open educational materials and open educational practices have their highest and best value.

To build these tests that can bring theories or hypotheses of ethical, effective, and adoptable educational technologies into real practice, in the third chapter I review previous designs and research that helped me to create learning designs that honor and relate back to my theories of educational innovation. I use these designs to introduce and frame the four empirically oriented chapters of this dissertation, which are four publishable or published papers.

The first paper is a design experiment to put these hypotheses and designs into practice in a real classroom situation, centering feedback from learners who are implementing the practices. As the set of theories was not final, but generative, the feedback of learners further refined and clarified what is necessary in the whole system of innovation, introducing new foci on equity and conversation. A second paper deepens these theories through a comparison of learning designs with philosophical writing on epistemic justice – the vital practice of creating equity in group knowledge creation. Drawing on these refined theories, in the two empirical chapters, which each function as a research article, I modify these assignment designs and the supporting technologies attempting to implement epistemic justice into learning design, and then test the resulting designs in a real classroom environment by gathering learner feedback on them and evaluating student work resulting from assignment designs built to enact these theories. After describing the results of these design experiments, I use the final chapter to draw conclusions and suggest future work and iteration to further develop these theories and practices, to deepen positive impacts on higher education and the learning sciences.

### **The Role of Personal Experience**

In the beginning of this chapter, I described my own experience with the reasons for innovations – seeing wasted potential, high costs, and errors resulting from executive missteps as I worked in higher education. Good predictions and designs are rarely validated by personal experience but can be rooted in them. I bring my personal experience into the beginning of this dissertation because I have a personal relationship with this work. While I try in the following chapters to use this experience as a jumping off point to describe statistics, theories, and academic, empirical research that builds evidence and knowledge in relationship to this personal experience, I think that it is valuable to acknowledge personal experience in these academic pursuits for two reasons – first, narrative memory is a great scientific instrument, and while it is

not infallible, it is good at detecting some things which other instruments struggle to document. It is one source of knowledge, and I believe disregarding personal experience as a valid source of knowledge has been a damaging myth in formal learning contexts.

Secondly, my personal experience gives context to the research I have done. It is one experience, one that I have checked against sources and other scholars, and against data and theory, but those data and theories enhance, rather than replace, a personal perception. I and others around me wasted time and money, and I would rather not have it wasted again by myself or others. My experience was as one mid-level staffer at the University of Washington. Multiply this personal experience by all the R1s, all the liberal arts colleges, and state and technical colleges, all the students, all the staff, all the teachers, and we again begin to see the scope of the problems – the scale of the slow-motion disaster of poorly selected educational innovations.

### **False Horizons: Examples of Failed Predictions**

To get a sense of the scope of poorly selected educational innovations, and the difficulties in selecting them, let us look at perhaps the most popular source of discussion of innovations in higher education. The New Media Consortium (NMC), now owned by Educause, the largest higher education technology professional organization in the United States, releases, once a year, a “Horizon Report” – a series of predictions of what technologies and practices will change higher education in the coming years, and when. This report has been released every year since 2002, and the reports from 2006 to 2018 provide a string of 74 predictions that include the nature of the innovation, and when they believe it will see broad adoption. The provision of a year range the innovation will be adopted provides an opportunity to test or falsify the predictions, to measure the accuracy of this Horizon Report.

Such a measure is useful, because the Horizon Report is widely used. Each report since 2011 has been downloaded more than 500,000 times, and worldwide readership is estimated at

more than a million (New Media Consortium, 2017). Many of the readers of these reports are decision makers at colleges and universities, decision makers for whom the Horizon Report is an important source of information about what trends they should watch and invest in, through purchasing software and services, committing research dollars, assigning staff to investigate and pilot, or all the above. Interestingly, since its purchase by Educause, the Horizon Report format has changed to make such predictions impossible to falsify, and to speak of more broad trends than of specific technologies and implementations. While this shift has brought praise from some in the education technology/innovation community (Kim, 2020), it's important to note that these trends still guide thinking and may be more potentially dangerous for being unfalsifiable. Talking about trends without a timeline doesn't make the report right, it just makes it harder to prove wrong.

I reviewed every Horizon Report from 2006-2018 (reports prior to 2006 are not readily available in Educause's archive, and the format shifted after 2018). Of the 74 predictions counted as judged by this author, 12 were true, a success rate just above 16% and even fewer were true of any kind of wide application in education (the reader can use the table below to conduct their own evaluation if desired). Given that predictions drove millions of dollars in funding, this is a troubling success rate, one shifting the format doesn't fix.

**Table 1**

Horizon Report Predictions: Year Predicted, Success?

Innovation	Predicted to Arrive	Arrived	Wide Use in Education
Extended Learning	2006	No	No
Ubiquitous Wireless	2006	Yes	Yes
Intelligent Searching	2007-2008	Yes	No
Educational Gaming	2007-2008	No	No
Social Networks & Knowledge	2009-2010	Yes	No
Webs			
Augmented Reality	2009-2010	No	No
Social Computing	2007	Yes	No
Personal Broadcasting	2007	Yes	No
Delivering Ed. Materials to Cell	2008-2009	Yes	No
Phones			
Ed. Gaming	2008-2009	No	No
Augmented Reality & Enhanced	2010	No	No
Visualization			
Context-aware environments & devices	2010-2011	No	No

User Created Content	2008	Yes	No
Social Networking	2008	Yes	No
Mobile Phones	2009-2010	Yes	No
Virtual Worlds	2009-2010	No	No
New Forms of Scholarship & Publication	2011-2012	No	No
Massive Multiplayer Ed. Games	2011-2012	No	No
Grassroots Video	2009	Yes	No
Collaboration Webs	2009	No	No
Mobile Broadband	2010-2011	Yes	No
Data Mashups	2010-2011	No	No
Collective Intelligence	2013-2014	No	No
Social Operating Systems	2013-2014	No	No
“Mobiles”	2010	Yes	No
Cloud Computing	2010	Yes	Yes
Geo-Everything	2011-2012	No	No
The Personal Web	2011-2012	No	No
Semantic-Aware Applications	2013-2014	No	No
Smart Objects	2013-2014	No	No
Mobile Computing	2011	Yes	No
Open Content	2011	Yes	No
e-Books	2012-2013	Yes	No
Simple Augmented Reality	2012-2013	No	No
Gesture-based Computing	2014-2015	No	No

Visual Data Analysis	2014-2015	Yes	No
e-Books	2012	Yes	No
Mobiles	2012	Yes	No
Augmented Reality	2013-2014	No	No
Game-Based Learning	2013-2014	No	No
Gesture Based Computing	2015-2016	No	No
Learning Analytics	2015-2016	No	No
Mobile Apps	2013	Yes	No
Tablet Computing	2013	Yes	No
Game-Based Learning	2014-2015	No	No
Learning Analytics	2015-2016	No	No
Gesture-Based Computing	2016-2017	No	No
Internet of Things	2016-2017	No	No
Massively Open Online Courses (MOOCs)	2014	Yes	Yes
Tablet Computing	2014	Yes	No
Games and Gamification	2015-2016	Yes	No
Learning Analytics	2015-2016	No	No
3D Printing	2017-2018	Yes	No
Wearable Technology	2017-2018	Yes	No
Flipped Classroom	2015	No	No
Learning Analytics	2015	No	No
3D Printing	2016-2016	Yes	No
Games and Gamification	2016-2017	Yes	No

Quantified Self	2018-2019	No	No
Virtual Assistants	2018-2019	Yes	No
Bring Your Own Device	2016	No	No
Flipped Classroom	2016	No	No
Makerspaces	2017-2018	Yes	No
Wearable Technology	2017-2018	Yes	No
Adaptive Learning Technologies	2019-2020	No	No
The Internet of Things	2019-2020	No	No
Bring Your Own Device	2017	No	No
Learning Analytics and Adaptive Learning	2017	No	No
Augmented and Virtual Reality	2018-2019	Yes	No
Makerspaces	2018-2019	No	No
Affective Computing	2020-2021	No	No
Robotics	2020-2021	No	No
Adaptive Learning Technologies	2018	No	No
Mobile Learning	2018	No	No

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*References: New Media Consortium, (2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017)*

*Note: For “Broad Educational Use” I used the following criteria: would an average higher education institution see lower enrollments by not using this across 25% of classes? And: Would the average student suffer in comparison to their classmates at other institutions by not having this available?*

Many of the technologies have seen attempted adoption, but attempts have yet to lead to broad impacts. For example, in 2005, NMC predicted intelligent searching arriving by 2007-2008— searching which would search all files, emails, and internet assisting scholars, and educational gaming to be in wide use (25+% learning contexts) by the same time (New Media Consortium, 2005). Augmented reality and enhanced visualization were predicted in 2006 to be widespread in 2010-2011 (New Media Consortium, 2007). In reality, Google and ASU spent more than a million dollars to create a virtual reality biology lab in 2018 (ASU News, 2018), and while the resultant company, Labster, is making headway in selling their platform, it has yet to see broad adoption even in the wake of the COVID-19 pandemic.

These innovations are not only problematic because they fail to be adopted. Thomas F. Luschei's chapter on "Assessing the Costs and Benefits of Educational Technology" in the *Handbook of Research on Educational Communications and Technology* makes the difficulty of proving the value of these innovations clear by calling attention to the lack of real research on the costs and the cost-benefit balance of educational technology (2014). Through a thoroughgoing review of the research, Luschei concludes that while there has been extensive research into the efficacy of technologies in bringing about particular ends, this research is rarely paired with an evaluation of the costs of adopting those same technologies (Luschei, 2014, p. 247). Research to evaluate costs is vitally important, because without low enough costs, innovations are not adoptable and could be detrimental when compared to alternative innovations or interventions, or simply increased resources for standard practices which could be pursued with the same funds.

In my own experience, this lack of investigation into the costs of educational innovation helps those marketing educational innovations to hide the costs of adoption and support, which

hide the longer-term costs of innovations. Lacking more information about the costs of educational technologies, educational leaders and decision makers of all sorts don't have a basis to evaluate the comparative cost-benefit analyses of any given intervention, and instead must rely upon claims or beliefs about their efficacy.

As we've reviewed, educational innovations often fail, and predictions of their success are very difficult to make accurately. However, predictions are still needed and useful. The Horizon Reports' shift to reporting trends does not mean that colleges and universities will stop investing in educational technologies or innovative practices, or seeking guidance on what innovations and practices are worthwhile. The failure of the New Media Consortium was not that they made wrong predictions, it was that they did not seek to establish the basis for more accurate predictions. To establish these foundations, we need a meaningful theory, which can be tested - a theory which can predict learning innovations which will succeed, and which will fail - and what particular ends particular innovations are likely to achieve. By developing more robust theories of educational innovation, we can develop or select innovations which lead to the ends we desire.

### **Struggles with Content, Theory, and Participation in Misaligned Objectives**

If we cannot stand on the shoulders of giants in this field, perhaps we may stand on their corpses. Further reading in the history of failed innovations may help us understand why they failed - and what innovations would be likely to succeed. To quote from the National Research Council's 2003 report on digital transformation of teaching and learning:

“Edward Lazowska of the University of Washington began his talk by discussing the numerous examples of failed predictions that technology would revolutionize education. These include predictions about the impacts of film, radio, and television. In each case, initial hype was followed by a struggle to produce material for the new medium, then by

a more mature judgment about the capabilities of the medium, and finally by a sense of disappointment and cynicism. This cycle was renewed with each appearance of a new technology.” (National Research Council, 2003, p. 62)

Ironically, the report goes on to suggest that this time it’s different – now, technology will become ubiquitous in learning environments (the Council’s first proposed transformation educators need to prepare for) and learning technology will meld with science-based guidelines in human learning. Neither has come to pass. These predictions were made in 2003, twenty years ago, and while we might argue that technology became ubiquitous in learning environments for two years during the COVID-19 pandemic and related lockdowns and social distancing, that use of technology is rapidly losing its ubiquity, as schools and many learners seek, and desire, a return to the classroom (Vegas, 2022). Perhaps more importantly, and as I will argue further, the innovations which will unlock a useful ubiquity of technology cannot just be an adoption without an innovation – they must be an innovation which creates positive shifts in the relationships between learners, authority, content, technologies, and theory. Only then will they follow the science-based guidelines of the council’s second innovation, the melding of learning technology with science-based guidelines in human learning. As I will repeat in the next chapter, Freeman et al (2014) found that active learning is scientifically so impactful, were it the treatment in a controlled medical trial, the FDA would end the trial because the treatment is so effective it would be unethical to keep anyone in the control – and yet this has not been adopted (Miller & Metz, 2014; Eickholt et al., 2019).

It is particularly worth noting that Lazowska cites the “struggle to produce material for the new medium” (Council, 2003, p. 62) as the first struggle of failing technologies– and the first time cynicism emerges about the capabilities of the new technology. Producing useful, valuable content for the medium that can then be accessed by reasonable ease with users in a format fit to

their intended use of the technology is difficult. This can be doubly difficult for active learning contexts, where materials need to be produced in a different format than traditional scholarly writing or lecture. Based upon this hurdle alone, many predictions of the promise of educational innovations fail.

It is instructive to think of the difference between the ‘failure through lack of content’ of many previous innovations, and the ‘failure through disengagement’ of recent technologies. The so-called virtual or “emergency remote” classroom which sprung up in the midst of the COVID crisis is rapidly becoming another case study of a different kind of failed innovation than previous ones. As cases of COVID spread across the US and necessitated social distancing and emergency remote education, the most popular tool for conducting these emergency remote classes, Zoom, was so prevalent as to give rise to the name of a generation: “Zoomers.” However, the failings of this boom of sudden remote teaching have been widely documented, most recently, and damningly, by a study from The Harvard Center for Education Policy Research, CALDER, and NWEA study (Goldhaber, 2022) which argued that remote/hybrid education was both a net negative for students, and widened achievement gaps. This study has been equally widely reported, notably in the New York Times (Leonhardt, 2022). Broadly, these failings have been recognized by teachers and learners, leading to an abandonment of Zoom almost as rapid as its adoption (Vegas, 2022).

This finding is interesting and troubling, especially in contrast to previous research which found little difference in outcomes between remote and in-person education. Given this historical difference, it is interesting that faced with a crisis, we in the educational system did not select methods of remote teaching and learning which would replicate the prior, documented success (see Means et al, 2009 for a thorough meta-analysis of successful online learning), but instead

built a system which has now been documented to have underperformed relative both to traditional classroom instruction, and to online instruction from the previous 20 years.

It is also interesting to note how this broad adoption solved the issues of content – content on Zoom, and the other widespread educational technology adoption, the Learning Management System (LMS) is created, controlled, and owned almost entirely by individual instructors. As I will argue at more length in the coming chapters, while individual instructors could be briefly recruited into creating digital content in an emergency, they had neither the expertise to maximize the value of that digital content, nor the orientation to develop the kind of interactive uses of technology that are a norm for non-educational uses. Here, I agree with, and slightly modify the National Research Council report (2003) – to make their ubiquitousness educationally effective, technological innovations have to produce useful/usable content, in a sustainable way, and they have to do so in a way that aligns with learning sciences. We might frame this as a kind of two-part requirement: Adoption (through useful content) and efficacy of learning (through learning sciences research).

Further reading in the history of educational technology innovations aligns with this framework as a part of creating a field continually mired in crisis that does not lead to adoption. As we briefly reviewed earlier, *The Evolution of American Educational Technology* provides an overview of constant technology change, requiring constant development and redevelopment of content, combined with constant development and redevelopment of theory (2003). Saettler's thorough review of the development and continuing evolution of many forms of educational technology dating back to ancient history shows that such technology consistently brought with it two things: First, continual need for change as new forms of technology emerged (even the shift from silent to sound film sparked a now mostly forgotten crisis), and at the same time, a kind of accretion of ideas. Saettler makes the key point that the past is prologue to the future, but

is also never truly past – and both past technologies and past theories tend to accrete and reappear, while not necessarily resolving into an applicable or testable theory of efficacy.

Two patterns emerge from these two ideas. First, that the continual change creates a continual and accelerating need to produce new materials in each of the emerging technologies or learning processes. Second, that the continual crisis creates and interacts with a continual analysis of the underpinning theories of learning, which had not resolved as of Saettler's writing (and I will argue, still has not been resolved) into useful predictions for what educational technologies and learning processes are effective within a real-world learning environment. Even more unavailable are finer-grained delineations of what learning technologies may be best fit for what learning environments. Saettler's aim was not to make an argument about the value or lack thereof of educational innovations, or any given innovation, he is a historian interested in tracking the developments of the field. However, his examples of continuous change during theoretical uncertainty are unsettling and instructive as we dig further into a theoretical framework of how to shift educational practice, given that many of the educational innovations which failed and were cited above happened in exactly this frame, of continuous change and theoretical uncertainty.

Deepening this same theme, Sevan Terzian reviewed the history of educational technology in relationship to social foundations and concepts of education (Terzian, 2019). Social Foundations of Education is an emerging discipline, which grew out of concerns about diminishing attention paid to human and social needs within educational practices and contexts. Social Foundations as a study and program emerged out of the overlapping, interdisciplinary interests of a number of educational communities and groups, such as the American Educational Studies Association (AESA), Comparative and International Education Society (CIES), History of Education Society (HES), John Dewey Society (JDS). Together, these groups expressed

concerns that the overlapping ecosystem of human needs was not being served in education – and that, simultaneously, and in a related sense, society as a whole had not formulated a concept, or foundational idea, of education which would serve to allow it to create educational systems that would serve the needs of learners well (Council for Social Foundations of Education, 2010). Continuing to respond to testing-and-technology heavy educational shifts in the 1990s and early 2000s, the field, which is still developing, has broadly dedicated itself to understanding the interdisciplinary, humanities-oriented needs of people in complex, sociological learning ecosystems, and of understanding the relationships between how societies conceive of, and enact a conception of, the purposes and structure of education. Terzian applies this field of study to the history of educational technology.

Terzian calls out the historical use of concepts of progress and theoretical alignment as generally uncritical of both the assumption of progress inherent in many discussions of the history of educational technology, and simultaneously, uncritical of the depth to which theories of instruction and learning have been validated before being applied. Where these concepts have been critical, they are often simultaneously competitive – that is, criticism has not generally been centered on the evaluation of either technologies or theories of learning in themselves, but as attempts to enlist criticism of learning theories or technologies in the advancement of other learning theories or technologies. In this misalignment of theory and practice, the only winners are companies selling ‘innovations’ who can do so not by clearly demonstrating the value of their innovation, but instead by comparing their innovations to the perceived failures of other technologies. Terzian argues that the lack of strong, clear social foundations in educational innovation is a part of what leads to ineffective innovations. As Luschei calls for deepened research and thinking on the costs and benefits of learning technologies, Terzian calls for a

deepened historical analysis of the social foundations of educational technologies – the concepts and norms which enable the adoption, use, and praise of specific modes of learning.

As Luschei, Terzian, and Saettler all discuss, educational technology innovations are often partnered, at the very least in marketing materials, with new revelations from educational psychology, learning sciences, or neuroscience. Working together, the technology and sciences wings of the educational technology cultural complex make compelling arguments to faculty, administrators, and learners. Whether presenting new research on the sciences of human learning applied through technology or new technology applied with the help of new learning research, educational technology marketing can obfuscate questions about the effectiveness of either the science or the technology by making the combination seem, if not infallible, inevitable, and urgent in its effects. Unfortunately, as Luschei also points out, these predictions are rarely backed by rigorous research, and when backed by such research, there are often studies which counter the findings of that research, drawing the field as a whole back into the question of what is effective, and when.

### **Suggested Resolutions: Adoption, Efficacy, and Equity**

Together, we can conceptualize the analyses of Terizian, Saettler, and the National Research Council's report with a typology of three key elements of successful learning innovations: First, the technology must be able to become relatively ubiquitous at relatively low ongoing cost, second, there must be educational content which can be leveraged or developed within this educational platform, and third, there must be a basis in the sciences of learning for the effectiveness of the new interactions or content the new technologies enable.

This is not to say that there haven't been some learning innovations that have been impactful and useful (and we'll review several in chapter 3.) Several technology platforms, like UW's own Catalyst Learning Tools, were ahead of their time, and coding-or-technology-

teaching platforms, like Jupyter Hubs/Jupyter Notebook, or LOTO, or Scratch at MIT haven't been successful. We might also look at MIT and Harvard's development of Open edX as an openly-available learning platform that uniquely implemented a number of learning science ideas (like peer instruction activities, formerly unavailable in an asynchronous form). However, many of these innovations have not been nearly ubiquitous – the Catalyst Learning Tools, while ahead of their time, could not keep up with technological and learning sciences enhancements (though that may be due to a shift in university funding and the public vision of the role of the university), technology-teaching platforms seem to be limited in adoption outside of technology, and Open edX was recently purchased by the for-profit company 2U. None of these has become nearly as ubiquitous as Canvas, Blackboard, Zoom, or Panopto – they have all faced struggles with adoption, even if their ethical (open learning, technology learning) and effective (learning sciences integration) designs have been strong.

From the National Research Council and Terizan's perspectives, the transformation in the ubiquity of information technology resources has been achieved in part, as we have seen through the ubiquity of Zoom and the LMS in learning environments. However, the second transformation, the growth of educational content, has only been supported through extensive recruitment of teachers into creating content that is only fit for the specific situation they are in – and which is often not stored, cataloged, or reused, but disappears into either deletion or an unused archive. The rooting of these technologies and this technological transformation in the learning sciences has also not been achieved – in part because of the uncertainty of what learning sciences principles apply, and how these principles apply to any given learning situation.

Unfortunately, there are significant limitations and complexities in trying to generalize the principles of learning sciences developed in labs to scenarios in the highly complex environment of a plenitude of individual classrooms. Laboratory educational psychology

experiments, with their limitations of time, space, and audience often don't translate cleanly into classroom environments, with their long timeline, complicated interpersonal dynamics, variation in spaces, and variation of ages. These complexities can be even more extensive in lifelong and life-wide learning, outside the formal structures of a classroom.

Moreover, laboratory educational psychology experiments are often not generalizable to audiences outside of undergraduate learners in the United States. Extended research calls into question the generalizability of psychology and learning psychology. Perhaps most broadly, the paper "The Weirdest People in the World?" presents a number of cases showing that "WEIRD" (standing for White, (formally) Educated, Industrialized, Rich, Democratic) people – undergraduate college students in western universities - do not resemble other groups around the world. Even in psychological experiments as simple as the experience of optical illusions, differences between cultural experiences call learning experiences into fundamental question (Henrich, Heine, & Norenzayan, 2010) This represents one small example of the broader 'replication crisis' within psychology, from which the psychology of learning has not been spared (see Plucker, & Makel, 2021)

While this dissertation can by no means address all these broader issues of the field, it is important to frame the issues addressed in this dissertation in regard to the broader issues in the field, we can acknowledge those issues and seek methodologies which attempt to remediate them in this research. Perhaps more importantly, taken together with the crisis of content in educational innovation, laying out the difficulties of the learning sciences may help us understand what educational innovation might remediate both the crisis of content, and in part, the crisis of learning sciences. If learners can be called and organized into participation with the creation, curation, and further research on content and interactions with content, this learner or user-created content could help to solve the issues of content creation in emerging educational

technologies. Furthermore, participatory structures could be designed to create and curate content responding to particular educational theories or contexts, fulfilling the need for new learning sciences knowledge not only to be implemented into content, but that content organized by context fit.

This is what I mean in the title of the chapter by referring to alignments – currently, innovations in education are not usually aligned with teachers or with learners in terms of their way of creating value. Innovations in education create value through stock prices, salaries, and company ownership. Often, these values relate to the sale of the technology, or data aggregated from students. Teachers, similarly, are not aligned with the needs of students, because the teachers' value is perceived as coming from the limited resource of their knowledge, which is diluted the more effectively that knowledge is disseminated to the students, as in a market full of highly capable engineers, those with special knowledge of engineering become less valuable (though most teachers I've known do not respond to this misalignment, and do genuinely seek to spread the knowledge they hold). Students are not aligned to either party, because their goal is to pay as little time, money, and attention as possible while also maximizing their learning (or perhaps their employability), thus making them reluctant to spend additional money on new learning technologies or additional time attending to content.

Writing about broader issues in technology and innovation, Shoshanna Zuboff argues in *The Age of Surveillance Capitalism* that similar misalignments between companies capturing user data and the users of those company products are driving current crises of trust and behavioral modification in participatory technological innovations outside education (2019). Zuboff argues compellingly that large technology companies have sought to detach themselves from ecosystems of community wealth creation by creating cycles where information about people can be used to modify their behaviors, behaviors which can be modified to then extract

more information. Zuboff frames this as explicitly a type of extractive capitalism, where the wealth is created not through cycles of mutually beneficial exchange, but instead through extracting as much valuable data as possible and using that data to change behavior to benefit a small group who sit largely outside this cycle (Zuboff, 2019).

This is not participation in the deeper sense of the term, but instead a sort of pseudo-participation, where minimal value is returned to those creating content. While my career trying to help people modify their own behavior through technology leads me to think technology companies are not (yet) as effective behavior modifiers as Zuboff thinks, the cycle she describes is at least partially in place, and is very sobering. As I will describe further in the next chapter, such a cycle is opposed to the ethical orientation I hold and believe should be held. As such, it is vital that if participation is a key part of a learning innovation, that participation be aligned with the values of the participants.

In an (albeit idealized) truly participatory system, all participants would benefit. Learners would reap rewards of rich, contextualized well-chosen content available in a variety of forms. Teachers would have some of the load of content creation and evaluation removed from them, and the technology company or companies providing this infrastructure would provide its value in such a way that it would not have to resort to unethical harvesting of data to justify its value. It is important to state, moreover, that it is difficult, if not impossible, to create truly participatory structures outside of aligned motivations. At the very least, the more the motivations of each participant are misaligned, the more motivation each participant has to cheat the system to their benefit – and in a system as complex and long-term as education, where impacts are hard to measure, cheating is readily available, and contributes to slow-motion disaster. Even if idealized, to better align the motivations and benefits of all participants is a vital part of the horizon we are

attempting to create, and I will call this an “ethical” element, which we can add to our previous typology of adoption and effectiveness.

Compared to the vital importance, and the dangers, of the ethical and effective dimensions of learning sciences and technology innovation, adoption or cost may be considered a lower-order, or less important measure of the effectiveness of an innovation. However, it is important to remember that without adoption, neither efficacy nor ethics can have an impact or reality in the world. In short, if an innovation is not adoptable, it will be neither effective nor ethical for a broad population. There is doubtless more that leaders, staff, faculty, and students can do to find and adopt more efficacious and ethical educational innovations, however, from another perspective, there is more that developers of educational innovations can do to make efficacious and ethical innovations widely adoptable. From a certain perspective, the widespread adoption of Zoom for emergency remote learning can be seen less as a failure of faculty, staff, and learners to adopt more efficacious means of remote learning, and more as a failure of innovators and those working in innovation to make efficacious remote learning adoptable.

In this chapter, the criticism of the existing state of the field of educational technology is not meant to inspire despair about the value of technology, though that assumption could be understandable. Nor is this meant as a sort of luddite’s retort and a smashing of the looms. Instead, this chapter is meant to call attention to the failures of the field to generate testable, generalizable research into the values and applications of educational technology, to expose the gap in the research which this dissertation is one partial attempt to fill.

That educational technology has relatively scarce examples of success does not mean the success is impossible, but that the factors needed for success are undertheorized in comparison to the resources that have been addressed to implementing unsuccessful theories. Addressing these parallel issues, this dissertation is an attempt to elucidate two interwoven lines of questioning:

Do High Structure Renewable Assignments present an educational innovation which is potentially ethical, effective, and adoptable? Similarly, and in interaction, are these three elements a useful typology in the design and implementation of learning innovations? What new theories and practices emerge as we attempt to implement these theories?

To begin answering these questions, it is helpful to develop hypotheses about what the requirements of an educational innovation that fulfills our goals of being ethical, effective, and adoptable would be. In the next two chapters, I seek to develop a framework for this hypothesis. First, in chapter two, I relate these elements of educational innovation to three thinkers and use their ideas to further explore and describe how an educational innovation or a design might enact the ideas of ethics, effectiveness, and adoptability. In the following chapter, I relate these descriptions to four empirical educational designs, to further develop the practical, empirical side of these ideas, and to find examples of how these ideas have been developed in the past.

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## **Chapter 2: Theories of Liberation, Proximity, and Epistemic Justice in relationship to Ethics, Adoptability, and Efficacy**

### **Overview of chapter and relationship of ideas**

While part of the difficulty in predicting the success of educational innovations lies in choosing the right requirements (what the innovations need to do) another difficulty lies in the multitude of potential ways we might attend to in implementing on these requirements. There are many possible answers to the question of what innovations may be ethical, effective, and adoptable, just as there are many possible descriptions of what is ethical, effective, or adoptable within educational practice. In this chapter, I will analyze relationships between the theories of a philosopher of learning, a learning psychologist, and an epistemologist, each of whose research has bearing on learning, but who approach learning from three distinct viewpoints. I will argue that each of these viewpoints contributes to an understanding of how we might implement an ethical, effective, and adoptable educational innovation.

The three philosophers of learning I refer to in this chapter are Paulo Freire, Lev Vygotsky, and José Medina. All three approach theories of learning from different cultural and theoretical standpoints, and each makes a unique contribution to thinking about the requirements of a learning innovation. Freire, a Brazilian educator and philosopher, developed an influential post-colonial and anti-oppressive theory of learning centered on redefining both the goals and the processes of learning. Medina, a Spanish-American social epistemologist, recently penned a book that argues and lays out guides for an anti-racist, anti-misogynist epistemology that extensively explores the interactions of justice and testimony that are contributing to (or detrimental factors in) the ability of a society to create participatory processes that generate or curate knowledge. Vygotsky, the Russian psychologist, approaches learning and knowledge building from a research base centered on the learning of children but explores two key concepts

particularly applicable to our aims: First, the relationships of tool and symbol use in socially-mediated tools, which educational technologies are, and the role of a ‘Zone of Proximal Development’ – that is, how close a learner is to being able to independently complete a task, as indicated by whether they can complete the task with help.

Each of these thinkers contributes something unique to the conceptual framework I am developing, and shares overlapping themes with the others. I will argue that all three of them have something to contribute to our frame of efficacy – Freire centering the active participation of learners in solving local problems, and Medina the importance and impact of honoring the knowledge of marginalized participants in testimonial practices as not only an ethical, but also an effective process in the continual refinement of a societies’ knowledge, and Vygotsky’s ‘proximity’ emphasizing the importance of effective learning being achievable from the perspective of the learner, as well as entangled enough with the learners’ constructed (and co-constructed) social meanings that the tool use is itself meaningful.

Freire’s and Medina’s strongest contributions to this framework are in the development of ethical requirements for the learning innovations I have been working to develop. Freire’s focus centers learners not only through their participation, as might constructivist approaches, but through engaging them in their own empowerment and the empowerment of their communities. This sets a high bar for the ways an educational innovation might engage with learners and their communities of knowledge (Freire, 2014). Medina’s focus on just epistemological practices likewise sets a high bar for the interactions between learners a participatory educational innovation would enable (Medina, 2013).

By contrast, I will refer to Vygotsky primarily as a guide for efficacy and for adoption – his development of the theory of a Zone of Proximal Development (ZPD) is a useful guide for requirements both in terms of the level of difficulty that can be present in an educational

innovation for learners to find it effective, and the level of difficulty that can be present for teachers and others involved in the adoption of the learning innovation. However, Vygotsky's framing of this Zone of Proximal Development as one enabled by and wrapped up with social symbolism and social psychological drives interacting with the attention and participation of the individual shouldn't be divorced from Freire's or Medina's (Vygotsky, 1978, pp. 31-39). All three of these thinkers and writers see the process of knowing and exploring knowledge to be bound up in social relationships and the tools of society, which is fundamental to my approach to designing and developing educational innovations.

### **Freire, Oppression, and Designing for Participatory Liberation**

We begin with Paulo Freire. Freire's understanding of the mechanisms of oppression provides insight into the ways the technologies and techniques of colonialist education mirror and reinforce the ideologies and practices of oppression, and the ways we might develop technologies and techniques which reinforce ideologies and practices of liberation. Using Freire's *Pedagogy of the Oppressed* as a primary text (I read from the 2014 30<sup>th</sup> anniversary edition), Freire develops an opposition between 'banking education' in which learners are conceptualized as holding minimal value relative to teachers, primarily valued as empty vessels, waiting to be filled by the narrative of the teacher (p. 71, 73), and liberatory education, in which learners are active participants in their own liberation through posing and responding to problems combined with reflection (p. 81) These different ideas have many implications for the role of teachers, learners, and of technologies in any shift of learning practices, but particularly for the sources of value and ways the participants create value in the learning situation.

Freire understands that positioning learners as empty vessels to be filled in the banking model justifies two key evaluations of the relative value of participants in the learning process. In this model, teachers are seen as having value by their holding knowledge and their ability to

transmit that knowledge to students. Students only gain value through their ability to receive and repeat back that knowledge – they are conceptualized as worthless except as vessels to be filled, and the teachers’ position and power is justified by the knowledge they can deposit in learners (p. 71, 76). While Freire speaks of the teacher conceiving themselves as giving the ‘gift’ of knowledge to learners (p. 72), Freire also makes it clear that this is a false gift – a false generosity (p. 44) which seeks not to humanize learners through bringing them into full participation with the world, but by keeping them in a constant state of having to receive a gift, which is a state of subjugation (p. 45).

The core dichotomy Freire explores is not the dichotomy between banking education and liberatory education, but of them as specific systems or instances of the dichotomy between dehumanization and humanization. Whereas banking education seeks to keep people dehumanized and therefore to keep them oppressed, liberatory or humanizing education seeks methods to humanize learners and bring them into full participation with their society and environment. Though I don’t believe Freire addresses it directly, his situation being different than my own, I cannot help but remark on the parallel of banking education to expected repayment – it takes little prompting to draw parallels between the belief that knowledge is a value deposited in otherwise dehumanized people, and the readiness to saddle them with unreasonable debt for a perceived privilege.

While, so far, this situation might be thought to humanize teachers through providing them with power in the teaching system, Freire makes it clear that this is also not the case. Teachers who participate in banking education are not fully humanized but are enlisted in instead a teacher-student contradiction in which their only role is that of a “depositor, prescriber, domesticator, for the role of the student among students would be to undermine the power of oppression and serve the cause of liberation” (p. 75). The models and roles of banking education

places teachers in the role of ‘depositor, prescriber, domesticator,’ they cannot act in relationship to students, but must act upon learners, and in doing so, enter an impossible situation, ever seeking more fully to do what is impossible – to impose thought, to tell a learner what to think, which imposition would not be thought by any real definition, but repetition, and which imposition only provokes more resistance (p. 77).

In contrast to this banking model, Freire conceptualizes a ‘problem-posing’ model of liberatory education, in which learners, participating with a teacher who poses problems (or, I might suggest operating of their own volition,) work together to contribute their knowledge and learning to solve problems present within their own communities (p. 79). Rather than being conceptualized as empty vessels, this problem-posing model conceptualizes learners as bringing with them not only knowledge, but abilities to see, learn, and create solutions to real-world problems that impact them and their communities. Moreover, it conceives of learning and learners as a continuous state of communication with the world – acting upon the world and reacting to the responses of the world, reflecting upon the effects of proposed solutions and actions taken being a deeply humanizing process, a praxis in dynamic interaction (p. 84). These ideas have been so thoroughly resonant with the development of the social sciences that his book *Pedagogy of the Oppressed* is believed to be the sixth-most-cited book in the social sciences (Green, 2016).

Through these descriptions, Freire builds an ethical model we can use as both a goal to test innovations against (is this model enabling problem-posing or liberatory education?), and a framework by which we can test this progress – that of praxis, action paired with reflection, operating in concert so that the action creates a situation we can reflect upon (both the action and the outcomes) and the reflection improves the action, which can further inform reflection . We can apply this framework to the development of educational innovations, presenting one measure

of what an ethical innovation would be efficacious towards. In Freire's conceptualization, unethical or anti-ethical innovations would enhance the power or ability of the banking model. Such innovations might hold learners more entranced to the voice of the instructor, ensure that they are repeating back the information conveyed to them (particularly without modification), or ensure that they return the 'value' deposited in them during the learning process. By contrast, liberatory educational innovations would enhance the ability of learners to pose problems, and to form and enact participatory structures through which they would work together to resolve these problems.

To my knowledge, there has been no thorough review of educational technologies in comparison to Freire's conceptualization of the banking model. A more thoroughgoing analysis of these differences would be a valuable next step in my research, but in the current situation, I seek to contribute to this description of the problem the following brief analysis.

Most of the educational innovations evaluated or predicted in the New Media Consortium horizon reports fall within a 'banking model' framework. In this model, teachers create the content, and theirs is the voice that 'counts' – they produce the contents for learners to 'consume'. This echoes the issues present in our review of the history in the previous chapter and reiterates one of the first difficulties of most educational innovations: that 'experts' are expected to contribute content to the learning process, and learners are expected to consume it. In this framework, both are dehumanized and disempowered – even in the practical difficulties of creating content for the platform. I will note that creating and consuming content is not necessarily dehumanizing in this framework (content can be consumed to help solve problems.) Rather, setting up systems where one is conceptualized as only being a creator or only being a consumer of content is dehumanizing.

We can use Freire's ideas to develop requirements for an educational innovation as we attempt to develop one that will fit this ethical model. In our reading of Freire, a key requirement of an ethical educational innovation would be its ability to organize the learning of participants to respond to local problems, and increasingly draw them into reflective participation with this problem-posing interactive practice. We also cite as a requirement the orientation of the learning systems or educational innovations toward the knowledge and contributions of learners. In short, an educational innovation which centers or advances the transmission of knowledge from teachers to learners, or the repetition back of that same knowledge from learners in a testing form might be cited as following a 'banking' model of educational innovation. By contrast, an educational innovation which centers or advances the abilities of learners to contribute their own knowledge, or their abilities to learn, their reflection and their action, and thus to the solution of problems, might be regarded as a liberatory learning innovation. As we will cover in the next chapter, there have been a number of examples of these innovations, including Knowledge Building (Scardamalia & Bereiter, 2014), but there are others we could cover but have not, like Freire's own practices as a teacher, and research like that of Meixi, whose work to bring students into teacher professional learning settings as owners of important ideas and explicitly shift power relationships in schools (Meixi, 2017) is a revealing and impactful example. Unfortunately, such innovations have rarely been widely adopted, or even taken up within the discussions of educational change such as the NMC Horizon Report.

One apparent contradiction in this framework must be addressed – when Freire conceives of problem-posing and liberatory education the primary problem he is interested in posing, and in participating in the solution to, is the contradictions of oppression (pp. 112-113) Given the broad-based interest of this dissertation in educational technology which may serve for general educational purposes, how do I reconcile this general interest with Freire's interest in resolving

the problems of oppression? I address this in two ways. First, I base my reconciliation in Freire's framing of the leader of liberatory educational processes as trusting the people and their creative power (p. 75). Given this trust, it seems good to trust learners also to frame problems of their own, whether those problems are those of the right engineering of hydraulic systems for public works, or the discovery of new undersea animals. Perhaps more importantly, I do not draw a clear line of separation between learning about oppression and its contradictions and learning in other subjects. As I will discuss further when addressing Medina, our ways of learning other subjects are wrapped up in oppressive, banking-oriented forms of education, as are our current broadly adopted learning technologies. I will argue, then, that in learning other subjects, learners engaging with the practice of participating with each other as peers to solve problems is itself a form of liberatory education, albeit around the edges and corners of the prevalent issues of dehumanization. Furthermore, in participating in liberatory frames of learning about and creating knowledge about other subjects, may learners not create the material, perhaps even the capital, for further liberation?

This suggestion brings with it an interesting contrast. Both innovation in educational technology and liberatory education are conceptualized in a global context. It is one of the benefits of educational technology that innovations made in one place can, at least in theory, be replicated in others, that technologically produced curricula can be reproduced. Likewise, liberatory education responds to global issues that are a result of a history of colonialism and capitalism, global politics which influence every context of education. By contrast, learners in these contexts would likely be engaged in local projects in improving materials. However, there is real value to this local application of generalizable models, because learners engaging with local issues bring with them a deep knowledge of these issues – a resource from which to contribute in combination with the generalized knowledge they are learning, as well as the ability

to operate within localized teams, which is often easier to do than globalized teams, if only for language and point of reference. None of this, of course, precludes materials these learners might produce within renewable assignment or open education frameworks from being used, reused, translated, and localized around the globe, but there is a deep difference between frameworks which encourage this localization and encourage use within local networks and cultures, rather than restricting this use.

Many of the most broadly adopted educational innovations of the past century share more with the banking model than with the liberatory model. One element of this is their conception that materials and teaching developed in one place can be re-used in other places with little to no modification. Even beginning from the early 20<sup>th</sup> century fascination with film (silent or ‘talking’) as education, radio, and materials delivered by mail, the most broadly adopted and used innovations in learning have been focused on the transmission of knowledge from the teacher to the learner. This has changed surprisingly little with the growth of interactive technologies in the later years of the 20<sup>th</sup> century and the beginning of the 21<sup>st</sup>.

While some innovations (like the domain of one’s own or Wikipedia) have been hailed as bringing with them a new era of interaction in learning, in reality, the leaders in terms of market adoption have been the ‘Learning Management System’ or LMS, the name itself seeming fitting for a bank. Most of its functionality fits the sound of the name, focused heavily on pages created by the teacher for the students to review, videos created and posted by the teacher for the students to review, and tests or evaluations given by the teacher to check the learners’ retention of the knowledge deposited. While LMS’s also regularly include opportunities for learners to contribute, the ‘discussion boards’ in them are, as the name indicates, centered on the students discussing the knowledge or prompts given by the teacher, and responses are not owned or

carried forward by learners, as we will discuss further regarding Knowledge Creation in the next chapter.

Finally, assignment submission portals are generally built around the assumption of individualized assignments to match with a ‘rubric’ of the instructors’ design. Perhaps most tellingly in this model, Learning Management Systems assume the teachers’ ownership of the learners’ materials. In most Learning Management Systems, teachers can withdraw or delete materials from the platform – even materials contributed by students from the discussion boards. If the teacher deletes an assignment a student has submitted, that submission disappears from the platform. While teachers teach similar classes across years and can carry their content with them into new classes through ‘course copy’ or ‘course import’ functionality, learners have no similar functionality, and instead, the content they reviewed and produced in previous classes remains in the teachers’ control, disconnected from their future and past learning. In contrast to designs that have been modeled after a community of knowledge contributing, critiquing, and creating knowledge, particularly Scardamalia and Bereiter’s Knowledge Building software discussed in the next chapter (2014), or the STARS Legacy Cycles design also discussed in the next chapter (Schwartz, et al., 1999)., it is telling that the LMS, with its assumptions of teacher ownership, has remained a dominant force in educational technology.

The two other most widely adopted educational technologies, Videoconferencing and Lecture Capture, require less discussion to show their relationship to the banking model of education. Videoconferencing, while its two-way interaction might suggest the possibility of community building, has largely not borne out this promise, instead, increasing the perceived passivity of learners, particularly during the COVID-19 crisis. In reality, a videoconferencing in this particular application is a poor solution for a liberatory model of education, because it is primarily organized around the idea of a single speaker and an audience, as multiple voices

speaking at once within a videoconferencing system is more unsustainable than in a physical space. Lecture Capture, with its focus on capturing the lectures of the teacher for asynchronous transmission to and viewing of learners needs even less discussion. If only for the sake of theoretical completeness, I will mention here the similarity between the name of UW's lecture capture system "Panopto" – one of the most popular lecture capture systems in the university market, and Michel Foucault's criticism of the "Panopticon." (1977)

It is interesting to note that many of the most successful (both in terms of efficacy and adoption) non-educational technology-based innovations of the previous century, and arguably earlier, invert this paradigm and focus on new contributions and interactions from communities that were previously audiences. Sites like Wikipedia, YouTube, and even Facebook or Tiktok have facilitated broad adoption by creating platforms in which communities do not listen to an authoritative centralized voice, but to other users who develop and express their expertise within the community. These platforms have transformed the traditional power relationships of publishing and knowledge creation within our society, in a way markedly parallel to the transformation incited by the printing press (see Kerr, 1990; Bawden, & Robinson, 2000) in which a much broader segment of the society can participate in knowledge creation and dissemination.

Of course, in this description, the problems of these platforms are almost immediately apparent, particularly to any current observer of the technological landscape. These platforms are notoriously and measurably inequitable environments for the solving of community problems. Each one of these platforms has been the subject of separate research on its inequities. For Wikipedia, the inequities in content and editorship between genders (Tripodi, 2021), as with gender and sexual violence on YouTube (Chakravarthi et al, 2021) have been well researched. With Facebook or TikTok, researchers have particularly discussed the deeply unethical ways the

platforms creates an anti-reciprocal relationship with its users by drawing them into echo chambers in which voices are valued which share the vices of being both similar to the user in question, and divide the user from other users (Zuboff, 2019).

In many ways, this theoretical problem appears to be currently caught between the proverbial rock and hard place. One can ‘lock down’ the means of publishing and knowledge creation, and in doing so can form an undemocratic ‘banking’ model of knowledge creation, curation, and sharing, which relies upon often overworked ‘experts’ to create and disseminate content. On the other hand from this unacceptable outcome, one may throw open the doors to all creation, and repeat the inequities of the culture on a broad scale. This is precisely the paradigm that played out in Wikipedia’s creation; the platform beginning as an encyclopedia of peer reviewed, expert advice struggled with content generation and only found broad adoption when it opened its editing to a broader populace (Sanger, 2005), but in doing so, has struggled with issues of ethics and inclusion (Tripodi, 2021). In order to dig deeper into how to enact learning innovations which take advantage of the technological means of production while upholding the ethical values of both being open and being inclusive, we need to develop both theoretical and practical guidance on how to develop equitable knowledge creation communities.

### **Medina: Resistance as a Way to Create Equitable Participatory Structures**

Toward the end of ethical and equitable knowledge creation communities, I draw from the work of José Medina, a philosopher of epistemology, whose recent book *The Epistemology of Resistance* (2013) is a fertile analysis of processes of social knowledge creation and justice within those processes. Medina provides a way to describe and further evaluate innovations which might be both ethical and effective through engaging with ‘resistance’ to create both just, well-validated knowledge and a just society.

In Medina's conception, racial and gendered injustice (and other forms of injustice) take on an epistemological dimension in that they lead to marginalized people being blocked from contributing to the culture's knowledge in keeping with their actual expertise, while dominant groups can make 'contributions' (often erroneous) well beyond the pale of their actual expertise. This is detrimental both to marginalized people, who are unable to fully participate in the broader culture, and that broader culture cannot benefit from their participation (p. 27). Resistance takes place through a variety of forms of 'friction' –actions that (when they are 'beneficial friction') call into question the presumed expertise of dominant group individuals or presumed ignorance of marginalized group individuals, while calling on dominant group individuals to learn about marginalized communities as a form of ethical and epistemological development (p. 3).

It is important to state that Medina's analysis touches on both ethics and efficacy in terms of epistemology. Centering his analysis on descriptions of what he calls 'virtuous' and 'vicious' epistemological habits (p. 30-40, p. 40-48), Medina describes ways in which 'virtuous' epistemic habits create more accurate, verifiable, and valuable knowledge through rightly respecting the testimonies of various participants (p. 19). By contrast, vicious epistemic habits undermine knowledge creation by relying on biased assumptions and shirking one's epistemic responsibilities to participate in the community by rightly evaluating testimonies and knowledge claims (p. 17). These vices lead both to the degradation of epistemic character, and to the degradation of the knowledge created.

Medina's analysis is primarily related to the role of race in epistemic practices, but his descriptions of vices in the sense of racially unjust epistemic practices and virtues in the sense of racially just epistemic practices can be easily and effectively extended to a fuller description of the forms of supremacy practiced in our and other cultures. Classism, patriarchy, heteronormativity, colonialism, and other forms of cultural supremacy repeat these same biased

knowledge creation practices, and by repeating these same epistemic vices, they also produce the same poor effects, degrading knowledge practices and the state of knowledge in ways large and small.

While Medina does not explore these in more detail, it is worth mentioning here the similarities between Medina's descriptions of racist epistemic vices and the epistemic vices that have done damage throughout our culture. Other researchers have documented how *epistemic arrogance* has led to airplane crashes (Alam, 2015) through ignoring the input of 'lower-class/less knowledgeable' co-pilots, the propagation of deadly medical practices through the intersection of gender and class on judgements of women's knowledge of medicine (Malterud, 1993), and the contributions to ecological damage done by racist and colonialist close-mindedness toward the testimonies of indigenous peoples (Betasamosake Simpson, 2017). In the field of learning, the ineffectiveness of learning innovations has been partially ascribed to the epistemic laziness of educational technology innovators in regard to the knowledge of teachers and practitioners of learning (Kerr, 1989). Other researchers have even documented relatively mundane (but important) financial impacts on the success of hotels caused by classist assumptions about staff raising problems impacting customer experiences (Koc, 2013).

A core idea, as represented in Medina's title, is that of 'resistance.' The metaphor is physical— that of friction. Medina's point is that calling attention to the facts of situations misrepresented by people who are unjustly believed and the expertise of people who have been epistemically marginalized, can create 'rough ground' or epistemic friction, giving opportunities for the participants in that culture to change their behaviors (2013, p. 3-4). Medina's idea of resistance could be thought to be like the resistance encountered by weightlifters, who build strength by exposing themselves to progressively increasing forms of resistance.

Further extending this parallel, Medina writes about the roles of beneficial and detrimental resistance – resistances which build up or break down. In the same way the right amount of progressive resistance increases the strength of a weightlifter, the right amount of epistemic resistance helps to develop epistemic virtues. As with physical resistance, there is also a detrimental form. Just as poorly applied resistance may cause injury or overtraining in a weightlifter, too much epistemic resistance or resistance at the wrong times can also be detrimental – particularly to marginalized people who encounter significant resistance simply existing in a dominance-oriented culture. Through their cultural position, people from epistemically marginalized communities tend to encounter greater resistance, putting them in a position to develop greater strengths in a subset of epistemic virtues than those from epistemically privileged communities (p. 43).

This occurs in part because being from an epistemically marginalized community creates automatic resistance between one's position and that of the culture, while those from privileged communities not encountering this resistance may not develop these epistemic strengths – instead, nurturing epistemic laziness in the same way the muscles of the chronically immobile further weaken. Through these differing experiences, learners develop, or fail to develop, what Medina calls 'lucidity' – awareness of one's ignorances and motivation to correct them (p. 44-45).

Medina expands on this key social dimension. Unlike weightlifters, who generally cannot develop the muscles of people around them through lifting weights, epistemic virtues and vices exist in a highly social context, informed by the social imagination of representations, scripts, and beliefs created by everyday social interaction (p. 67). Our epistemic interactions as humans, from structures of power and influence to small actions of recognition, of open-mindedness, of humanization, or of dehumanization, impact the actions of others, particularly when made from a

position of power. As such, epistemic virtues and vices can be developed, or at least triggered, by social action, and are strongly influenced by the systems and structures societies put into place.

Medina discusses at some length the vital responsibility of society and of organizations to provide beneficial resistances. Medina uses the example of a student at Vanderbilt University, who, after a party involving the roasting of a whole pig, left the pig's head outside the Ben Schulman Center for Jewish Life. The student then claimed ignorance as to the meaning of pigs in Jewish culture or why this action would be offensive. Medina's thoroughgoing analysis points out that this claim of innocence through ignorance is both an attempt to avoid the resistance of discovering one has acted in an ignorant and racist way, as well as an attempt to absolve the institutions and social contexts the student has interacted with, as those institutions and social contexts did not provide the necessary resistance to the students' ignorance to help them avoid a racist act, and what Medina refers to as *culpable ignorance* which is not only an ignorance of one's peers, but of the history of one's own community (pp. 135-144). As such, social institutions, like universities, are responsible to both practice and develop epistemic responsibility.

Medina also develops a positive version of this social structure of responsibility, laying out the impact of actions which cause beneficial resistance, and enable others to create beneficial resistance. In Medina's conception, since epistemological justice, virtue, and vice are informed by the social imaginary, a social setting that permits and even encourages encounters with beneficial friction, creates "chained actions." These chained actions are instances of epistemic resistance which enable other acts of resistance. Chained actions can, and often do, occur through the leadership of *meta-lucid subjects*, people with a deep understanding of these epistemic inequities and their impacts. However, chained actions also often happen through everyday interventions, as when a woman's voice is believed and called attention to, allowing

other women to speak out, or the preservation of indigenous language supports preservation of indigenous knowledge. It is important to note that, as with the previous metaphor of weightlifting, the aim of these interactions is to create a “transformative but not shattering lucidity” (p. 220) – that is, a chained action which introduces a healthy, helpful level of resistance.

Acts or words which create epistemic friction can also create a virtuous epistemic cycle. This framework ties the ethical/epistemic development of society to small interactions within groups of people, rather than solely to leaders. Medina’s framework can be read as parallel to Freire’s in its incrementalist and local nature, envisioning the learning of the society to be far more related to the interactions of people within the society than in a kind of transmission from above. Medina does not prescribe classes, seminars, or lectures, nor does he think ‘banking’ will be an effective means of changing the attitudes and actions of the epistemically vicious. Instead, in interactions often engaged in local issues, epistemic virtue can be developed. In this way, Medina describes his own theories and practices as incrementalist, as opposed to the revolutionary frameworks described by some, in which the necessary changes come in large and immediate forms.

Medina’s framework, however, does not disallow the idea of guides or what Medina calls *metalucid subjects*, who are aware of the impacts of oppression (one level of resistance) and of its further impacts upon the knowledge of the group (another level). These metalucid subjects, like leaders in Freire’s conceptualization, serve both to point out problems, and to help guide groups and communities into interacting with those problems in beneficial ways, but do not ‘transmit’ their metalucidity and are not called upon to be authorities who deposit their virtue in others, but instead, become people who spark chained actions – which is the responsibility of less lucid subjects to take up themselves as actions and participate in, rather than receive. Medina

explores both the poet Sor Juana Ines de la Cruz and the activist Rosa Parks as examples of specific epistemic virtues at work in meta-lucid subjects, whose work and who by living fully as themselves had an impact not only on the people directly around them, but the whole culture's conception of the role and scope of action of people like them, and who enabled others to see, and resist, epistemic vices.

Thinking of Medina's theorization in terms of what design requirements we might generate for an educational innovation, two primary aspects come to mind. First, an educational innovation that integrates an understanding of the ethical goal of inclusive epistemology would build into its process of participation features that would help ensure the contributions of people are valued based upon their expertise and ability to contribute, rather than on assumptions based on their outward appearance, social position, or other scripts. Perhaps more importantly, such a technology would participate in creating "cultural and structural conditions that can open up spaces for the expression and appreciation of different perspectives, of the indefinitely many ways of thinking, acting, and living that can be part of a pluralistic society." (p. 265) in this way, such a technology would help learners to minimize epistemic vice, and develop epistemic virtue, whatever the subject they are studying, because being part of the social imaginary, such epistemologies pervade and participate in developing knowledge about any subject. They might even create chained actions, helping participants in learning experiences create and manage epistemic resistance for themselves.

### **Vygotsky: Meaning-Making, Levels of Resistance, Capacities for Adoption**

The ideas of beneficial resistance, of chained actions, and the participatory, social nature of knowledge and discovery all have resonances with the work of Lev Vygotsky. Both his social position and his area of study were different from Medina's. Vygotsky was a researcher within Soviet Russia, studying mostly the learning of children as they adopted relatively simple tools

and language, not as heady as the social imaginary or liberation. Still Lev Vygotsky's thinking about the way learners learn to use pencils, words, numbers, and colored cards still evokes Medina's social imaginary. Vygotsky's framework of how these tools are learned and adopted, the "Zone of Proximal Development" (ZPD) is strikingly resonant with Medina's development of sensitivities or lucidities through beneficial resistance.

Working here from *Mind and Society* (1978), an English-language compilation of Vygotsky's writings, Vygotsky worked almost exclusively as a psychologist of learning and society in Russia in the mid-20<sup>th</sup> century, and was primarily interested in the adoption of tools (pencils, notes, or numbers are examples) by school-aged children. Vygotsky and his collaborators were responding to previous theorists who saw children's adoption of tool and language use as being 'botanical' (p. 19) or animalistic (p. 23), that is, seeing children's development of the use of tools and language as a result of the maturation of the organism (in the same way a flower is a result of the maturation of its plant), or in the animalistic frame, as a pure imitation. Working from a number of experiments, Vygotsky argues that symbolic activity and tool use (or "practical intelligence") have a dialectical unity in human psychology and development (p. 24).

Through several experimental investigations, Vygotsky and colleagues demonstrated examples of the socially embedded and non-linear ways that tools are treated and embedded with meaning in the process of learning to use them. For example, a child given the opportunity to get a piece of candy from the top of a cupboard, and a stick and a stool as tools to get it, talks out loud, reflectively, through the action (p. 25). Like Freire, the learners in these situations are conceived of as active, and bring with them prior knowledge that is both beneficial to adopting the use of tools, and also is related to the overall social understanding of the use of those tools. Vygotsky also deeply emphasizes the recursive nature of the learning processes – just as

Medina's epistemic virtues and lucidities help learners to find new ways to become more virtuous and lucid, so too the practical intelligence and symbolic reflections gained in a round learning and development of becomes applicable to adopting new tools – and the tools themselves often become useful in the further accumulation of knowledge (p. 51). Like Medina, this process of growth and recursive learning is conceived as both wrapped up in a social imaginary (p. 30) and as incremental (p. 57)

Perhaps Vygotsky's most important theoretical contribution to this theory of tool use is the concept of the "Zone of Proximal Development," a theoretical 'space' of learning which is close enough to the learners' current abilities that they can 'move' (movement in this metaphor meaning increasing their skill and understanding) into this area with the help of someone more knowledgeable in the use of that tool (p. 84-91). Equally importantly, this structure suggests that abilities for independent action (what Vygotsky calls 'development') lag behind the learning processes that are the beginning of children internalizing the uses of symbols or tools (p. 90-91). Furthermore, this suggests that learning and development are not parallel processes, but a highly dynamic process, mediated by the individual, their social situation, and the processes that the individual follows toward initial learning and the internalization (their own unique internalization) of the ways they interact with the world (p. 92).

For our purposes, Vygotsky's theories are particularly useful for three reasons. First, their parallels to Medina's and Freire's theories can give us more guidance toward the specifics of design requirements which might bring these three sets of theories into practical application through an iterative approach focused on meaningful use of tools. Second, these parallels suggest a shared effective dimension across ethical goals. Freire, Medina, and to a greater extent, Vygotsky, are all oriented towards different ethical goals in their work. However, all three figures hold to the importance of learner participation in meaning making. Whether that meaning

making is engaged in the liberation of communities of learning, creating a society that reaps the benefits of being just to all contributors of knowledge, or the science, technology, engineering and mathematical tool use Vygotsky explores. All three of these figures hold to the importance of learner's active participation and a social context that guides effective learning experiences, and emphasizes the role social imagination and social interaction play in creating knowledge bases imbued with all the participatory richness that only social interaction can supply.

Third, and perhaps most importantly for our purposes, Vygotsky's Zone of Proximal Development suggests an expansion on our previous dichotomy of content production and consumption. Rather, if we take Vygotsky's frame seriously, content can be seen as a tool for learners to use, a tool which they are invited to invent new meanings and uses for, which they can play and interact with in a dynamic and unpredictable participatory process, in which uses shift, as can the uses of the tools used to mediate those interactions. Vygotsky particularly explores the ways tools are 'internalized' by culture, which we can frame as another form of input on the social imaginary. The tools people use have an impact on what they imagine to be possible, and what they imagine themselves to be capable of. In a very real sense, Vygotsky argues that our tools also make us (as others have argued). As such, if we create and adopt tools with the aim of creating effective participatory structures, we will also help people to internalize those participatory structures, to the point that they may be able to imagine and enact them in ways they were not able to do prior to that tool use.

Educational innovations introduce tools into the usage of practitioners, and those tools can be relatively familiar or unfamiliar to the practitioners of teaching and learning. In this framework, we can understand that innovations which are not 'proximal' to current usages and processes are unlikely to be adopted or have social meaning within the context. In fact, the outcomes of these tools may be unimaginable in the context, since the users did not have the

capability former to accomplish what those tools now enable. Likewise, tools and innovations which are not proximal to learner practices may be so unfamiliar that learning to use the tool distracts from learning the subject at hand or solving the local problem together, and therefore is ineffective.

This is a useful perspective when we evaluate the reasons some of the more transformative models of educational innovation have not found more broad adoption within educational communities. As effective as they might be (and the high efficacy of some such models will be further discussed in the next chapter), if they are so different from current processes as to be regarded as non-proximal, adopting them will be out of the reach of practitioners, and they will be neither effective nor will they be able to achieve their ethical ends. Furthermore, they sometimes seek to counter their unfamiliarity by ‘simplifying’ their adoption through being relatively prescriptive, where real tool adoption and use is dynamic and social. So, in addition to pursuing ethical ends and doing so in ways that will be effective in the learning process, educational innovations need to pursue adoptability by remaining ‘proximal’ or incremental to usual practice, and being socially engaged and dynamic to the extent possible while remaining proximal. But there is deep promise to this proximal design, as well, because the suggestion is that with the iterative internalization of these tools and their capabilities, learners and the social groups they inhabit will become ever more capable of achieving these ethical aims, eventually even without the tools that first enabled them.

Freire, Medina, and Vygotsky, perhaps most deeply, share an experimentalist, interactionist, relational framework to their epistemology and orientation. Coming from such differing cultural, linguistic, and academic backgrounds, all three thinkers frame “ideals ... not as ahistorical standards of assessment for any society, but as imagined solutions for particular problems, or as hypotheses” (Medina, 2013, p. 10). The cycle of problem, hypothesis,

experiment/action, and reflection, is present to a great degree in all of them, as particularly in Vygotsky it comes into an experimental form, as he argues that to understand higher-order human behaviors, we have to understand the interactions of signs and tools in overall processes of behavior and change, rather than in purely behaviorist interactions or objects (Vygotsky, 1978, p. 61) I seek to embed this cycle, both in the technologies I design, and in the way I measure them in this dissertation – not as an external authority, but as a participant-observer, suggesting to groups ways they might work together in order to better achieve the aims they have set, within the context of their action.

In summary, the varying perspectives and contributions of Paulo Freire, José Medina, and Lev Vygotsky can be instrumentalized to create requirements for ethical, effective, and adoptable learning innovations. In the descriptions we have reviewed here, we found that such requirements would include: valuing learners' contributions, posing or facilitating problems for them to solve in their communities, facilitating the groups' valuation of comments based upon their knowledge and ability to contribute, rather than based upon social stigma or bias, facilitation of 'chained actions' and the general development of epistemic virtue through encountering beneficial epistemic resistance, and a 'proximity' both to learners' and teachers or administrators' practices so that the innovation can be adopted and its uses developed in a social system of participatory meaning.

Of course, this is only one reading of Freire, Medina, and Vygotsky, and I remain very aware that each of these three sources have contributed a substantial body of work. As such, it would doubtless be possible to generate alternative interpretations and alternative requirements for ethical, effective, and adoptable learning innovations from these sources, and from others. However, this exploration could also be endless, and if we do not turn at some juncture from the description of the requirements to their realization, we risk being caught in an endless loop of re-

theorizing and reinterpretation, which would not only not serve the ends of educational innovation, but would also not serve the principles of any of these authors. With this brief apology for brevity, we turn next to practical predecessors – examples of learning design which have brought some of these requirements into the practice of teaching and learning, as a way of exploring what sources we might draw on to create learning innovations that practically and positively impact the practices of teaching and learning.

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### **Chapter 3: The Jigsaw and the Wheel: Jigsaw activities, Challenge Cycles, Renewable Assignments, and High Structure Renewable Learning as Practical Designs.**

#### **Structure of the Chapter, Relationship to Broader Research in the Field**

As there are innumerable ways we might conceptualize and measure the ethics, efficacy, and adoptability of learning innovations, there are likewise innumerable ways we might enact the ethics, efficacy, and adoptability of learning innovations. It is not sufficient for the current conceptual framework to lay out descriptions or requirements of what an educational innovation might accomplish. It is also necessary to describe, if briefly, some practically tested educational innovations and justify why they may hold potential to be starting points for the ethics, efficacy, and adoptability we are seeking in our learning innovations.

This is an important transition point for two reasons. First, there are numerous ways of interpreting theories and theorists like Freire, Vygotsky, or Medina into practical learning designs and technologies. By comparing their theories with examples of learning designs and technologies in the real world, we can draw guidance on how we might make this difficult translation, other practices on which to model our own. Previous examples help us select among the almost innumerable ways we could use theory to guide practice. Secondly, and perhaps more importantly from the framework of this dissertation, the sort of design experiments which I'm most interested in are a conversation, a back-and-forth between theory and empirical reality. It is through this process that the processes of learning we are trying to reveal is made clear. This back and forth is closely aligned with all three thinkers we reviewed in the previous chapter. It is closely related to Vygotsky's methods for uncovering the internal and external formulation of children's learning. It enters Freire's writings in his descriptions of Praxis – the working out of (and updating of) theory through interaction with the real world, which avoids the

dehumanization present in idealized theories, which supercede human experience and communal verification. Similarly, as in Medina, the ‘friction’ of empirical realities, the design constraints of non-theoretical practice, provide a form of friction, a resistance, against which we can test our ideals of adoptable, effective, and ethical learning innovations. By rooting our approach not only in the thinking of past theorists, but in the practices of other practitioners, we can strengthen our opportunity to correctly frame and measure the impacts we seek to have.

This chapter is an attempt to lay out a brief history of some practical explorations that align with the theoretical constructs of Freire, Medina, and Vygotsky. In describing these practical explorations, I will also attempt to describe the ways these practical innovations intersect with the previously described theoretical constructs. Particularly, I’m interested in when we might believe that further incremental improvements on these innovations could lead to learning innovations that are ethical, effective, and adoptable by being effectively liberatory, problem-posing, equitable, and adoptable by a broad range of current practitioners. As we reviewed in the previous chapters, I am looking for opportunities to transform key relationships within the learning process, particularly the relationship of learners and instructors to content.

This chapter functions as a brief review of several combinations of technology and design that could be classed as educational innovations. We will move in roughly chronological order, though research of some form on these innovations has been ongoing for decades. This chapter will discuss four innovations: Jigsaw exercises (Blaney et al., 1977; Aronson & Bridgeman, 1979), STARS Legacy Cycles (Schwartz et al., 1999), Knowledge Building (Scardamalia & Bereiter, 2014), and Renewable Assignments (Wiley & Hilton III, 2018). Each of these innovations presents a unique combination of the requirements we covered earlier, whether through emphasis on equity of knowledge contributions in jigsaw activities, the deep emphasis

on learner empowerment of knowledge building, or the social meaning-making processes of STARS legacy cycles.

As each of these innovations presents a part of the requirements described in the last chapter for an equitable, effective, adoptable educational innovation, this chapter should not be regarded as presenting models we will later copy, but as a set of influences we can adopt and adapt as we develop new modes of teaching and learning. As we begin this description, I also want to frame the efficacy of these models in the broader discussion of the field of high structure active learning. In a very brief summary, empirical classroom research over the last decade has contrasted active learning, in which learners are participants in their learning, with passive learning, in which learners' role is to 'absorb' the information provided by an instructor. Freeman et al's thorough 2014 meta-analysis looked at 225 studies of science learning in higher education found that when learners were called to be active participants in learning, their learning improved significantly – and the learning of students from marginalized backgrounds improved even more. Given that each of the following instructional designs is a form of high structure active learning, and the theoretical overlap between Freire's participatory and problem-solving approach (2014), and Vygotsky's social meaning-making (1978), it feels appropriate to call attention to the broader discussion and evidence in the field that these types of innovations may be significant.

The following models are also relatively 'high structure.' Though structure and scaffolding are not dealt with directly by Freire or by Medina, we can see parallels again in the conception of "transformative but not shattering lucidity" and beneficial resistance (Medina, 2013 pp. 48-49, 220) and in Vygotsky's framework of the Zone of Proximal Development (1978).

In the field of education, a fair bit of theory and evidence indicates that structured learning usually serves more students better than learning that minimizes structured elements. See particularly work from Mayer on extraneous cognition (Mayer, 2017), the various approaches to scaffolding (Doo et al., 2020; Ninio & Bruner, 1978), and Kirschner et al.'s (2006) criticisms of the lack of evidence for results of lower structure active learning. I will note that relatively little work has been done (as far as I have found) in creating typologies that would help to classify learning designs as high or low structure, and this might be an avenue of future research in active learning useful to researchers and learning designers alike. Our project here, however, is to review specific designs and relate them to theoretical constructs that might help us understand their ethics, efficacy, and adoptability, as well as designing learning interventions that would beneficially draw on these relationships.

### **Jigsaw Assignments**

Jigsaw assignments were developed in the context of the desegregated classrooms of the late 1970's as an explicit response to racial dynamics in those classrooms that led to students from marginalized communities being marginalized in classroom discussions and group work. As such, Jigsaw exercises can be regarded as a form of anti-racist pedagogy holding direct parallels to Medina's framework of epistemological resistance.

In the now-classic Jigsaw exercise framework, students are placed in small groups (4-6 students per group, but it is important that the groups each have the same size). Lesson materials that would usually be distributed to each student are instead divided into 'jigsaw pieces' – individual sections of the lesson material separate from the other sections. These pieces are then distributed to members of the group so that each member of the group has a unique piece of the lesson materials, with no two students in the same group holding the same information. Each

learner is tasked to independently learn their part of the material and teach it to the other learners in their group.

In early versions of this instructional design, jigsaws were often quickly followed with quizzes that each member of the group took independently. Through these quizzes, students learned that it benefited them to listen to and give space for the contributions of all the members of their group, as they would miss vital information, and therefore quiz questions, if they silenced any member of the group (Aronson & Bridgeman, 1979, p. 441).

In comparative experiments between classrooms implementing Jigsaw assignments and traditional, individualist forms of teaching, with matched curriculums, jigsaw assignments were demonstrated to increase liking for schools, school assignments, and groupmates within and across ethnic boundaries, as well as to increase self-esteem. Interestingly, these positive trends occurred for both members of marginalized and members of dominant ethnic groups - and these results were demonstrated in an independent experiment (Aronson & Bridgeman, 1979, p. 441). Other experiments showed that learners from marginalized ethnic groups performed significantly better in classrooms that implemented Jigsaw activities compared to those in traditional teaching classrooms, while learners from dominant ethnic groups performed similarly (Blaney et al, 1977). In their description of then-current research on Jigsaw learning assignments, Aronson & Bridgeman compare them to other emerging methods of interdependent learning, and find broad similarities, with each of the different approaches focusing on forming interdependence within groups of learners, which also found similar positive results.

In this way, Jigsaw assignments particularly fulfill the requirements we've described above through being relatively similar to normal practice (instructors do not need to develop new materials, only to divide materials into the requisite parts, learners have to learn materials in a similar way they would otherwise, only in smaller chunks) as well as in the effective and ethical

dimensions of guiding learners into attending to each other's contributions, even when those contributions come from people from epistemically marginalized groups. Jigsaw assignments enlist learners in formulating their own learning and synthesizing it in small groups, an advance over listening to and repeating back the words of the instructor. Of course, classrooms implementing Jigsaw assignments could strongly emphasize this synthesis, or not, based on the ways that they encourage student learning and report out. For example, by encouraging and praising small groups in applying the synthesis of materials to problems in their own community, this assignment might take on a more liberatory form, while emphasizing the quizzing, memorization, and repeating back of the divided materials, can make the activity more resemble a banking education model.

Jigsaw assignments do still place at their center a high value on the words of the instructor or the authority, in this case, through the materials distributed, and reassembled, by students. While the interdependent groups are working to (re)create the knowledge, there is still minimal emphasis on their own thoughts and contributions. Students engaged in Jigsaw-style learning are not, at least not directly within this construct, tasked with expressing their own voice, or bringing their past knowledge together with new knowledge to express, own, or develop their best thoughts and contributions.

### **Knowledge Building**

By contrast, "Knowledge Building", the innovation Marlene Scardamalia and Karl Bereiter have spent the last thirty years developing, heavily centers the perspective, knowledge, and ownership of learners in the learning process. Unlike Jigsaw Assignments, knowledge building is also a unique combination of tool and learning design, which Scardamalia, Bereiter, and colleagues continuously develop to assist learners in developing, demonstrating, and owning their knowledge (Scardamalia & Bereiter, 2014).

Built specifically to emphasize the practices and needs of knowledge communities in a knowledge-centric world, the Knowledge Building platform and practices provide learners with strong opportunities to express, own, and develop their own thinking on subjects, and partner together to solve problems and answer questions in groups. In a knowledge building classroom, learners use the knowledge building software created by Scardamalia, Bereiter, and colleagues to create answers to key questions in science materials. They are then encouraged to review, revise, and update these materials throughout their learning careers – owning, and reviewing, their own growth and development. These ethical and effective commitments are broadly appreciated by learners, who comment on and value the emphasis on the learning becoming useful and re-usable to themselves, as they can see the development of their thinking and track their contributions across time (Scardamalia & Bereiter, 2014).

In contrast to other innovations, Knowledge Building, while ethically and effectively centering the knowledge and contributions of learners, has struggled with adoption since its development nearly thirty years ago. Scardamalia and Bereiter have not been apologetic or cagey about the fact that knowledge building as they practice it requires a significant investment into a shift of learner and teacher relationships. It requires the adoption of tools that are relatively unlike those used in many other educational contexts, and a shift of expectations about who develops content that can be difficult for both teachers and for learners (Scardamalia & Bereiter, 2014). Given that they have not developed a relatively incrementalistic pathway to adopt knowledge building, the high value and benefit of this approach has been relatively underrealized.

Simultaneously, regarding our framework of ideas and requirements, there is relatively little focus from Knowledge Building on group knowledge work or on just epistemic relationships with other contributors. While there are opportunities within the Knowledge

Building framework and toolset to develop knowledge as groups, when compared to explicitly antiracist pedagogical forms like jigsaw assignments, Knowledge Building as it is currently practiced has not developed the same level of guidance for learners in groups to develop equitable epistemic relationships with each other.

### **STARS Legacy Cycles**

Software Technology for Action and Reflection (STARS) Legacy Cycles were developed at Vanderbilt University in 1999 as a response to a developing theory of the overlapping ‘centers’ of learning experiences. Working from theories laid out in the now-classic text *How People Learn*, developed and distributed by the National Science Foundation and National Research Council (National Research Council, 2000), the authors were themselves attempting to account for four key requirements from the theoretical perspective presented in *How People Learn* – that learning experiences be “learner centered, community centered, knowledge centered, and assessment centered.” (Schwartz, et al., 1999).

In response to the challenge of fulfilling these four-part overlapping (and sometimes seemingly contradictory) requirements, the researchers developed an instructional design and supporting software centered on walking learners through a set of five steps (which learners could also move through non-sequentially, returning to previous steps if needed or valued by the learners).

Learners begin by encountering an authentic challenge – a situation that they might deal with as a real-world practitioner of the subject they are studying. Given this initial challenge, learners are tasked to document their initial thoughts - what do they currently know about the subject, how might they solve the challenge? This initial thought sharing occurs individually or in groups of learners sharing their initial thoughts. With initial thoughts in mind, learners proceed to expert perspectives and resources, either gathered by teachers, or sought out by learners

themselves. Learners are tasked to compare the expert perspectives and resources with their initial thoughts, and to apply each to the challenge or puzzle at hand, discussing how they might solve the challenge. In this part of the cycle, they assess both their initial thoughts and the expert perspectives and resources in terms of their ability to resolve the real-world challenge. Finally, learners work together with teachers to wrap up their learning, and solve the problem, or discuss the advantages or disadvantages of different solutions. In this step, learners are tasked to revise their initial thoughts. Similar to knowledge building, these revised thoughts are intended to be brought with learners into future challenges, and further revised, so that learners develop a repository of well-revised knowledge and approaches, which they can apply to a variety of challenges in the real world (Schwartz, et al., 1999).

In comparison to the requirements we developed in the previous chapter, STARS legacy cycles appear to perform relatively well in the creation of ‘friction’ – presenting learners with numerous opportunities to encounter epistemic friction, while calling on them to also activate their initial ideas, which has been shown in other research to help those ideas be revised through the learning, rather than the initial learning experience and knowledge being held separately from the new learning experience (Mueller, 2007). While STARS legacy cycles, in their initial development, lack Jigsaw assignments’ explicit focus on epistemic justice and inclusion of various voices, they are relatively easily modified to have this focus, through inclusions of explicit turn-taking in the initial thoughts section, and through dividing up the expert resources between learners to create a hybrid of jigsaw and challenge cycle assignments.

Perhaps the strongest element of STARS legacy cycles in relation to our requirements is the structured approach to engaging learners in working together to resolve issues and own and share these resolved issues. Learners in a STARS legacy cycle go through a structured process of confronting and being prompted to bring their own thoughts and knowledge to addressing the

challenge, as well as engaging with expert resources as resources to use within their own framework, rather than as authorities to imitate.

Like other methodologies that share this alignment toward shifting the relationships between learners and authorities, a weakness of challenge cycles has been in adoption. Though the initial paper describing STARS legacy cycles won the Educational Technology Research and Development “1999 article of the year” award, and though further research has shown the efficacy of this design in the context of higher education (Laghari, Ansari, & Bughio, 2017) and professional learning among engineers (O’Mahony et al., 2012), there have been relatively few, and diminishing, citations of legacy cycles in the 20 years since they were developed according to semanticscholar.org (<https://www.semanticscholar.org/paper/Software-for-managing-complex-learning%3A-Examples-an-Schwartz-Brophy/351b46c0311a5a6cf07b1db76b1bc041549188a3>), and the framework or its variations have not been implemented into the widely distributed tools like LMSs, lecture capture, and web conferencing that have become the dominant tools for technology-enhanced learning over that same time period, according to the semantic scholar page for the original Schwartz et al. article in 1999. We might hypothesize that the reason for this lack of adoption is primarily related to the difficulty of converting traditional courses to STARS challenge cycles. This conversion, while appealing, requires both the framing of new problems in the course, and the gathering of resources. While this presents difficulties for the creation of traditional challenge cycles, it presents another opportunity, potentially, to enlist learners in participation with the solutions for the problems of their community.

### **Renewable Assignments**

Renewable assignments emerge out of the practices of Open Educational Resources (OER) and Open Pedagogy. Both of these segments of research have extensive histories, and

giving them full space is well beyond the scope or aim of this dissertation. In brief, Open Educational Resources began as a technology-centric movement leveraging creative commons licenses to create educational materials anyone can adopt, adapt, and redistribute. Within Open Educational practice these rights of information use are referred to as the 5Rs – “Retain” – to keep or to archive, for an unlimited time (as opposed to time-bound licenses or access expiration) “Reuse” – to return to and use and reuse content again and again and with different groups (as opposed to single-use materials common in academic publishing) “Revise” – to change, update, edit content (as opposed to traditional academic publishing, which, short of a Dead Poets Society-style ripping of pages, resists revision) “Redistribute” – to freely distribute the content in its altered or unaltered form (as opposed to traditional academic publishing, which generally strictly restricts redistribution) and “Remix” – to rearrange or to combine content with content from other sources in order to create new or modified works (Weller et al., 2017). Though there has been some debate over the exact limits of these rights (for example, should a software provider be permitted to redistribute open educational resources with added interaction for a time-limited paid fee?) in general, the community has erred on the side of maximizing the use of these rights (McAndrew, 2010). Through this emphasis on free access to and distribution of learning resources, the OER community has focused on two primary ways of adding value to the educational process – first, by saving students costs, and second, by increasing student access to materials (Jhangiani, 2017)

Responding in part to issues of adoption, in part to questions of ethics, and in part to increase efficacy, the Open Education community has developed what has been called variously Open Pedagogy, or OER-enabled pedagogy. As one article said, “come for the resources, stay for the pedagogy” (Katz & Allen, 2020). Though Open Pedagogy as a concept predates the rise of Open Educational Resources, its adoption within OER communities developed a particular type

of relationship to Open Pedagogy. In short, Open and OER-enabled Pedagogy utilize the “five Rs” described above to engage learners in the processes of modifying, remixing, or otherwise changing OER. Given this focus, the history of previous methods known as Open Pedagogy led researchers to suggest the term OER-enabled pedagogy to represent pedagogies that focus on the use, revision, and remixing of OER (Wiley, & Hilton III, 2018).

One variant of these OER-enabled pedagogies are “Renewable Assignments” which take a fundamentally similar stance toward materials as Knowledge Building or Challenge Cycles, but with a markedly social bent. In renewable assignments, assignments are centered around prompting learners to create or revise open educational resources which can then be used and revised by future groups of students, creating a ‘renewable’ stockpile of materials for the course, thus giving future learners the benefits of highly refined course materials, which those learners can then adopt, adapt, engage with, and own for themselves (Wiley, & Hilton III, 2018).

Adopters and advocates of OER, as well as practitioners of Open Pedagogy or OER-enabled pedagogy have stated and developed explicitly ethical aims, both in the development and adoption of OER (Farrow, 2016), and in the development and adoption of OER-enabled pedagogies (DeRosa & Robison 2017). This is particularly true of Renewable assignments, given their emphasis on learners solving the problems of their community and saving future students money. Within the conceptual framework I’m developing in this dissertation, their ethics align very well with Freire’s through this iterative communal development of a solution to that communities’ issues, empowering learners to not be dependent upon a knowledge authority, but to co-construct resources for themselves and others. One difficulty with these ethical aims, which the field of OER/Open Education has recognized, is a failure to explicitly address issues of equity within the creation, curation, and dissemination of OER (Lambert, 2018; Bali, Cronin, & Jhangiani 2020).

Renewable Assignments hold an interesting variation on approaches to adoption – while they, like knowledge building and challenge cycles, shift the relationship between learners and content, tending toward active construction rather than repetition of authorities’ inputs, Renewable Assignments shift this approach in a way that also results in content creation – relieving perhaps the greatest barrier to adoption in the educational innovations we reviewed in this and the first chapter of this dissertation. By enlisting students to help solve the problem of educational content creation, renewable assignments also hold the theoretical potential to assist in the emergence of new educational innovations, as groups of students working together can more quickly and effectively generate new learning materials as new modes of education.

From the perspective of our framework, where research on Renewable Assignments has so far been lacking is in their ethic of epistemic justice. The OER community has recently recognized that they have not intentionally centered social justice issues in their work, particularly through the contributions of Lambert (2018) and Bali, Cronin, & Jhangiani (2020). However, this new emphasis has yet to be worked out in practical senses – in the real world with research directly applied to renewable assignments -until the research of this dissertation described in the next chapters. Furthermore, the research in this dissertation directly applies the lessons and guidelines of the research outlined above in order to develop a learning innovation that fits well with all the requirements I outlined in the previous chapter. The innovation I outline below borrows from renewable assignment structure where learners create content future learners can adopt and adapt to create an innovation that is adoptable by avoiding the difficulties of instructor-created content. This innovation uses high structure Jigsaw and Challenge Cycle methods to increase equity of contribution as an ethical orientation, and efficacy of learning experiences and the improvement of materials produced for all members. Finally, the design presented below attempts, through the model of assignments like tagging, to do so in forms that

fit easily with common usage, so as to create changes within the zone of proximal development of adopters of this innovation.

### **High Structure Renewable Assignments: Developing a new educational innovation**

Developing from the lessons taught by the history of educational innovation, integrating with the theoretical contributions of Freire, Medina, and Vygotsky, and the practical innovative lessons of Jigsaw Assignments, Knowledge Building, STARS Legacy Cycles, and Renewable Assignments, this dissertation centers an attempt to create an educational innovation that combines ethical, effective, and adoptable elements from all of these sources into a unified innovation, which we will call High Structure Renewable Assignments.

In short, these assignments use structures like Jigsaw or STARS Legacy Cycles to organize teams of learners to complete Renewable Assignments, bringing their own knowledge and problem-solving skills, combined with the input of experts and the contributions of their classmates, to the challenge of developing open educational materials, useful to them and to learners after them. These future learners not only have the chance to learn from these materials, but to rebuild them and own them. The following papers develop in more depth this concept, and test it in real world learning environments, utilizing the assignment structures we reviewed and testing them in classroom situations, as well as deepening theoretical and practical guidance on how teachers creating group assignments can implement theories of epistemic justice.

### **Design Research as a Methodology to Evaluate and Evolve Educational Innovation**

To accomplish this research, I have relied heavily on design research methods, also known as design experiments, and a mixed-methods approach. While design research is limited in its ability to guarantee causal relationships when compared to controlled experiments, it is appealing in four regards: First, it embeds the experiment in real-world environments, in all their richness and complexity (Collins et al., 2004). Second, it can center and represent the perspective

of participants in the learning experience (in this case, particularly learners who I want to center as vital participants in the transformation of their relationships to content and authority). Third, in its ability to explore and develop relationships between real-world experience and theoretical constructs (Bell, 2004). Fourth, and perhaps most importantly, it helps us refine questions and generate new by questions, particularly in its connection to real-world environments, which present challenges or barriers to effective learning not imagined in theoretical constructs. These sometimes surprising questions help hone further research on issues and questions that will have a strong impact on desired outcomes.

Especially in situations with many overlapping requirements, like those of educational innovations, the interactions of multiple requirements and environmental factors are difficult to predict and control. As a response, some learning sciences approaches have relied on laboratory experiments. While these may be strong and beneficial in establishing causation in the simple environments of the laboratory, laboratory experiments, with their short duration, special environment, and the usually relative independence of their subjects, do not represent real learning environments well, particularly learning environments where we might ask questions about the relationships of learners to authority figures, to content, or to each other. As such, the conclusions drawn from these laboratory experiments are difficult to generalize to real-world learning experiences, inside or outside of the classroom, and may not address the real barriers encountered in these environments.

Design research methods center learning in real environments, and often use a combination of methods for gathering data and information to accurately represent the complexity of these environments, and the unfolding processes of learning. Design research, however, is usually particularly interested in a theoretical concept and its development, and gathers data and evidence to describe the relationships between the theory, the implementation of

that theory, the environment, and the participants. Perhaps more importantly in the current context, in Vygotsky's terms, traditional controlled experiments tend to overvalue objects as determinant factors in interactions, instead of attending to processes and the unfolding of learning and development (Vygotsky, 1978, p.68-72) which, pleasingly, and meaningfully, mirrors the framework of action and reflection laid out as praxis by Freire (2014, p. 51)

While design research does not usually center the lived perspective of participants as deeply as ethnography and similar forms of pure qualitative research, design research does highly value empathy with participants (Surma-aho, & Hölttä-Otto, 2022), and particular ways of gathering design data can include feedback from participants as it does in my research. What sets design research apart from ethnography in terms of its ability to analyze the values of educational innovations is the centrality of making changes to the learning environment, process, or situation. These design experiments allow for the implementation of theories about learning practices in real world environments, in addition to the description of situations or their evolution(s) as in other forms of qualitative research.

Perhaps where design research is strongest is in its relationship to this implementation of theory in real-world situations. Other researchers have framed design research as 'speaking back to theory' (Bennett & Oliver 2011; Design-Based Research Collective, 2003) due to their interest in creating situations where the theory is enacted in a (real-world) context where it is intended to produce certain outcomes, and then the situation is monitored for further, sometimes unexpected, elements that need to be taken into account in the theory. Further changes to the environment, process, or technology are used to respond to these additional, sometimes unexpected elements, explore details of the theory, and to attempt to develop stronger and more complete theories, while keeping the goals of the theory and the practice in mind.

This exchange of information between theory and lived reality runs parallel to the idea of Praxis, which is important in Paulo Freire's *Pedagogy of the Oppressed* (2014). Freire neatly summarizes praxis as "reflection and action on the world in order to transform it" (51) he later reiterates this exchange between action and reflection: "This discovery cannot be purely intellectual but must involve action; nor can it be limited to mere activism, but must include serious reflection: only then will it be a praxis." (65) In this framing, we can think of design research as a praxis-oriented method of research, as it directly involves both acting on the world, and reflection upon that action. This is particularly true for design-oriented research which takes as a focal point the humanization and liberation of its participants.

Vygotsky and Freire both take dialectical approaches towards learning and development, seeing them not as linear cause-and-effect actions, but as evolving interactions that cycle between opposites in the process of their development. This is visible in Freire's conceptualization of action-reflection as Praxis, and in Vygotsky's' formulation of describing the observation of the evolution of processes in research on learning and development. Both emphasize that these theories and their workings are bound up together – there is not a clear theoretical framework that can be used to describe and create the reality (liberation or complex learning) that is the goal of their interventions, but instead, the theoretical framework is refined by observation, and that the observation and framework interact in a process of rich reflection that tries to adapt to observations that go beyond simplified visions of outcomes as specific or linear (Vygotsky, - Pg. TK)

In my particular instantiation of design research, I rely upon mixed methods – using surveys, focus groups, and monitoring the content developed by learners through the renewable assignments to suggest further changes and iterations. In the case of the first paper in this dissertation, these methods used surveys and focus groups to closely center the experiences of

learners completing high structured renewable assignments, and lead to a deepening of the theories explored in this dissertation, by highlighting the importance of the relationships of learners to content, and by highlighting the importance of equity in the conversations through which learners develop these renewable assignment materials. In this case, there was also a blend of qualitative and quantitative approaches to both surveys and focus groups, as I use quantitative survey questions and quantitative analysis of those questions, along with quantitative topic analysis of the focus groups to describe and analyze the perspectives of learners.

My second paper is purely theoretical, and primarily aimed at the conversation between theory and practice so central to design research. By analyzing the work of José Medina in relation to empirical research in the effectiveness of structured learning assignments, Tomas and I deepen our understanding of the requirements of an ethical learning innovation, and theorize further work that can be completed to test this implementation.

The third and fourth papers carry this work back into real learning environments, across three classrooms, two at the University of Washington, and one at Seattle Central College. While the two classrooms in the fourth were not explicitly conducting renewable assignments, and instead doing equitable group work, I believe the results are still applicable to the framework of this dissertation and so have included them as representative of my work in this area.

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## **High Structure Renewable Assignments Introduction**

The following paper was the first research I was able to conduct after developing the idea of high structure renewable assignments. While the environment was limited (a class moved into emergency remote during the COVID-19 crisis, taught by a teacher teaching the class for only her second time) these provocations provided opportunities to really think about how to shift practices, and how practices could be built in non-normative situations. I intentionally focused it on the experience of learners and teachers, and primarily used survey and focus group methods to match this emphasis. I wanted to really understand and respond to the experience of these teachers and learners, to begin to refine the idea of High Structure Renewable Assignments, and to understand the key ideas that were active in this educational innovation.

This emphasis on learners and their voices revealed three particular requirements. First, the emphasis suggested the core idea of content-comment conversation, and the overall shifting relationships to content that High Structure Renewable Assignments function within, as a part of the theoretical framework of this research. Second, the importance to some learners of having their whole voice included in their contributions pushed back against the structured nature of some designs, and third, similarly, the (different) experience(s) of learners and teachers with these assignments highlighted the vital importance of equity in group knowledge creation, leading to the focus of the papers that follow this one. This is the first of four total papers I'm presenting in the dissertation, after this Tomas and I took an opportunity to dig deeper into the concepts of epistemic justice and structured learning (paper 2), and I followed that with empirical research into the impact of structured learning on student perceptions and outcomes (papers 3 and 4).



## **High Structure Renewable Assignments: A Design Study (Paper 1)**

Peter Wallis; Jen M. White; Stephen T. Kerr

## Abstract

We seek to guide design, development, and adoption of Renewable Assignments by testing structures through which learners contribute to Open Educational Resources (OER). We design, test, and iterate four assignment structures to this end. Testing was completed in an upper-division undergraduate endocrinology course, taught in emergency remote mode due to COVID-19.

Using mixed methods: surveys, focus groups, and iterations, we assessed assignment structures and extracted design guidance for renewable assignments and open pedagogy. We find that in a remote course, these assignments were effective in advancing learning goals. Both students and teachers favored their inclusion in the course. Analysis revealed six design principles to maximize effectiveness of renewable assignments and courses, and empowering teachers and learners to contribute to open knowledge. These principles also provide insight to praxis related to theories of open pedagogy, scaffolding, peer interaction, and active learning.

### Nature of the Problem

This project was motivated by some of the broader problems in Higher Education. College costs have risen consistently and considerably (College Board, 2020). Textbook costs have increased sharply (Weissmann, 2013). Open Textbooks save students money, reduce dropout, and increase student engagement (Colvard et al., 2018) while opening the door to promising practices of Open Pedagogy (Paskevicius & Irvine, 2019), yet adoption remains low (Biswas-Diener, 2017). Efficacy of College teaching, and the worth of college degrees have been called into question (Bennett & Wilezol, 2013). Active Learning designs have been shown to be clearly effective (Freeman et. al. 2014) but adoption remains limited (Miller & Metz, 2014; Eickholt et al., 2019).

Our project seeks to address these problems through the design of high-structure renewable assignments, creating pathways easing adoption of best practices, simultaneously reducing costs and increasing learning. We build upon the conceptual framework laid out by Wiley and Hilton (2018) proposing renewable assignments in which students are invited and empowered to contribute to open knowledge. We hope to expand this doubly beneficial pathway by answering the following research questions:

1. How might we design active, structured, renewable assignments?
2. What is the feedback of teachers and learners regarding these assignment designs?
3. What practices and design guidance are revealed as we test and iterate renewable assignment designs in an authentic teaching context?

To answer these questions, we implemented, iterated, and gathered feedback on open/renewable assignments designed around open textbooks, high structure active learning, tagging, and peer review, then analyzed the feedback to find ways to maximize design effectiveness. Our literature review briefly covers the developing research in these areas, to give a sense of the threads of research and theory we drew on for our real-world design/implementation research.

### **Literature Review**

#### **Open Textbooks, Open Pedagogy, and OER-enabled pedagogy**

*Open Textbooks*: Over the past 20 years, researchers developed a strong base around adoption and use of open textbooks. Overall, their research finds that open textbooks save students money (Hilton, 2016), and increase desirable academic outcomes, especially persistence of students from marginalized groups (Colvard et al., 2018) while not negatively impacting other academic outcomes. No clear drawbacks have emerged in research on Open Textbooks.

Faculty and student perceptions of open textbooks are generally positive, with some concerns about quality and about the difficulty of adopting a new textbook (Weller et al., 2017). Concerns about shifting to open textbooks also center lack of ‘supporting materials’ like quiz/review questions, labs, and LMS/online supplements. In part because of these concerns, adoption of Open Textbooks has remained low, despite their benefits (Dastur, 2017). One other main barrier to adoption is the lack of relevant open materials for specific courses or sub-disciplines (Seaman & Seaman, 2017). We hypothesize that empowering learners and teachers to co-create and improve textbooks and supporting materials is a key method by which educators and institutions can solve this limitation.

*Open Pedagogy*: Empowering students to co-create and improve materials with the teacher is a form of open pedagogy. Open pedagogy predates recent internet-enabled open textbook and open-educational research work. In part because of this longer history, Wiley and Hilton (2018) argue that open pedagogy suffers from difficulties of definition, covering an extremely wide range of practices from students co-defining the course structure, to unstructured pedagogies. Wiley and Hilton propose a limited definition for *OER-enabled pedagogy*: Practices enabled by OER adoption and renewable assignments. Across both Open and OER-enabled pedagogy, teachers share the goal that learners learn not just the content of courses, but abilities to think about the structures of the concepts, and how they structure their own learning, broadly, Meta-cognition (DeRosa & Robinson, 2017).

#### High Structure Active Learning

High Structure Active Learning practices have been proven to improve outcomes for all students, and particularly for students from marginalized backgrounds. See Freeman et al. (2014) for meta-analysis. We are not aware of a framework or research that directly measures how structured a given active learning assignment is. We propose a comparative definition: High

structure learning generally includes shorter periods of time (assignments completed in hours and due in weeks, as opposed to days and semesters) and increased scaffolding through detailed instructions and steps.

Up-front costs of low-structure active learning are lower for teachers. For example, a simple term paper assignment requires less construction than multiple assignments walking students through each step of thesis, outline, and paper construction and revision. However, greater benefits of higher structure fall in line with well-researched theories, particularly extraneous cognition (Mayer, 2017), scaffolding (Doo et al., 2020; Ninio & Bruner, 1978) and Kirschner et al.'s (2006) criticisms of the lack of evidence for results of lower structure active learning.

**Table 2.**

Comparisons between High and Low structure active learning in science and the humanities

High Structure Examples (Fictional)	Low Structure Examples (Fictional)
<p><b>higher-structure science ed. example:</b></p> <p>A teacher wants to teach students about the cellular biology of neuroscience, particularly, the generation of an action potential in a neuron nucleus through reception of incoming signals from dendrites leading to the threshold of activation, and the action potential traveling down the axon.</p> <p>The teacher first uses a short quiz to activate students' prior knowledge, and then teachers about the nucleus and dendrites for five</p>	<p><b>lower-structure science education example:</b></p> <p>A teacher wants to teach students about the cellular biology of neuroscience, particularly, the generation of an action potential in a neuron nucleus through reception of incoming signals from dendrites leading to the threshold of activation, and the action potential traveling down the axon.</p> <p>The teacher assigns students to read the chapter on neurons in the textbook, and post their best definition of neurons on the</p>

<p>minutes. The teacher then asks students to apply this knowledge by drawing a nucleus and dendrites. She then quizzes students with a new single question about dendrites, neuronal nuclei and thresholds to test their understanding of this element. Only then does the teacher move forward to asking a question about the action potential resulting from the dendritic inputs crossing the threshold of activation. The students respond to this question, and the teacher responds to one misconception in a response. She then has the students act as a axion, ‘transferring’ an action potential by holding hands and creating a ‘wave’ down the length of the students. The teacher finally has the students discuss in small groups differences and similarities between the way students holding hands interact and the ways a axon might interact. Together, teacher and learners plan how they could model the whole interaction of dendrites,</p> <p>In this example, the level of high structure occurs primarily through subdivisions of the</p>	<p>discussion board, then respond to one other students’ definition by suggesting a change or agreeing with a point of theirs.</p> <p>In class, the teacher describes neurons for a half an hour, including axons, dendrites, thresholds, and action potentials, and gives examples of each. As she speaks about each, she gives students opportunity to share their knowledge or what they learned from the discussion boards.</p>
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<p>topic (specific teaching on axons, dendrites, and nuclei, in addition to teaching about ‘neurons’,) and guided activities with students about each of the elements of these lesson, and intentionally drawing them all together.</p>	
<p><b>higher-structure humanities example:</b></p> <p>A teacher wants students to develop a deeper understanding of the similarities and differences in tyrannical state actors between Henry the VIII and Cromwellian England.</p> <p>The teacher divides up readings of Shakespeare, Milton, Machiavelli, Queen Elizabeth, Charles the I, and William Cavendish between students, and asks them to do a little research on the figure whose works they’re reading, so that they can represent that figure’s arguments.</p> <p>In an online synchronous discussion, the students are assigned to groups, each of which has one learner who represents each of the figures from the reading. They each give a short introduction to their figure, and then are presented with four historical scenarios, and are assigned to discuss how the figure they</p>	<p><b>lower-structure humanities example:</b></p> <p>A teacher wants students to develop a deeper understanding of the similarities and differences in tyrannical state actors between Henry the VIII and Cromwellian England.</p> <p>The teacher divides up readings of Shakespeare, Milton, Machiavelli, Queen Elizabeth, Charles the I, and William Cavendish between students, and asks them to do a little research on the figure whose works they’re reading, so that they can represent that figure’s arguments.</p> <p>The teacher gives students the option of reading one or several of these figures’ original works, and asks them to come to the in-person class, where the teacher leads a fairly free-form discussion after drawing a column on the whiteboard for each figure.</p> <p>The teacher and students add descriptive</p>

<p>are assigned to would respond to those scenarios, and how other figures would respond. The teacher rotates between discussion groups to give input.</p> <p>After the class meets and discusses, the students who represent each figure work together to write one-to-two paragraph responses to each scenario, whether that response is tyrannical by the standards of the time, and of our time, and why.</p>	<p>words or phrases to each column, representing how that historical figure responds to the actions of their opponents in their time. The discussion is relatively free-flowing, moving quickly between historical figures.</p> <p>After the in-person discussion, the instructor asks each student to write a short essay on a specific example of tyrannical action by one figure, and what it is that makes that action tyrannical.</p>
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In these theories and this criticism, lower structure active learning requires more extraneous cognition, as students must create the activity's structure in addition to thinking about the subject they are supposed to learn. Given the empirical and theoretical support for higher structure, we adopted higher structure designs like tagging and peer review. What is unclear in the literature, and is a key design question, is whether high structure active learning reduces metacognition – learners' thinking about their own thinking and the structure of the field.

#### Tagging, Social Annotation, and Peer Review

Tagging, social annotation, and peer review have been relatively well studied both as specific modes of high structure active learning, and as social media. See Ghadirian et al., (2018), Krouska et al., (2018), for literature reviews of social annotation, Macgregor & McCulloch, (2006) for review of tagging, and Double et al (2020) for a meta-analysis of peer review. Generally, these structures have not been used in OER-enabled learning environments.

Tagging, peer review, and social annotation have been found effective in engaging students and increasing their learning in other environments.

In general, social annotation refers to any work done to ‘mark up,’ add explanation or marginalia to a text. Within academic studies, annotation usually takes the form of a sentence or paragraph of commentary next to the text. By contrast, tagging in general refers to adding metadata to texts or images, usually in the form of single-word markers. Peer review generally involves students evaluating (often through annotation) other students’ contributions. Ghadirian et al., (2018) notes that there has been little design research on tagging and social annotation, and we note that design studies are generally lacking in peer review assignment research as well.

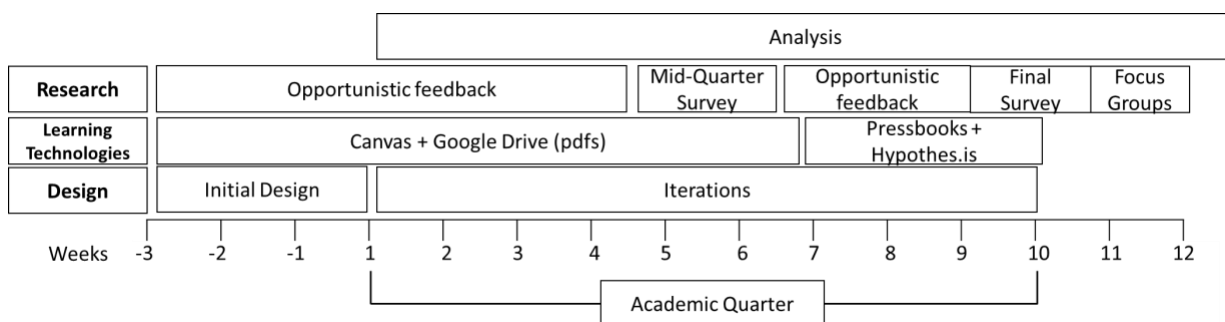


Figure 1: Timeline of research activities

## Methods:

### Study system & Limitations

“Design research studies problems in their inherent messiness” (Sandoval & Bell, 2004). Our research took place during the COVID-19 pandemic. The University of Washington moved all courses to emergency remote teaching late in Winter Quarter 2020. Spring Quarter 2020 was conducted almost entirely online. During that quarter, the teacher in this teacher-researcher partnership taught this course in Endocrinology for the first time, in an open pedagogy model, working with students to begin adapting the previous teacher’s course pack to open text. 79 students took the Spring course. In the last weeks of Spring quarter, we formed our teacher-

researcher partnership, and planned to test and evaluate high structure renewable assignments in Summer Quarter.

### Population

The summer quarter course had 24 students enrolled, of which 16 agreed to participate in data gathering and focus groups. The course was taught remotely from Seattle. Student demographics approximated general demographics of the University of Washington, which in Summer 2020 were 56% Female, 44% male, 58.7% Residency was: Washington residents, 23.3% residents of other US States, and 18% International. Of these, 4.2% identify as African-American, 1.2% American Indian, 25% Asian, 40.3% Caucasian, 0.9% Hawaiian/Pacific Islanders, 7.4% Hispanic or Latino, 18% “International” and 3% did not indicate an ethnicity. (<https://studentdata.washington.edu/quick-stats/>).

The course was taught by one teacher and one TA. Initial assignment designs were co-determined by the teacher and researcher before the start of the quarter. Throughout the course as well as in a final focus group, the TA and teacher gave feedback and input that informed iterations and research direction.

### Assignment Designs

Before the start of the course, the instructor and researcher met three times (approximately three hours total), selecting and defining assessment designs. We also discussed desired outcomes of the course, in terms of specific knowledge, and conceptual shifts. We shared the goal that students learn practices of knowledge generation and critique, and to think about how knowledge is created and learned. We wrote and edited four assessment designs, based on the literature summarized above. Brief descriptions of these four designs follow. To our knowledge, this is the first study to present tagging and peer review used in open textbook revision.

1. *Tagging*: An exercise where individual students highlighted and tagged (socially annotated with tags) chapter-length pre-existing course pack materials with (initially) the following four tags:

Core – This section (length selected by students, generally about a sentence) is core/feels really important to the chapter or to endocrinology as a whole.

Unclear – This section is unclear to me. (If you don't understand something, that may not always be your fault!)

Connect – This section feels disconnected from the rest of the text.

Incorrect – This section contains an error, is incorrect, or out of date

In class, we briefly reviewed and summarized students' tags of the chapters in question following their tagging.

2. *Peer Review*: Student groups reviewed paragraph-length suggested additions to the course pack/open text generated by previous quarter students. We provided a detailed rubric to evaluate these sections.

3. *Working group assignments*: Student groups reviewed and re-wrote small sections (one paragraph or image) of the course pack materials for conversion into an open textbook.

4. *Chapter rewrite*: Students individually tagged and re-wrote larger sections of the course pack materials.

We wove designs throughout the course, generally in alternating days (Tuesday-Thursday). We included 11 working group assignments (4 drops, where student's lowest scores, including any not turned in, don't affect their grade, allowed to accommodate pandemic life-demands and uncertainty), 5 tagging, and 5 peer review assignments (1 drop each), and one final chapter rewrite which included elements of tagging, peer review, and revision. The course also

included 4 low-stakes quizzes (in total accounting for less than 10% of student's grades), in response to student requests for opportunities to check their understanding.

#### In-Class Opportunistic Data Collection:

During the class sessions, conducted by Zoom, we gave opportunities for students to comment on assignment designs. Several students were open with experiences, feedback, and concerns. We cautiously integrated their thoughts into iterations, cross checked with a mid-quarter survey. Generally, the same students spoke up throughout the quarter. This opportunistic participation peaked around introduction of new assignments. During group work sessions in class time, the teacher, TA, and researcher, would often discuss assignments and plan iterations.

#### Mid-course Survey:

We surveyed students in week 6 (of 10). We surveyed students about assignment designs, particularly asking questions about tagging and peer review as novel designs. 22 of 24 students completed the survey. Students who did not consent to the full research protocol had the option to participate in the survey anonymously. For the full survey, see Appendix A.

#### Assignment Design Iterations:

Throughout the course, we used feedback from opportunistic conversations and surveys to make changes to assignment designs. Student and instructor feedback centered on tagging. In hindsight, we believe this was because this design was novel, and novelty sparked additional conversation and questions. For more discussion, see the Future Directions section.

*Tagging iterations:* We made changes to tags available and how and when students could see other students' tags or tagging patterns. We also changed the system we were using for tagging, from Google Drive comments to *hypothes.is*, (a social annotation system).

Changes to tags were mostly additions to words used to tag, in response to students' requests. We split "Core" – into important concepts and "ah-ha moments." After students

expressed hesitance to tag problems or errors, for fear it would expose their ignorance, we added detailed tags for potential problems in the text, “repeated,” “unclear,” and “needs more context,” as we hoped those would help students use more critical tags.

In our first iteration of tagging, students tagged a shared document in which each student could see all other students’ tags. While all 25 students successfully completed an assignment of adding five tags, they reported struggles with hesitating to repeat others’ tags, and struggling to find novel tags when they were the last to read. They also reported wanting to tag independently, and then see each other’s tags, which aligned with research (see mid-quarter survey and design guidance). Later iterations of tagging assigned each student a separate document, which they tagged independently.

In the last tagging assignment, we moved systems from PDFs in Google Drive to Pressbooks, where students tagged using hypothes.is, and we allowed comments ‘with’ tags. This informed students’ comments on usability and the inclusion of comments.

Collectively, multiple brain regions, the hypothalamus in particular, integrate hormonal and neural signals. Through connections to decision making centers (e.g., the PFC, hippocampus, and amygdala), integrated signals regulate to the generation of homeostatic food drive and energy expenditure (i.e., to maintain energy homeostasis; predominantly based on signal integration by hypothalamic circuits) and hedonic food drive (involving the mesolimbic reward system). While the interactions between components of the reward system involved in food-related rewards have been primarily studied in rodents, these interactions are far more complex in humans, in which behavioral drives based on rewards are more strongly impacted by cognition.

Numerous signal molecules, both hormones and neurotransmitters, collectively reflect energy balance within the body. It is important to remember that these hormones and neurotransmitters have different effects at different synapses and tissues. For example, while it may be a potent factor promoting food consumption, NPY can also suppress ovulation and inhibit sexual behavior.

End WG13

### Orexigenic Signals

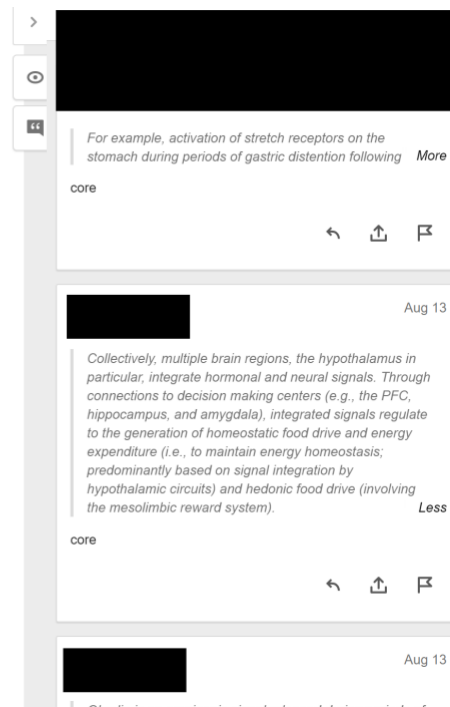


Figure 2: Anonymized screenshot of later tagging in pressbooks and hypothes.is

*Peer Review Iterations:* In contrast to the tagging assignment, students gave significantly less feedback on peer review in course sessions. Lacking learner feedback, the teaching team worked to identify and assign particularly high-quality submissions for students to peer review. We were hoping this change would increase student learning (as they had to focus more closely to find any issues) and focus peer reviews on submissions likely to contribute to the text. In the final weeks of the quarter, and in parallel with the tagging exercise, we assigned peer reviews in Pressbooks and hypothes.is, as opposed to earlier Google Drive and Canvas. We made this change both for comparison, and to begin use of the open Pressbooks platform.

*Group Work Iterations:* As with Peer Instruction, we completed little iteration based on feedback from students about group work. We did offer students the opportunity to change group membership. Only one group did so, most reported happiness with their group assignments and groups' contributions. We split the one group up between others when they reported dissatisfaction. The teaching team reported that student satisfaction with groups and contribution to group work was generally higher in this OER-enabled context than in most disposable assignment designs.

End of the course Data Collection (Survey & Focus Groups):

*Post-course survey:* At the end of the course, we distributed a survey to students, focused on experiences with and perceptions of tagging and peer review assignment designs. We included questions about experience with the iterations. For the full survey, see Appendix B.

*Focus Groups with learners:* Within two weeks of the course ending, we conducted three focus groups with learners, with 3 learners in each of the first two focus groups, and 2 learners in the third, for a total of 8 participants. All focus groups were conducted virtually. Two were synchronous through videoconferencing software. One was asynchronous through the messaging

system in the LMS. Synchronous and asynchronous groups used the same questions, and answer length was similar across modalities. Each focus group represents approximately one hour of spoken time. We asked participants to speak to questions centering on experiences with assignment designs (see Appendix C for focus group questions).

*Focus Group with the instructional team:* Following the course, we held one focus group with the instructional team (the course instructor [author] and graduate student TA). We asked about assignment designs, difficulties administering or grading assignments, and feedback on the structure of the course. The researcher conducted this focus group after completing the work with student focus groups and their analysis, to center student's input, and not drive potential questions or analysis of student response from teacher perspectives

### **Analysis**

We conducted a thematic analysis of the open text response fields in the mid-quarter survey, final survey, the three student focus groups, and the one teacher focus group. After anonymizing focus group notes and survey responses, we reviewed open-ended questions to extract themes, categorize key quotes, and re-reviewed answers to ensure both themes and conclusions extracted represented student comments and foci. Finally, we counted the appearance of each theme within each instance of feedback (six total instances: two surveys, four focus groups.)

### **Results**

#### **Thematic Analysis**

Figure 3 contains short descriptions of each theme and the number of times learners mentioned each theme, excluding those that received 2 or less comments. We expand on themes in the discussion section of this study.

Positive or negative perception	Of which	Sum	mid-q survey	final survey	FG1	FG2	FG3	FG4 (teachers)	
Positive - all assignment designs		112	0	39	0	6	8	18	5
Positive general re: OER-enabled pedagogy		8		1	1	1		3	2
Positive - tagging increased:		88		38		1	2	9	2
	careful reading	28		21		1	2	4	
	critical thinking	21		19		1		1	
	focus	18		16		1		1	
	memory	5		4				1	
	reading	7		5	1	1			
	understanding of lecture (was simple)	6		6					
		3		2					1
Positive - peer review		13		1		1	4	6	1
Positive - working group		8				2	2	3	1
Positive - final exercise		3				2			1
Negative - all assignment designs		22	0	13	0	1	4	4	0
Negative - tagging		18		13			1	4	
	General tagging resulted in disconnecting paragraphs from overall text	4		2				2	
	tagging distracted from reading for content	12		10			1	1	
Negative - peer review									
Negative - working group		1				1			
Negative - final exercise		3					3		
Neutral (or positive to teachers, negative to students)		14							
	Tagging resulted in student	11		5		2	2	2	
	Tagging was time consuming	3		2			1		
<b>Design Guidance - Structure within assignments</b>									
	Integrate individual skills	6		1			4		1
	Compare only after contributing	7		1			4	2	
<b>Design Guidance - Structure across assignments</b>									
	Create opportunities to dive deeper	19		5		3	6	3	2
	by creating glossary	2				1	1		
	Design for depth and breadth	8		2		2	1	1	2
<b>Technology guidance</b>									
	Allow tags+comments	14		6	1	4	2	1	
	Ease of use	12		0	8		4		

Figure 3: Thematic analysis of teacher and learner comments

## Quantitative Survey Analysis

In the mid-quarter survey, in addition to open-ended questions, we asked several quantitative, Likert-style questions, with ranges of 1-6, with 6 indicating strong agreement, and 1

strong disagreement. Figure 4 provides descriptive statistics for the results of quantitative questions in this survey, and figure 5 provides the choice counts for each option on each prompt:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Tagging is a useful exercise	22	2	6	4.55	1.011
I'd like to see other student's tags while I'm tagging	22	1	5	2.82	1.097
...like to see other students' tags after I'm done tagging	22	1	6	4.18	1.708
...like access to others' tags for final project	22	2	6	5.27	1.120
Valid N (listwise)	22				

Figure 4: Descriptive statistics of Likert-style questions in mid-quarter survey

	Counts on Likert Scale					
	"Strongly Agree"					"Strongly Disagree"
Tagging is a useful exercise	6	5	4	3	2	1
I'd like to see other student's tags while I'm tagging	4	7	9	1	1	0
...like to see other students' tags after I'm done tagging	0	1	5	8	5	3
...like access to others' tags for final project	9	0	4	5	3	1
	14	2	5	0	1	0

Figure 4: Counts on scale of Likert-style questions in the mid-quarter survey

## Final Survey

In the final survey, we focused on detailed questions about designs of tagging and peer review. We wanted questions to allow students to respond to assignment iterations, so we asked about added tag definitions, and usefulness of tagging and peer review in the final project. Questions included responses to themes of mid-course feedback and iterations, and Likert-style response to a question about usefulness and timing of seeing other students' tagging. Results are summarized in figures below:

	# of tags students would prefer to have if they were...		
	3-5	5-7	7-9
Tagging a chapter	3	6	3
Revising a chapter with someone else's tags	3	8	1

Figure 5: Student response counts to number of tags students would prefer to have when tagging a chapter and using others' tags to revise a chapter.

Reading with tags, I learned:		
A lot more than without	A little more than without	About the same
5	2	5

Figure 6: Student perceptions of learning with tags, as compared to without.

Overall, the addition of new tags:		
Helped me Learn	Made no Difference	Made it harder to learn
9	2	1

Figure 7: Student responses to the usefulness of new tags in learning

Likert-style counts of a question on the helpfulness of others students' annotation and peer review responses					
	"Extremely Helpful"				"Not Helpful at All"
Count	6	4	1	0	1

Figure 8: Counts for Likert-style question about how helpful other students' peer review and tagging contributions were when revising the final project.

## Discussion

Overall, the assignment designs were successful; according to surveys and focus groups, students appeared to learn a similar if not greater amount than in the previous iteration of the course, and were able to create improvements to key parts of the textbook. Designs required minimal additional effort to adopt. Student feedback was overwhelmingly positive, with 112 positive comments, compared to 22 negative. Most negative comments related to things that could be improved about the designs or applications, rather than inherent ineffectiveness. For

example, students critiqued the lack of opportunity to return to tagged sections and improve them, or a preference to focus on the same topic in several successive peer reviews.

To our surprise, in focus groups and surveys, students not only gave us feedback on the assignment designs, but on the course structure, particularly, the connections between assignment designs. For example, they asked for more opportunities to dive deep into a topic by repeating the same section or contribute to a glossary overview of the subject. As such, our design guidance represents both guidance on designing assignments, and on bringing those assignments together into a course. We take this as an indication (among others) of metacognition enabled by high structure renewable assignments.

Below we discuss the application of results to each research question:

1. Can we design and implement high structure active learning, open pedagogy assignments?

The answer to this research question is yes. In one academic quarter, we were able to design and implement four high structure active, renewable, OER-enabled assignments. All four assignment types were easily adopted by teachers and students. They presented no major confusion or breaks in the class, even though several were novel.

2. What are the perceptions of teachers and learners of high structure open pedagogy assignment designs?

Teachers and learners were positive about the assignments we developed. All assignment types prompted positive student comment in focus groups. The majority of students said the assignment structures helped them achieve their goals in the class. Of the 12 students who completed our final survey, 10 (83.3%) said that they planned to use similar tagging in their other classes, even when not assigned. In one of the focus groups, a student said “Group work (working group assignment) updating sections was one of the most useful activities. We had to

understand what the paragraph was saying, applying it to whatever you were going to create, and the specific section.” Another student spoke to their experiences as a dyslexic student and finding tagging particularly useful to their reading process and focus. Many other students without similar diagnoses spoke highly of tagging’s ability to help them focus while reading. Several commented that in later non-tagged readings, they noticed themselves going back to habits of paying less attention.

Assignment designs had weaknesses, like tagging’s tendency to over-focus learners on details, and peer review and working group assignments’ lack of structure for role-based teamwork. However, both learners and teachers suggested these weaknesses could be balanced by continued iteration of the designs (see Design Guidance for examples).

A few students reported neutral impact to their outcomes, and a minority reported having to spend more time to maximize their outcomes. None said they learned less due to these designs. Several students offered to continue to be engaged in the project after the course ended.

3. What design guidance emerges as we test and iterate those assignment designs in a real teaching context?

We were surprised that the student participants not only thought critically and creatively about the structure of assignments, but also about the context of those assignments within the course. For example, in many cases they addressed a potential drawback of one assignment by suggesting a pairing with another assignment. Learners suggested tagging assignments, which they were concerned over-focused them on details and single sentences of a text (mentioned 4 times), be combined with a ‘glossary’ assignment or one that would outline the text (mentioned twice).

Other students suggested they be given the same segment of text for multiple assignments, so groups could own a section through multiple iterations. They understood and

integrated the aims of renewable assignments and sought to maximize the meaning of those assignments for their learning, and for others.

Overall, six themes emerged from our data collection summarized as follows:

STUDENT-DRIVEN GUIDANCE FOR RENEWABLE ASSIGNMENTS WITHIN AN OER-ENABLED COURSE	
<b>WITHIN-ASSIGNMENT GUIDANCE</b>	
<b>1. Create Opportunities to Dive Deeper</b>	
Create opportunities for an excellent contribution to a smaller part of the open resource, and to learn a part of the subject in depth. Have multiple assignments contribute to the same part of text, or have several steps in an assignment iteratively improve an open resource.	"Overall the most helpful thing for learning in the course was the working group assignments. (another student nodding) One for each chapter, had to collaborate and discuss. With WG assignments, assigned a working group on each chapter. Know one thing in that chapter very well. (In-depth contributions) Could work well."
<b>2. Design for Depth and Breadth</b>	
Use a mix of assignments as opportunities to contribute to open knowledge about both specific topics and the scope and structure of the field - empowering students to learn about the field's breadth. "Broad" co-constructions can include glossaries, chapter listings, summaries, and more.	"I did enjoy these assignments and feel that the concept of an open text like this is wonderful for many reasons, but I do think it's worth noting that I definitely learned more about the sections my group was assigned than other topics presented in class." "Make a glossary hyperlinking words. Could we make a glossary when doing edits? Would be really helpful for an online textbook, to have that."
<b>ACROSS-ASSIGNMENT GUIDANCE</b>	
<b>3. Integrate Student Skills</b>	
Students appreciate opportunities to use the skills they bring to the class to contribute to the open resources through role-based groups.	"(My) group had an english minor, had a lot of grammatical changes. Mostly biology students- writing isn't the biggest skill. A lot of edits were grammatical. Could be used with role-based peer review."
<b>4. Compare only after Contributing</b>	
Learners and educational theory agree that opportunities for learners to compare their contributions with others come best after, not during or before, they contribute. For example, show other students' tags only after students completed their own tagging.	In a survey question, no students strongly agreed with wanting to seeing each others' tags while tagging. 16 of 22 disagreed to strongly disagreed. 9 strongly agreed with seeing tags after they were done tagging, 14 strongly agreed that other's tags are useful when they edit a section.
<b>TECHNOLOGY GUIDANCE</b>	
<b>5. Enable Layered Contributions</b>	
Most learning technologies focus on one-time viewings, contributions, and submissions. Learning technologies in general, and renewable learning technologies in particular, will benefit from enabling students to return, compare, revise, and recontribute.	"It can be helpful to have already thought through the good areas and potential problem areas of the reading before group work so I already have some ideas of what could be improved upon (or can look to the well done areas for inspiration of how to make things better)."
<b>6. Maximize Ease of Use</b>	
Despite the priority given ease of use and design in technology construction, learners still feel systems fall short - and appreciate technologies that are very easy and straightforward to use.	"I found both platforms to be easy to use, and don't have any major grievances with either.... google would occasionally lag behind, and we couldn't see each other comments that were made on separate computers for a few minutes.... Pressbooks had a different issue where some people's comments were hiding/reappearing..."

Figure 10: Brief summaries and quotes of student's guidance for renewable assignment and course design.

## Structure Across Assignments

We were struck by how completely students understood and spoke to the dual goals of OER-enabled pedagogy in course organization. When prompted with questions about assignment designs, students suggested not only changes to the assignments, but changes to the structure of the course - adding assignments or pairing assignments to produce open materials while helping them achieve their learning goals of deep and broad knowledge.

1. *Create Opportunities to Dive Deeper* Most student design guidance for renewable assignments (n=19) related to opportunities for students to create more complete contributions to parts of the text – and dive deeper into knowledge of specific topics. Students spoke of the opportunity to maximize both their own learning and their contribution to the open resource over multiple assignments.

Students provided examples of how assignments could be aligned across the course to maximize the depth of student knowledge and contributions. They suggested providing work group section assignments before tagging, so they could pay particular attention to that section of the text, then following with peer review and completing work group suggestions in that same section.

Students also spoke to of the importance of scaling the assignment properly. Should this assignment cover the breadth of the subject, or a few particular facts? Should it be one paragraph, or five pages? Students gave us guidance. They generally said that about two paragraphs of textbook, at least within endocrinology, is a good ‘chunk’ to try to improve over the course of a week. A larger chunk could be handled in a quarter-long project, or deeper improvements (such as checking all facts, including illustrations) could be completed across a quarter for a smaller segment, in combination with other learning across the quarter.

Last, several students suggested that the final project be structured across the whole course to build up to a greater contribution in that area. They suggested a sequence of tagging, then peer review, then work group, and then final project to maximize the depth of contributions to a section of text. The teaching team confirmed that this structure would work well from their perceptions, and along with students suggested assignment types to combine this depth with breadth. We cover those in the next section.

*2. Design for Depth and Breadth* While students asked for opportunities to dig deeper, develop expertise, and polish topics in the open resource, they also remained aware of their goal to learn overarching principles and concepts of endocrinology. Eight times, particularly in depth in the focus groups, they spoke of a desire to balance breadth with depth. They wanted to contribute to the text in depth but understand it in breadth.

Both renewable and disposable assignments create focus, both a positive and negative. As one learner said, “I did enjoy these assignments and feel that the concept of an open text like this is wonderful for many reasons, but I do think it’s worth noting that I definitely learned more about the sections my group was assigned than other topics presented in class.” Students expressed this concern with the tagging assignment— it over-focused some students on reading for problems in the text, rather than for the broader concepts.

Suggestions to resolve this issue focused on assignment designs that help students learn the breadth of the subject, while creating open resources that cover or organize often used concepts. For example, by contributing to a glossary, or chapter summaries, or suggesting organizational schemas for the text, learners contribute and learn context. Learners and teachers suggested, for maximum effect, a course go back and forth between ‘breadth’ and ‘depth.’

### Structure Within Assignments

3. *Integrate Student Skills* Students bring existing skills to their work, especially in group contexts. In focus groups, students expressed a desire to integrate their skills into group work. Suggestions for cultivating student skill development included assigned roles, such as editor or fact-checker. Students showed awareness that, both in learning and producing open resources, prior skills and talents help. This theme was mentioned once in surveys, and five times in focus groups.

Learners suggested we intentionally pair groups to review each other's work. If one group did not have a particular strong editor, for example, their work might be reviewed by a group with particularly strong editing skill. Meanwhile, teachers emphasized the content-learning needs of students - that while role and skill-oriented designs can work, care must to be taken to balance content learning with students using their skills to improve open texts.

Building on this, teachers suggested opportunities for collaboration across departments, using renewable assignments to connect classes. For example, a course on editing could copyedit STEM courses, or students learning graphic design or science illustration could contribute illustrations. We hope to have opportunities to explore these efforts in future iterations of this course, given the size of the University of Washington, and its writing-across-the-curriculum/writing integrated curricular designs.

4. *Compare only after Contributing*. Students were clear that they only wanted to see other students' work after they had read the material, and ideally, contributed themselves. Seven students mentioned this theme in our focus groups and surveys. Students also answered a survey question in the mid-quarter survey, asking whether they'd like to see other students' tags, and they generally (59.1%, N=13) said they'd like to – but only after completing tagging themselves. In contrast, students, responding a Likert-style question were generally negative about seeing others' tags while they were tagging on a scale of 1-6 (n=22,  $\mu=2.82$ , st. dev=1.10).

This design guidance is in alignment with other high structure active learning findings, like those of peer instruction (Crouch & Mazur, 2001) and with experiments in physics education that find better retention of correct information when students had, first, committed to an incorrect answer (Muller et al., 2007). This design principle is interesting given the tendency of many learning technologies to focus either on the presentation of the teachers' answers, or on student contributions or responses, but not on a contribution-comparison conversation, where questions are answered and re-answered, and answers are compared, a practice much more in line with practices of scientific consensus building, and with learning research.

#### Technology Feedback

5. *Enable layered contributions*: Of the minority of negative feedback we received, a relatively large number (14) students mentioned wanting to add comments as well as tags. They saw the value of tags for further open text production, but often wanted to comment and explain their tags in more depth.

Given the relative rarity of students asking to create additional explanations, and the potential of tags to represent group thoughts and contributions, we believe this indicates a need to design systems that support collaborative writing in layers of work – tags, peer review, and document-level feedback. Future researchers and designers may benefit from taking up efforts to create learning technologies that allow for multiple layers of contribution, such as tags alongside comments, or the ability to see several peer reviews of a segment of open text once a learner has reviewed the text. Students indicated a desire, in the final survey, for a wealth of resources as they update or edit text.

6. *Maximize Ease of Use*: In some ways, this is an obvious principle of design, but given the issues our students encountered, it bears repeating. 12 students across our focus groups and surveys mentioned the difficulty of highlighting and annotating text, particularly in Google Docs.

Text often wouldn't select naturally, highlighting an additional word would cause the interface to select the whole following sentence as well. User experience enables – or disables all collaborative, computer-based learning.

### **Conclusion & Future Directions**

In this research, we demonstrated effective, easy-to-implement high structure renewable assignments, appreciated by students and teachers. We analyzed data from surveys and focus groups to extract design principles that can continue to improve these designs, courses that implement them, and future OER-enabled pedagogy efforts. We found evidence throughout that students thought deeply about the structure of their learning in renewable assignments. We conclude with one encouraging finding: high structure OER-enabled pedagogy, engaging undergraduate students in creating materials that save themselves and other students money, while giving them structured practice in being knowledge creators, is possible, and practical, and generative.

The extent to which student feedback on this pedagogy suggested further, very practical, improvements has likewise been encouraging and enlightening. In future work, we hope to make good on these suggestions by structuring our course in accordance with suggestions to structure renewable assignments for deeper dives, and a combination of breadth and depth across the course, as well as integrating student skills. We are interested in continued work on structure not only within assignments, but across the course or courses, that guide students to maximize learning and contributions to open texts.

We look forward to future research in this subject area. We hope that we, or others, will have opportunities to conduct causal experiments, especially relating to student outcomes in OER-enabled pedagogy courses. These will help resolve open questions in the field about the

effectiveness of these and similar assignment designs in helping students to achieve their educational goals.

In our findings, teachers and learners indicated that learning equivalent to non-renewable assignments is possible, while students contribute to free and open knowledge. Exploring these learning designs, we found key principles to make these and other assignments more effective, maximizing both student learning and contributions. Principles derived from this study may be applicable well beyond the bounds of renewable assignments, but ethically, it makes sense to continue to pursue the double benefit of student learning and contribution to open knowledge.

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## **Introduction to Designing for Resistance**

From the previous investigation, I saw a need to ensure equity in the designs of High Structure Renewable Assignments, emphasizing the equity of learners' contributions to the work of the assignment and the resulting open texts . While a need for equity was rarely explicitly called out by learners, it was implicit and constant in the discussions of the course.

Jennifer, the teacher in that partnership, shared that it was one of her primary aims for her students to not see a textbook, teachers, or herself, as unquestionable authorities. Students shared their own struggles with being able to fully express themselves in the midst of structure – the core theme of most of the negative comments – and students, with and without disabilities, shared their perspectives on being able to fully participate in assignments, not only in regards to technological or process limitations, but in their peers and even their own relationship to their voice.

There was an situational factor outside the research on the assignments (but closely related to the content). We had been working with a course pack, passed down from a previous instructor, and some of the students' work had been to modify that course pack in order to create new materials from it. Unfortunately, this previous instructor withdrew their support for the project, as a potential graduate student had expressed interest in turning it into an online, interactive (and presumably profitable) text. This disruption led me to reflect on the relationship between content and ownership, and contributions and ownership, and the need for groups of learners to be able to create content that was truly theirs. Listening to the voices of students and teachers, and working to synthesize across them, as well as analyzing the situations involved, shifted my own regard and position about equity.

Prior to this research, at least in regards to the instructional designs I was working to innovate, I would describe my position towards inequity in these designs as passive and

avoidant. I was interested – even eager – to avoid any mistakes that would cause inequity in the designs, or cause the designs to create inequities. As I worked and read following this research, my position shifted to an increasingly active orientation, attempting to proactively pursue equity, and research ways to increase equitable outcomes in my designs. This, combined with reading Ellie Theobald and colleagues work in the design of equitable biology study groups, and José Medina’s work on epistemic justice, gave rise to the following paper, which I co-authored with Dr. Rocha. I believe we increased the depth of our understanding of the issues and relationships between those issues present in learning innovations, particularly open or renewable pedagogy. I’m happy to say this paper has been accepted for publication with the Journal for Multicultural Education’s special issue on equity in open resources and open pedagogy.

One small formatting note for my committee: The journal required Harvard formatting, and I have brought the paper into this dissertation with that formatting. If it is an important requirement to the dissertation that I convert it to APA, I will do so upon request.

Required copyright text from the journal follows:

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# Designing for Resistance: Epistemic Justice, Learning Design, and Open Educational

## Practices (Paper 2)

Peter Wallis & Tomas Rocha

### Abstract

#### **Purpose**

To encourage more just open educational practices (OEP), we describe José Medina's theory of epistemic justice and develop a framework to apply this conception of epistemic justice to OEP through learning design. We hope this framework will help researchers and practitioners develop more equitable learning experiences in open educational contexts.

#### **Design**

This paper is conceptual and design-oriented. We seek to draw relationships between José Medina's work in *The Epistemology of Resistance*, recent empirical studies in learning design, and OEP. By analyzing relationships between these works we lay out design principles that can empower educators seeking to create equitable open learning experiences.

#### **Findings**

We find several generative intersections between the social justice centered epistemology presented by Medina, empirical learning design studies, and open educational practices. We find that structured learning designs which integrate well-researched principles may provide guidance for further practice and research in ways not generally discussed in open education literature. We build on these findings by describing practical ways these intersections can be implemented in OEP.

#### **Originality**

To our knowledge, this is the first theoretical analysis of the relationship between epistemic justice and OEP.

## Introduction

This paper explores a framework to help address the ‘justice problem’ of *open education practices* (OEP). As we theorize it, the justice problem of OEP is a specific manifestation of a more general problem of distributive educational justice. Namely, learners with greater resources or power more readily dominate, consume, or otherwise take up time, energy, and attention. Educational spaces (e.g., virtual learning platforms) exist, and educational activities (e.g., group learning projects) are undertaken, under conditions of social injustice. The same observation applies to OEP and *open educational resources* (OER). To fulfil the progressive, democratic, egalitarian aspirations of OEP and OER, careful attention must be paid to pedagogical design so that OEP do not inadvertently reproduce existing educational injustices.

In a recent paper Bali *et al.*, (2020) address some of these issues by presenting a typology of OEP from a social justice perspective. Their typology deals with large-scale OEP: structures at the course or curriculum level, as well as the selection of high-level practices, assignment types, or modalities of OER. We similarly draw from theories of social justice—in particular, a theory of *epistemic justice*—and recent learning design research, but argue that these practices and modalities can be implemented in ways that have negative impacts even when they are implemented with the best intentions. We will argue that some of these negative impacts happen not at the level of activity type or modality, but in specific design practices. However, by changing specific design practices, negative impacts can be ameliorated, and transformative impacts unlocked, even within the same modality or assignment type.

Prior to Bali *et al.*, (2020), Lambert (2018) wrote insightfully that the prior ten years of OE did not intentionally center the needs of those they purported to serve, and that various types of justice were regularly not present in discussions of OE. We advance this line of understanding by analyzing the role of *epistemic justice* in OEP, while specifically addressing design changes

to open education learning assignments. Like Bali *et al.*, (2020), Lambert (2018) focuses on large scale OEP movements and conceptualizations. While this work is important, changes must be made at large *and* small scales—at conceptualization, modality, and design—in order to realize socially just open education.

We are interested in how concepts featured in accounts of *epistemic injustice* can be leveraged and operationalized in the service of designing just OEP and theorizing principles of transformative OEP. We draw our main conceptual framework from the work of social and political philosopher José Medina, in particular his discussion of epistemic injustice in *The Epistemology of Resistance: Gender and Racial Oppression, Epistemic Injustice, and Resistant Imaginations* (2013). By applying Medina’s philosophy to design for open education, we hope to encourage and empower the creation of equitable OEP by describing changes that can be made in the everyday use of OEP.

Part I of this study gives a broad introduction to Medina’s social epistemology in *The Epistemology of Resistance* by focusing on core concepts we think can be usefully transferred to discussions of pedagogical design within open education communities. These include: *testimony*, *epistemic virtue*, *epistemic vice*, *epistemic friction*, *meta-insensitivity*, and *meta-lucidity*.

Part II discusses a set of recent empirical studies of group learning activities and suggests that epistemic injustice, as Medina conceives it, can be perpetuated by OEP activities that would appear to be equity-oriented. These same studies, however, suggest that the perpetuation of this injustice is at least partly a *design* flaw. In other words, the studies show the potential of well-structured activities to help mitigate the problem of epistemic injustice if design flaws are fixed. In this way, we begin to draw a connection between equity-oriented OEP and equity-oriented learning research.

In Part III, we extend the conclusion of Part II by suggesting four principles for the design of collaborative assignments that maximize epistemic justice and help students cultivate epistemic virtues in an open education context. We relate these principles to Medina’s work, and three additional group learning activities—*Peer Instruction*, *Think-Pair-Share*, and *IRS/Legacy Challenge Cycles*—showing how these activities can either perpetuate or mitigate epistemic injustice depending on specifics of their design. This section includes practical guidance that practitioners, even those not engaged in school or curriculum level open projects, can implement in open learning activities. A conclusion proposes some possible next steps for empirical researchers and education practitioners.

### **Part I: Medina’s Social Epistemology**

Medina’s (2013) theory of epistemic injustice attempts to make sense of how social injustice distorts the knowledge-sharing, or *testimonial* (p. 28), practices of people who occupy different social positions.<sup>1</sup> In this view, the giving and taking of *testimony* (communicated knowledge) does not occur in a cultural vacuum; rather, it is significantly inflected by the *social imaginary*: the “repository of images and scripts that become collectively shared,” and which “constitutes the representational background against which people tend to share their thoughts and listen to each other in a culture” (p. 67). Under conditions of oppression, the social imaginary is severely distorted: members of historically oppressed groups suffer from systematic deficits in the attribution of testimonial credibility because of culturally circulated representations depicting them as incapable of possessing knowledge and unworthy of sharing true beliefs. They are disproportionately and unjustifiably deemed *incredible* in their knowledge-sharing acts and knowledge-building practices. The inverse is also true: members of historically

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<sup>1</sup> Medina focuses on racialized groups and women. His approach has been critiqued for lacking an analysis of capitalism as a structural cause of oppression that co-constitutes and is co-extensive with racial and gender-based oppression. See Ferguson (2013). We recognize this weakness while drawing from the strength of the fine-grained account of just and unjust social interactions Medina nonetheless provides.

dominant groups are afforded an unjustified *excess* of epistemic authority.<sup>2</sup> On average, we believe them *too much* relative to the degree of trust they have earned, even if each individual decision to trust must be judged on its own merits.

Disproportionately extending epistemic authority to members of historically dominant groups may instill bad character traits as they internalize bad epistemic habits. Medina refers to a person or group with such habits as “epistemically spoiled.” For Medina, “those who are epistemically spoiled have a hard time learning their mistakes, their biases, and the constraints and presuppositions of their position in the world and their perspective” (p. 30). Being in a position of greater social power may confer pleasure and wealth, yet gravely risks corrupting one’s epistemic character by cultivating what Medina refers to as *epistemic vices* (pp. 30-40). The three he focuses on are *epistemic arrogance* (p. 31), *epistemic laziness* (p. 33), and *closed-mindedness* (p. 34). These are, respectively, a kind of cognitive superiority complex stemming from an overestimation of one’s cognitive powers; a lack of curiosity about areas of life or social domains that one hasn’t had to concern oneself with; and a kind of epistemic ‘hiding’, or avoidance of knowledge that is difficult to accept or acknowledge (especially because of how it might implicate oneself in the perpetuation of social injustices). All three can be present in any given situation. The prototypical example of *epistemic arrogance* is ‘mansplaining’ – when a woman suffers a man’s explanation when she knows the content better than he does (the man’s assumption that he knows more is the arrogance). However, this may also be informed by *epistemic laziness* if the mansplaining is about subjects primarily experienced by women, and the man has been lazy in understanding these subjects or a woman’s relationship to this knowledge. Finally, the man in this example may demonstrate *close-*

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<sup>2</sup> The stereotype here is of the White, straight, cisgender man who confidently asserts wrongheaded opinions to an audience of experts who do not share his identity markers.

*mindfulness* if he refuses to listen to the woman about her expertise, especially because accepting that expertise would implicate him in sexist knowledge behaviors.

These vices can, of course, also appear separately, as *epistemic arrogance* when a person from a colonizer culture might arrogantly assume that his or her knowledge of what a healthy ecosystem needs is superior to indigenous knowledge. *Epistemic laziness* might occur when a relatively wealthy employer exhibits no curiosity about the reasons employees ask for higher wages, being lazy to learn about the impacts of inflation, cost of living increases, and wealth disparity on their employees. Another example of *close-mindedness* may arise if a professor is unwilling to accept that he or she made assumptions about a student's knowledge of a subject simply by the fact of them being a student.

These and other epistemic vices feed off one another and can express themselves through certain wrong-headed views of social reality. Defensive avoidance of explicit discussion of one's dominant racial or gender identity, for example, involves all three vices (pp. 36-38).<sup>3</sup> The *actively ignorant subject* is a type of person who has developed this suite of epistemic vices and can be interpreted as playing an active role in the maintenance of their own ignorance. They can therefore be blamed for having “epistemic attitudes and habits that contribute to create and maintain bodies of ignorance” that reproduce social injustice (p. 39). They suffer particularly from a form of insensitivity we might label *meta-insensitivity*—a “cognitive and affective numbing” (p. 89) that afflicts those who are deeply unaware of (and uninterested in) self-knowledge, knowledge of others, and facts about empirical reality related to social injustice.

The flip side of this coin is that members of historically oppressed groups, while suffering on average from deficits of attributed testimonial credibility, power, wealth, access, and so on, are nonetheless more likely to develop a subset of what Medina calls *epistemic virtues* (pp.

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<sup>3</sup> In traditions of law and policy, this has also been referred to as a ‘color-blind’ or ‘gender-blind’ approach. We refer to the ableist term to better contextualize this discussion historically.

40-48).<sup>4</sup> The three prototypical examples are *epistemic humility* (p. 43), *intellectual curiosity/diligence* (p. 43), and *open-mindedness* (p. 44). These are, respectively, a humble and self-questioning attitude toward one's cognitive abilities that can facilitate learning processes (p. 43); an interest and fastidiousness in learning new bodies of knowledge due to special incentives generated from the need to survive and flourish under oppressive conditions; and an ability to extend beyond one's parochial perspective or the standpoint of one's group, arising particularly from acknowledging differences between one's own perspectives and the perspectives of dominant others (p. 44). In a compelling analysis of the Mexican poet and philosopher Sor Juana Inés de la Cruz and the Black American civil rights activist Rosa Parks, Medina illustrates a distinctive type of character formation: the *meta-lucid* subject who is "aware of the effects of oppression in our cognitive structures and of the limitation in the epistemic practices (of seeing, talking, hearing, reasoning, etc.) grounded in relations of oppression" (p. 192). *Meta-lucidity* is a "crucial cognitive achievement" attained by the subject who is "aware of a whole body of ignorance, a set of blind spots, to which others remain insensitive" (p. 196). The meta-lucid subject exhibits lucidity not just about the social world, "but about the cognitive attitudes, cognitive structures, and cognitive repertoires of those who navigate that social world" (ibid). This type of lucidity can be triggered or cultivated by experiences of, for example, what the Black American sociologist, philosopher, and activist W. E. B. Du Bois termed *double consciousness*: the "capacity to entertain two perspectives, two ways of thinking, and two ways

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<sup>4</sup> A caveat here is worth noting. Medina is clear that epistemic virtues and vices are *not exclusive* to any one group, are *not universal* features of the epistemic character of any group, and are *not automatic* features of the epistemic character of any group. The analysis of epistemic virtues (e.g.) in relation to historically oppressed groups is a tool used to elucidate the "particular shape that these epistemic virtues can acquire among oppressed subjects and their distinctive genesis under conditions of oppression" (43). In other words, Medina is not engaged in an essentialist project. He notes, commonsensically, that members of historically oppressed groups can manifest epistemic vices (and that these can take a particular shape) and that members of historically powerful groups can manifest epistemic virtues (and that these can take a particular shape).

of looking at the world” (p. 192) as a result of directly experiencing one’s own degradation and the mechanisms of oppression and social distortions that produce it (p. 196).

Educators might ask Medina the following question: how does one harness the intricate framework outlined above to cultivate people who are epistemically virtuous and meta-lucid? Medina’s response would undoubtedly draw from his notion of *epistemic friction*. It is useful here to think of friction in a basic metaphorical sense, as the result of opposing forces exerting energy on one another. In Medina’s account, the forces that interact and form resistances (p. 1) may be either *internal* or *external*, and (p. 2) result in *beneficial* or *detrimental* friction. Imagine, for example, an *internal* force (your belief in your own diligence) rubbing up against an *external force* (a script from the social imaginary depicting you as unproductive because of your disability). Upon meeting, these opposing forces create resistance. For Medina, this resistance may result in *beneficial epistemic friction* if the tension between these two forces motivates you to develop insight, powers of self-criticism, the ability to meet justificatory demands and recognize cognitive gaps, and so on. However, they risk producing *detrimental epistemic friction* if the tension between these two forces deteriorates your confidence, causing you to become inhibited or insecure. Good pedagogical design would focus, then, on accurately identifying the internal and external forces at play in any given educational context and directing them intelligently to maximize opportunities for beneficial epistemic friction.<sup>5</sup> We purposefully state this overarching guideline in general terms here and explore detailed manifestations of it throughout the rest of the paper.

## **Part II: Empirical Studies Parallel Medina’s Framework**

Collaborative learning and group knowledge creation is core to the development of OEP. The broadest possible definition of OE evokes any use of OER. Increasingly, however, OEP uses

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<sup>5</sup> The *subject matter* of pedagogical activities may in addition, of course, draw attention to harmful components of the social imaginary.

the removal of constraints on editing, remixing, and creation to assign learners to open knowledge construction, asking them not only to absorb, but to engage in remixing, writing, or editing (Bali *et al.*, 2020). In higher education, these types of practices have also been called “OER-enabled pedagogies” (Wiley and Hilton III, 2018). Notable examples have included: creating and editing Wikipedia articles (Azzam *et al.*, 2017), annotating open documents and resources (Brown and Croft, 2020), using collaborative reading technologies (Liu *et al.*, 2015), and co-writing open textbooks and anthologies (DeRosa and Robison, 2017;).

Within these OEP, social epistemology is clearly an active concept. It is fundamentally the *testimony* of learners that is being evaluated as worthy of inclusion in evolving OER. Likewise, especially when learner groups participate in remixing, editing, and writing, learner contributions or testimonies are evaluated by peers and teachers. This is true of a broad swath of OEP, from K-12 learners annotating open texts (Kalir, 2019) to the group work of Ph.D. students, educators, and researchers developing open software (Arimoto *et al.*, 2016). In these circumstances, testimonial justice matters, because proper transmission of and regard for learner testimony is central to the contributions learners are making to open knowledge, and therefore to the quality and integrity of OERs and to learning experiences involved in creating them. As sociologists and philosophers of social science have argued, the value of testimonial justice goes beyond benefits to student emotional well-being: an inclusive and diverse learning and research community adds objectivity, creativity, and validity to processes of discovery and justification (e.g., Harding, 2015; Tuhiwai Smith, 2021).

Given that OEP express social knowing and exist in contexts of epistemic injustice, we can compare theories of epistemic justice with learning designs for group assignments. These groups often include learners from both historically marginalized and dominant groups, who bring to the classroom distinctive sets of epistemic virtues and vices. We are unaware of

empirical research in OEP equitable learning design, so we leverage research in group active learning and learning design to explore these principles. This research presents a strong empirical complement to Medina's theoretical work. We focus initially on two specific cases, Grunspan *et al's* (2016) research into classroom perception of student expertise by gender, and Theobald *et al's* (2017) research into the performance of groups of learners when one student dominates group discussion. Both are building on Freeman *et al's* finding (2014) that high structure active learning is significantly more effective for STEM teaching and learning than traditional lectures. We suggest the findings of these studies can be taken as examples of *testimonial injustice* and are directly related to the notion that *epistemic virtues* and *vices* are expressed by learners building and sharing their knowledge. Particularly in the second study, there are suggestions of design choices that can ameliorate epistemic vices and encourage epistemic virtues in OEP.

Grunspan *et al.*, (2016) asked students to name the most knowledgeable students in three iterations of the same large undergraduate biology course (p. 5). The researchers found that men nominated men so much more frequently than they nominated women, women had to outperform men by more than half a letter grade (0.765 points on a 4-point grade scale) to be as likely to be nominated (p. 6). By contrast, women in these courses nominated their peers in a pattern much more closely aligned to the skill indicated by their grade (*ibid*). In addition to a general difference in the attribution of expertise, the study documented 'celebrity' students who were broadly acknowledged as having expertise. Across the 3 courses, the 3-4 most nominated students were all male, and the researchers noted that maleness was a predictor among these learners for celebrity status (p. 9). At the end of the study, the authors note several reasons the identified biases are stronger and more widespread in STEM fields other than Biology (p. 12).

Men disproportionately acknowledging or recognizing other men's skill and underestimating women's skills is a form of epistemic injustice: women's testimony of their skill

in this context is disregarded, male testimony is overestimated. In Medina's terms, this study identified a tendency of men to exhibit a gender-specific form of *epistemic arrogance*. In turn, we may label the women's more accurate evaluation of learners' knowledge as a product of epistemically virtuous testimonial practices. The under-estimation of women's knowledge easily risks triggering *detrimental epistemic friction* if it discourages women from pursuing work and ways of life in which their testimony will be under-valued. (The same general idea applies to epistemic injustice between settlers and natives, between those who present as straight and those who present as queer, between those who bear upper-class markers and those who bear markers of poverty, and so on.)

Notably, this potential detrimental epistemic friction occurred despite the teachers' attempts to create a course that encouraged learners to participate by expressing their expertise. Learners beginning the exercise in a socially dominant position extended that dominant position. Relating back to OER, this calls into question Bali *et al.*'s, (2020) classification of Virtually Connecting OEP (opening conversation between attendees of a conference and those who cannot attend) as “[ameliorative] (toward social justice) when dominant voices are amplified and other participants don't get room to speak or challenge,” (p. 6) which the authors recognize as a risk later in the article (p. 8). While Grunspan *et al.*, were specifically investigating the impacts on women's voices, it is important to note that very similar impacts have been observed and described consistently by people experiencing oppression in relation to other identities, including for example race (Collins, 2008) and indigeneity (Betasamosake Simpson, 2017).

Grunspan *et al.*, (2016) do not discuss how educators might construct activities that mitigate epistemic vices. However, following a related line of research, Theobald *et al.*, (2017) tested jigsaw activities as a way of promoting positive interdependence. Jigsaw activities were developed by Aronson *et al.*, (1979) to increase the effectiveness of group work in desegregated

classrooms by reducing competitiveness and increasing interdependence (p. 438). In a jigsaw activity, learners are assigned to groups, lesson materials are divided up within groups, giving each learner a unique piece of information. Learners are tasked to assemble this ‘jigsaw’ of information, with each taking the role of ‘expert’ in the piece of information they are given (p. 441).

Theobald *et al.*, (2017) were interested in emotional factors contributing to successful group work. They asked learners how comfortable they were in their groups, if they had a friend in the group, and if someone had dominated the discussion. They asked this after two variations on small-group discussion were introduced: one relatively unstructured, and the other using a ‘jigsaw’ model to structure collaboration. Learners in both conditions took a pre- and post-test on the subject matter they were reviewing.

Several findings from Theobald *et al.*'s (2017) research are of interest as we think about minimizing negative impacts of overly dominant voices within OEP. First, groups that reported a dominator consistently scored lower on a post-test of subject matter comprehension by one full question, or about 12% (p. 7). Groups reporting high levels of comfort scored higher on their test than groups not reporting comfort (*ibid*). In short, a group member dominating discussion diminished the whole group’s ability to learn, and group comfort increased the ability to learn (p. 13).

This research also found that specific learning designs can contribute to changes in this chain. Groups assigned an interdependence-encouraging jigsaw activity reported fewer dominators and scored higher on post-tests. This was a strong result—a jigsaw activity resulted in 70% lower likelihood that learners “strongly agreed” one learner dominated the discussion (p. 7). The study design alternated groups between jigsaw and unstructured activities, and found the

same groups who experienced a dominator, and hence lower test scores, in unstructured conditions, did not report a dominator or experience lower scores in a jigsaw activity (p. 4).

These findings parallel Medina's descriptions of the impact of epistemic vice on the whole community of knowers. Epistemically lazy practices have negative impact on the epistemic character and effectiveness of the whole group. More vitally, these findings indicate that design choices within an assignment can help groups express epistemic virtue. In short, structured interdependent exercises, like jigsaw exercises, can make beneficial epistemic friction easier to achieve by limiting the impact of epistemic vices on group learning (possibly by deactivating detrimental scripts from the social imaginary, or alternatively by modulating the contributions of epistemically vicious characters). Note that in unstructured activities, dominant voices were not explicitly rewarded, nor were learners explicitly in competition. Nonetheless, learners competed for time and space to express their ideas. A change of design at a small level ameliorated, and perhaps even transformed, this practice.

In the next section, we describe design principles that align with both Medina's description of epistemic justice and research in learning design that can be applied broadly within OEP. We will compare these principles with well-researched learning designs to articulate ways these principles can be implemented in OEP.

### **Part III: Designing for Beneficial Resistance**

Alignment between theories of epistemic justice and learning design principles holds great potential for OEP because it suggests ways to cultivate epistemic virtues while drawing learners into deeper participation with open knowledge and creating better OER. Given that epistemic injustice crosses all contexts of learning, designs intentionally rooted in epistemic justice may improve learning across various contexts, including K-12, Higher Education, and workplace learning, and across technologies.

By taking epistemic justice as a regulative ideal and using it to offer additional guidance to learning designs, we can derive design principles to instigate positive *epistemic interdependence* by encouraging *beneficial epistemic friction* in OEP. In this section, we will briefly propose four principles, and then discuss them in the context of three well-researched instructional designs—*think-pair-share*, *peer instruction*, and *challenge cycles*— and apply them to OEP.

*Principle 1: Provide opportunities to build individual expertise*

At core, group OEP will be most effective and most just when every member of the learning community has an opportunity to authentically contribute to the group product. One member of the learning group dominating the conversation by doing most of the work (or detracting from work) and then presenting it as group work is both dishonest and damaging to the learning process, as demonstrated by Theobald *et al.*, (2017) However, not all learners come with the same level of preparation in the subject to immediately contribute to group knowledge, particularly in domain-specific discussions. As such, it is useful to give opportunities for learners to prepare contributions. This can be done through a moment of reflection, as in think-pair-share, or through structured assignments as in jigsaw activities or challenge cycles.

*Principle 2: Guide learners to take turns*

As discussed by Theobald *et al.*, (2017), jigsaw activities give learners instructions to take turns in sharing knowledge (p. 12). This was likely a key factor preventing one voice from dominating discussion. It is impossible for the testimony of historically marginalized people to be evaluated properly if it is denied the opportunity to be expressed. So, teachers or anyone guiding a learning community interested in epistemic justice can use explicit turn-taking in their

instructions to facilitate equity. This has broad application for OEP, from how a class attends to different learners' annotations, to who is contributing in renewable assignments, to who has opportunity to connect when Virtually Connecting. Across these and other practices, giving explicit instructions to take turns, as well as modeling and encouraging habits of taking turns, and listening equitably to learner input or views, can help students learn equitably.

*Principle 3: Emphasize factual feedback*

Feedback is central to the learning process. It is also central to the process of creating strong OERs. Perhaps most importantly, it is important to the formation of epistemic character—it is, at least when well deployed, a key element of *resistance* that offers recognition when we are wrong, and encouragement when we are correct. It can limit epistemic arrogance and encourage the epistemically humble. However, it is unlikely to live up to this potential if guided by a teacher's or peer's preference for particular students' work, or work of a particular type.

*Principle 4: Evaluate the process*

Especially for learners operating in a context of stress and complexity, there can be apparent benefits to ignoring the reality of epistemic injustices. Accepting cultural norms can speed up production of an acceptable assignment submission. It can be tempting to defer to an apparently knowledgeable group member. Several learners in Theobald and colleagues (2017) explicitly spoke to this, saying that they didn't mind someone dominating the discussion, since they perceived that person to be the most knowledgeable (p. 11).

While educators sometimes can't intervene directly to halt epistemic injustices, they can emphasize following processes of virtuous social knowledge construction. By evaluating how learners follow these processes, rather than or in addition to focusing on whether end products

meet certain criteria, practitioners of open learning can emphasize just elements of open learning and give learners feedback on developing epistemic virtues.

### *Examples of Designs that Use these Principles*

Several existing well-researched and validated instructional activities integrate some of these principles into their designs, but these must be implemented intentionally to maximize equity. Jigsaw activities use these principles by beginning with an opportunity for learners to build individual expertise, then giving learners instructions to take turns. Notably, jigsaw activities do not necessarily require turn-taking and can be implemented without this important feature—so practitioner understanding of design principles is necessary in creating more epistemically just practice. Jigsaw activities can also lack a feedback stage, as they do not necessarily require an evaluation of the learners' contributions. They are explicitly strong, however, in developing individual expertise.

By comparison, peer instruction and think-pair-share models rarely include a step in the process where learners develop individual expertise, but explicitly prompt turn-taking and excel in providing feedback. Peer Instruction, as developed and described by Crouch and Mazur (2001), involves learners answering a factual question, which the instructor intentionally constructed to be difficult to answer at learners' current level of knowledge. Learners take turns saying why they answered the way they did, and finally re-answer the question before seeing the teachers' answer. This involves learners in cycles of feedback, improvement, and listening to each other. Think-pair-share (Lyman, 1981) in which learners "think" (or write) individually, then pair up to discuss their thoughts, then share with the whole group, emphasizes the development of individual knowledge through reflection in the "think" phase, but often struggles to minimize dominant voices during the pairing and sharing portions unless explicit prompts are given to take turns during 'pairing', or random call or similar methods are employed in 'sharing'.

One more design worth mention is the IRIS STARS (Software Technology for Action and Reflection) Legacy Cycle, also known as the Challenge Cycle; developed by Schwartz *et al.*, (1999). This model was explicitly created to help teachers integrate four aspects of how people learn: Learner Centered; Knowledge Centered; Assessment Centered; and Community Centered. We cannot help but note the parallels to Bali *et al's.*, (2020) framework of content-centric, process-centric, teacher-centric, learner-centric, and primarily pedagogical (assessment centered) to primarily social justice focused (community centered) (p. 2).

In Challenge Cycles, learners begin by confronting a challenge, documenting initial thoughts, then compare these with existing resources, and finally, reflecting on differences and producing new documents that compare the two. These cycles closely parallel the principles we posit. Comparing initial thoughts with expert perspectives and resources develops individual expertise and provides feedback, and learners take turns to share these comparisons and their growth.

Each of these well-researched group learning designs implements some of the design principles we articulated. These principles are also applicable to OEP. Students can create OER with or without attention to turn-taking. Learners can receive feedback from teachers on their Wikipedia entries or get ‘flamed’ by other editors. OEP assignments can emphasize processes of equitable knowledge creation or over-emphasize rapid creation of an OER, even if through the sacrifice of opportunities to include multiple voices. In any of these cases, however, the transformative power toward a more just practice is not held only in which practice is selected, but in the design through which that practice is carried out.

### **Conclusion: Shared Goals and Potential Next Steps**

Open educators want to help learners not only to learn subject matter, but also to participate in knowledge creation in ethical ways. In other words, to develop epistemic virtues.

Significantly more research is needed before we can conclude the principles we articulate verifiably help learners develop epistemic virtues. However, in this paper, we have laid out a framework for how to conceptualize the development of epistemic virtue through specific design choices within OEP. We began by laying out key concepts from José Medina's work *An Epistemology of Resistance* (2013), such as *epistemic virtues*, *epistemic vices*, and *beneficial epistemic friction*. Working from recent active learning research, we argued that design choices within OEP can negatively or positively express these concepts. Last, we proposed design principles we find at an intersection of epistemic justice, learning design, and OEP. Using this conceptual development, we can plan research and work to further maximize the value of OEP for learners everywhere. In the spirit of openness, much of this research will be done best if practitioners take up sharing how they might design for epistemic justice in their assignments.

For practitioners interested in implementing the learning designs we discussed directly into OEP, we described specific designs. In their simplest form, these can be ways of helping learners reflect on the OERs that they engage with. In more complete forms, these designs have also been implemented within open education platforms, as peer instruction is in Open edX (Englund *et al.*, 2021). However, greater potential may lie in using these and similar designs as methods for involving learners in the co-creation of OER, shaping them into renewable assignments. For example, peer instruction can be used to validate existing open resources and provide learner feedback on how well these resources are understood. For a more complex example, challenge cycles could be implemented as a process for co-constructing OER.

Open educators interested in designing transformative, socially just courses should attend both to choice of practice, and to design specifics within these OEP to ensure the justice and efficacy of these practices. Further, we note that attending to these nuances using Medina's conceptual tools should easily complement anti-oppressive pedagogical approaches framed using

other vocabulary and discourses, such as that of decoloniality. (Indeed, one can easily trace how colonialism and neo-colonialism both depend on and perpetuate testimonial and hermeneutic injustices.) As teachers and researchers develop these practices further, we hope new principles or new articulations will be developed and that this conceptualization will mostly serve as generative.

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**Introduction to**  
**Epistemic Justice and the Structure of (Renewable) Group Writing Assignments**  
**& Epistemic Justice of Group Writing in R1 and Community College Contexts**

Following this deepening of the theories of the effect and ethic of epistemological justice in open education, I was eager to put these ideas to further practical test by measuring the outcomes of this work in these theories in renewable assignments within a practical learning design. Thanks to the connective efforts of Dr. Handwerk, I was able to find two interested partners in Tim Billo and Lubna Alzaroo. While the subject matter of their courses was similar, their situations differed. Lubna was teaching a Comparative History of Ideas (CHID) course on environmental writing at UW, and an Environmental Science (ENVS) course at South Seattle Community College. This offered an intriguing potential to try out assignment designs across these different environments. Tim was teaching one course at UW about Seattle's ecology and social history. This course had about the enrollment of Lubna's two courses put together. Tim was particularly interested in working with students to create a website about the ecology and social history of Seattle.

The primary difference between their approaches was that Dr. Alzaroo's previous experiences with group work led to her preferring shorter assignments done in a group setting, whereas Dr. Billo's approach extended the group work over more sessions, allowing for alternation between structured and unstructured work within the groups. However, Dr. Alzaroo's teaching was a rare opportunity to compare equitable assignment designs in similar courses in a city college and a research university. Across both papers, I took a more directly experimental approach, attempting to use the quality of materials developed, balanced and analyzed with the perspectives of students who participated in the assignments to give evidence for the principles developed in the previous paper with Tomas. Both collaborations allowed me opportunities to

vary the conditions of assignments with higher and lower structure versions of the assignments, in all three courses. This, while not quite a controlled experiment, allows some amount of causal comparison to determine the relative impact of structured assignments on epistemic justice in group assignments. These also allow us to contrast the quality of materials generated in each condition – that of high, and of low, structure. Given that a central hypothesis of my work has been that the structure of assignments might impact the epistemic justice under which renewable assignments create materials, and thus impact the both the experience of students, and the quality of materials produced, this was an excellent opportunity to put these questions into practice in the real world. In addition, two collaborators gave me an opportunity to utilize similar measures across contexts, and maximize the value of the time used to develop research methods.

Together, as well as independently, these empirical assignments deepen the development of High Structure Renewable Assignments, but do not give evidence that the principles Tomas and I laid out in the previous chapter were causal factors for learners' experiences of epistemic injustice or improved group writing in these specific contexts. While this research did not validate the proposed hypothetical causal relationships between structure and epistemic justice, we were able to use the mixed methods design research to deepen our understanding of these group writing processes and the experience of learners in them. Specifically, we found evidence that what troubled students most in these group writing assignments in this context was not domination of the discussion by particular voices, but the complete absence of other voices. This finding suggests further research in renewable assignments, particularly in applying high structures to individual activity for setting up group work.

**Epistemic Justice and the Structure of (Renewable) Group Writing Assignments (Paper 3)****Peter Wallis & Timothy Billo**

## **Problem Statement**

New ways of interacting with educational materials can unlock new potential for learning. However, both the new materials and the new interactions are often at a premium. As a way of addressing issues of cost, affordability, and interactivity, the Open Educational Resources movement has been attempting to unlock the latent potential in digital resources and collaborative creation. One proposed way of unlocking this potential is through “Renewable Assignments” – assignments in which learners create materials with open licenses, which are useful to future learners, and can be remixed and reused as part of future learning (Wiley & Hilton III, 2018).

However, Renewable Assignments are a new development, and as with any group assignment, there are a myriad of issues that can interfere with learning. Some of these issues may be ameliorated through careful design of group learning assignments. Key issues in any group learning assignment is the equity of learners – can all learners contribute? Can they contribute their best work? Are any learners being silenced by other members of the group, or valuable contributions being disregarded because of racial, ethnic, gender, class, or other biases (Wallis & Rocha, 2022)?

Careful design of assignments may ameliorate some of these biases, and studying these structures is necessary to ensuring that the potential of Renewable Assignments is available to all learners, especially as learners’ contributions to renewable assignments impact not only them, but generations of students coming after them.

This study investigates this issue in an honors course on local and cultural issues within a Honors course at a R1 university in the US Pacific Northwest. Learners were tasked with creating vignettes about the history and culture of the area local to the university and weaving those vignettes into a section of a website communicating basic ideas about the history and culture of the local area. They were told that these sites would be updated or further developed in future work, either with future students, or with website designers, particularly for layout and organization of the website.

To the questions of this research, groups of learners had to work together to develop a connecting narrative between the vignettes they contributed. We created a structured and unstructured assignment condition, and randomly assigned groups of learners to the structured and then the unstructured condition (or vice versa) in a 2x2 design, while we as researchers worked to evaluate the impact of these structures or the lack of structure on the group work completed, and on the impact of student experience through surveys.

The course contents included concepts of epistemic justice – that is, what communities in the local environment are seen as providing valid histories about it, and questions of whose history is seen as worth writing. As such, this research also integrated with the learning objectives of the course – and students’ thinking about whose input was valued in courses aligned well with the goals of the course.

### **Research Question(s)**

Most fundamentally, we are interested in the way group structures can impact the epistemic justice of group work. Epistemic justice as a concept has been developed by philosophers in recent years, and we draw our conception of epistemic justice primarily from José Medina (2013).

We conceptualize epistemic justice as the ability of a community to listen to a contributor of knowledge in proportion to their abilities to contribute to that community of knowledge. Classic examples of testimonial injustice could include a black doctor who is not regarded as an expert because of their skin color, or a woman being talked over in a discussion of science and technology, despite her expertise.

As Medina explores, testimonial injustice often happens not through a direct denial of the contributions of epistemically marginalized people, but instead through an over-regard or domination of the conversation by people from epistemically dominant groups (2013). Medina frames this as ‘epistemic pride’ a self-overevaluation from dominant groups of their own knowledge. This epistemic dominance does not only negatively effect people (in our study students) from marginalized communities, it also negatively impacts the growth of all members of the learning group, and any products that result from the group work (see Theobald et al (2017) and Wallis & Rocha (2022)) for further exploration of this impact in education.

In the situation of Renewable Assignments, where the results of this group work will be inherited and updated by future groups of students, epistemic justice is especially important, because materials created by groups, and therefore the epistemic decisions of groups of students, will live on in the materials they contribute. Perhaps even more impactfully, as materials evolve through successive iteration in renewable assignments, group biases have the potential to compound, leading to increasingly biased materials, even if the bias in any given round of contributions is minimal. Both Theobald et al. (2017) and Wallis & Rocha (2022) suggest that increased assignment structure, particularly structures that include collaborative, turn-taking practices, may ameliorate the impact of epistemic injustice in group learning assignments.

As a result, we wanted to evaluate three research questions:

1. Can we use structured learning activity models to help students create equity-oriented renewable assignment artifacts?
2. What was the impact of high structure, or a lack of structure, on the quality and equity materials resulting from renewable group assignments?
3. What was the impact of high structure, or lack of structure, on experiences equity and assignment quality for learners completing renewable group assignments?

### **Literature Review**

In designing this research, we are drawing from several bodies of literature, which we summarize briefly below. From a philosophical basis, we activate theories of epistemic justice and testimonial justice within the context of college group learning, relying primarily on José Medina (2013) for our concepts of epistemic and testimonial justice. For the development of our group learning activities, we draw on research in instructional design and high structure active learning, particularly in regard to justice-oriented models of instructional design, e.g. Jigsaw assignments (Aronson & Bridgeman, 1979; Theobald et al., 2017) and community-constructed knowledge, as in Schwartz, Brophy, Lin, & Bransford (1999). We attempt to account for all of these within the framework of renewable assignments, a form of Open or OER-enabled pedagogy in which uses group assignments to generate materials which can be updated, revised, and improved by future groups of learners (Wiley & Hilton, 2018).

In group learning, learners contribute knowledge to the group, and their claims are evaluated by other learners in the group. Particularly in cases where learners work together to create assignment submissions or other artifacts, learners have to work together to evaluate who should speak, whether the things that are being said are true, and whether they are worth including in a final artifact. As such, these practices are a form of social epistemology, a group

coming together to know things about a topic, and doing so through enacting social models of sharing, evaluating, and curating what has been shared.

One important foundation of social epistemology is epistemological justice, which is the equity of these social practices of sharing, evaluating, and curating knowledge in groups. Within a just social epistemological process, members of the group can contribute knowledge, work together to evaluate claims free of biases, and curate content that represents the perspectives of the group. In an unjust epistemological process, all these processes are challenged – some members are not allowed contribute, other members contribute too much, and members' contributions are subject to judgement based on race, class, gender, and other factors that do not relate to the validity of their contributions. The group as a whole selects contributions for priority in sharing with others based on group members' hierarchical status, rather than as a representation of the group's true priorities or the structure of the field they are trying to represent.

Recent social philosophers have explored this subject in some depth. For the purposes of this research, José Medina is an important touchpoint, as he developed a model in *The Epistemology of Resistance* (2013) that both describes the impact of dominance hierarchies on the epistemological practices and attitudes of dominant and marginalized communities, as well as suggesting a framework for how these practices and attitudes can be modified to create more just social epistemologies. In very brief summary, Medina focuses on the knowledge sharing practices of both dominant and marginalized communities, and in the attitudes toward knowledge that consistently being silenced or unjustly over-attended to create. Medina frames these habits as 'virtues' and 'vices' and discusses them as the practices of knowledge communities and social groups, more than virtues and vices ascribed to any given individual. These virtues and vices are also specific, and include concepts like 'epistemic laziness' (a

tendency to rely on others' biased beliefs in your favor and therefore to avoid epistemic labor) or 'lucidity' (the virtue of being aware of the impact of just and unjust epistemic practices on your own knowledge as well as the knowledge of the community.)

Using this framework, Medina expands on these virtues and vices, and on ways to resist them. Resistance is, in fact, his primary way to challenge epistemic vices and develop epistemic virtues, and is conceptualized as being small practices of challenging these beliefs and biases, 'resisting' dominance-based epistemic hierarchies through more just contributions and more careful evaluations of fact and expertise. As we explored in previous conceptual work, Medina's philosophical work has strong alignment with recent empirical research in high structure active learning (Wallis & Rocha, 2022).

High structure active learning has been proven over the past 30 years as a highly effective form of educational practice. Freeman et al's 2014 meta-analysis provides an excellent overview and analysis of the balance of evidence in favor of high structure active learning. Following the growth of evidence for active learning as a practice, recent literature has turned to understanding the impact of specific active learning structures on learners. In Wiggins et al., (2017), the authors develop the "ASPECT" survey, a validated survey instrument for evaluating the attitudinal impacts of different activities. Using this survey, as well as pre-and-post tests, Theobald et al (2017) evaluated more-and-less highly structured forms of activity, using the Jigsaw assignments model developed in the late 1970s by Aronson & Bridgeman in response to issues of epistemic justice in recently desegregated classrooms. Theobald et al (2017) found that the structured interdependence of jigsaw assignments resulted in more comfort for learners, less domination of group conversations, and correlated with increased learning in the groups, compared to unstructured group discussions in the biology course.

We are interested whether similar impacts can be found in group writing projects, particularly renewable assignments. Renewable assignments are a recent innovation in what is known as Open Pedagogy or OER-enabled pedagogy. In renewable assignments, learners create, improve or otherwise interact with OER materials (Wiley & Hilton, 2018). We are particularly interested in this as a form of educational practice because of its relationship between learners and materials. Traditional education and jigsaw exercises focus learners on the content created by an instructor and other perceived authority figures, whereas renewable assignments can be deployed as practices that teach key 21<sup>st</sup> century practices in information gathering, evaluation, and the development of epistemic virtues (DeRosa, & Robison, 2017), focusing learners on their own production of knowledge, their knowledge gathering practices, and the voices of primary sources who may or may not be marginalized. Especially in a course about local ecologies and societies that seeks to help learners analyze the relationship of officially recorded history to the voices of various groups that have been centered or marginalized in those histories, activities which centered the processes of discovering, evaluating, and writing history as a group were particularly appropriate to our learning objectives.

To address the knowledge creation aspect of this group writing, we combined Jigsaw exercises with another thread of high structure learning, STARS Legacy Cycles (Schwartz et al., 1999). STARS Legacy Cycles emerged in the early 21<sup>st</sup> century as a computer-supported way for learners to engage in multifaceted learning that balanced their own activity and perspectives with factual assessment and social setting. STARS Legacy cycles lead groups of learners through five steps – first stating their initial knowledge, then interacting with expert resources and perspectives, then evaluating their initial knowledge, assessing themselves, and finally, sharing their newly reformulated understanding. As this instructional design centers the active participation of learners in finding sources and contributing knowledge to the group discussion, it

seemed a natural fit with jigsaw activities' focus on structured interdependence in enabling learners to find and share knowledge in a common store. Our versions of these combined assignment designs can be reviewed in Appendix D.

Many experiments in the learning sciences do not draw on as many frameworks simultaneously as this experiment does, and for good reason. Drawing on fewer concepts can help to develop specificity and allow for a more precise causal argument in one or two factors. However, we are synthesizing between bodies of literature to develop an experiment for several equally important reasons. First, alignment between the conceptual framework of epistemic justice (see Medina, 2013) and recent empirical studies in active learning (see Theobald 2017) is too close to not dig deeper into the overlap between these ideas. Second, in the situation created by renewable assignments, epistemic justice and injustice, active learning, and group cohesion are very present factors. It is important to account for the intersection of these factors in the design of real-world assignments. As such, embedding an experiment within a situation that develops all these factors is a key element of this study.

## **Methodology**

### **Design of Assignments**

This course included both individual and group writing. Students were tasked with individually developing 'vignettes' – narrative descriptions communicating the personal, social, or geographic history of areas of a northwest US city, as if they were providing a mobile guide along the light rail. As a group, students worked together to write descriptions of the social, cultural, and geographic histories of areas of the city. Groups stayed assigned to one specific area of the city (a neighborhood that includes a stop on the city's metro light rail system) for the whole quarter.

Through several iterations, the researcher and teacher in this research created both highly and less-structured versions of assignment instructions to create the group descriptions. Full text of these assignment instructions can be found in Appendix D.

### **Administration of Assignments**

Assignment instructions were delivered to students through Canvas, and communicated in person. A brief introduction to structured and unstructured assignments was presented to students by webinar, as well as a short exercise to help them understand. Each group was assigned to a highly structured or relatively unstructured assignment first, and then to the opposite condition for the second round of submissions. The assignments differed only in the time period students covered in writing – the first set of assignments brought together vignettes from the pre-1900 history of the city’s neighborhoods, and the second set of assignments covered history post-1900. Assignments were completed by groups both in and outside class time and the classroom, and were submitted through the LMS by representatives of each group. The assignments were due 10 days apart in the 10 week course.

### **Administration of Surveys**

To gather data about students’ experiences in each condition, we asked students to complete a modified versions of the ASPECT survey (Wiggins et al., 2017) twice, once after completing the assignment in each condition. Of the 33 students in the course, 21 completed the first survey (64% response rate), and 12 the second (36% response rate). Full text of our modified versions of the ASPECT survey can be found in appendix F. We included free-text responses at the end of this survey, which allowed learners to give more open-ended feedback on their feelings on the assignments.

## **Population**

The group of students populating in this study were undergraduate students at a large R1 university in the Northwest. While we considered collecting demographic information in surveys, we decided not to do so, given the overlapping potential validity issues of activating expectations of marginalization or dominance based on ethnicity or gender during survey taking, and simultaneously, concern that students from some backgrounds would be hesitant to answer questions about experiences of marginalization while revealing their marginalized identities, as it could be seen as negatively aligning with stereotypes about that identity.

## **Data Analysis Methods & Results**

### **Analysis & Results of Surveys**

Compared to the analysis done by Theobald et al. (2017) our analysis was limited, because we were interested in specific questions of equity and contribution in these group learning assignments. Prior to distributing the survey, we selected four Likert-style questions related to learners' contributions to the group: "Overall, the other members of my group made valuable contributions during the activity."; "I made a valuable contribution to my group during this activity." "The students in my group were open to/valued my contributions to the group activity." And "I think one or more students in my group (intentionally or unintentionally) undervalued my contribution because of my identity or background." We compared responses to these with whether learners identified as having "an identity or background you believe sometimes leads to people disregarding your input or not recognizing your knowledge?", and which condition they were in when they answered the question – the structured condition with (Jigsaw/Legacy Cycle) assignment instructions, or the unstructured condition with minimal guidance for the structure of the group activity.

Descriptive statistics and Likert-style counts for these questions follow, where 1 is strongly disagree, and 6 is equivalent to strongly agree:

**Table 3.**

Students' reporting of being involved in structured or unstructured version of assignments  
( $n=33$ )

Version of Assignment	<i>Frequency</i>	<i>Percent</i>
Structured	16	48.5
Unstructured	17	51.5
Total	33	100.0

**Table 4.**

Students' reporting of having an identity or background they believe sometimes leads people to disregarding their input or not recognizing their knowledge ( $n=33$ )

Response	<i>Frequency</i>	<i>Percent</i>
No	21	63.6
Yes	12	36.4
Total	33	100.0

**Table 5**

Likert-Style Statistics &amp; Counts for student's responses about contributions across all conditions

*(n=33)*

Question Title	6	5	4	3	2	1
	<i>Strongly</i>			<i>Strongly</i>		
	<i>Agree</i>			<i>Disagree</i>		
<i>Others made valuable contributions</i>	20	9	3	1	1	0
<i>Others valued my contributions</i>	18	10	1	1	1	
<i>I made valuable contributions</i>	15	14	2	1	1	
<i>My contribution was undervalued because of my identity</i>	3	0	0	0	5	25

As we can see, while students were unlikely to report someone undervaluing their contributions due to their identity, there is a wider range in reporting that others in the group valued their contributions. We did see two students who reported that their contributions were undervalued, who answered “6 – Strongly Agree” on all Likert-style questions, including others in the group valuing their contributions. While we would usually eliminate these “straight-line” answers, one was reported by a student in the minority who reported that they had an identity or background that sometimes results in their input being disregarded. Given the subject of this research, disregarding this input, even if the responses seem questionable, does not seem advisable.

**Table 6**

Descriptive Statistics of Student responses to Likert-style questions about their contributions and other students' responses ( $n=33$ )

Version of Assignment		<i>Others made valuable contributions</i>	<i>Others valued my contributions</i>	<i>I made valuable contributions</i>	<i>My contribution was undervalued because of my identity</i>
Structured	Mean	5.37	5.00	5.50	1.69
	N	16	16	16	16
	Std. Deviation	1.08	1.21	1.03	1.70
	Mean	5.41	5.47	5.27	1.53
Unstructured	N	17	17	15	17
	Std. Deviation	0.87	0.51	0.88	1.23
	Mean	5.39	5.24	5.39	1.61
	N	33	33	31	33
Total		0.97	0.94	0.96	1.46

As we can see, there are small variations across the conditions. On the whole, students indicated they contributed more in the unstructured assignments, but that their contributions were valued more in the case of structured assignments. Differences between structured and unstructured conditions did not pass a single-tailed t-test ( $p > .05$ ). As such, in this course, we reject the hypothesis that increased structure (in this specific context, and practiced this specific way) reduces student experiences of marginalization in single-assignment cases.

## Analysis & Results of Assignment Submissions

In the case of student writing, both authors completed evaluations of student materials separately, using the rubrics available in appendix E. The researcher rated the student submissions first, and then the compared their scores to the instructor's, to ensure general scoring alignment. The researcher then completed the rest of the ratings blind to the instructors' scores. Author scores were compared and cross-rater reliability was calculated using Fleiss Multirater Kappa, resulting a  $K = 0.034$ . In the following tables, we report the average scores of the teacher's ratings of the materials submitted. We used only the teachers' ratings for these analyses, because their greater knowledge of the subject matter increased their accuracy, and there was a low level of disagreement between the ratings.

### Table 7

Comparison of means (TAVG) for instructor's ratings of student submissions to structured and unstructured assignments:

Version of Assignment	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. Error Mean</i>
Structured	9	12.32	2.11	0.70
Unstructured	9	11.87	1.82	0.61

There were small differences between the means of structured and unstructured assignment ratings by the instructor. However, t-tests using Levene's Test for Equality of Variances revealed no significant differences between the means, therefore, in this condition we cannot conclude that the structured assignment had any significant impact on the quality of writing students turned in in the differing conditions.

## Discussion

To focus for a moment on the positive, by and large, learners in both conditions of these group assignments reported that other students valued their contributions, and that other students made valuable contributions (both were  $\mu = 5.39$  on a 6 point scale,  $n = 33$ ). Group work in both conditions produced enjoyable, educational, accurate content that needed only minor editing to be ready to be shared publicly on a website that could inform others.

However, our study did not find evidence that increased structure either improved students' experience of epistemic justice in their group work, or the artifacts resulting from that group work. This suggests that, while there is always nuance to be added to teaching practices, renewable assignments with groups of undergraduate students producing work for their and other's consumption is a readily adoptable, and may not be as dependent on the level of structure in the assignment as Wallis & Rocha (2022) suggest. It is important to note, however, that we were testing these assignment designs in a small group of relatively equity-oriented students—and that we only used each design twice. It is possible that across the course of a quarter, or in contexts where students are less prepared to address equity issues independently (what Medina might call contexts of increased epistemic vice) these differences in structure would create greater differences in student experience, as Theobald et al. (2017) suggest.

### Limitations on Transferability

Our results, do not mean that experiences of epistemic justice don't occur or have an impact within these group work contexts. It is very possible that such experiences occur, but our sample size or intervention length was too limited to detect them, or that they occur, and our instrumentation was not effective at detecting them. It is possible that this course, as a humanities-oriented honors course, lacked some of the biases present within a course focused on the harder sciences, or that students in this course were more attuned to various voices and to

epistemic justice by the nature of the sample. One particular note we explore more below is that while individual students did not feel silenced, students commented on the silence, or relative lack of contribution, of other group members. Future research may seek to increase contributions from normally ‘silent’ learners. We hope that further research may find this work valuable as a guide and starting point for comparison or methodology in this or other ways, and that future instructors will find the overall outcomes – that various structures of renewable assignment can be effective in producing useful public text from student work - encouraging.

### **Recommendations for Research**

One particularly intriguing possibility emerging from student free-text responses in this research is that the negative effects of domination are in large part introduced not through the direct silencing of marginalized voices, but rather through self-censorship of marginalized voices in these contexts of knowledge creation. This would explain both learner’s ratings of their own contributions, and their unwillingness to call out other students for not participating. This also aligns well with Medina’s framework of epistemic injustice, particularly his characterizations of dominant voices as being epistemically arrogant, particularly when compared with the voices of those who, through resistance, have developed epistemic humility, and are therefore less likely to speak up as they are less certain of their answers or of the value of their contributions (2013). This also aligns with the research conducted by Theobald et al (2017), who found effects of overly dominant voices, as well as the feedback of learners who felt like they should not contribute.

While these differences may, and likely do, intersect with gender, race, class, and other sociocultural biases, there is also a personality and communication preference element here, as well as likely one that intersects with experiences of trauma. Significantly more research could

inspect the factors contributing to learners not participating in class assignments, and how we might encourage more learners to fully participate.

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**Epistemic Justice of Group Writing in R1 and Community College Contexts (Paper 4)**

**Peter Wallis & Lubna Alzaroo**

## **Problem Statement**

It is good for students to leave an environmental studies course knowing things about the environment they live in. However, if they leave a course about the environment without learning something about how humans work together to learn and know things about the environment, their knowledge will be ineffective at best, and may even be harmful. Perhaps more importantly, if learners do not develop skills to justly find, evaluate, and collaboratively connect knowledge about the environment, they will not be able to bring facts they learn into knowledge sharing practices with others throughout their lives – which will include innumerable knowledge sharing opportunities, whether in business, local governance, home and family choices, or community and cultural organizations. Without these skills, even their learning in the course will be limited, as they may ignore some sources based on bias, and overvalue others inaccurately. Broadly, the study of the rightness of these judgements about knowledge and contributors of knowledge is referred to as epistemic justice.

Questions of epistemic justice are very present today, particularly in environmental studies and environmental writing. Who knows about the environment and who can meaningfully contribute to decision making and public debate are vital questions. The answers that groups choose plays a part in determining who is regarded as being knowledgeable about the environment, as well as what knowledge is regarded as worth recording, sharing, and further developing. Within science courses, questions of who should be listened to have an impact on the performance of all students in the course. Drawing on a longer history of collaborative assignment structures, research by Theobald et al showed that students dominating group discussion had a negative impact on all learners in their group, and that structured group exercises helped eliminate this domination, and its negative effects (2017). What Theobald et al

did not address is how these dynamics play out in the creation of complex learning artifacts. Their study measures learning based on pre-and post-discussion quizzes, whereas learners in our study are engaged in group writing of learning artifacts that represent their groups' ability to address key abstractions, such as their conception of an audience, or a theme in environmental writing.

### **Research Question(s)**

Working from this basis, our work addresses problems of participation, domination, and epistemic justice – that is, knowledge sharing practices, in the group work of learners in two different environments, a synchronous, classroom environmental writing course at an R1 university, and an asynchronous, online environmental science course at a community college in the same city. Specifically, we work through a mixed-methods non-randomized experiment to see if increased structure in collaborative writing assignment instructions had an impact on:

1. Learners' knowledge sharing practices, particularly domination of discussion and equity of contributions in complex learning.
2. The knowledge artifacts (assignment submissions) learners turned in.
3. Whether there were different impacts across the two course environments.

This is an initial and exploratory, correlational study. Clearly, the differences between class setup, modality, and type of institution can have interacting, complex effects. While we cannot draw causal connections from our findings, we believe that the correlations and student feedback suggest interesting directions for future research.

### **Literature Review**

There is reason to believe increased assignment structure has an impact on the epistemic experiences of learners in group work. Research from Theobald et al. (2017) compared discussion groups that used a structured Jigsaw assignment (Aronson & Bridgeman, 1979).

formulated to encourage collaboration and prosocial knowledge sharing. Working in a large undergraduate biology course, Theobald et al. found that learners where a student dominated the discussion performed worse on post-tests of the knowledge covered in the discussion compared to groups where no learner dominated – and that jigsaw assignment structures limited domination of group discussion, and raised group post-test scores. More recently, Wallis & Rocha (2022) suggest principles for group work in the frame of collaborative writing of open texts, that incorporate the structures of Jigsaw materials.

Wallis & Rocha (2022) compare the experiences of these biology courses, and students in other courses with José Medina’s theories in *The Epistemology of Resistance* (2013) a philosophical text that explores in some depth the ways that bias and what Medina calls ‘epistemic vices’, particularly ‘epistemic arrogance’ and ‘epistemic laziness’ impact the knowledge building and knowledge sharing practices of communities. Medina, and Wallis & Rocha, also suggest ways that these vices can be ameliorated or eliminated in group work. Increasing the structure of group work and prompting everyone to contribute are two important methods in Wallis & Rocha’s framework.

What the Jigsaw assignments developed by Aronson & Bridgeman (1979) and used by Theobald et al. (2017) do not provide is a structure for group learning and writing. We are particularly interested in how groups come together to contribute knowledge, and in how we can help our students practice these skills in healthy, effective ways. The development of STARS Legacy Cycles as an instructional design by Schwartz et al. (1999) provides a method to manage and structure complex group learning. In this study, we combine STARS legacy cycles and Jigsaw assignments to create a highly structured instructional design which encourages learners to co-create complex knowledge artifacts, while listening to each other and attending to each other’s knowledge.

## **Methodology**

### **Assignment Designs**

As stated in the literature review, we used both STARS Legacy Cycles developed by Schwartz et al (1999) and Jigsaw Assignments developed by Aronson & Bridgeman (1979) as models for our structured assignment designs. To generate assignments that would maximize our ability to test these designs in real-world learning environments, the researcher and teacher in our partnership discussed difficult topics for learners in these courses to grasp, settling on the topics of audiences for the Environmental Science course at the Community College, and themes for the Environmental Writing course at the R1 University. We hoped that addressing topics which students particularly struggle with might help us to understand how these assignment designs operate in real-world environments where learners struggle. For comparison, we developed a short ‘unstructured’ assignment that would represent a normal, minimal prompt for a group writing assignment. These two ‘structured’ and ‘unstructured’ conditions are the two conditions for our experiment. Full text of the assignment instructions is available in appendix G.

### **Administration of Assignments**

Students were given text assignment instructions in person in the environmental writing course, and through the college LMS (Instructure Canvas) in the environmental sciences course. We presented a brief introduction to structured and unstructured assignments in both situations, through videoconference in the environmental writing course, and through pre-recorded videos in the asynchronous environmental science course. In this course, assignment instructions were also provided by pre-recorded video, and students could view text, video, or both.

Students were given the option, after having reviewed the instructions, of choosing which structure they wanted to implement with their group. Researcher and teacher made efforts not to influence student selection.

## **Administration of Surveys**

We administered a survey online in the week following student assignment submission, to gather students' views on their experiences of epistemological justice or injustice in these group assignments. We asked students to complete a modified version of the ASPECT survey (Wiggins et al., 2017), once after completing the assignment. We used this survey specifically to replicate the procedures and measures of Theobald et al. (2017), so that we could compare across their data. Of the 11 students in the environmental writing course, 9 completed the first survey (82% response rate), and in the environmental sciences course, 9 of the 30 students completed the survey (33% response rate). Full text of our modified versions of the ASPECT survey can be found in appendix I.

## **Data Analysis Methods & Results**

### **Analysis & Results of Surveys**

Compared with Theobald et al. (2017) our analysis was limited by our sample size and the complexities of our research questions. From the ASPECT survey we modified, we chose four Likert-style questions that particularly represented students' experiences of their contributions, others' contributions, and how those contributions were regarded by the group: "Overall, the other members of my group made valuable contributions during the activity."; "I made a valuable contribution to my group during this activity." "The students in my group were open to/valued my contributions to the group activity." And "I think one or more students in my group (intentionally or unintentionally) undervalued my contribution because of my identity or background." We analyzed responses to these questions in relation to whether or not students had answered yes or no to having "an identity or background you believe sometimes leads to people disregarding your input or not recognizing your knowledge", as well as whether their

group participated in the structured condition with assignment instructions based on the Jigsaw and Legacy Cycle designs, or the unstructured, minimally guided assignment instructions.

Descriptive statistics and Likert-style counts for these questions follow, where 1 is strongly disagree, and 6 is equivalent to strongly agree:

**Table 8**

Students' reporting of being involved in structured or unstructured version of assignments  
( $n=33$ )

Version of Assignment	<i>Frequency</i>	<i>Percent</i>
Structured	11	61.1
Unstructured	7	38.9
Total	18	100.0

**Table 9**

Students' reporting of having an identity or background they believe sometimes leads people to disregarding their input or not recognizing their knowledge ( $n=33$ )

Response	<i>Frequency</i>	<i>Percent</i>
Other	1	5.6
No	12	66.7
Yes	5	27.8
Total	18	100.0

**Table 10**

Likert-Style Statistics & Counts for student's responses about contributions across all courses and conditions ( $n=36$ )

Question Title	6	5	4	3	2	1
	<i>Strongly Agree</i>				<i>Strongly Disagree</i>	
<i>Others made valuable contributions</i>	7	2	2	2	2	2
<i>Others valued my contributions</i>	7	6	4	1	0	0
<i>I made valuable contributions</i>	7	6	4	1	0	0
<i>My contribution was undervalued because of my identity</i>	1	0	0	1	4	12

Generally, students were unlikely to report other students as having undervalued their identity in this group work, despite a quarter of them saying that sometimes their identities led to epistemic discrimination against them. Overall, students generally felt their contributions were valued, and valuable, and that others made valuable contributions. There was some wider range of responses on others making valuable contributions, and students responded in text fields that they felt some others had not participated in the assignment at all.

Having established the range of responses, we compared means across groups to evaluate whether further statistical analysis of survey results was warranted.

**Table 11**

Descriptive Statistics of Student responses to Likert-style questions about their contributions and other students' responses ( $n=33$ )

Version of Assignment		<i>Others made valuable contributions</i>	<i>Others valued my contributions</i>	<i>I made valuable contributions</i>	<i>My contribution was undervalued because of my identity</i>
Structured	Mean	4.10	4.91	4.55	1.55
	N	10	11	11	11
	Std. Deviation	1.79	0.944	0.934	0.68
	Mean	4.43	5.29	5.57	1.71
Unstructured	N	7	7	7	7
	Std. Deviation	2.15	0.951	0.787	1.89
	Mean	4.24	5.06	4.94	1.61
	N	17	18	18	18
Semi-structured	Std. Deviation	1.89	0.938	0.998	1.24

There are small variations in the means between conditions. Students responded that others more highly valued their contributions in unstructured assignments, and felt they contributed more in the unstructured assignments. Of these differences, only the differences in the groups' openness to their contributions passed a two-tailed t-test:  $t(17) = -2.51, p = .025$ . As such, in this course, we reject the hypothesis that increased structure reduces student experiences

of marginalization, and must consider an alternate hypothesis, that at least for some students in this group, less structured assignments led to experiences of being more listened to.

### **Analysis & Results of Assignment Submissions**

The researcher evaluated the quality of the students' contributions, using the rubrics available in appendix H. In the following tables, we report the average scores of the ratings of the materials submitted.

**Table 12**

Comparison of means (TAVG) for ratings of student submissions to structured and unstructured assignments:

Version of Assignment	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. Error Mean</i>
Structured	7	3.16	0.61	0.23
Unstructured	3	3.52	0.50	0.28

The differences between average ratings by condition were very small, and t-tests using Levene's Test for Equality of Variances revealed no significant differences, therefore, for these groups, we cannot conclude that structured or unstructured assignment instructions had a meaningful impact on the quality of the materials the learners created.

### **Discussion**

The significant statistical outcome of this study comes as a surprise – where we expected that increased structure would result in more students being heard, particularly through explicit prompting to take turns, we found the opposite, as the unstructured assignments, which instructed students to work in groups however they liked, resulted in students, on average,

feeling more heard. At the same time, this feeling did not measurably improve the output of these groups as measured in teachers' ratings of assignment submissions.

### **Limitations on Transferability**

While this is an interesting result, our initial study has a very small number of participants and assignments submitted, and is worth trying to replicate at a larger level. In the meantime, we could explain the results easily by hypothesizing that, for some students, the experience of having to share time more equally may have seemed like an undervaluing of their own experience. Of course, it is also possible that the unstructured assignments simply gave students more freedom to listen to each other in ways that made sense to them. Further research is needed both to confirm these findings, and to explore the factors influencing this feeling of being more listened to within the assignment. It is also worth considering replication across fields, as Theobald et al.'s research in a harder sciences course (Biology) found seemingly opposing results.

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## Summary and Conclusions

In one form or another, I have advocated for Open Education, Active Learning, and Open Education Practices for ten years at UW. I have presented on the subject to faculty, staff, several vice provosts, librarians, and students. Many have been interested, and I am grateful for their interest. Many more have been blasé or dismissive. This dissertation represents a deepening of my advocacy, and some of the most valuable efforts I have been able to make towards moving both research and practice of Open Education forward at UW and in the Learning Sciences as a whole.

In this dissertation, we have reviewed how the history of educational technology is scattered with many innovations which encountered intractable barriers to their adoption, and that despite these barriers, strong and expensive efforts are still made to adopt them. We reviewed several theories of why these efforts fall short, and how we might change those trajectories by designing educational innovations to be adoptable through renewable, participatory content creation, effective through being participatory, and ethical by ensuring that participation honors and facilitates the best from the contributions of all participants. By reviewing the theories of Freire, Medina, and Vygotsky, and then by inspecting instructional designs like Jigsaw Assignments, Knowledge Building, Legacy Cycles, and Renewable Assignments, we created a conceptual framework that allows us to frame our approach to the practices of Open Education. Simultaneously, we were able to compare broadly adopted learning technologies, like Learning Management Systems, Web Conferencing, and Lecture Capture, and specify ways in which they fell short of our aspirations for ethical, effective, and adoptable educational innovations.

Moving from theory and theoretical framework into practice, we conducted a design experiment in which we gathered learner and teacher feedback on highly structured renewable

assignments, found that these assignments were adoptable, and helped the class make good progress toward finishing a renewable textbook and renewable assignments, despite the difficulties of implementing it during the COVID-19 pandemic and lockdown. Following on student feedback about their desire for their voices to be more fully represented in these assignments and brought into richer conversation with the content, we deepened our ethical framework by laying out several principles, based in José Medina's philosophy, and previous empirical work, that we hope will help us to deepen the Open Educational Practice of including all voices.

Unfortunately, in applying these principles to classroom and online group assignments, we were unable to find clear empirical validation that increased structure reduced incidences of epistemic injustice, promoted beneficial resistance, or improved the materials students produced. In fact, in one instance, we found one indication of the opposite. However, the evidence of any detrimental effect in applying these principles to assignment design was very limited, and encouragingly, we found minimal indication of epistemic injustice in these groups at all. While more research is most certainly beneficial on epistemic justice in group assignments, particularly those taking place over longer time periods, my own next research projects will likely begin to focus on different questions.

My sample sizes in this research were limited by the scope of interest. As I attempted to find participants who might adopt these projects, I continued to notice problems that have made open education and active learning work difficult – faculty being dismissive of open education and open pedagogy, and dismissive in a frame that is very reminiscent of Freire – the belief that they hold valuable knowledge, and must give that valuable knowledge to students. There is no doubt in my mind that faculty and teachers are overworked and under-resourced, and simultaneously, are most often conceptualized as 'givers of knowledge' – a concept which makes

what I perceive to be beneficial shifts in practice toward open education difficult to achieve. In many ways, shifting these self-concepts will be a necessary next step for any adoption, particularly for an educational innovation which asks faculty to treat students as less-experienced collaborators.

This would represent both a change in the student-teacher relationship, and a change in the institution's regard for this relationship. One element that came up in every survey in the last two studies was students' frustration that other students were not contributing to the group assignments. This comment, combined with similar feedback from teachers and learners in other circumstances generates two thoughts for me – first, the designs I implemented with Jennifer White generated surprisingly little of such feedback for a class almost entirely conducted online during a pandemic using group work. Whether this was because we spent the class co-constructing a student-facing textbook, or the assignments themselves happened in smaller 'chunks' of time, the engagement of those students in particular, or of students in that field, I cannot say. It does suggest an interesting line of further research, one that is appealing because it draws directly on the feedback and conceptualization of students about what the problem is.

The second thought that I derive from learners' feedback is that they are frustrated by other learners not participating is the role of trauma in group learning and assignments. It has been my experience, and is the opinion of many experts in the field, that trauma often results in a 'freeze' response, where in situations that remind people of the trauma, there is a cessation to any activity. I cannot help but see the parallel in the disengagement from learners, particularly given the precipitous rise, even pre-COVID pandemic, in student mental health issues (Rossen, 2020). despite which, there is no mention of either interpersonal power (a key part of interpersonal trauma) or of trauma responses in the National Academies Press 2018 "How People Learn II"

which intended to address social issues of education (National Academies of Sciences, 2018). It seems a grave error to leave the social realities and social impacts of interpersonal trauma out of a widely distributed guidebook used by teachers to consider how people learn. It also seems ill-advised to elide the concept of consent, which this research report does. We know that non-consenting learners may also disengage, yet the engagement of learners is rarely related back to their choice or autonomy in the subjects they study or who they study those subjects with, much less to their consent to structures which assign them work that will all but disappear once graded.

In chapter two of this dissertation, I argued that ethics and efficacy are intertwined. Without creating structures in which learners can participate in the active construction of knowledge, we cannot be effective in creating learning, particularly the types of learning we most want to encourage. Without creating structures in which all learners can feel safe and effective to contribute and be co-creative, and in which instructors have the resources needed to facilitate this co-creation, the innovative potential will be limited. One of the things I love about design research is the ways it can help us understand what is hampering those we are designing for. What often comes from design research is not a new set of answers, but a better set of questions. When I embarked on my work with open education, I hoped that open education was the answer to questions of how we might create content and help learners participate. What I have found in these studies is that this work is in the reach of teachers and learners – it is doable, and not insurmountably difficult, but it is not done. To use Medina’s phrasing, it is not that the possibilities of better educational technologies and practices are unseeable, it is that they are unseen – it is that practitioners are blind to them. This feels, in some ways, like a question for Vygotsky – if someone is fully capable of an action or of a learning, and still does not engage with it, why? Is there a zone of inhibitory development? What I love about design research is that it helps us to ask better questions, not only to find better answers. The classic question of design

is “how might we?” What I have found, through engaging with ethical, effective, and adoptable ways of educational innovation is much more of a “why don’t we?” and the answer to this seems to be a form of structural inhibition, a learned blindness, or a learned helplessness, re-enforced through trauma, interpersonal power and choice, and overwork.

Without addressing these key issues of trauma, interpersonal power and choice, and overwork and under-resourcing, I don’t believe we can effectively get to the ‘good stuff’ of exciting educational innovations, though we may iterate in small ways in these directions. I do believe the previous studies represent small iterations toward these effective practices and ethical positions. However, these iterations will always be hampered by disengagement and the natural limitations of overworked and traumatized learners and teachers. In this regard, our life and learning outside of school is like that inside it.

Humans, in and out of formal schooling contexts, do not learn well in conditions of trauma and strong interpersonal power differences. Being struck by the similarities between group knowledge creation and the workplace practices of agile/SCRUM organizations (see Arimoto et al., 2016, for a description of agile practice and an interesting example of an agile framework used to create open textbooks), I may extend future research into that population. As I am interested in how people learn and collaborate to create knowledge across all groups, I may work in the future on the impacts of interpersonal power in group knowledge creation. I am also interested in how people dealing with trauma respond to different kinds of prompts, and my work in Papers 3 and 4 may combine with Paper 1 as I consider how we can use the assignment of discrete tasks (rather than multi-step assignments) to help learners who are dealing with trauma create and grow together. There’s some interesting scaffolding potential there.

Particularly in the context of finalizing promising research that has been at times frustrating, I recall Robert Caro’s harrowing biography of Robert Moses, *The Power Broker*.

Moses' early days were spent as a reformer, attempting to put in place structures in New York city and state which would reward civil servants for their knowledge and ability, and provide pathways to increased knowledge and ability, and increased reward. Moses fundamentally was attempting a form of epistemic justice – to base the power of people in the public services on their skills and abilities. Moses, finding that he could not put these aspirational models in place because of the influence of powerful people, sought power for himself, and over the course of decades, as Caro documents, became callous to the voices of those he purported to serve (Caro, 1975). As I close this chapter and take my next steps, I rededicate myself to the voices of those who lack power, and who seek to contribute to our knowledge and growth despite lacking that power. As I continue toward that work, I am somewhat encouraged by overall finding in this dissertation that renewable assignments using high structure methods are adoptable and appreciated by learners, and by some teachers, even in the midst of crisis.

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**Appendix A: Study 1 Mid-course Survey**

1. What is your name? (Leave blank if you prefer to respond anonymously)

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2. As you do the tagging exercises, are you noticing if the tagging exercises influence how you read the material (or not)?

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3. Are any of the influences particularly negative? (like, perhaps you find yourself 'interrupted' or it's harder to get the overall 'gist' of the passage, you find yourself paying more attention to the tags than to the concepts you're reading about?)

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4. Are you noticing anything particularly positive? (like more periods of focus, easier to keep focus on the text, noticing more about your own understanding of the text?)

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5. Are you noticing anything different about your interaction with the materials later (in lecture or group work) after you've tagged a section as compared to when you aren't asked to tag?

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### Questions on a scale

Please answer the following questions on a scale, where 1=strongly disagree, 2=disagree, 3=disagree a little, 4=agree a little, 5=agree 6=strongly agree

6. Tagging is a useful exercise to me

*Mark only one oval.*

1      2      3      4      5      6

Strongly Disagree       Strongly Agree

7. I'd like to see other student's tags while I'm tagging

*Mark only one oval.*

1      2      3      4      5      6

Strongly Disagree       Strongly Agree

8. I'd like to see other students' tags only after I'm done tagging

*Mark only one oval.*

1      2      3      4      5      6

Strongly Disagree       Strongly Agree

9. I'd like access to other students' tags for the section I'm updating in the final project

*Mark only one oval.*

1 2 3 4 5 6

---

Strongly Disagree       Strongly Agree

---

10. Anything else you want to tell us about tagging? (Did anything else come up in your group as you discussed tagging?)

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Thank you so much for your help!

### **Appendix B: Study 1 End-of-course Survey**

1. Name (required for gift card drawing)

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Thank you so much for your help!

2. Comparing reading assignments when with tagging to reading assignments without tagging, I learned:

*Mark only one oval.*

- 1. A lot more when tagging
- 2. A little bit more when tagging
- 3. About the same
- 4. A little bit more when not tagging
- 5. A lot more when not tagging

3. Throughout the quarter, we introduced new tags. In general, the addition of more tags:

*Mark only one oval.*

- 1. Helped me learn
- 2. Made it harder to learn
- 3. Made no difference

4. Throughout the quarter, we introduced new tags. About how many tags do you imagine would be 'ideal' for tagging as an ongoing assignment?

*Mark only one oval.*

- 1-3
- 3-5
- 5-7
- 7-9
- Other: \_\_\_\_\_

5. Did you notice any particular differences between tagging in google, and tagging in hypothesis (Hypothesis=Pressbooks - the last tagging and final assignment)?

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### Creating – Tagging

6. When editing documents in the future (your own, or others') do you think you'll do something like tagging on your own?

*Mark only one oval.*

- Yes
- No
- Other: \_\_\_\_\_

7. If you were given the assignment of updating a tagged chapter, how many different tags would you prefer to have? (when we say 'different' tags' we mean options students could tag the chapter with, like 'error' or 'unclear')

*Mark only one oval.*

- 1-3
- 3-5
- 5-7
- 7-9
- Other: \_\_\_\_\_

### Learning – Peer Review

8. Compared to other kinds of assignments (e.g. traditional exams, reading quizzes, writing assignments, worksheets), I learned:

*Mark only one oval.*

- More in peer review assignments, compared to the same amount of time on another assignment
- About the same in peer review assignments, compared to the same amount of time on another assignment
- Less in peer review assignments, compared to the same amount of time on another assignment
- Other: \_\_\_\_\_

9. Throughout the quarter, we became more and more selective in the sections we gave you to review. Did you notice any difference? (select more than one)

*Check all that apply.*

- Peer reviews didn't really change
- I noticed the change, but it didn't affect the assignment
- I noticed the change, and it made the assignment harder
- I noticed the change, and it made the assignment easier
- I noticed the change, and think I learned more in later peer reviews
- I noticed the change, and think I learned less in later peer reviews

Other:  \_\_\_\_\_

### Peer Review - Creation

10. As you completed the final project, you had access to other students' peer reviews of that section. On a scale of 1 (not helpful at all) to 5 (extremely helpful) how helpful were these peer reviews when you were editing the section you assigned?

*Mark only one oval.*

	1	2	3	4	5	
not helpful at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	extremely helpful

11. Anything else you want to tell us about peer review?

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**Thank you so much for taking the time to complete the survey, and participate in this research!**

## **Appendix C: Study 1 Focus Group Questions & Guidelines**

### **General guidelines for conversation:**

Respect for all perspectives

Don't assume anyone knows anything

Listen and take turns

### **Questions:**

1. Introduce yourself – name, working group, final project
2. Anything in general you want to say about the tagging exercise?
3. For the tagging exercise – we were trying to create an active learning exercise that helped you notice particular elements as you were reading, while contributing to an open textbook.
  - a. What did you notice about reading and tagging as an activity?
  - b. Any differences between reading with tagging and reading without?
    - i. Were you more engaged with reading or without tagging?
  - c. Did you notice anything about reviewing the tags with the class?
  - d. Did you notice any shifts/differences as we added more tags?
  - e. Did you notice any shifts when you were asked to tag only within your work group?
4. Anything in particular you noticed about tagging in google, vs tagging in hypothesis/pressbooks?

5. For the peer review exercise – we were working to find an assignment that would help you both think critically about other student’s contributions, and help develop improved contributions to the open text

a. What did you notice about peer review – do you feel like you were able to improve the sections?

b. Did you find yourself noticing things or understanding things you didn’t after your original reading?

c. Do you have any suggestions for how we run the peer review exercises?

d. Behind the scenes, we were working to try to select better peer review materials for you – did you notice any difference in the materials between the beginning and end of class?

6. Any other general comments? Thoughts that come up?



## **Appendix D: Structured and Unstructured Assignment Instructions for Research Study 2:**

### **Unstructured Assignment Instructions**

Part 1b (see assignment for Part 1a to see how this fits with 1a):

As a group, you must work together to weave a narrative that connects the individual vignettes from Part 1 to each other:

For example, you should provide a brief introduction to the geology and early history of the area the train is traversing, either at the station or on the way to or from--use additional maps or diagrams as necessary to not only provide factual information for the reader, but also to set up the vignettes. Try to be conversational and imagine you are giving a tour to someone on light rail, giving them a heads up about where they will be traveling next.

Together you may need to craft brief introductory and linking material to coherently pull your vignettes together and provide relevant background especially if there is background which is common across each vignette. But if there is background specific to one particular vignette only, then make sure to include it with that vignette (see Part 1a).

Think also about what we know about what is happening in [nw city] at this specific point in time, and forces more broadly happening in the U.S. or world, again especially in the context of environmental history.

To accomplish this, you can spend the group time as you wish, but we suggest at a minimum sharing verbally the vignettes you've created (or will be creating) such that you can efficiently tie the vignettes together, along with introductory material that introduces the landscape (cultural and natural) around the station. You can provide placeholders for each vignette, by saying something like "Insert vignette #1 here," or simply reference the vignettes by title in the text of your narrative.

When you've written your narrative as a group, please have one of your group members upload it here.

Your text should be about 3 pages, not including illustrations/photos. Should be concise and pithy.

### **Structured Assignment Instructions:**

Part 1b (see assignment for Part 1a to see how this fits with 1a):

As a group, you must work together to weave a narrative that connects the individual vignettes from Part 1 to each other:

For example, you should provide a brief introduction to the geology and early history of the area the train is traversing, either at the station or on the way to or from--use additional maps or diagrams as necessary to not only provide factual information for the reader, but also to set up the vignettes. Try to be conversational and imagine you are giving a tour to someone on light rail, giving them a heads up about where they will be traveling next.

Together you may need to craft brief introductory and linking material to coherently pull your vignettes together and provide relevant background especially if there is background which is common across each vignette. But if there is background specific to one particular vignette only, then make sure to include it with that vignette (see Part 1a).

Think also about what we know about what is happening in [nw city] at this specific point in time, and forces more broadly happening in the U.S. or world, again especially in the context of environmental history.

The text for this section will be limited to about 3 pages of text, not including illustrations/photos. Again, must be concise and pithy.

To accomplish this, we've laid out structured instructions:

Start with introductions:

Share what you plan to write about in your vignettes. Make sure that you are not covering overlapping topics. Make sure that your vignettes represent a balanced perspective on the place (to the extent possible).

Begin outlining that narrative for that station, including thinking about: What geology and early history do you want to include about the area the train is traversing? What ideas from the course do you want to make clear in the vignettes, and how can these ideas connect to the narrative? What creative pieces can you add? What additional media (maps, diagrams, sounds, video) can you include to help bring the connecting narrative to life? Some of these ideas might come out of discussion around the first point, as you make tough choices about what to write about and/or what not to write about.

Start writing your vignettes as individuals.

Share your vignettes with each other, once written.

Return to your narrative outline and divvy up sections of the outline.

Assemble the narrative and proofread multiple times to make it sound like it was authored by a single voice, and that it coherently links the vignettes (or at least sets up the vignettes to be read

separately) and provides essential background on the evolution of the natural landscape and the early human history of the area.

Note that you can provide placeholders for each vignette, by saying something like "Insert vignette #1 here," or simply reference the vignettes by title in the text of your narrative.

When you've written your narrative as a group, please have one of your group members upload it here.

## Appendix E: Rubrics for Research Study 2

[*question number*] *evaluation item* [*maximum points*]

[1] GroupID

[2] Brief intro to geology-biology-other aspects of natural or pre'colonial landscape [15]

[3] Brief intro to relevant early history-culture [15]

[4] Diagrams-maps-figures as appropriate [5]

[5] Links to big picture of City-US-World as appropriate [10]

[6] Appropriate length 2-3 pages [5]

[7] Appropriate Citations Appropriately cited [10]

[8] Does a good job setting up vignettes [15]

Note: The second rubric varied slightly from this in the topic of early vs modern history/landscape

## Appendix F: Modified ASPECT survey for Research Study 2

Note: there were small variations between this and the first survey delivered to this class, specific to the assignment topic (early vs modern history)

[1] Please enter your name

### *Research Survey: Instructions*

All questions in this survey refer to the class, "Group Project Part 2b" (Structured or Unstructured) in which you completed a group activity weaving a narrative that connects individual vignettes and background on recent history of areas in[]. Your responses on this survey will be used to evaluate how we do group work in this course, and in other courses and contexts. Your instructor will not know whether you completed this survey or how you answered the questions, but your effort will impact the experience of future students.

[2] Which version of the assignment instructions did your group do (specifically in part 2)?

Mark only one oval.

*Structured*

*Unstructured*

[3]

You and your classmates completed this group project together. How many students (including you) worked in your group?

2

3

4

5

6

*More than 6*

[4]

Are you friends with at least one person that is in your group?

*Yes*

*No*

[5]

Do you have an identity or background you believe sometimes leads to people disregarding your input or not recognizing your knowledge?

*Yes*

*No*

*Other:*

[6] Did your strategy on the assignment change after having done a similar assignment in Part 1 (irrespective of whether you were assigned to structured or unstructured)? If so how?

*Open text field*

*Instructions for students:*

The following questions ask you about your experience in "Group Project Part 2b" (Structured or Unstructured) in which you connected individual vignettes and background on recent history in areas in []. Please rate how strongly you agree or disagree with each of the following statements:

*1 - Strongly Disagree*

2

3

4

5

*6 - Strongly Agree*

[7] Talking about the recent history of a [city] neighborhood with my group improved my understanding of the neighborhood and/or [city] culture

[8] The instructor's enthusiasm made me more interested in this group activity

[9] Having my group members explain their vignettes to me improved my understanding of [8]

[10] [city] history, culture, and themes related to my own vignette

[11] Group discussion during the activity contributed to my understanding of the natural and cultural history of [city]

[12] The instructor offered and provided support in our group work.

[13] I had fun during the activity on vignettes and recent historical background in [city].

[14] Overall, the other members of my group made valuable contributions during the activity.

[15] I made a valuable contribution to my group during this activity.

[16] The students in my group were open to/valued my contributions to the group activity.

[17] I think one or more students in my group (intentionally or unintentionally) undervalued my contribution because of my identity or background.

[18] I would prefer to take a class that includes this group activity over one that does not include this group activity.

[19] I am confident in my understanding of the recent history of [city] my group was writing about in this assignment.

[20] The activities my group did (writing, editing) in this assignment increased my understanding of the course material.

[21] I was focused during this group activity.

[22] The knowledge that this activity was part of research about teaching and group activity strategies increased my interest or focus in this activity.

[23] The knowledge that this activity was part of creating a website for public consumption increased my interest or focus.

[24] I thought the level of detail in the instructions for this group activity was a helpful level of detail.

[25] This activity stimulated my interest in the course material.

[26] I worked hard during this group activity.

[27] I'd like to join a 30-minute focus group to talk more about my experience with this group activity.

*Yes*

*No*

*Other:*

[28] This is an open space for any other feedback you have. Thank you for taking the time to participate!

*Open text field*

## **Appendix G: Assignment Instructions for Research Study 3**

### **Condition 1 (low structure):**

As part of this course, you'll be given a sustainability 'case study' and will develop a sustainability strategy to address the concerns and goals of a fictional stakeholder and consumers. In this exercise, we'll be practicing defining and describing an audience, understanding their needs and how they relate to their environment.

The main goal here is to work as a group to describe a potential audience of a sustainability case study. You can choose any audience, one members of your group know something about, and create a 2-4 paragraph long description of the audience and their relationship to their environment. If it helps, you can think of this as a part of a case study – the 'population' part where one describes the audience and how the case study applies to them.

You can spend the group time as you decide as a group, but we suggest starting with introductions, and by sharing audiences you're interested in, choosing an audience to focus on, then working together to create descriptions of the audience in question.

After you complete this assignment, we'll send out a short (10-15 minute) survey about your experience in the assignment. In the survey, you'll have an opportunity to opt in to a focus group as well. We'll also analyze differences in submissions between groups that completed the structured and the unstructured assignment. All the analysis and research will be anonymous - we won't share your name with anyone! (Survey and focus group names will be stored separately from answers). We'll use our analysis to inform teaching and group work - and we all work in groups a lot in life. Whether as part of a neighborhood deciding how to handle waste management, or a business figuring out how to become more ecologically sustainable, group decisions and knowledge building are part of our lives - and impact our lives. Making that a little bit better, can make a lot of things a little bit better. Thanks for being part of this research!

### **Condition 2 (high structure):**

As part of this course, you'll be given a sustainability 'case study' and will develop a sustainability strategy to address the concerns and goals of a fictional stakeholder and consumers. In this exercise, we'll be practicing defining and describing an audience, understanding their needs and how they relate to their environment.

The main goal here is to work as a group to describe a potential audience of a sustainability case study. You can choose any audience, one members of your group know something about, and create a 2-4 paragraph long description of the audience and their relationship to their environment. If it helps, you can think of this as a part of a case study – the 'population' part where one describes the audience and how the case study applies to them.

We've laid out step by step instructions to putting together these short descriptions of the audience.

1. Start with introductions (if groups haven't already introduced themselves): Your name, pronouns, an audience that stands out to you.
2. Choose an audience for your group to focus on. Try to choose one that most of your group knows something about, you might try choosing one that most of the group is happy with, rather than something one member of the group particularly wants to write about.
3. Lay out what you know about the audience right now. Take turns sharing the pieces each of you know about the audience. It's important to take turns – go around your group and make sure everyone talks about what they know.
4. Lay out the order you want these pieces to be in. As you go through the audience, you might find pieces you can eliminate too.
5. Agree on what pieces each of you can write, and write those pieces.
6. Edit/give feedback – ask questions of each other, suggest additional information for each of the parts of the description, or suggest something that could be researched later.
7. Pick something each of you can research.
8. Do a little more research – dig into your part individually, and try to find an expert's opinion/perspective on the audience in question.
9. Re-evaluate your initial writing. Does it still work? Do you want to add or remove anything? Do you want to add something? Make those changes as a group, and do a final editing pass.

After you complete this assignment, we'll send out a short (10-15 minute) survey about your experience in the assignment. In the survey, you'll have an opportunity to opt in to a focus group as well. We'll also analyze differences in submissions between groups that completed the structured and the unstructured assignment. All the analysis and research will be anonymous - we won't share your name with anyone! (Survey and focus group names will be stored separately from answers). We'll use our analysis to inform teaching and group work - and we all work in groups a lot in life. Whether as part of a neighborhood deciding how to handle waste management, or a business figuring out how to become more ecologically sustainable, group decisions and knowledge building are part of our lives - and impact our lives. Making that a little bit better, can make a lot of things a little bit better. Thanks for being part of this research!

*Note: Small variations existed between courses in these assignments, almost entirely related to the topic of the group writing prompt.*

## **Appendix H: Assignment Evaluation Rubrics for Research Study 3**

[1] GroupID

[2] Lays out theme clearly and concisely [4]

[3] Level of accuracy [4]

[4] Relates to other themes in the course [4]

[5] Organized well and Coherent [4]

[6] Adds appropriate additional information [4]

[7] Covers meaning, history, relationships, or other appropriate information [4]

[8] Good length for the assignment [4]

Note: Small variation existed in the rubric across course contexts to account for the variance in topic of assignments.

### Appendix I: Modified ASPECT survey for Research Study 3

Note: There were minor variations (in the class name and topic of the assignment) between the two courses in this study. Only small variations were made to reflect these differences in class name, and topic of the activity.

Post-Assignment Survey: Structured & Unstructured instructions

[1] Please enter your name or your email address

[2] Which version of the assignment instructions did your group choose?

*Structured*

*Unstructured*

*Instructions for students:*

All questions in this survey refer to the ENVS 160 assignment about audiences. Your responses on this survey will be used to evaluate how we do group work in this course, and in other courses and contexts. Your instructor will not know whether you completed this survey or how you answered the questions, but your effort will impact the experience of future students.

[3] During class, you and your classmates completed a activity about audiences in a group. How many students (including you) worked in your group?

2

3

4

*More than 4*

[4] Are you friends with at least one person that was in your group?

*Yes*

*No*

[5] Do you have an identity or background you believe sometimes leads to people disregarding your input or not recognizing your knowledge?

Mark only one oval.

*Yes*

*No*

*Other:*

*Instructions for students:*

The following questions ask you about your experience with the audiences activity that you completed in ENVS 160. Please rate how strongly you agree or disagree with each of the following statements.

*1 - Strongly Disagree*

2

3

4

5

*6 - Strongly Agree*

[6] Talking about audiences in case studies with my group improved my understanding of them

[7] The instructor's enthusiasm made me more interested in the activity

[8] Having my group members explain potential audiences helped me to me improved my understanding of audiences in written work

[9] Group discussion during the audiences activity contributed to my understanding of the goals of the course

[10] The instructor put a good deal of effort into my learning for this activity.

[11] I had fun during the audiences activity.

[12] Overall, the other members of my group made valuable contributions during the activity about audiences.

[13] I made a valuable contribution to my group in the activity.

[14] The students in my group were open to/valued my contributions to the group activity.

[15] I think one or more students in my group (intentionally or unintentionally) undervalued my contribution because of my identity or background.

[16] I would prefer to take a class that includes this group activity over one that does not include this group activity.

[17] I am confident in my understanding of the material presented during the activity about audiences.

[18] The group activity increased my understanding of the course material.

[19] I was focused during the group activity about audiences.

[20] The knowledge that this activity was part of research increased my interest or focus in the activity.

[21] The activity format (whether structured or unstructured) helped me learn and contribute my best.

[22] The activity about audiences in a case study stimulated my interest in the course material.

[23] I worked hard during the group activity.

[24] I'd like to join a 1-hour focus group to talk more about my experience with this activity in this class.

*Yes*

*No*

*Other:*

[25] This is an open space for any other feedback you have. Thank you for taking the time to participate!

*Open text field*





**Appendix J: University of Washington IRB Approval**

Type of Review: Initial Study

Title of Study: High Structure Active Learning Designs for Remote Open Education

Investigator: Stephen T Kerr

IRB ID: STUDY00010494

Funding: None

Entered IRB: 6/5/2020 4:08 PM

Initial approval: 6/25/2020

Status: Exempt