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Linking capabilities to functionings: adapting narrative forms from role-playing games to education

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Abstract This paper explores science, technology, engineering, and mathematics education in the context of inequality of opportunity by examining educational systems through two lenses: curricular mode and system scale. Curricular mode classifies learning experiences as addressing knowing, acting, or being, while system scale captures how learning experiences are aggregated into credentials. The paper argues that the curricular mode of being can be better implemented and credentialed within educational institutions if students learn to develop a self-narrative through navigating a multiplicity of learning experiences. Since narrative is implicit rather than explicit in existing university structures, the paper develops a speculative model based on role-playing games that integrates narrative and allows new forms of personalized credentials. The goal of the paper is to initiate a conversation around alternative curricular structures that allow emergent self-narratives within disciplinary structures.

Keywords Role-playing game · Credentialing · Curriculum structure · Narrative · Educational philosophy · Agency

This special issue asks what it means to be educated in science or engineering during a time in which change is challenging many of the underlying assumptions and mythologies of higher education (Kress 2008; Noam 1995), particularly with respect to inequality. Two anchoring thinkpieces challenge existing views of education. The first thinkpiece claims that as knowledge expands and becomes more differentiated the two historical educational modalities—curriculum focused on content (scenario 1) and curriculum focused on action (scenario 2)—will not suffice in the future (Muller 2015). To move forward requires

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intelligently combining the best features of these trends by understanding the epistemic and pedagogic architectures of curricula to construct meaningful sequences of inferential, procedural, and personal knowledge. The second thinkpiece (Walker 2015) asks why STEM education does not work for many non-privileged, non-majority students whose resources and credentials predict they will succeed in a university. The thinkpiece posits that it is necessary for curricula to develop human capabilities and functionings that are both meaningful to, and actionable for, students from diverse backgrounds. This student-centric viewpoint envisions students learning to combine valued functionings to define a good life.

If students are to connect the expert knowledge and skills that create capabilities to the functionings valued by diverse communities, the two thinkpieces need to be conceptually bridged in order to develop curricula. This paper argues that such connections are difficult to achieve in curricula which are structured by discipline. In order to understand the difficulty and thus bridge the two thinkpieces, it is first necessary to define two curricular lenses: the mode of curriculum and the structural scale of education. The *mode of curriculum* describes the intent of learning. Three curricular modes—knowing, acting, and being—emerge from the thinkpieces (Barnett and Coate 2004):

- The *mode of knowing* encompasses Muller's scenario 1 (Muller 2015) that emphasizes the intrinsic and societal value of both knowledge itself as well as how to find and manipulate knowledge.
- The *mode of acting* encompasses Muller's scenario 2 (Muller 2015) and reflects the increasing emphasis on acquiring skills whether they are discipline-based, transferrable across many contexts, or required for certain jobs.
- The *mode of being* captures elements of motivation, engagement, and character. Being has been represented as "ontological commitment" in that a student must commit to becoming someone before knowing and acting can take root. Being thus relates capabilities to student-desired functionings (Walker 2015).

These three modes frame the espoused purposes of a curriculum in a way that transcends STEM disciplines.

Regardless of the mode of curriculum, the *structural scale* of education characterizes the continuum of organizational levels that students interact with within an educational system. Here "educational system" is used in the integrative sense to capture the combination of elements that are used to provide and credential learning. The term "scale" can be thought of in terms of a continuum of granularity. In a student's education, there are many transient fine-grained activities such as homework or examinations that contribute to a grade or mark. At the middle scale are elements such as classes covering months, while at the coarse-grained scale are a student's major and the credential earned that stretch over years. These scales are linked through a process of aggregation in which scores on assignments at fine scales lead to grades in courses at the middle scale and finally a societally recognized credential at the coarse scale. Throughout this paper the term "structure" represents constraining or enabling rules that determine how this process of aggregation is instantiated within an institution. The structure of a university is often taken for granted or accepted as fixed. The curricular mode and structural scale are related since how learning is assessed and activities are weighted favors some curricular modes over others.

Applying these lenses to the thinkpieces, the first thinkpiece suggests aligning the curricular modes of knowing and acting developed at fine-grained structural scales will

better define a clear conceptual progression in each discipline. The second thinkpiece's emphasis on capabilities aligns with the curricular mode of acting, while the question of how to connect capabilities with functionings links the curricular mode of acting to the mode of being. Capabilities are what one can do while functionings are what a person chooses to become. Here the capabilities developed at finer scales lead to credentials at larger scales which society accepts as proxies for functionings.

The argument for integrating both thinkpieces

Both thinkpieces highlight pathways forward for STEM education, yet in sum they create a tension. The tension is structural and arises from the simultaneous need to: (1) support existing structures of disciplinary knowledge so students can develop societally meaningful capabilities (Muller 2015) and (2) relax these structures sufficiently to enable students to connect capabilities to personally meaningful and potentially emergent functionings (Walker 2015). The remainder of this paper argues that existing educational structures—how learning experiences lead to credentials—inhibit students from successfully engaging this tension.

The argument for reconsidering structure rests on two claims. First, that STEM programs currently focus primarily on the curricular modes of knowing and acting at fine-grained scales to support a limited range of functionings. In other words, the structure of the university allows a wide range of knowledge and skills to be developed which are then aggregated into a small number of credentials. Thus developing a more agile and supportive structure could open new pathways for student agency (Liebowitz et al. 2012). The second claim is that a more agile structure can be created by explicitly supporting the curricular mode of being. Being is not something taught through a specific pedagogy, but rather is a measure of whether a curriculum exhibits emergence, the property that meaningful functionings can arise through interaction of many capabilities. The property of emergence distinguishes being from the modes of knowing and acting where effective discipline-based pedagogies at small structural scales are relatively well developed (Singer et al. 2012).

To outline the argument made in the rest of the paper, the structural tension discussed above needs to become more visible to students so they can more explicitly navigate it during their education. To accomplish such navigation, STEM education's underlying structure needs to better emphasize the curricular mode of being. It is hypothesized that developing being can be accomplished by implementing narrative modes of understanding in parallel with the predominately rational modes that currently exist in STEM education. In other words, educational structures should engage students in actively creating their own story that ties learning experiences together in a personally meaningful way and better linking this story to the process of earning a credential. The paper then argues that ideas from role-playing games can be adapted to higher education in a way that supports both the necessary narrative architecture and sufficiently flexible means of credentialing. The basic structure of role-playing games is then explained, and the paper concludes by exploring three scenarios that outline an actionable plan for curricular transformation. Education can be seen as either creating new cultures or consuming existing cultures (Bruner 1987), and creating new, interdisciplinary cultures requires addressing cultural issues within higher education (Holley 2009). This paper seeks to stimulate the conversations necessary for change by exploring actionable models that enable emergence of new functionings.

Emergent change in structures and environments is a relatively unexplored area of education research (Henderson et al. 2011).

Developing the curricular mode of being through narrative

Although the conception of "being" is a metaphysical question addressed by ontology, in this paper a synthetic definition is developed. In education elements of being that emerged from a qualitative study based on faculty interviews (Barnett and Coate 2004) included the need to nurture a student voice, authenticity, engagement, and an implicit recognition that students are human. In seminal work in economics, Sen (Sen et al. 1987) considers being as a contributor to the capability to live a good life, and Nussbaum's list of capacities (Nussbaum 2011) captures aspects of being including being able "to search for the ultimate meaning of life one's own way," human emotional development, practical reason, and affiliation. Macfarlane (2012) relates Sen's capabilities to academic freedom. Being can also be framed through psychological constructs such as intrinsic motivation (Ryan and Deci 2000), self-efficacy (Bandura 2001), and conceptions of grit and self-control generally classified as character (Peterson and Seligman 2004). In this conception character is synthetic rather than reductionist and defines one's ability to act in the present in a way that leads to a desired future state. What emerges from these frameworks for being is that there is a broad array of characteristics that lead to fulfillment as a human, and no single definition works for everyone. Unlike the modes of knowing and acting where claims of knowledge and ability need to be in accordance with experts, the mode of being is more personal so choice becomes integral to becoming. Rather than mandating what one should become, education enables the student to imagine a broader spectrum of possible futures and gives them abilities that make these futures more likely. Hence in this paper being is defined pedagogically as development of the ability to actively synthesize experiences in a way that approaches a desired future state for oneself or one's friends and family. The curricular mode of being teaches, in the words of George Bernard Shaw's (Shaw 1905) Don Juan, "…to be able to choose the line of greatest advantage instead of yielding in the direction of the least resistance…to be in hell is to drift, to be in heaven is to steer." Being thus must both enable student agency and serve educational needs. Too much agency favors well-prepared and motivated students while leaving those requiring more structure to flounder, yet too little preserves inequalities and inhibits the emergence of new functionings.

It is proposed that Bruner's (1987) conception of narrative construction of reality provides a framework for developing the curricular mode of being. Bruner, building upon Vygotsky, argues that there are two modes of cognitive function, rational and narrative, and that we make sense of lived reality through stories as much as reason. Each mode has its own logic that implies causality, but rational modes of thought require proof, while narrative modes are based on likeliness or alignment with one's past experience. In other words, the quality of a story is judged by different metrics than the quality of a proof. While rational modes of thought strive for abstraction independent of human concerns, narrative modes strive for situatedness and connection to others. Bruner (1987) argues that we construct stories about alternative realities in an ongoing, recursive process that leads to valid, generalized abstractions about the world. Thus constructing a narrative about one's future self is the process by which learning experiences are synthesized, and such narrative construction can appropriately guide student agency.

Narratives in education

While there are multiple definitions of narrative (Herman et al. 2012), a working definition is characters in action with specific intentions in settings using particular means. Stories emerge through tensions or exigencies between these elements such as when means do not support actions or characters' intentions do not align. It is thus proposed that developing being can be implemented by creating a form of interactive narrative that allows students, through their academic experiences, to take on the role of a *character* who is challenged to perform *actions* within the *setting* of their chosen discipline. To advance toward a credential, students would act with *intention* to best utilize the university resources or *means* they need to develop relevant capabilities and connect these to personally relevant functionings. Here the curricular modes of knowing and acting are integral to environmental elements of means, setting, and action while being—the process of becoming—relates to character and intent. Students develop ontological commitment by consciously developing a self-narrative and exploring new roles and story pathways.

Elements of narrative already exist in STEM education, particularly through pedagogies that focus on authenticity such as project-based learning (Hmelo-Silver 2004) or service learning (Astin et al. 2000). These and similar authentic experiences help students develop a professional identity (Atman et al. 2010) without explicitly supporting personal narratives. In engineering programs, developing an identity as an engineer positively impacts retention (Atman et al. 2010; Matusovich et al. 2010) if supported by a social network and in- and out-of-class experiences that reinforce one's self-narrative. As numerous critiques of such pedagogies have pointed out (Prince 2004), however, there are opportunity costs, particularly with respect to content knowledge.

While active pedagogies tacitly put students in a STEM narrative, there is accumulating evidence that being able to explicitly frame events within a coherent story helps people positively redirect their interpretations of events. Wilson (2011) reviews behavioral interventions and finds that successful cases have elements of story editing where individuals explain events with a more positive self-conception. Effective techniques include writing stories about events, prompting people to reinterpret past evenings in ways that reinforce positive narratives, and having people undertake behaviors that reinforce positive conceptions of themselves.

Role-playing games as a model for linking narrative to credentials

To this point, the paper has argued that students may better connect disciplinary knowledge structures to personally meaningful functionings if they engage in explicitly developing a narrative from their choice of learning experiences. In other words, developing a STEM identity is aided by having sufficient agency to create one's own story. Herein the term *narrative agency* refers to the degree of choice that students have in connecting learning experiences through stories to their developing identity. Both the degree of narrative and agency can vary across a curriculum. For example, a rigidly prescribed sequence of courses offers little agency and a program that does not ask students to continuously engage their rationale for pursuing a degree offers little chance to create narrative. Similarly allowing too much choice or the freedom to explain away any choice with a story undermines existing and necessary disciplinary structures. This paper asserts that existing curricular structures offer too little narrative agency, and the remainder of the paper addresses the

question of how to practicably implement an educational structure that provides a degree of narrative agency that can be tuned to support learning outcomes.

While there are many the possible ways to introduce narrative into a curriculum, ideas from role-playing games (RPGs) offer both the narrative agency required for new functionings to emerge and practical mechanisms that enable assessments to be aggregated across scales into valid credentials. RPGs are a textual system consisting of rules for game mechanics, stories (modules) that give meaning and context to the actions of characters, and means of social interaction through which a story is co-created. Cover (2010, p. 168) recently examined tabletop role-playing games (RPGs) as a narrative form, defining RPGs as "a social activity to create narrative experiences under a system of rules," and in other words RPGs serve as narrative architecture. In playing an RPG, each participant, or player, creates a fictional character that serves as the player's avatar in the game world. Characters participate in a story that typically takes place in a fictional milieu, helping to create an emergent story by having their character interact with other characters and the milieu. The story evolution is determined by the game's system of rules, a contextualizing plot (module), a game master (GM) who serves as referee and chief story teller, and the players. What separates an RPG from other narrative systems, and makes it a candidate for introducing narrative agency into a curriculum, is the emphasis of character development within the story. At the start of a RPG, a player's character has few abilities, little experience, and can manage few challenges. As the game progresses, the character gains abilities, resilience, and resources that enable them to address more difficult challenges. The GM is responsible for ensuring the narrative evolves with players' capabilities. It is this continuous interaction between player, character, GM, and the story and rules that enable narrative agency within RPGs.

As an emergent narrative form, RPGs utilize various techniques to help players create narratives within the game world. One way is to engage players in quests, or short-term tasks, that engage them in the larger story. The evolution of the overall story depends upon the outcome of quests players choose. The game steers players into possible story lines through chance meetings with non-player characters who need some action or service performed. Quests are then chained into longer story lines by the GM so players become part of meaningful events occurring in the fictional world. In other words, action in role-playing games is situated in the narrative (Gee 2004). Quests are one element of RPGs that could allow the integration of existing learning activities into larger narrative structures to illuminate possible educational pathways and support emergence of new functionings.

RPGs combine emergent stories with a system of rules that determine the outcomes of character actions and how their actions further develop the character's skills and abilities. Most RPGs have both fine- and coarse-grained measures of advancement (Dickey 2007). A common fine-grained measure is "experience points" (XP) which characters earn by accomplishing or attempting quests. The number of XP awarded depends upon the difficulty of the task and how successfully it was accomplished. Experience points thus echo elements of outcome-based education (Mentkowski 2006) in that advancement depends on accomplishment. After accumulating enough experience, the character advances to a higher "level," the coarse-grained measure, at which point they gain new abilities and so are able to take on more advanced challenges. To make game play enjoyable, the GM ensures that available quests are at a level of difficulty so that the quest is both possible and sufficiently challenging. Appropriate challenge contributes to engagement with the game so successful games are those that engage players (Gee 2008).

Implementing structural change: three models

RPG's develop narrative agency by letting players participate in story creation and reward accomplishments through game credentials analogously to how grades and degrees reward learning in academic settings. There is significant overlap between RPGs and the structural scale of the curriculum in that they guide participants into developmentally appropriate learning experiences, determine how successfully the experience was navigated, and then aggregate the results to create credentials. Since stories emerge from interaction between characters, the GM, rules, and a plot RPGs offer guidance on better engaging students in navigating the tension that exists between capabilities and functionings.

The remainder of the paper explores ways that higher education might modify its structure by drawing ideas from RPGs. To illustrate how ideas from RPGs enable narrative agency, three speculative scenarios are presented that supplant and/or supplement existing elements of a STEM curriculum with structures from RPGs such as quests, experience points, and levels. The models are sequential and additive, each introducing successive changes to structure and thereby increasing narrative agency. Each model presents hypothetical student and faculty perspectives that are intended to be representative of perceptions reported in large-scale studies (Atman et al. 2010; Seymour and Hewitt 1994; Kuh et al. 2010). While models are framed in the context of an engineering degree at a US university for consistency, the underlying ideas apply across STEM disciplines.

Model #1: Changing credentialing processes

In this scenario, the process by which measures of learning are aggregated into credentials is changed by replacing grades with experience points (XP) at fine scales and switching from grades or marks to a level-based credentialing system at coarse scales. The table below illustrates how using ideas from RPGs to track academic progress and award credentials might affect a student, Noah, and faculty member, Dr. K.

In this model, Noah defines his progress through the program by his level, determined from cumulative experience points, rather than class year or grade. In such a system, a student might need to become a 40th level engineer to successfully complete a baccalaureate program. Since faculty continuously reward progress with XP rather than assign grades at the end of a marking period, students advance eight to ten levels each year. Direct and rapid feedback on progress is known to improve STEM learning outcomes (Ambrose et al. 2010). Rather than fail or advance with low marks, students who perform poorly delay graduation, retake classes, or find other ways to gain requisite knowledge and skills. In the model above, Noah performs remedial work to earn the XP he needs to apply for an internship, while higher performing students advance more quickly.

Moving from a coarsely discrete (one grade per course) to a fine-grained curricular structure based on experience points and level potentially allows more experimentation by both students and faculty since the risk associated with low grades is eliminated. Normative grades specifically and extrinsic rewards generally have been found to negatively affect intrinsic motivation (Butler and Nisan 1986; Ryan and Deci 2000). There is currently little evidence to judge if XP and more rapid measures of advancement through a program would have a different effect on motivation than grades, however. The immediate feedback may positively affect learning, but it is not clear if intrinsic or extrinsic motivation is addressed. A few early stage studies (Byl 2012; Muntean 2011; Sheldon 2011) provide anecdotal evidence of increased motivation among students, but may be due to the

Hawthorne effect (McBride 2013). Unlike this model, in all the experiments done to date XP are exchanged for grades at the end of the course.

	Student perspective	Faculty perspective
Grades as a credential	The required dynamics course has a reputation for being difficult. Noah hopes he will make a "B" in the course since his homework scores are above the class mean. He got a 56 on the first exam, just below the class average, and needs to do well on the second test. Unfortunately he receives a 32, while the class mean is a 61. With only the final and two homework assignments remaining, Noah needs to decide whether to risk getting a C or to drop the course. Dropping the course will help to maintain his GPA but delay graduation	Dr. K believes dynamics provides important foundational material in the engineering program, and his grading policy reflects the fact that students need to master the content. Although tests reflect content covered in lectures and reinforced in homework, the class average is usually low. Dr. K typically sets the mean score on the exams to correspond to a B—to ensure enough students pass the course. On particularly difficult tests, he gives extra credit assignments for students who performed poorly
XP and level as credential	Noah, a 13th level engineer, is doing fairly well on his homework assignments in dynamics with 524 of 800 possible XP. Noah hopes to earn another 100 XP by the end of the semester. Noah has not done so well on the tests, getting 112 on the first and 64 on second out of a possible 200 XP. At this rate, Noah would not reach his goal of advancing to 15th level before Christmas break which he needs to be able to apply for the summer internship he wants. From the online quest board, Noah learns about a series of dynamics quests worth 50 XP each, and completing three of the optional assignments will help him reach 15th level	Dr. K tries very hard to make sure the tests and homework assignments in his dynamics course reflect the level of competence expected from students. While most students only earn about 1300 XP of the 2000 XP available in the course, the better students can earn 1800 XP. Since students were not gaining enough experience points in dynamics to hit the university's 9 semester graduation target, Dr. K developed several tutorial problem sets that are worth 50 XP each. Since there is a minimum XP requirement in dynamics to be able to enroll in many popular electives, many students opt to complete the tutorials

Model #2: Supplementing the curriculum with quests

The second model maintains fine-grained credentialing and replaces some fraction of classes in the curriculum with quests. Quests—which can be either optional or compulsory—can serve to encourage exploration, break a large task down into sequential units, or introduce a player to another character, location, or opportunity (Dickey 2007). Like college prerequisites, quests are usually only available to a player of a certain level or who has completed prior quests in the quest chain similar to course prerequisites.

In the previous model, experience points and levels enabled a shift from discrete to continuous credentialing. Here quests shift the curriculum from a rigid hierarchy to a more adaptive and interconnected structure that supports student experimentation. Knowledge remains organized around classes, but quests add flexibility to student pathways through the curriculum. The degree to which quests replace or supplement traditional courses is variable. Emily is constructing a narrative about her identity as an industrial engineer with wireless radio-tracking expertise, and quest chains provide opportunities to further develop this identity and customize her credential. The full quest chain will have her practice

component skills until competence is achieved, integrate component skills, and then apply them to a relevant problem.

	Student perspective	Faculty perspective
Curriculum defined by courses	Emily, just starting her third year in industrial engineering, was thinking of changing majors before her summer internship tracking product flow with wireless radio devices, but she is now motivated to persist. Emily finds a course where she can learn more about this technology, but the instructor, Dr. Diggs, said she lacks the necessary prerequisites. The instructor gives her a laboratory manual and suggests she apply for an undergraduate research award so she can work on a summer wireless engineering project with one of his graduate students	Dr. Diggs recruits potential graduate students from his undergraduate radio engineering course by offering internships in his laboratory to students who do well in the course. Since many students do not have sufficient background for the course, he has written a student laboratory manual on radio instrumentation to help students get up to speed quickly on taking high-frequency measurements. Several students from other departments ask for the manual each year when they have projects that require such measurements, which gives him another pipeline of potential graduate students
Courses supplemented with quests	Emily, a 27th level industrial engineer, completed a summer internship to earn XP after a bad second year. During her internship, she worked with wireless tracking devices and would like to gain more experience in this area since industrial engineers with such experience are in demand. Emily looks into a radio engineering course, but needs to be 32nd level with 4000 XP in software modeling to take the course. Checking U-Wiki, Emily finds a quest chain on radio instrumentation that starts by visiting Dr. Diggs during office hours. Since she only needs to gain 520 more XP in software to qualify for the quest, she begins a self-guided tutorial to earn the needed XP	To attract more students to his RF design course, Jim Diggs, along with university and industry colleagues, developed a series of quests that let students learn the basics of common radio frequency instrumentation. The quests are now being used at several peer schools. About half of the students in the requisite electromagnetics course complete at least one of these quests to make up for the experience points they lose on exams. Students have shown more interest after learning his industry partners preferentially recruit students who have completed the quests. The success of these quests has encouraged him to develop a new series of quests around electromagnetic modeling software that he hopes will help him identify potential graduate students

This model shows how quests can expand the curriculum to create a finer-grained structure than is typically allowed by courses alone. One such aspect is scalability. Studies have found that few course-level interventions are adopted outside the home institution (Fairweather 2011; Henderson et al. 2011). Quests may more readily diffuse across institutional boundaries since they exist outside a traditional curriculum, are smaller, and potentially more adaptable to local situations. Another aspect is how quests can be used to develop requisite skills needed to scaffold or support disciplinary learning, allowing a university to expand its curriculum. Universities that seek to explore new curricula can structure extracurricular learning experiences such as internships or massively open online courses (O'Connor 2014) as quests. Furthermore, quests may allow students to establish more extended social networks. In the scenario above, Emily can connect with an established affinity group (Gee 2004) since her quest has been adopted at multiple universities.

Quests have analogies in programs like *Iron Range Engineering* (Ulseth et al. 2011) where students self-organize learning around projects and *Just Press Play* (Martinez et al. 2012) that integrates game-like achievements into learning.

Model #3: Full RPG implementation

In this model, courses are replaced by quest chains which guide students through a multitude of learning pathways, allowing students to customize their narrative and credential. Such customization enables a student to develop functionings or credentials that cross disciplinary boundaries.

	Student	Faculty
Curriculum defined by courses	Olivia is both nervous and excited for her first day of college. She is relieved she made a lot of new friends at orientation week since few of her high school friends attended university. At the required meeting with her faculty advisor, she learns about the freshman core, chooses electives, and registers. Because she did not pass her math placement test, she cannot take Calculus I which will put her behind her peer group. Her student mentor suggests she enroll in Dr. Smith's Engineering 101 section since he learned a lot when he took it, and the work load is not too bad	Two weeks before the semester started, Gail Smith learned her latest grant had not been funded and decided to teach ENG101 for the overload pay and the chance to meet new students. Although the class negatively impacts her research productivity, the extra pay will make it easier to write proposals over the summer. While not getting the grant hurt her chances of reaching full professor next year, the high teaching evaluations she expects to receive in ENG101 will help her case
Quests replace courses	Olivia's first face-to-face meeting of her affinity group is the highlight of her orientation week. Compared to groups like sustainable energy, her smart buildings group has only five students of which Olivia and one other are taking engineering. They worked with their advisor, Dr. Smith, to develop learning plans from existing quests over the summer. Although many in her group matriculated above first level thanks to summer camps, Olivia did not have these opportunities. However, she has already leveled up to third through the campus exploration quests offered to new students. Since she needs 1000 XP in Calculus to qualify for the first group quest chain in smart buildings, she signs up for several mathematics quests	Gail Smith made the transition to the faculty mentor/designer track about five years after tenure when she admitted to herself that she had more interest in teaching than research. She enjoyed her transition year and finds she enjoys developing new quests and mentoring students majoring in civil engineering as well as the smart buildings affinity group. Her intelligent building control quests have been adopted at enough universities that the revenue helps pay most of her summer salary; she makes up the rest by using her expertise in quest design to help research faculty develop quests for the broad impact requirements of their grants

This model, while highly speculative, illustrates the curricular flexibility that can be achieved by hybridizing a curriculum with ideas from RPGs. Learning takes place through a narrative co-constructed between the student, peers in an affinity group (Gee 2004), and expert advisors or mentors who serve a role similar to the game master in an RPG. Like current curricula, quest chains are constructed by experts (faculty) for novices (students) in collaboration with instructional and game designers. Scaffolding is primarily provided by

quests rather courses. Unlike courses, quest chains can be of any length, be repeated if failed during the first attempt, branch and merge, and can easily incorporate learning activities that emphasize the modes of knowing and acting. As implied by this scenario, quests can help students explore new roles or environments and make "in-between" student trajectories more transparent (Anderson and McCune 2013). Since students have more control over their degree pathway, there is more ability to explore individual identities and develop agency in pursuing immediate and life goals. Observations of massively multiplayer and live action RPGs show that players try out different identities and strategies to build social capital (Cover 2010; Stark 2012).

Criticisms and issues

These three models illustrate that while hybridizing higher education with games offers a way to integrate narrative while enhancing curricular flexibility, it is not a panacea. While some potential advantages have been discussed, there are many possible criticisms that can be leveled at hybridizing structure with ideas from RPGs. First, not all students who enter college, particularly novices, are prepared for a flexible curriculum. Too much flexibility may reward privileged students while inhibiting learning for those with less preparation. Second, the role of faculty changes in significant ways that could either lead to greater academic freedom or undermine it. What role would faculty play at a university that can draw from a public repository of quests to quickly custom-build a degree program? Third, while increasing the number of pathways through a curriculum enables transdisciplinary opportunities, it may also contribute to increasing disciplinary fragmentation. While competence-based credentialing can potentially support mastery learning, the extent to which curricula can be customized while retaining existing disciplinary knowledge structures is not known. Fourth, while continuous assessment of student progress offers advantages from an evaluation perspective, the insights provided by large datasets raise questions about privacy and how institutions would use these data in allocating resources. Finally, the impact on student status and equality is unclear. While eliminating grades implies greater equality, status may simply shift to speed of level advancement, the quests students have completed, and how experience points are distributed among various capabilities. Equality is not the reality in massively multiplayer online RPGs where creation of a character can elicit behaviors the player would not express in the real world and status is both visible and important (Dickey 2007).

Another issue is how to credential students who pioneer new curricular pathways, and who should determine what constitutes valid educational credentials? On the one hand, the deep disciplinary expertise of faculty enables them to serve as arbiters of knowledge and skills (Muller 2015), while on the other hand taught capabilities may not reflect societally relevant functionings (Walker 2015). In the scenarios above, faculty support and reward the curricular modes of knowing and acting on fine structural scales within a discipline, but students play a greater role in synthesizing functionings relevant to their own lives. While this more flexible credentialing system may better represent student needs, existing credentials are vested with the societal imprimatur of needed functionings so change may meet widespread resistance from multiple stakeholders.

Finally, there are significant pragmatic criticisms that can be leveled at the proposed scheme related to the effort and resources required from administrators and faculty members, the belief of faculty in the status quo, and resistance by STEM students. Such criticisms broadly apply to all change, whether in higher education or other organizations. An example is the difficulty encountered in transitioning programs toward active learning.

Since the structural change outlined in the three models change both the nature of faculty work and student support structures, analyzing the relative resource cost is difficult. Faculty attitudes are a significant concern, perhaps rightly so given the issues discussed above. Nevertheless, both early adopters and staunch critics of new ideas are found within the faculty as they are in the population at large. As with any innovation, an iterative process based on small-scale experiments followed by larger trials is needed in implementation. With respect to the attitudes of STEM students, they are increasingly exposed to games that utilize the mechanics explored here to engage players. While students also resist change, there is a large body of knowledge on successful game design that can inform how such programs might be implemented.

Conclusions

Despite these potential criticisms, ideas that have been developed in role-playing games already have significant overlap with some functions and purposes of higher education. As Gee (2007) points out, games and learning have much in common. The path forward in this paper is not to make comparative value judgments between an established and a disruptive model, but rather to look for affordances where ideas from games can better support learning. The reality is that in aggregate college students are devoting less time to academic work and more to games. Since research has begun to identify the factors that make games engaging to young people (Gee 2007), it is worth exploring whether adapting strategies from games can increase student engagement.

The claim that to be educated in science and engineering requires students to construct a personally meaningful narrative reopens long-standing debates on subjective versus objective knowledge. However, the point of this paper is not to completely throw the decision of what to learn to students, but rather to better tie the credential awarded by the institution to how students make personal sense of what they have learned and what meaning it has to their life. The story created by a student may not fully align with the expectations of society or faculty. However, if alignment with existing hierarchies is required for credentialing, or if a curriculum does not support developing self-agency even at personal risk, neither academic freedom (Macfarlane 2012) nor social justice is supported. If education, like health, has intrinsic value to the individual, then it is a mistake to conflate the value of education to an individual with societal value. Only if education, like factory production, stamps out many copies of the same product can one claim societal value through the proxy of an individual's education. Rather, the value of education to society is through the aggregate of all educated individuals, their knowledge, and their connections to each other. It is thus worth asking whether greater societal value could be achieved by creating more emergent pathways through a university and the functionings created therein.

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