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The Inclusion Potential of Student Production of Digital Learning Objects

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Abstract: This account of the inclusion potential of students' digital production is based on the large-scale research and development project *Students' Digital Production and Students as Learning Designers* (2013–2015), funded by the Danish Ministry of Education. The target groups were primary and lower-secondary schools. The project explored teacher-designed frameworks that engage students' agency as digital producers of learning objects for their peers. The findings indicate that digital production facilitates students' learning processes and qualifies their learning outcome when executed within a teacher-designed framework that accommodates and empowers students' agency. The Danish parliament passed the Law of Inclusion In 2012 with the objective that by 2015, 96% of all students would be included in normal classes. Inclusion was not part of the initial research agenda, but this changed unexpectedly during the project. Specifically, students who did not participate or participated only sporadically in everyday school activities at the beginning of the project adopted new positions as participants and agents. We understand these changes as inclusive processes initiated by the combination of teacher-designed frameworks, student agency and digital production. This paper describes two representative cases, analysed from a post-phenomenological perspective to explore the inclusive potential and role of digital artefacts and digital learning production.

We found that 25 out of 50 student we at first identified as non-participants changed position during the project. We argue that both the learning design and the use of specific technological resources played a major role as actors in the observed emerging process of inclusion for both students and teachers.

Keywords: inclusion, exclusion, digital production, students as learning designers, actors, agency

1. Background

The project *Students' Digital Production and Students as Learning Designers* was one of five large-scale research and development *Demonstration School Projects*, representing the largest such effort initiated by the Danish Ministry of Education. Running from 2013 to 2015, the project involved a consortium of two universities, three university colleges and the LEGO foundation. Participants included 13 researchers, 40 teachers and 800 students; schools were chosen from a pool of applicants to reflect geographical and socio-economic dispersion.

The project built on our previous research findings, which challenged the consensus that design for learning lies exclusively within the teacher's domain, as even young students proved capable of engaging with design for learning, both reflectively and in practice (Sørensen and Levinsen, 2014; Sørensen and Levinsen, 2015). We also found that staging digital productions as learning objects aimed at peers had a positive impact on students' learning, as both process and product.

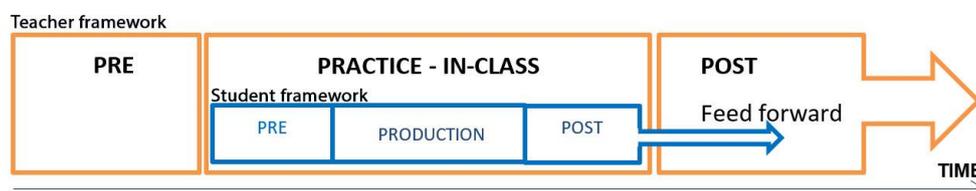


Figure 1: Chronology of the relationship between teacher's and students' work as learning designers.

Building on this premise of design for learning as part of the students' domain, we created frameworks for six variously themed interventions involving student digital production. These productions encompassed a variety of multimodal forms, such as digital books, videos, blogs, robots and games. While some themes were subject-related (e.g. math stories, Danish digital storytelling, math games), others were cross-disciplinary (e.g. online collaboration on a given topic with other classes or schools, LEGO Mindstorm robot programming and Danish, explore your local environment and publish online). The interventions were informed by the following specifications.

- Complexity increases from intervention 1 to intervention 6—from simple productions to trans-disciplinary activities involving advanced technologies (e.g. social media, robotics, location-based technologies).
- The digital productions are learning objects aimed at peers.
- The interventions are integrated as everyday practices during the school year.

In each school, teachers developed and adapted the interventions and themes to their school's culture, producing their own learning designs in a collaborative process, with the researchers as sounding boards.

2. Data collection

The interventions ran over three semesters in first to second and fifth to sixth grades, and in two cohorts at a tenth grade centre. Because of the project's complexity, we used mixed methods to produce a complementary set of data for the interventions at both macro- and micro-levels (for details, see Levinsen et al 2014). The researchers followed one class from each school intensively at each level, following parallel classes extensively.

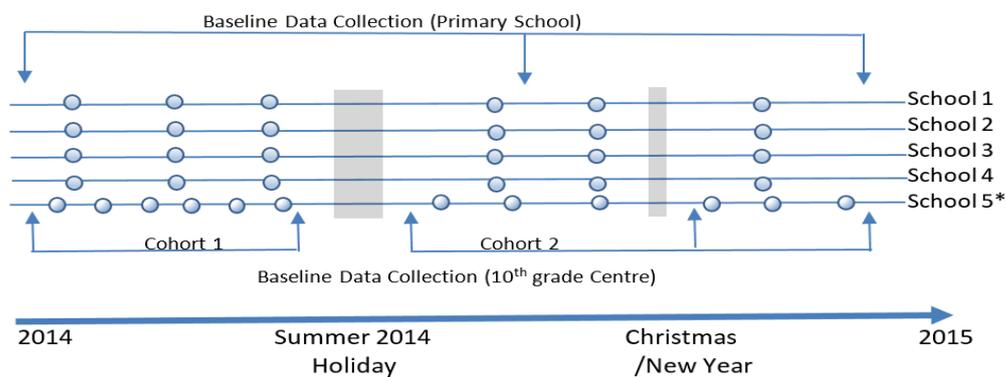


Figure 2: Distribution of the six interventions (circles) and baseline measures (arrows) over the project's life cycle. Note: As a 10th grade centre with two succeeding cohorts, 12 interventions and two sets of baseline measures, School 5* is an exceptional case.

The mixed-methods research design comprised two data-collection strategies (Figure 2).

- Baseline measures at the beginning, middle and end of the project identified overall trajectories of transformation from a diachronic macro-perspective, using quantitative online surveys combined with qualitative structured observations.
- Longitudinal anthropological methods included thick description, informal and formal interviews with teachers and students, and reference to videos, photos, team meetings, material products and artefacts. The longitudinal macro-perspective identified changes in practices during and between interventions. The case-oriented micro-perspective identified transformations in individual students' and teachers' agency and practices.

3. Influence of the Danish Law of Inclusion

At the time of the project, inclusion was a hot issue in Denmark; the Law of Inclusion was passed by the parliament in 2012 with the goal that, by 2015, 96% of all students would be included in normal classes. The law was supported by massive digital investment but not by human resources. As Denmark was a signatory to the Salamanca Declaration in 1994, the political context revived an old discussion about whether "students with special needs and students who, for various reasons, cannot adjust to or function within the school ought to be included or excluded from the general school" (Petersen, 2015, authors' translation from Danish). The parliament decided on an inclusive strategy to be called *the spacious school*. However, inclusion turned into segregation; in 2010, 6% of a cohort was allocated to special offers, and the budget for special offers skyrocketed (Ministry of Education 2013). This situation led to the Law of Inclusion in 2012.

In terms of numbers, the law was successful but teachers found themselves professionally unable to deal with the wide spectrum of special needs students, and extra resources did not follow. This created massive pressures on schools, on individual included students and on their parents. In this process, students "who, for

various reasons, cannot adjust to or function within the school” were to a large extent neglected. Following massive protests, the 96% measure was withdrawn in May 2016 (Ministry of Education, 2016).

The project took place at a time when conflict and debate about the Law of Inclusion and its consequences were at their highest. Although inclusion was not within the project’s original scope, we were bound to notice and document incidents and actors that related to the issue of inclusion, as these affected both the realisation of interventions and our collaboration with teachers. We then began to notice that some students who had not previously participated appeared to change their position and engaged with the project. As these changes seemed to align with the idea of inclusion and at the same time related to the project, we decided to include these changes in the research in order to explore this unexpected potential for inclusion.

4. Student cases

Due to the Privacy Act (Datatilsynet 2015), we do not know how the students who did not participate in the beginning of the project related to the Law of Inclusion. For that reason, we could not distinguish between students with defined special needs and students who for some reason did not participate. Accordingly, we coded the thick descriptions of cases for person-related non-participating instances. The analysis showed about 50 students distributed across the five schools who appeared to be non-participating at the beginning of the project. Of these, we identified trajectories for 25 individual students, who can be divided into two clusters:

- students who changed from non-participation to (some degree of) participation during the project, coming to occupy new positions as agents in everyday activities as the classroom arena transformed; and
- students who were unable to change their position without external intervention; these students began to adopt new positions as teachers identified new options within the transformed classroom arena.

The cases described here, which follow two individuals, are representative of the two clusters. The case descriptions draw on the thick anthropological data and follow these students through interventions 1 to 6.

4.1 Jan changes his position

We followed Jan from fifth to sixth grade. He was an immigrant with limited spoken Danish-and almost no written Danish language skills. Teachers on the team referred to Jan as having weak resources and lacking motivation. In this sense, Jan was doubly excluded: by his language challenges, and by the teachers’ negative expectations.

Jan Now we have read yours
Susan I write all the good things first and then the errors
Jan me too
Susan we think it is good with all the pictures
Jan we like you written when the Zoo is open and how much it costs
Susan your errors are that the names on page 1, 3 and 6. are not translated – you have written the Danish words
Jan UPS
Susan and there is almost no text. We think you should write more about the pictures and make headlines too.
Now, what are our errors?
Jan we should not write many text
Susan Why? Who said that?
Jan the (name of the teacher)
Susan Can we ask her?
Jan OK, and now your errors. Next time write bit more text
Susan Ok but why should we write more text when you do not have to????
Jan ask (name of the teacher)

Figure 3: Excerpt from online chat (authors’ translation from Danish, including Jan’s weak writing).

At the project's outset, most of what was going on appeared to escape Jan's attention. However, in the third intervention (math games), Jan was paired with a well-functioning girl. They managed to negotiate and test their design, but Jan became frustrated by his language limitations, speaking loud or turning away. The teacher failed to notice the level of collaboration, seeing only what he interpreted as aggressive behaviour. In the fourth intervention, the product was a tourist guide in English, aimed at the English friendship school. Jan was paired with a passive boy, and throughout the production period, the teacher ignored them. The teacher told the boys to produce a visual production with only a few written words but forgot to inform their peers. This created a conflict during an online chat-session (Figure 3) in which the groups provided peer-feedback. For Jan, this proved to be a turning point, as his effort to participate and contribute became visible to the teacher because of the other group's complaints. In the fifth intervention, Jan and another boy produced a multimodal instruction guide for a self-chosen Lego Mindstorms robot-programming task aimed at fifth graders. The teacher did not expect too much but supported and challenged their digital production. When the time came for the fifth graders' big test, Jan was very nervous. The fifth graders used the instruction, but the robot moved too far, leaving them puzzled. Jan suggested that it was not about the robot's speed but the length of time for which it was set to move forward. Together, they experimented and solved the problem.

It was fun to watch Jan today ... because he was so sweet and patient with the fifth graders – he didn't say too much, but what he said was completely relevant. That is, he really thought about the relationship between speed and time – he managed to facilitate an experiment without taking over, and the next time the robot drove directly to that square. And ... he cannot see it himself ... he was just doing so well. (Excerpt from teacher interview (author's translation))

At the end of sixth grade, the students work through self-evaluation. Jan wrote notes to himself about how he was doing well and how he needed to improve. He placed arrows in the evaluation circle to indicate the direction of progression. Most of the arrows point inwards, meaning "improvement". By now, he had caught up in the general subjects. He was fully included in everyday school activities and was considered a resourceful student. Although Jan now speaks Danish, he is still an insecure writer.

4.2 Peter—teacher-initiated intervention

Peter avoided grownups and eye contact and spoke only in single words. He sat at a remote table with another boy who did not participate. They played on the iPad and made inarticulate sounds. These boys represented the dilemma of the Law of Inclusion, as the teachers felt helpless. They referred to Peter as having weak resources, and they had no expectations at all for him. Like Jan, Peter was doubly excluded: self-excluded by avoiding all contact with adults, and further excluded by the teachers' lack of expectations. However, Peter did appear to be socially included at playtime.

In the first intervention, the teacher was a substitute who introduced the theme (digital production of math stories) in dialogue with the class. Peter and his partner went to their remote table, and to everyone's surprise, they produced simple math stories about erasers. During the peer evaluation, the boys tried a peer production but produced no feedback. When they received feedback on their own work, they giggled and made sounds. Following the first intervention, the original teachers returned, and Peter was again "parked" at the remote table until the fourth intervention (the English language tourist guide). Peter was paired with Zlatko, with whom he played computer games during breaks. Zlatko took the lead and insisted that they start working on the iPad. They found images from the Zoo and wrote simple text descriptions that Zlatko wanted them to speak aloud. Peter tossed an eraser in the air, but Zlatko grabbed it and put it away. He pointed at the screen: "Come on, just say 'how', come on ... you know you can do it ... just say 'How do they feed (the animals in the Zoo)?" Peter repeated this for the recording. Zlatko pointed at the screen, and Peter tried to bite Zlatko's hand. Again, Zlatko said the words and Peter repeated them. The support teacher misinterpreted the collaboration, telling Zlatko not to distract Peter and moving him to another table while ignoring Peter. Peter grabbed a new eraser-man and tears off the head while making sounds, splitting it into tiny bits. This incident led to a discussion, initiated by the researcher, about the teacher-team's views of Peter and Zlatko. The teachers then decided to change their practice from ignoring or disciplining them to expressing expectations and facilitating their working process. During their continued collaboration, Peter began to speak: "Where do they (the animals in the picture) live?" He did this while pointing at the screen, although sitting with his back against the wall and as far from Zlatko as he could get. The boys ended up producing an acceptable iMovie tourist guide.

... Then Peter tries to hide in the corner but Zlatko puts the iPad just in front of him. He doesn't get a chance to get away ... and that's where I think that the digital ... there is something there. Peter has participated and contributed, and Zlatko can hardly wait for their turn in the presentation round. Then the wireless cannot execute all the sounds, text and images ... and they reduce the format ... They simply insist that we all see their product. You can discuss whether the subject objectives are present, but they have produced a product and they have worked hard; they have contributed, and they could accept the feedback from their peers. It was simple, but it was OK. (Excerpt from teacher interview)

In the final intervention, second- and sixth-graders worked together to produce a 30-second video about a place in their local environment. Peter was given a special deal: he must not leave and he must contribute, but it is okay if he does not speak. The group chose Peter as the camera operator. As they worked on their video takes, Peter pointed to the paper storyboard and suggested potential positions, angles and distances using the iPad camera interface. He communicated using hand-signs and contributed by suggesting alternative takes and by pointing out details on the screen.

In the subsequent interview, the second graders said, "It was a bit weird he didn't talk, but then we found out and it was okay". They liked Peter and found that he produced good video in terms of composition, angle, distance and duration of the single shots. Similarly, the teachers said that Peter was involved and appeared to enjoy his new position: "The others just talked to him as if he was talking and he was there from beginning to end ... and the way he nonverbally communicated while they were doing their takes. He contributed to improving the quality" (teacher interview)

5. Theoretical frame—A post-phenomenological perspective

As the scope of our research did not encompass inclusion as a strategy or phenomenon, we have chosen to focus on the inclusive potential of learning design and digital technology. The following is an account of the post-phenomenological perspective we used to analyse the two representative cases.

In his *Philosophy of Artefacts*, Verbeek (2005, p. 234) stressed that we should expand research about unspecified technologies and their *backwards* conditions of possibility for humans and the world. According to Verbeek, we should use both existential and hermeneutic perspectives to explore how relations between humans and specific technologies and artefacts *forwards* co-shape emerging experience and existence. In other words, research should focus on the entanglement of artefacts and humans; how humans are present in the world; and how the world becomes present to humans.

According to Heidegger (1967), when something (humans, artefacts, practices) are introduced to systems, they are *thrown-into-the-world* and marked with historicity. They act as disturbers that set the system in motion, initiating transformations that may materialise at various levels of the system: within relations and negotiations of meaning between human and non-human actors; in the organisational and structural co-shaping of arenas for agency; and in new artefacts (non-human actors). In return, these transformations mark the system with a historicity that becomes both constitutive of and constituted by the constantly emerging system (Barad, 2007, p. 172; Verbeek, 2005, p. 138).

For Verbeek, these changing marks of historicity have both hermeneutic and existential implications for how reality becomes present to humans in the form of phenomena (ibid, p. 112). In his exploration of these processes, Verbeek draws on Don Ihde's concept of mediation: how the presence of specific artefacts co-shapes and transforms human perceptions in terms of relations of mediation. According to Ihde (1978, p. 21), these relations perform within a structure of amplification/reduction, where every amplification implies a reduction of aspects of reality. Both Verbeek and Ihde reject the position that humans are alone at the centre of agency. Instead, they subscribe to the post-humanist position, which understands humans and non-human actors as mutually interdependent or entangled (Barad, 2007). However, in their understanding of human and non-human actors, they diverge from actor-network theory (ANT). According to ANT, there is no *a priori* distinction between actors, and they should therefore be treated symmetrically (Latour, 1996). In contrast, according to Ihde (Eason et al, 2003, p. 129), there is an *a priori* difference between human and non-human actors. Orlikowski (2005, p. 185) elaborates on how to balance a symmetrical approach with a distinction between types of actor, arguing that asymmetrical approaches may lose sight of intermingling relations while

symmetrical approaches may neglect the differences between actors. To maintain the necessary perspective on both relations and actors, Orlikowski suggests the terms *human agency* and *material performativity*. She argues that these are interdependent and not given *a priori* but temporally emergent as phenomena in practice: “Human agency is always materially performed, just as material performances are always enacted by human agency” (ibid, p. 185).

Following Orlikowski, this approach enabled us to identify the unexpected and emerging conditions and consequences of temporal intertwining of students who, during the course of the project, unexpectedly emerged as partial or full participants in everyday practices from a position of non-participation—a process that can be characterised as a change from exclusion to inclusion. We adopt Orlikowski’s position that while human and non-human actors differ *a priori* with respect to agency and performativity, the parts they play in the emerging agency cannot be determined *a priori*. With Verbeek, we consider how reality becomes present to participating actors in the entanglement of human agency and material performativity, which both Verbeek and Ihde characterise as mediation.

6. Analysis: Relations of Mediation

Following Verbeek (2005, p. 221), Ihde provides a valuable framework for analysing how humans relate to the world, involving four basic forms of technological mediation. First, *embodiment relations* arise when technology is literally between humans and their world. Embodied artefacts become extensions of the human body that co-shape our relationship with our environment through their human-enacted material performance. In the present context, this applies to the various digital input and output devices and to learning-design practices. Second, *alterity relations* occur when we experience technology as a living being/quasi-other that may materially perform as either a helper or an opponent enacted by human agency. In our case, this applies to both learning design and technologies as drivers in communication and reflection processes. Ihde locates the third *hermeneutic relation* between embodiment and alterity, in which technology materially performs as a representation of reality. Through their agency, humans experience and interpret this as “something” in the world—in our case, for example, a map, a digital interface, a simulation or a specific learning-design practice. The fourth *background relation* blends into and co-shapes the context of our agency and perception. In general, the material performance of the background passes unnoticed as a co-shaper of human agency. As described, the four relations perform materially within a structure of amplification/reduction that co-shapes human experience, agency and perception of the world on a scale that ranges from certainty through probability to uncertainty regarding expected outcomes. In the enacted and emerging practice, everything is inseparable; only in the analysis can the researcher distinguish between actors, agency, performativity, experience, and so on as analytical constructs to reduce complexity and to operationalise “the empirical mess” (Hastrup, 1999, p. 154). In this way, Verbeek and Ihde provide an analytical approach to the intertwining of humans and technologies.

The cases reveal that both actors and their school bear marks of historicity that include the students’ positioning as excluded and the negative expectations in the surrounding environment. The project introduced two new artefacts to this system: the learning-design framework (Figure 1) and the specific technological resources used for digital production. While these artefacts disturbed the system, historicity produced inertia because the actors needed time to unlearn previous practices and to adopt new ones. However, the transformations predicated on the research hypothesis slowly emerged (Sørensen and Levinsen, 2014) as the teachers’ practices transformed from intermediary to facilitative, and time was re-allocated from primarily one-way communication to dialogue with students. Simultaneously, most students gained more control of their learning process and acted as learning designers. In short, while the learning-design framework transformed the arena for possible human agency and material performativity, specific digital artefacts transformed the arena for students’ agency in terms of empowerment and means of expression.

Two unexpected clusters of students emerged from this process. In the case of Jan, students gradually transformed their position and teachers transformed their perceptions of Jan-like students. Peter’s case highlights students around whom the teacher began to transform the context, shaping a new arena where Peter-like students transformed their perception of the school and of themselves at school. In both clusters, specific digital artefacts seemed to play an important role in these emergent transformations.

6.1 Learning design at work

In the first intervention involving Peter, the substitute teacher's lack of history with the class and his willingness to adopt the learning design co-created an arena in which Peter moved from his excluded position and delivered a digital production. This unexpected transformation was appreciated, but its potential for inclusion of Peter-like students went unrecognized by the teachers. In retrospect, however, this combination of learning design, teacher attitude and technology emphasized the robustness of the inclusive potential that gradually became a new mark of historicity, subsequently co-shaping new and more inclusive everyday school practices.

In the entangled emergence of transformations, the material performance of learning design as digital production mediated a hermeneutical relation with the teachers that amplified Jan-like students' efforts to participate and agential options for the teacher to apply contextual changes, inviting Peter-like students to break away from their self-exclusion. The transformation emerged in the way that teachers became present in the school through a new teacher position that was observant and facilitative, with a broader awareness of student practices.

At the same time, the material performance of learning design as digital production mediated embodiment relations that amplified a new repertoire of student agency by actualizing their informally acquired digital literacy and play practices (ibid). As materialized through the digital productions, the new repertoire of agencies amplified student competencies that both teachers and students found relevant in a school context. The learning design as digital production also mediated hermeneutical relations in terms of new ways of becoming present in school. These transformations materialized as a change in students' agency from passivity (waiting for teacher instructions or asking "What should we do now?") to empowerment (taking initiatives regarding digital production). In this way, mediation relations co-shaped a new and more positive perception of *school* and *being in school* for Jan-like and Peter-like students.

6.2 Technology at work

Prior to this project, technology was typically present in the form of educational instructional design aimed at training specific subject-related competencies (e.g. calculation and grammar), positioning students as reactive users and consumers. During the project, technologies became production resources for multimodal digital productions, repositioning the students as proactive participants and producers. One major finding was that the multimodal and intuitive digital interfaces materially performed as externalizers of otherwise invisible dimensions of the students' thinking and learning (ibid). For both students and teachers, the material performance of these externalizations mediated hermeneutical and alterity relations that amplified non-human actors as helpers and negotiators of meaning during the learning process.

For Jan-like students, the multimodal material performance of specific technologies amplified options for expressing themselves visually, in contrast to spoken or written language. As they already possessed basic operational and multimodal digital competencies, the technology mediated both embodied and hermeneutic relations that amplified the technology as an alterity relation and helping actor in their efforts to change position. In the fourth intervention, the teacher had organized a peer evaluation in the form of an online chat between two groups. Here, Jan drew upon his experience in writing chat messages. As he did not associate chatting with school and spelling correctly, Jan wrote as well as he could during the peer evaluation (Figure 3). Because of the other group's complaint about the teacher's different demands, the chat came to the teacher's attention. The chat materially performed the communication between the students and amplified Jan's efforts to participate and contribute, causing the teacher to change their perception of Jan. In this case, the chat performed a hermeneutic relation because the chat was not Jan's actual effort but a representation, which the teacher interpreted as Jan's effort. In this way, the hermeneutic relation co-shaped the teacher's perception of Jan and future practices involving Jan-like students.

In Peter's case, the teacher's awareness of changing the context around Peter was co-shaped by the new observant teacher position that amplified "cracks" in Peter's self-exclusive behaviour. Peter was good with computers and often constructed things at home. When he was finally freed from the teacher's demand that he speak, he exploited his embodied technological competence to enact material performances that produced new hermeneutic relations with his peers. As early as the first intervention, Peter broke out of his self-exclusion and managed to produce math stories because he did not have to speak. In the final intervention,

Peter developed the sophisticated competence of co-shaping collaboration with a non-human helping actor, producing representations that externalized his unspoken utterances and hermeneutically mediated communication.

7. Conclusion

During this project, we found strong evidence that in engaging students as learning designers of digital multimodal productions, both the learning design and the use of specific technological resources played a major role as actors in the observed emerging process of inclusion. We also found that most students make an effort to participate, and that some of them (Jan-like students) work quite hard to change their positions. Additionally, we found that when students used digital resources for production, the hermeneutic mediation externalized and amplified their efforts. It therefore appears that teachers' lack of awareness regarding the student efforts to participate remains a dominant obstacle to inclusion.

In conclusion, we argue that the new observant teacher's position in relation to learning design and the use of technology co-constructed how students became present in school as participants in learning activities.

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