WIP: Design Competency Development via Digital Storytelling in Culture-Inspired and Client-Driven CAD Projects

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Introduction

This work represents an initial phase of a broader research effort. The interventions and assessment strategies described here are being refined and expanded in future semesters. In today's highly globalized society, engineering students begin their journeys into higher education with increasingly multifaceted skillsets, by nature of their prior experiences, diverse upbringings, and cultural perspectives. This heterogeneity propagates to student skillsets and can inform students' approaches to design problems and challenges, especially in early engineering courses [1]. The existing engineering education structure takes on a one-size-fits-all model, rooted in the assumption of a uniform and monocultural student body. However, the discipline of engineering is in constant flux and necessitates an ever-adapting and student-centric pedagogical approach. Integrating early curricular interventions to foster, refine, and amend core design competencies in students is a promising approach to ensure success across a multitude of professional environments [2].

Digital storytelling is a widely documented storytelling approach that leverages multimedia tools for narrative-based communication [3]. In a constantly evolving world, digital storytelling provides a pedagogical technique ideal for project-based, constructivist classrooms to elevate student engagement, acquisition of technical skills, and technological literacy, while promoting creativity, critical thinking, and deep learning [3] [4].

This study explores the implementation of digital storytelling in a first-year design course to support design competency development through early-curricular intervention. The implementation in *ME 1670: Introduction to Engineering Graphics and Design* weaves story-based communication tasks directly within the engineering design process across both collaborative and solo projects. The communication framework and guided intervention require students to narrate the entirety of their design journey– from ideation and contextualization of their design to their engineering constraints and design decisions. As a secondary facet of this intervention, first-years learn to deconstruct and decode more advanced thinking by analyzing projects completed by senior-level Capstone students and subsequently using their findings to inform their respective design choices. A two-phase approach consisting of pre- and post-activity survey tools coupled with rubric-based assessment are used to measure the resultant growth in design competencies.

Literature Review

Historically, engineering students typically began college with homogenous backgrounds and skillsets; in today's world, however, incoming students come from increasingly diverse backgrounds, prior experiences, and cultural perspectives. This variability, coupled with the pervasive impact of the digital age has noticeably shifted the competencies of novice students, ultimately impacting how they approach engineering problems. A study by Goff and Terpenny found that engineers produced through the current engineering education system, while strong in technical skills, tend to lack several professional attributes essential to practice in today's globalized society, including proficiency in communication, collaboration, ethics, flexibility, and creative thinking [2].

Core design competencies refer to a set of non-negotiable, fundamental skills that ensure student success both in academia and industry, given that skills are cultivated and deficiencies corrected through targeted interventions early in the design curriculum [1]. Some sample traits and attributes desired of graduating engineers by organizations in academia, industry, and government include strong abilities in communication, collaboration, technical aptitude and proficiency, continuous learning and reflection, and critical and creative thinking [2].

While most curricular designs traditionally rely on conventional activities such as lab reports, technical drawings, progress reports, or presentations to assess performance and engage students in course material, the notion of intertwining multimedia technology with educational tools has gained considerable momentum [5] [6]. Digital storytelling, in particular, is a promising technique that merges a narrative-based framework with multimedia to offer activities that actively augment student learning.

Lazareva and Cruz-Martinez characterize digital storytelling as an activity that enables users to become creative storytellers by following the traditional approach of selecting a topic, conducting research and reflection, storyboarding a script, and developing a compelling narrative, and harnessing powerful multimedia resources such as graphics, animations, audio, music, and video clips. They report that digital storytelling is optimal for “constructivist” classroom settings with project-based activities, where students are tasked with forging their own understanding and knowledge of the subject matter through active exploration [3]. Digital storytelling is deemed as highly effective in intellectually engaging students by facilitating the delivery of complex material, connecting the dots between theory and application, and appealing to a wide range of learning styles, when supplemented with other instructional methods [6]. Additionally, while storytelling is innate to certain fields, the art of crafting meaningful stories in the realm of engineering design requires tremendous effort, which culminated through hands-on experience, reflection, abstraction, can catalyze deeper thinking and learning, [4] [7].

Given the pedagogical value of digital storytelling, there exists an opportunity to integrate narrative learning activities in this project-based first-year design course. As such, this study strives to leverage the benefits of the multimedia and digital storytelling to address key design competencies including creativity, technical proficiency, collaboration, communication, and reflection.

Assessment of design competencies in engineering education has evolved significantly to address the multidimensional nature of design learning. Traditional evaluation methods such as exams and reports often fail to capture the complexity of design thinking, creativity, and collaboration. Consequently, rubric-based assessment has emerged as a preferred approach for providing structured, transparent, and formative feedback aligned with competency-based education principles [8] [9].

Role of Rubrics in Competency-Based Assessment:

Rubrics articulate clear performance criteria and levels of achievement, enabling both instructors and students to understand expectations and quality benchmarks. They support consistency in grading, reduce subjectivity, and enhance student confidence by clarifying what constitutes “good” performance. Well-designed rubrics also promote metacognition, guiding students to reflect on their design process and outcomes. However, literature emphasizes that rubric design is complex, requiring alignment with learning objectives, authenticity, and interdisciplinary considerations [10].

Frameworks and Best Practices:

Recent frameworks, such as the Design Competency Assessment (DesCA) model, advocate for mapping rubrics to distinct competency levels and design activities, ensuring curricular coherence and progression [11]. Performance-based rubrics in engineering design courses often include criteria such as problem definition, ideation, technical execution, and reflection, with descriptors for varying levels of proficiency [12]. Studies highlight the formative potential of analytic rubrics, which break down tasks into discrete criteria, as opposed to holistic rubrics that provide a single overall score [13].

Course Interventions and Project Structure

This course is the first major-specific class in the Mechanical Engineering curriculum and serves as students' initial introduction to engineering design. The narrative storytelling framework was integrated into two major design experiences in *ME 1670: Introduction to Engineering Graphics and Design*:

1. A solo, culture-inspired CAD project
2. A collaborative, client-driven team project

Both projects shared a common goal requiring students to create digital stories that documented and narrated their design process but differed in scope and emphasis. To support these deliverables, students received structured resources, including ideation guidelines, checklists, and storyboard templates. The storyboard framework was particularly critical, guiding students through three key stages:

1. Identifying problem context and design constraints
2. Translating design problems into technical requirements
3. Reflecting on reasoning and outcomes

This approach shifted communication from a chronological recounting of steps to logic-based storytelling, emphasizing *why* decisions were made rather than simply *what* was done.

<u>Solo Project: Culture-Inspired Design</u>

Students designed a home décor piece that balanced form, function, aesthetics, and cultural attributes, treating their chosen culture as a "client." They were tasked with carrying out the engineering design process, including ideation, sketching and dimensioning, solid part modeling, assembly, and 3D printing. The final deliverable was a three-minute vertical video narrating the design journey and its cultural connections. This assignment aimed to:

- Encourage reflection and introspection by articulating how cultural values informed design decisions
- Train students to justify design choices logically, moving beyond procedural descriptions

The video served as a medium for students to communicate their design rationale clearly and persuasively.

<u>Team Project: Client-Driven Functional Design</u>

The second project was a collaborative group assignment, with teams selecting either:

- A **Senior Design Capstone project**, emphasizing creativity, mechanical design, and dynamic system animation
- A **socio-technical project aligned with UN Sustainable Development Goals (SDGs)**, focusing on low-cost, locally sourced solutions for global challenges

Both projects involve frontier design problems with real-world context, defined specifications and constraints, and relevant stakeholders, going beyond typical textbook design exercises. Teams distributed responsibilities for key design tasks including part modeling, sub-assembly development, rendering, and animation. The final deliverable was a five-minute video showcasing functional design and team reasoning.

To deepen learning, each team was paired with a current Capstone mentor and provided past Capstone reports after the first design review. These reports were not templates for solutions, but exemplars of professional reasoning. Teams were required to demonstrate in their videos how insights from these analyses influenced their own design decisions, reinforcing cognitive apprenticeship and reflective practice.

The flowchart in Figure 1 below illustrates the storytelling intervention techniques aligned with the key activities of the course projects.

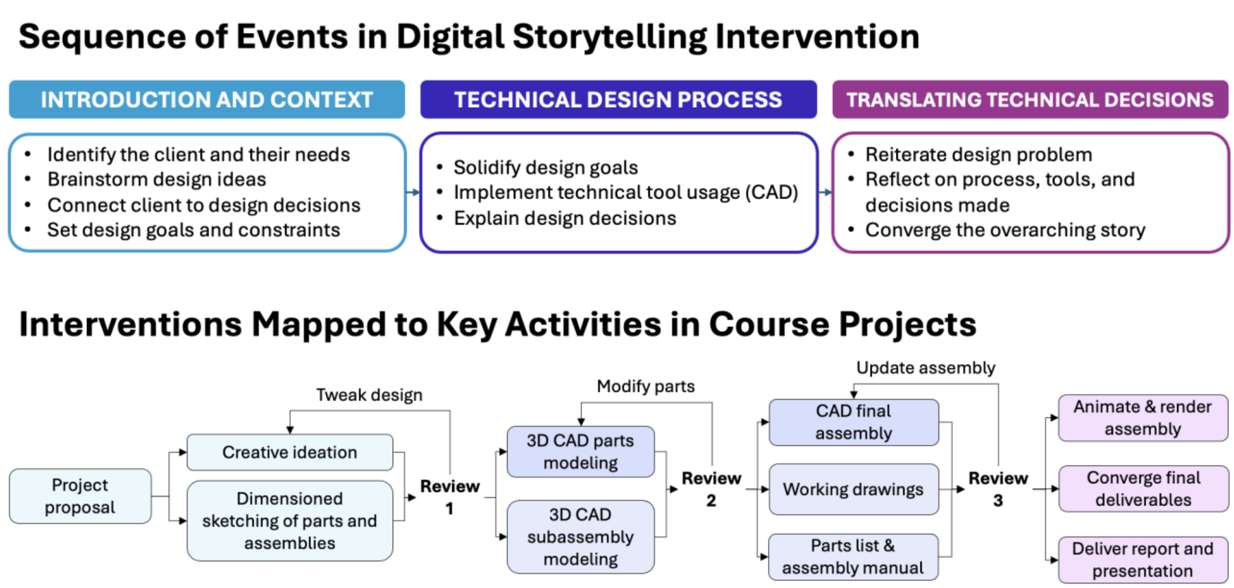

Figure 1. Interventions [14]

How interventions foster multiple design competencies:

A matrix mapping project attributes, learning activities, and course outcomes to targeted design competency categories is shown in Figure 2, illustrating how each competency is addressed across the course. Areas shaded in red indicate primary competencies emphasized by a given course element, while yellow denotes secondary emphasis.

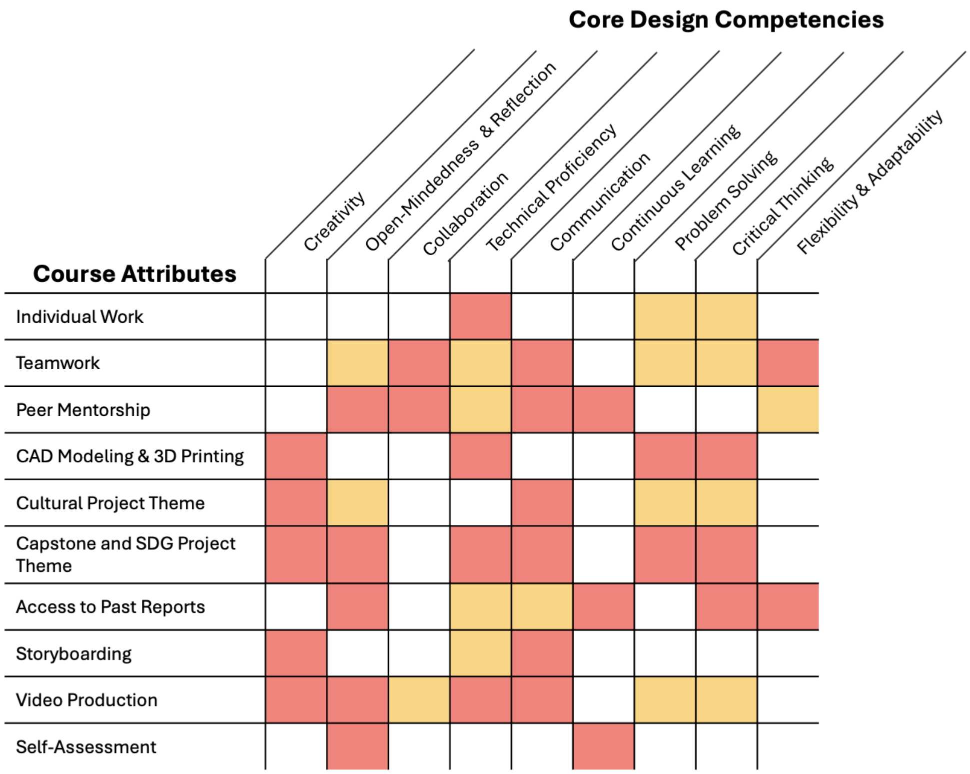

Figure 2. Competency mapping matrix

The competency mapping matrix provides a visual and conceptual representation of the intentional alignment between instructional design and targeted design competencies. By linking specific project attributes (e.g., cultural context, client-driven functional requirements), learning activities (e.g., ideation, storyboard development, peer review), and course outcomes (e.g., technical proficiency, reflective reasoning), the matrix clarifies how competencies are developed through multiple, coordinated experiences rather than isolated tasks.

The matrix demonstrates that key design competencies such as creativity, technical execution, collaboration, communication, and reflection are systematically embedded across both solo and team projects. For example, the culture-inspired solo project places strong emphasis on creativity and reflective reasoning through cultural interpretation, as described in Appendix A. In contrast, the client-driven team project prioritizes collaboration and functional design reasoning, as shown in Appendix B. Activities such as storyboarding and digital storytelling further reinforce communication and metacognitive skills, encouraging students to articulate not only what they designed, but also why specific design decisions were made.

The matrix also reveals differences in the depth and persistence of competency integration throughout the course. Technical execution is reinforced consistently across all project phases, while competencies such as cultural empathy and sustainability awareness are emphasized in more context-specific settings. This structured alignment ensures coherence between instructional activities, learning objectives, and assessment practices, enabling instructors to evaluate student performance holistically while maintaining transparency in expectations.

Ultimately, the competency mapping matrix clarifies the pedagogical intent of the course by explicitly linking instructional activities to targeted design competencies. By identifying how project attributes and learning activities support specific competencies, the matrix directly informed the development of assessment rubrics. This alignment ensured that rubric criteria such as design process documentation, technical execution, narrative quality, visual communication, and reflection corresponded to intended learning outcomes across both solo and team projects. As a result, rubric-guided assessment could be implemented in a coherent and transparent manner, providing a foundation for balanced evaluation of design competencies. The following section describes the structure and use of these rubrics in more detail.

Rubric Development for Assessment

Assessing design competencies in first-year engineering courses requires more than grading technical accuracy; it demands a holistic approach that captures creativity, reasoning, collaboration, and communication. Traditional assessment method such as written reports or exams often fails to reflect these multidimensional skills. Rubrics provide a structured, transparent, and consistent framework for evaluating complex tasks, aligning assessment with learning objectives and competency-based education principles. They not only standardize grading but also serve as formative tools, guiding students toward improvement by clarifying expectations and performance benchmarks. When shared with students early, rubrics promote metacognition, enabling learners to self-assess and refine their design process throughout the project lifecycle.

The rubrics developed for this study were designed to evaluate both solo (culture-inspired) and team (client-driven) projects, ensuring alignment with the course's dual emphasis on technical proficiency and reflective reasoning. Each rubric includes five core criteria:

1. Design Process Documentation
    - Measures clarity and completeness in articulating ideation, iteration, and decision-making steps.
    - Requires integration of sketches, CAD models, and prototypes to demonstrate progression from concept to execution.
2. Technical Execution
    - Evaluates accuracy and detail in CAD modeling, adherence to design constraints, and effective use of tools such as 3D printing or simulation.
    - For team projects, this includes proper assembly modeling and motion analysis.
3. Narrative Quality
    - Assesses coherence and engagement of the digital story, ensuring alignment between narrative structure and design goals.
    - Focuses on logical sequencing and justification of decisions rather than chronological recounting.

4. Visual and Audio Communication
    - Examines the quality of multimedia elements, including images, animations, transitions, and rendering.
    - Considers clarity and professionalism of voiceovers or text narration to enhance audience understanding.
5. Reflection and Insight
    - Captures depth of introspection and evidence of learning, growth, and future considerations.
    - For team projects, emphasizes collaborative reasoning and integration of insights from Capstone exemplars.

Weighting and Feedback Strategies

Each criterion was assigned an equal weight of 20%, reflecting the course's commitment to balanced competency development across technical, communicative, and reflective dimensions. (see Appendix C). Instructors provided detailed comments for each criterion, ensuring feedback was constructive and actionable. This approach supports transparency and encourages iterative improvement, reinforcing the formative role of assessment in design education.

Adaptation for Solo vs. Team Projects

While the core criteria remained consistent, the rubrics were adapted to reflect the unique cognitive demands of each project type:

- Solo Projects: Emphasized cultural interpretation, aesthetic reasoning, and personal reflection. Narrative quality and introspection carried greater weight in feedback, encouraging students to articulate how cultural values shaped design decisions.
- Team Projects: Prioritized collaboration, functional reasoning, and integration of professional insights. Reflection focused on how teams analyzed Capstone reports and applied expert reasoning patterns to their own design choices. Technical execution was assessed at both solo and collective levels to ensure equitable contribution.

By embedding rubric-based evaluation into the course structure, this intervention provided a robust mechanism for assessing multidimensional design competencies while fostering transparency, accountability, and student growth. The rubrics served not only as grading tools but as learning instruments—helping students internalize the principles of effective design communication and reasoning.

<u>Use of Rubrics for Formative and Summative Assessment:</u>

Rubrics played a dual role in both formative and summative assessment. Formatively, they provided students with clear expectations and actionable feedback throughout the project lifecycle, promoting iterative improvement and self-assessment. Summatively, rubric scores offered measurable indicators of competency development, supporting transparent and equitable evaluation. The alignment of rubric criteria with the competency mapping matrix ensured that assessment remained coherent and targeted, reinforcing the course's pedagogical intent to cultivate well-rounded, reflective, and communicative engineers. This comprehensive assessment approach not only measured student outcomes but also informed ongoing course refinement, supporting the integration of digital storytelling and rubric-based evaluation as central pillars of design education.

Assessment and Evaluation Methods

A robust, multi-faceted assessment strategy was implemented to evaluate the impact of digital storytelling interventions on student design competency development in ME 1670: Introduction to Engineering Graphics and Design. This approach combined both qualitative and quantitative data collection, ensuring a comprehensive understanding of student growth across solo and team projects.

<u>Data Collection:</u>

Pre- and Post-Activity Reflections:
Students completed structured surveys once before the course and once after the interventions, capturing self-perceived abilities in areas such as clarity, confidence, narrative organization, audience awareness, and reflective judgment. Likert-scale items measured changes in confidence and skill, while open-ended questions provided qualitative insights into how digital storytelling influenced students' perceptions of design communication and reasoning (See Appendices D and E).

Rubric Scores:
Both solo and team projects were evaluated using detailed rubrics that assessed five core criteria: design process documentation, technical execution, narrative quality, visual and audio communication, and reflection/insight. Each criterion was weighed equally, and instructors provided targeted feedback to support student growth. The rubrics were adapted to reflect the unique demands of solo versus collaborative work, ensuring alignment with the course's competency mapping matrix.

Surveys and Peer/Instructor Feedback:
In addition to instructor assessment, students participated in peer review sessions, analyzing each other's digital stories and discussing how rhetorical choices conveyed design reasoning. Peer feedback reinforced disciplinary conventions and encouraged deeper reflection. Instructor observations during these sessions provided further evidence of increased attention to justification, audience awareness, and collaborative reasoning.

<u>Triangulation of Qualitative and Quantitative Data:</u>

To validate competency gains, data from reflections, rubric scores, surveys, and peer/instructor feedback were triangulated. This process enabled the instructional team to identify consistent patterns of growth and areas for improvement. For example, survey results indicated that narrative framing supported students in moving beyond procedural explanations toward intentional, audience-aware communication of design logic. Rubric scores corroborated these findings, showing improvements in both technical execution and reflective insight. Peer and instructor feedback added nuance, highlighting the development of collaborative skills and the ability to transfer expert reasoning from Capstone exemplars to student projects [14].

Results and Discussion

Preliminary findings from the pre- and post-activity survey instruments provide compelling evidence that the narrative-based digital storytelling interventions were highly effective in fostering multiple facets of design competency development among first-year engineering students. For example, pre-survey results revealed substantial variability in students' confidence and reflective practices, with only 60% feeling confident explaining technical ideas and 41% reporting that reflection was not a consistent part of their design process. Post-survey data showed marked gains, with 85% reporting increased confidence and improved ability to organize and present design ideas using narrative techniques [14].

Figure 3 shows the distribution of post-activity survey responses. The data reveals substantial growth across several key attributes, including the organization and communication of technical ideas, reflective practice, interdisciplinary collaboration, technical aptitude, peer engagement, and the application of systematic design thinking principles to engineering problems.

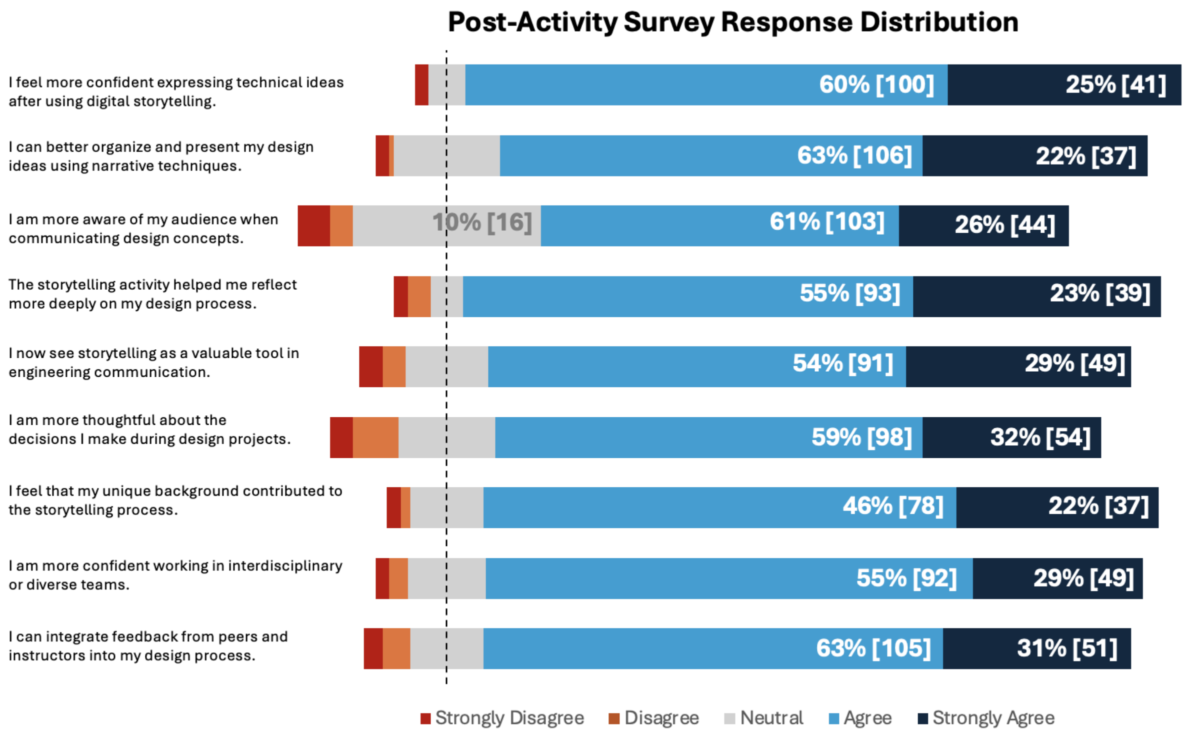

Figure 3. Post-activity student response results

A total of 173 post-survey responses were collected from a cohort of approximately 250 students (70% response rate). Notably, 95% of student respondents reported increased confidence in their ability to use CAD software and apply design principles to solve engineering challenges. Furthermore, 85% of students expressed greater confidence in organizing, communicating, and presenting technical ideas, while 87% indicated a heightened awareness of their design audience. Team-based collaboration was another area of significant improvement, with 91% of students feeling comfortable working in groups, and 94% successfully integrating feedback from peers and instructors into their design process.

On design judgment and decision-making, survey results indicate shifts in how students approached design decisions. Following the interventions, 91% of respondents reported being more thoughtful about the decisions they made during design projects, reflecting increased awareness of trade-offs, constraints, and justification. This finding supports the claim that storytelling functioned as a mechanism for reflective design reasoning, not merely as a presentation tool. Additionally, 83% of students reported viewing storytelling as a valuable tool for engineering communication after the intervention, indicating a shift in perception regarding the role of narrative in technical contexts.

Additionally, students provided qualitative reflections of their insights on the storytelling activity, which largely suggested that the initiative was well-received and effective in achieving several key objectives. For example, when describing their most valuable skill gained, one student mentioned "*learning how to clearly communicate the why behind my design*," stating that "*Framing my work as a story helped me think more about the user, context, and design decisions*." Another student echoed these sentiments, sharing that they gained a "*stronger ability to iterate with purpose, using feedback, teamwork, and structured reasoning to refine designs into more functional and user centered solutions.*"

When asked about the role of collaboration, one student recounted that they "*now see design as a more collaborative and iterative process*" and that "*Sharing my work through storytelling made me realize how much better ideas get when I ask for feedback and build on other people's perspectives.*" Another student stated, "*This experience strengthened my understanding that effective design grows from collaborative iteration where diverse ideas, clear communication, and shared problem-solving lead to more refined and resilient solutions*."

Lastly, when asked about their main takeaways from the storytelling activity, one response reflects that "*The most valuable part…was that it forced me to slow down and think about why I made each design choice instead of just showing the final model. Turning my process into a story helped me see gaps, improve my explanations, and connect my design decisions to the user and context more clearly*." Another student offered a slightly nuanced perspective, sharing that "*Translating technical decisions into a clear narrative sharpened my ability to communicate intent, highlight design rationale, and connect engineering choices to user experience*." Additionally, one reflection even demonstrated a sense of fulfillment and pride enabled by the project, with a student stating, "*Often people only get to see the final product and not all the thought and effort that goes into it. It feels good that this project allowed us to express that.*"

These results underscore the effectiveness of embedding narrative frameworks and digital storytelling into the design curriculum. Students demonstrated not only technical growth but also enhanced metacognitive skills, such as reflecting on their design decisions and articulating the rationale behind their choices. The interventions encouraged students to move beyond procedural recounting, fostering logic-based communication and deeper engagement with the design process.

Ongoing Assessment

Current assessment activities continue to monitor and analyze evidence of student growth in core design competencies, including creativity, technical skills, collaboration, and reflection. The impact of rubric-guided assessment is being closely examined, with early indications suggesting that structured feedback and transparent criteria significantly enhance student learning and self-awareness. Comparative analyses are underway to explore the development of broader design skills in relation to communication-focused outcomes, providing valuable insights into the holistic benefits of the course interventions. As the evaluation process evolves, the instructional team is refining survey instruments, expanding the integration of digital storytelling, and leveraging the competency mapping matrix to ensure that assessment remains aligned with targeted learning objectives. These ongoing efforts aim to further validate the effectiveness of the pedagogical approach and inform future iterations of the curriculum.

Conclusions

Integrating digital storytelling and rubric-based assessment in first-year engineering design shows strong potential for developing a broad range of design competencies, including creativity, technical proficiency, collaboration, communication, and reflection. Early findings suggest improvements not only in students' confidence communicating technical ideas, but also in their ability to justify decisions, reflect on design intent, and adapt communication strategies across different contexts. Structured rubrics and narrative-driven activities provided transparency and formative feedback, helping students better understand expectations and evaluate their own progress.

These results represent only an initial phase of a longer research effort. Ongoing analysis is focused on refining the assessment tools, strengthening the validity of the measures, and expanding the digital storytelling repository to support longitudinal tracking of student learning. Additional work is needed to more rigorously evaluate how these interventions influence the development of design competencies over time.

Future directions include collecting demographic data to examine possible performance differences across student groups, consistent with prior research reporting variation in engineering graphics performance. Implementing a control group or using paired pre- and post-tests for technical knowledge may also help isolate the effects of the intervention from other curricular influences. Further expansion of these digital storytelling and rubric-guided strategies across the Mechanical Engineering curriculum is also planned to evaluate scalability and curricular integration.

In summary, these preliminary findings demonstrate the promise of narrative-based interventions and rubric-guided assessment in cultivating reflective, communicative, and well-rounded early-career engineers. Continued refinement and future data collection will allow for a more comprehensive understanding of their long-term impact and effectiveness.

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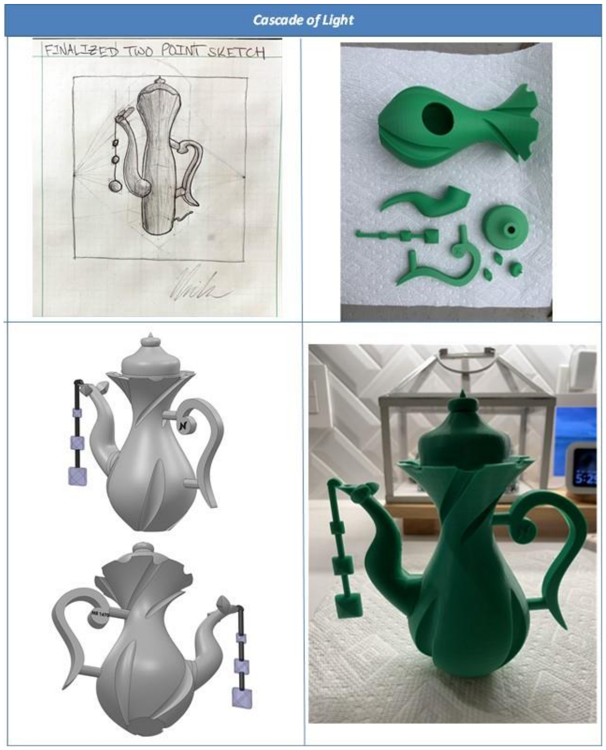
Appendix A: Solo Project design prompts and students' work

CAD & Culture : Design with digital story



In this project, you are an engineering designer, and your "client" is your culture. You must use creative ideation methods (learned in the class) for form design for the creative home decor product that reflects or serves this culture using CAD tools. Then, document how your object reflects your culture by discussing your design process and decisions. Focus not just on what you did, but on why you made those choices in response to your culture's needs, values, or aesthetics and the engineering tools available to you.

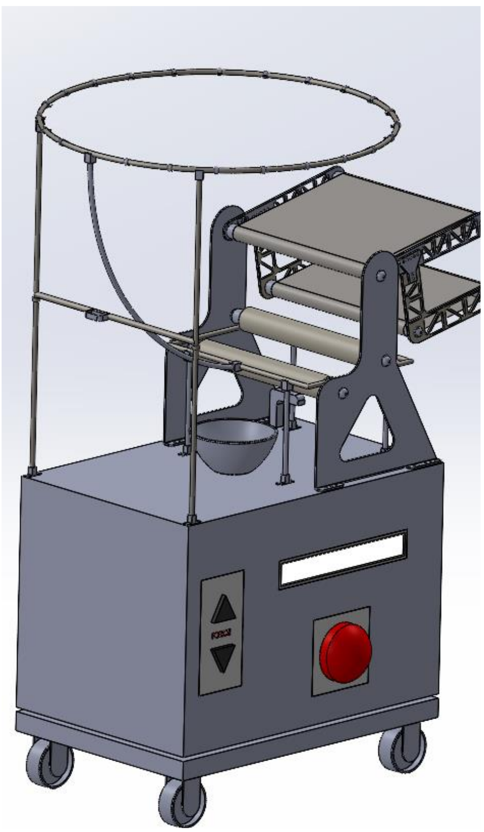
Complete it in 4 steps:

1. Creative ideation sketches for a décor to design and get approval
2. CAD and make design decisions
3. 3D print and make a digital poster
4. Record and submit your 3-minute video

Appendix B: Team Project design prompts and students' work

Prompt (from Capstone design project)

- High level volleyball requires fast and accurate sets, so hitters can attack competitively. However, hitters cannot realistically practice real game speed swings on their own, because they depend on a skilled setter to deliver consistent and game like balls.
- Current training options either require extra players or coaches, or use general ball machines that do not accurately replicate the timing, height, and trajectories of real sets, which slows hitter development and limits individual practice time.
- Design a volleyball setting system that can automatically deliver precise, repeatable sets at custom speeds, heights, and angles that emulate bump, standing, and jump sets.
- Ensure the device can be safely operated, loaded, and adjusted by a single hitter, including controls for set type, location, and interval between balls.



Solo Volleyball Hitter (Capstone)

Team Member 1

Team Leader and in charge of the sketches, CAD design, and CAD subassembly for the **volleyball roller** part of the project.

Team Member 2

In charge of the sketches, CAD modeling, and CAD subassembly, for the **base of the volleyball hitter including the wheels, buttons, and gadgets attached**.

Team Member 3

In charge of the sketches, CAD modeling, and CAD subassembly for the **net part of the project, including the hoop, legs, and attachment pieces**.

Appendix C: Digital Storytelling in CAD Projects - Rubric Template Instructions for Using the Rubric Template

This rubric template is designed to assist instructors in evaluating student digital storytelling projects within CAD coursework. Each criterion includes a description and a suggested weight, which can be adjusted based on specific course requirements.

Instructions:

1. Review each criterion and adjust the weight percentages if needed to reflect your assessment priorities.
2. Use the 'Instructor Comments' column to provide specific feedback on student performance for each criterion.
3. Ensure that feedback is constructive and aligned with the learning objectives of the project.
4. Total scores can be calculated based on the weighted performance across all criteria.
5. Share the completed rubric with students to support transparency and encourage reflection.

Criteria	Description	Weight	Instructor Comments
Design Process Documentation	Clear articulation of ideation, iteration, and final design decisions. Includes integration of sketches, CAD models, and prototypes.	20%	
Technical Execution	Accuracy and completeness of CAD models. Effective use of 3D printing or simulation tools.	20%	
Narrative Quality	Coherent and engaging storytelling structure. Alignment of narrative with design goals and user needs.	20%	
Visual and Audio Communication	Quality of visuals (images, animations, transitions). Clarity and effectiveness of voiceover or text narration.	20%	
Reflection and Insight	Depth of personal and team reflection. Evidence of learning, growth, and future design considerations.	20%	

Appendix D: Pre-Activity Survey Questions

I feel confident explaining technical ideas to others.	Likert (Strongly Disagree; Disagree; Neutral; Agree; Strongly Agree)
I am comfortable presenting my design ideas in both written and oral formats.	Likert
I find it easy to organize my thoughts when communicating complex concepts.	Likert
I regularly reflect on my design decisions and their impact.	Likert
I understand the importance of storytelling in communicating design ideas.	Likert
I consider multiple perspectives when solving design problems.	Likert
I enjoy working collaboratively on design projects.	Likert
I feel that my background and experiences influence how I approach design tasks.	Likert
I am aware of how communication affects teamwork in engineering contexts.	Likert
What do you think makes a design idea compelling or memorable?	Open-Ended
Describe a time when you struggled to explain a technical concept. What made it difficult?	Open-Ended

Appendix E: Post-Activity Survey Questions

I feel more confident expressing technical ideas after using digital storytelling.	Likert
I can better organize and present my design ideas using narrative techniques.	Likert
I am more aware of my audience when communicating design concepts.	Likert
The storytelling activity helped me reflect more deeply on my design process.	Likert
I now see storytelling as a valuable tool in engineering communication.	Likert
I am more thoughtful about the decisions I make during design projects.	Likert
The activity helped me connect more meaningfully with my peers.	Likert
I feel that my unique background contributed to the storytelling process.	Likert
I am more confident working in interdisciplinary or diverse teams.	Likert
How did digital storytelling change the way you think about design?	Open-Ended
What was the most valuable part of the storytelling activity for you?	Open-Ended