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Occam's Failure: How the Law of Parsimony in Research Methodology Hinders Definitive Consensus in Education Technology

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Abstract

Even while technological innovation in education has continually accelerated in the past decade due to massive growth of online activity, academic researchers are struggling to reach an overall consensus over the mixed results of these new emergent Education Technologies (EdTech). Some researchers are still unsure of the exact mechanisms within these technologies that produce the various mixed results we see in the data, while other researchers are busy blaming the other academic disciplines involved for failed methodologies producing the inconclusive results or calling for more rigor and parsimonious research. A few have even begun referring to EdTech as the wild west, summoning images of public hangings of "failed hypothesis," abandoned "EdTech Innovation" shanties and constant academic friendly fire. The thesis of this article to argue that the Principle of Parsimony, while a key strategy for most scientific enterprises and promoted by all, is a fundamentally unjustifiable research strategy for collaborative research into EdTech systems and is the likely cause for all of the turmoil and confusion due to fundamentals aspects that remain resilient to Parsimony, along with the compounding problems arising from a field that requires inter-disciplinary cooperation.

Keywords: Law of Parsimony | Education Technology | Research Methodology | Occam's Razor

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With the massive growth of various emergent educational technologies over the past decade, considerable research has been conducted from various disciplinary fields in this emergent area (Oliveira, Behnagh, Ni, Mohsinah, & Burgess, 2019). However, a substantial portion of these papers, if not most, do not replicate effects (Open Science Collaboration, 2015) (Landers, Callan, Bauer, & Armstrong, 2015). Some researchers argue over whether the unsuitability of certain techniques is the main cause of mixed findings in systems designed to promote student engagement (Alomari, Al-Samarraie, & Yousef, 2018). Other researchers claim that theoretical models in Gamified Learning suffer from a lack of a clear mechanism to explain the marked differences in engagement outcomes and call for more parsimonious research (Landers R. N., 2015), stating that a lack of parsimony creates literature with an abundance of theories that "cannot be distinguished theoretically or empirically" (Le, Schmidt, Harter, & Lauver, 2010).

Other researchers are pointing at other disciplinary research methods and statistical procedures used in empirical studies that require improvement (Wright D. B., A framework for research on education with technology, 2018) (Wright D. B., 2019), and that research teams needs more researchers like them to remedy it (Breakwell, Wright, & Barnett, 2020). While some have even started referring to EdTech as the Wild West (Reingold, 2015) and others have taken to compiling One Hundred item long lists that "chronicle[s] for you a decade of ed-tech failures and fuck-ups and flawed ideas" (Watters, 2019). Everyone is blaming everybody else, and yet no one has questioned the Principle of Parsimony itself as the root cause of confusion, taking this "simplicity bias" as an unchecked assumption within their own theories, which coincidentally enough, reduces parsimony of them.

The thesis of this article is to show that research methodologies in EdTech systems intrinsically rely on an assumption of Epistemological Parsimony to analyze the EdTech's technical effects upon student behavior, which by definition requires additional Ontological Parsimony, with the stacking of both Parsimonies in a cross-discipline field creating more problems than it is solves, and thus unjustifiable.

The Problem of Parsimony in EdTech Research

Occam's Razor, informally known as Principle of Parsimony, is defined in several different variations, usually as a preference towards reducing unnecessary assumptions in a scientific or philosophical theory. Popular definitions include, "Do not multiply fundamental entities without necessity" (Schaffer, 2015). "Multiple theoretical constructs should not be used when

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a single construct would suffice" (Cole, Walter, Bedeian, & O'Boyle, 2012). "All other things being equal, simpler explanations of data should be preferred to more complex explanations" (Gershman & Niv, 2013).

Due to this over-abundance of definitions for parsimony, we will refer to a variation of Herbert Feigl's "three meanings of simplicity" (Feigl, 1981) constructed by John Hubbard, to better illustrate the problems of this "simplicity bias" within research methodology of EdTech. Epistemological Parsimony, sometimes called Scientific or Nomological Parsimony, deals with reducing the NUMBER of assumptions posited in a theory and its usually employed for evaluating empirical data. Ontological Parsimony, sometimes called Philosophical Parsimony, deals with reducing the TYPES of assumptions and usually focused on evaluating metaphysical theories. Linguistic Parsimony deals with rephrasing language to make shorter sentences and less burdensome (Hubbard, 2005). For the purposes of this article, we will focus on the first two variations of this principle, which are reducing unnecessary assumptions by NUMBER and by TYPE.

Epistemological Parsimony is the standard research approach in searching for synthetic a posteriori truth in a scientific theory (Hubbard, 2005). This strategy has been proven to be very dependable for standard scientific research of natural systems. Copernicus's revision of the Ptolemy's geocentric model was more epistemologically parsimonious because it dealt with a fewer NUMBER of assumptions (placing the sun at the center required tracking only thirty-five separate rotational movements instead of seventy-five) strengthening his argument by simplifying the number of assumptions (Slobodkin, 1992).

The underlining assumption in EdTech research methodology, is that since you're dealing with a large NUMBER of technical systems in a typical online learning platform, with a huge variety of empirical data to sift and interpret, the best strategy for researching the effects of a single system is utilizing Epistemological Parsimony to reduce the NUMBER of overall systems involved as much as you can and then rigorously analyze the various effects on student behavior, the standard approach to scientific theory. However, this approach will continually produce inconsistent results when it comes to EdTech due to an overlooked fundamental flaw in this application of Parsimony.

Epistemological Parsimony alone is ineffective here because you are not only dealing with the problem of reducing the NUMBER of technical systems you now also have to deal with the problem of reducing the TYPES of students. The TYPE of a student is not an Epistemological concern, it is by nature an Ontological one, dealing with the metaphysical problem of the nature of being. This requires an added Ontological Parsimony stacked on top of your existing Epistemological Parsimony. This is the root cause of the issues creating multiple compound problems and massive infighting. The first problem is that Ontological Parsimony applied

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to student behavior is reductionism in all but name, which makes it difficult to identify why behaviors happen (McLeod, 2020), among other equally valid concerns.

The second problem is that the principle of Ontological Parsimony has no justification in scientific inquiry in the first place due to problems arising from choosing an ontology that has multiple types of entities, problems such as deciding how to tell the TYPES of entities apart, could outweigh any advantages of doing so (Hubbard, 2005). A method of justifiably separating the TYPES of students, by age, race, gender, class, prior education, cognitive abilities, past experiences, political viewpoint, etcetera, is a very tricky and dangerous research strategy, even for highly trained psychologists that are consciously aware of hidden biases.

Ontological Parsimony can also be argued against in the philosophical arguments of EdTech from an analysis of Occam's "sufficient reason for truth," which the Principle of Parsimony is derived from. If someone says they need a sufficient reason for its truth, with their criteria for determining sufficient reason being an observation of a fact, unbreakable logic, Command from God, or a Deduction from any of the above, then this principle is definitely not an Ontological axiom, it is an Epistemological or Methodological one (Boehner, 1957).

Finally, since EdTech relies on so many different diverse fields of research for collaboration, researchers in one field that are trained in their respective disciplines with utilizing Epistemological Parsimony in the physical systems of the EdTech, might have little to no training on how to reduce Ontological Parsimony within the student data aspects of the research, accidently causing research errors in the results (Wright D. B., 2019) and vice-versa. Forcing the need for large, well-funded, long-term, multi-discipline teams to be truly effective at reducing parsimony in every EdTech, leaving out many talented solo researchers who have no inter-disciplinary partner to cover the gaps in their specific methodological approach.

Conclusion

The Parsimony approach is a losing strategy for EdTech, usually requiring large team collaborations and extensive epistemological and ontological methodologies that are sometime impossible to reconcile, demanding large budgets to pay for research costs and substantial amounts of invested time to have any statistical significance after both levels of Parsimony are applied rigorously. Even when all-star academic teams are expertly assembled like the Avengers, they still have the very real danger of it winding up being too reductionistic in the end anyways, resulting in the same inconsistent mixed results that this A-Team was brought in to avoid in the first place. The problems seem too large, the pitfalls too hidden and the solutions too cumbersome to reliably utilize Parsimony effectively en masse, making it an unjustifiable approach for most research in EdTech. A more integrated holistic approach, where

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both the technical systems and human behaviors are each taken as a whole, is the safer approach to researching EdTech. This research strategy is not without its downfalls, allowing in more assumptions makes pinpointing underlining principles difficult to find and stagnates research, however incremental advancement is still preferable to massive setbacks, consistent contradictory results or sporadic Kung-Fu Fights in the Halls of Academia over methodology.

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