



Enhancing the Design and Make stages in Technology Education through authentic artefacts: Evidence from Grade 7 Technology classrooms in the Manthole Circuit, Limpopo Province

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ABSTRACT

This study explores the role of teachers in enhancing the Design and Make stages of Technology Education through authentic artefacts in Grade 7 Technology classrooms. It examines how teachers guide learners in designing and constructing real-world artefacts using authentic materials, methods, and learner-centred strategies. Instructional approaches, including scaffolding, inquiry-based learning, and hands-on design, were explored to illustrate how learners develop design principles and problem-solving skills. Data were collected through lesson plans and non-participatory classroom observations. A qualitative research approach was employed to capture rich descriptions of teacher practices, while Constructionist Teaching Theory framed the study by positioning learners as active constructors of knowledge. Findings revealed that emphasising authenticity within the Design and Make stages enhanced learners' ability to design and produce artefacts that address real-world problems. Authentic artefacts also supported diverse learning styles, with kinesthetic learners benefiting particularly from practical demonstrations during design and construction activities. The study concludes that teachers play a pivotal role in bridging the gap between theoretical knowledge and practical application by facilitating authentic learning experiences that foster critical thinking, creativity, problem-solving, and technical competence. It recommends supportive policies and continuous professional development to strengthen teachers' implementation of authentic Design Process pedagogies. The study contributes to scholarship by demonstrating how teachers utilise authentic artefacts to strengthen the Design and Make stages of Technology Education, extending current understanding of learner-centered pedagogies for authentic learning in South African Grade 7 classrooms.

Keywords: Design Process, Authentic Artefacts, Technology Education, Constructionism Teaching Theory, Learner-Centred Learning.

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INTRODUCTION

The Design Process is a structured methodological approach used to find solutions to identified problems in order to meet human needs. In the context of Technology Education, the Department of Basic Education (DBE) identifies the Design Process as the backbone of teaching and learning, providing teachers and learners with a systematic framework for investigating problems, generating ideas, designing, making, evaluating, and communicating technological solutions¹. It is a continuous cycle used to develop authentic artefacts and is commonly structured into five stages: Investigate, Design, Make, Evaluate, and Communicate (IDMEC).¹ The effectiveness of this process, however, depends largely on how teachers facilitate each stage, particularly the Design and Make stages, where learners translate conceptual ideas into authentic technological artefacts. Despite its centrality, teachers often face challenges in implementing the Design Process effectively, particularly in guiding learners to develop authentic artefacts.²

The Design stage goes beyond mere drawing or sketching; it involves generating practical solutions that integrate technical knowledge, user needs, and material constraints. Similarly, the Make stage requires learners to transform abstract ideas into authentic artefacts using tools, materials, and techniques, deepening their understanding through hands-on learning. These two stages are therefore crucial for enabling learners to translate conceptual thinking into functional, real-world products. Their success depends not only on learners' participation but also on teachers' ability to facilitate authentic, learner-centered learning experiences that scaffold design thinking and practical problem-solving. Research highlights the need for teachers to adapt their instructional strategies to optimise learner outcomes. Innovative thinking, problem-solving, and decision-making are essential skills that should be integrated into planning and teaching to enable learners to produce authentic artefacts.³ Similarly, professional teacher development plays a crucial role in enabling teachers to assess learners' design skills and their proficiency in producing artefacts. Yet, studies also show that many teachers still struggle to use authentic artefacts as part of the Design Process.⁴ Consequently, learners may have fewer opportunities to engage meaningfully with authentic design challenges that connect classroom learning to real-world contexts. Conversely, artefacts themselves have been shown to support both teachers and learners in developing problem-solving and questioning skills, thereby strengthening conceptual understanding.⁵

The importance of strengthening the Design and Make stages is not unique to the South African context. International scholarship similarly emphasises the need for pedagogical approaches that support learners' meaningful engagement throughout the Design Process. Evidence indicates that integrating project-based learning into Technology Education encourages learners to engage systematically with each stage of the Design Process, thereby fostering design thinking and preventing superficial progression through design activities.⁶ Moreover, Way et al. contend that the Design Process is widely recognised as a fundamental pedagogical framework in Technology Education because it enables teachers to expose learners to authentic, real-world problems that require practical and innovative solutions.⁷ Such authentic engagement encourages learners to apply theoretical knowledge during the

¹ Joalise Janse. van Rensburg, "Fostering Critical Thinking Dispositions in the Technology Classroom" (University of Pretoria (South Africa), 2020).

² Willem Rauscher, "A Philosophical Framework for Enhancing the Understanding of Artefacts in the Technology Classroom," *African Journal of Research in Mathematics, Science and Technology Education* 20, no. 3 (2016): 214–24.

³ Marilena Doncean and Gheorghe Doncean, "Critical and Creative Thinking," *Journal of Public Administration, Finance and Law*, no. 24 (2022): 123–32, <https://doi.org/10.47743/jopaf1-2022-24-12>.

⁴ Hendrick Ramaboea, Sylvia Ramaligela, and Thokozani Mtshali, "Grade 9 Technology Teachers' Ability to Facilitate Mini-Practical Assessment Tasks through 9E Instructional Model in Technology Classroom," *International Journal of Mechanical Engineering* 7, no. 12 (2022): 139–46.

⁵ Katerina Kasimatis and Theodora Papageorgiou, "Creating Authentic Learning and Assessment Environments," in *Education and New Developments 2020* (inScience Press, 2020), 58–62, <https://doi.org/10.36315/2020end013>.

⁶ Kuen-Yi Lin et al., "Effects of Infusing the Engineering Design Process into STEM Project-Based Learning to Develop Preservice Technology Teachers' Engineering Design Thinking," *International Journal of STEM Education* 8, no. 1 (2021): 1.

⁷ Thomas K.F. Chiu and Ching-sing Chai, "Sustainable Curriculum Planning for Artificial Intelligence Education: A Self-Determination Theory Perspective," *Sustainability* 12, no. 14 (July 10, 2020): 5568, <https://doi.org/10.3390/su12145568>.

design and construction of artefacts, thereby strengthening the connection between conceptual understanding and practical application.⁸

In South Africa, where the Curriculum and Assessment Policy Statement (CAPS) emphasises critical thinking and technological literacy, bridging the gap between theory and practice remains crucial. Existing research in Technology Education has highlighted several aspects of teaching and learning, including curriculum implementation, lesson planning, pedagogical strategies, and instructional models. However, comparatively less attention has been devoted to how teachers utilise authentic artefacts to strengthen the Design and Make stages of the Design Process.⁹ These stages are critical because they enable learners to transform abstract ideas into tangible artefacts, thereby fostering spatial reasoning, creativity, problem-solving, and technical skills. When these stages are underemphasised, learners are less likely to engage in authentic, hands-on learning experiences that are central to Technology Education. Consequently, there remains limited empirical evidence on the pedagogical practices teachers employ to facilitate authentic artefact production during the Design and Make stages, particularly within South African Grade 7 Technology classrooms.

This study, therefore, explores the role of teachers in enhancing the Design and Make stages of the Design Process through the use of authentic artefacts in Grade 7 Technology classrooms. Specifically, it examines the pedagogical practices employed by teachers to support learners in transforming design ideas into meaningful technological artefacts through authentic materials, learner-centred instructional strategies, and practical design experiences. In doing so, the study seeks to demonstrate how teachers can bridge the gap between theoretical knowledge and practical application by facilitating authentic learning experiences that foster learners' creativity, innovation, critical thinking, problem-solving, and technological competence.

LITERATURE REVIEW

The Design Process

In Technology Education, the Design Process (IDMEC: Investigate, Design, Make, Evaluate, Communicate) provides a structured, learner-centred framework for developing creativity, problem-solving, and critical thinking.¹⁰ The Design stage enables learners to conceptualise and develop practical solutions, while the Make stage transforms these ideas into authentic artefacts that bridge theoretical understanding and practical application.¹¹ The Evaluate and Communicate stages encourage learners to reflect on their products, justify design decisions, and refine their solutions, thereby reinforcing iterative learning and continuous improvement.

Although there is broad consensus that the Design Process promotes higher-order thinking, collaboration, technological capability, and learner engagement, researchers differ in the aspects they emphasise. Some studies highlight its role in fostering Science, Technology, Engineering, and Mathematics (STEM) competencies and collaborative learning,¹² while others emphasise its

⁸ Kirsten A. Way et al., "Empirical Investigation of Authentic Assessment Theory: An Application in Online Courses Using Mimetic Simulation Created in University Learning Management Ecosystems," *Assessment & Evaluation in Higher Education* 46, no. 1 (January 2, 2021): 17–35, <https://doi.org/10.1080/02602938.2020.1740647>.

⁹ Thokozani Isaac Mtshali, Sylvia Manto Ramaligela, and Moses Makgato, "Actualisation of Practical Lessons through Assessment in Civil Technology," *Journal of Technical Education and Training* 13, no. 1 (2021): 44–55; Ramaboea, Ramaligela, and Mtshali, "Grade 9 Technology Teachers' Ability to Facilitate Mini-Practical Assessment Tasks through 9E Instructional Model in Technology Classroom"; Natalia Svensson Harari and Anders Fundin, "An Early-Phase Design Process to Enable Long-Term Flexibility in Assembly Systems," *Research in Engineering Design* 34, no. 2 (April 18, 2023): 257–83, <https://doi.org/10.1007/s00163-022-00404-0>; Praygod Bonginkosi Nkosi and Sylvia Manto Ramaligela, "The Use of Educational Technologies for Creative Teaching in South African Technology Classrooms: A Social Constructivist Approach," *Jurnal Paedagogy* 12, no. 2 (April 25, 2025): 252, <https://doi.org/10.33394/jp.v12i2.14886>; Lark Sawyer et al., "Design Process Framework for the Definition and Conceptual Design of Structurally Transforming Multi-Mode Products," *Design Science* 11 (May 13, 2025): e13, <https://doi.org/10.1017/dsj.2025.5>.

¹⁰ Susheela Shanta and John G. Wells, "T/E Design Based Learning: Assessing Student Critical Thinking and Problem Solving Abilities," *International Journal of Technology and Design Education* 32, no. 1 (March 7, 2022): 267–85, <https://doi.org/10.1007/s10798-020-09608-8>.

¹¹ Victoria L Lowell and Robert L Moore, "Developing Practical Knowledge and Skills of Online Instructional Design Students through Authentic Learning and Real-World Activities," *TechTrends* 64, no. 4 (2020): 581–90.

¹² Tom Ongesa Nyamboga, "Sustainable Development through Competence-Based Education Strategy: Empowering Learners' Progression for Self-Reliance," *Newport International Journal of Current Issues in Arts and Management* 5, no. 2 (2024): 18–25.

contribution to creativity, innovation, and real-world problem-solving.¹³ Collectively, these studies demonstrate the educational value of IDMEC; however, comparatively less attention has been devoted to understanding how the Design and Make stages can be strengthened through the deliberate production of authentic artefacts.¹⁴ Consequently, there remains limited empirical guidance on how teachers can effectively facilitate these stages to maximise meaningful learning outcomes.

This limitation is particularly significant because the Design and Make stages constitute the practical core of Technology Education. Strengthening these stages has the potential to enhance learners' ability to apply theoretical concepts, solve authentic problems, and develop technological competence.¹⁵ Consequently, this study explores how authentic artefacts can be utilised to enhance the Design and Make stages within Technology Education.

The Role of Authentic Artefacts in Technology Education

Authentic artefacts in Technology Education refer to tangible products created by learners as evidence of their design thinking and technological capability. These artefacts play a crucial role in bridging the gap between theoretical knowledge and practical application, enabling learners to translate abstract concepts into concrete outputs.¹⁶ Beyond functioning as evidence of learning, authentic artefacts stimulate learner participation, imagination, and critical thinking, thereby enriching the overall learning experience.¹⁷

Existing research consistently demonstrates that authentic artefact production enhances learner engagement and motivation. Nieminen et al. highlight that learners become more committed and self-directed when actively involved in designing and constructing artefacts.¹⁸ Similarly, authentic product development deepens learner engagement by encouraging learners to apply Design Process principles in real-world scenarios.¹⁹ Furthermore, authentic artefacts provide learners with a sense of purpose by connecting classroom activities with real-world technological practices.²⁰ Hamilton further contends that authentic artefacts strengthen learners' understanding of Technology Education by demonstrating the practical relevance of technological concepts beyond the classroom.²¹

While these studies collectively establish the educational benefits of authentic artefacts, they primarily concentrate on learner outcomes, with comparatively limited attention given to the pedagogical processes required to support teachers in facilitating meaningful artefact creation. Furthermore, the literature tends to emphasise the final product rather than the iterative processes through which learners conceptualise, construct, evaluate, and refine authentic artefacts during the Design and Make stages.²² Consequently, relatively little is known about how classroom practices can be organised to ensure that artefact production promotes genuine technological understanding rather than merely task completion. Similarly, although authentic artefacts are widely recognised as valuable

¹³ Mtshali, Ramaligela, and Makgato, "Actualisation of Practical Lessons through Assessment in Civil Technology."

¹⁴ Sawyer et al., "Design Process Framework for the Definition and Conceptual Design of Structurally Transforming Multi-Mode Products."

¹⁵ Elise van Dooren et al., "Making the Design Process in Design Education Explicit: Two Exploratory Case Studies," *Design and Technology Education: An International Journal* 25, no. 1 (2020): 13–34.

¹⁶ Jinfa Cai et al., "Theory for Teaching and Teaching for Theory: Artifacts as Tangible Entities for Storing and Improving Professional Knowledge for Teaching," in *Theorizing Teaching: Current Status and Open Issues* (Springer International Publishing Cham, 2023), 225–51.

¹⁷ Maria Ampartzaki, "Utilizing Creative and Critical Thinking to Build Knowledge and Comprehension through Inquiry-Based and Art-Based Learning: A Practical Tool for Teaching Local History in Pre-Primary and Primary Education," in *Pedagogy, Learning, and Creativity* (IntechOpen, 2023), <https://doi.org/10.5772/intechopen.112688>.

¹⁸ Juuso Henrik Nieminen, Eeva Haataja, and Peter J Cobb, "From Active Learners to Knowledge Contributors: Authentic Assessment as a Catalyst for Students' Epistemic Agency," *Teaching in Higher Education* 30, no. 4 (2025): 970–90.

¹⁹ Willem Christiaan Bouwer, "The Effect of Using a Measuring Instrument to Analyse the Level of Creative Thinking of Visual Arts Students from a Teaching Perspective" (Stellenbosch: Stellenbosch University, 2022).

²⁰ Amina Parveen et al., "Enhancing Classroom Equity Through the Integration of Digital Technology," 2024, 65–84, <https://doi.org/10.4018/979-8-3693-2591-9.ch004>.

²¹ Boni Hamilton, *Integrating Technology in the Classroom: Tools to Meet the Needs of Every Student* (ASCD, 2018).

²² Cecilia Axell, "Broadening the Horizons of Technology Education: Using Traditional Cultural Artefacts as Learning Tools in a Swedish Sámi School," *Design and Technology Education* 25, no. 2 (2020): 192–216.

forms of assessment, there remains limited research examining how they can be assessed consistently and fairly across diverse educational contexts.²³

These gaps indicate that current scholarship provides substantial evidence of the educational value of authentic artefacts but offers comparatively limited guidance on how they can be systematically integrated within Technology Education classrooms. Accordingly, this study extends existing knowledge by moving beyond the question of whether authentic artefacts are beneficial to examining how the Design and Make stages can be strengthened to support their meaningful creation. In doing so, the study seeks to contribute a deeper understanding of the pedagogical practices that enable learners to produce authentic technological artefacts while informing teaching, curriculum implementation, and assessment in Technology Education.

METHODOLOGY

Methodological Framework: Interpretivist Qualitative Collective Case Study

This study adopted a qualitative research approach to gain an in-depth understanding of how teachers utilise authentic artefacts to enhance the Design and Make stages of the Design Process in Grade 7 Technology classrooms. Qualitative research involves collecting and analysing non-numerical data to explore meanings, experiences, and perspectives, enabling the researcher to interpret participants' views and explain the reasoning behind them. Data were generated through lesson plan analysis and non-participatory observations, allowing for rich, contextual insights into teachers' practices.

The study was grounded in an interpretivist research paradigm, which recognises that reality is socially constructed and shaped by individuals' experiences and interactions. Closely aligned with this, a constructivist perspective was adopted, emphasising the role of personal experience and reflection in shaping understanding. Within this paradigm, qualitative methods are particularly appropriate, as they allow the researcher to explore participants' lived experiences and meanings in depth.

A collective case study design was employed to examine multiple Grade 7 Technology teachers within defined primary school contexts. This design enabled the researchers to explore several cases, thereby generating a broader understanding of how authentic artefacts are utilised to enhance the Design and Make stages of the Design Process. The clearly defined boundaries of the study ensured that the focus remained on Grade 7 Technology teachers within the selected primary schools.

Population and sampling strategy

The population for this study comprised all Grade 7 Technology teachers in the Sekhukhune South District. The research was conducted in the Manthole Circuit, which consists of seven primary schools. Purposive sampling was employed to select seven teachers, one from each primary school within the circuit. Participants were deliberately chosen based on their relevance to the study and their experience in implementing authentic artefacts during the Design Process. This sampling approach was appropriate, as it enabled the researchers to identify participants capable of providing rich, relevant, and detailed data aligned with the research questions. The careful selection of participants ensured that the study generated meaningful insights into the phenomenon under investigation and contributed to the development of appropriate intervention strategies.

PRESENTATION OF FINDINGS

As previously articulated, data were generated through lesson plan analysis and non-participatory observations. Lesson plan analysis was used to address Research Question 1 (RQ1), while non-participatory observations informed Research Question 2 (RQ2). These data collection instruments enabled the study to respond to the following research questions:

RQ1: How do Technology teachers develop lessons that utilise authentic artefacts to enhance the Design and Make stages of the Design Process?

RQ2: How do Technology teachers utilise authentic artefacts to enhance the Design and Make stages during classroom implementation?

²³ H Abdurahim-Salain, "Analysis of Portfolio for Critical Thinking and Creativity Development among Education Students," *Environment and Social Psychology* 9, no. 11 (2024).

Lesson plan analysis findings

To respond to the research question, *"How do Technology teachers develop lessons that utilise authentic artefacts to enhance the Design and Make stages of the Design Process?"*, data were drawn from seven lesson plans developed by seven teachers from various schools in the Manthole Circuit, Sekhukhune South District, Limpopo Province. As part of the intervention program, teachers who attended the workshop were required to design a lesson plan. The document analysis focused specifically on the tasks intended for learners during lesson presentation. Emphasis was placed on learners' classroom activities, as these reflected how authentic artefacts were utilised to enhance the Design and Make stages of the Design Process. The lesson plans were analysed by the researchers using a structured lesson plan observation schedule and related criteria, and the findings are presented as follows:

The analysis of the seven Grade 7 Technology lesson plans reveals a consistent and deliberate utilisation of authentic artefacts within the Design Process. Using a structured checklist, the analysis examined how teachers developed lessons that moved beyond theoretical instruction toward meaningful, real-world application. Findings indicate that all teachers anchored their lesson introductions in learners' prior knowledge and aligned new content with phases of the Design Process (investigate, design, make, evaluate, and communicate). This alignment suggests that lesson development was scaffolded and pedagogically coherent, rather than activity-driven or fragmented.

A prominent feature across all lesson plans was the use of meaningful, context-based problems. Tasks such as designing temporary shelters, constructing bridges, developing hydraulic systems, building storage solutions, creating baskets, and assembling electrical circuits required learners to engage with realistic challenges. These activities were age-appropriate and cognitively demanding, reflecting authentic technological practices. The real-world orientation of the tasks demonstrates that teachers conceptualised authentic artefacts not as add-on activities, but as central vehicles for learning.

The analysis further shows that teachers structured lessons to promote active, inquiry-based engagement. Learners were required to generate design ideas, test materials, analyse performance, and refine solutions. This iterative cycle of design, testing, and modification mirrors professional technological processes and reinforces higher-order thinking skills. Importantly, all lesson plans incorporated opportunities for peer feedback, reflection, and revision, thereby fostering collaborative learning and critical evaluation.

Another significant finding is that learners were required to produce tangible artefacts that were tested, evaluated, and, in some cases, showcased beyond the immediate classroom task. Presentations, gallery walks, exhibitions, and real-use testing (e.g., load testing bridges or selecting a ladder for classroom use) extended learning into authentic performance contexts. This requirement for public demonstration strengthened accountability, communication skills, and practical competence.

Overall, the document analysis indicates that teachers developed their lessons by utilising authentic artefacts as structured, real-world design challenges that enhanced the Design and Make stages of the Design Process. The consistent inclusion of contextual relevance, iterative refinement, collaboration, and public presentation suggests a strong alignment with authentic learning principles. These findings imply that the intervention supported teachers in shifting toward learner-centred, practice-oriented Technology education that integrates both conceptual understanding and applied problem-solving.

Observational data findings

To address the research question, *"How do Technology teachers utilise authentic artefacts to enhance the Design and Make stages during classroom implementation?"*, classroom observations were conducted across seven Grade 7 Technology lessons. Using a structured observation tool, the analysis focused on lesson enactment, instructional strategies, learner engagement, material use, and feedback processes to determine how authenticity was operationalised in practice.

The findings indicate that teachers consistently grounded their lessons in real-world contexts, using introductory stimuli such as videos, demonstrations, recyclable materials, and practical classroom challenges to activate prior knowledge and frame authentic problems. These contextual entry points

established meaningful connections between theoretical concepts and everyday technological applications.

Across classrooms, teachers facilitated structured progression through the phases of the Design Process (investigate, design, make, evaluate, and communicate). Learners actively engaged in sketching, modelling, constructing, testing, and refining artefacts using accessible and contextually appropriate materials. The emphasis on physical construction and performance testing, such as load-bearing assessments, water resistance trials, structural stability checks, and circuit troubleshooting, demonstrates that authenticity was enacted through functional evaluation rather than symbolic task completion.

Importantly, iterative refinement emerged as a consistent pedagogical practice. Learners modified and improved their artefacts based on observed weaknesses, peer critique, and teacher feedback. Collaborative group work, reflective discussions, and presentations further reinforced communication and critical evaluation. Teachers' movement around the classroom to scaffold learning and provide formative feedback supported active knowledge construction and sustained engagement.

Overall, the observations reveal that teachers enhanced the Design and Make stages by utilising authentic artefacts within inquiry-driven, performance-oriented Design Process cycles. Authenticity was realised through meaningful problem framing, hands-on prototyping, structured testing, collaborative critique, and reflective revision. These practices suggest that the intervention not only influenced lesson planning but also translated into enacted, learner-centered Technology instruction characterised by experiential and applied problem-solving.

DISCUSSIONS

The findings demonstrate that authentic artefacts can significantly enhance the Design and Make stages of the Design Process by transforming Technology Education from predominantly theoretical instruction into learner-centred, experiential learning. Rather than treating the Design Process as a sequence of isolated classroom activities, teachers embedded authentic technological problems that required learners to investigate, design, construct, evaluate, and communicate practical solutions.²⁴ This finding emerged because the intervention enabled teachers to restructure their pedagogical practices around meaningful design challenges, thereby encouraging learners to actively participate in the construction of technological knowledge. Consequently, authentic artefacts became the mechanism through which theoretical concepts were translated into practical understanding, allowing learners to develop technological competence through direct experience rather than passive instruction.

Constructionist theory provides a useful explanation for these findings. The theory proposes that meaningful learning occurs when learners construct tangible artefacts that externalise their thinking and provide opportunities for reflection, revision, and social interaction. The consistent production of bridges, shelters, hydraulic systems, baskets, electrical circuits, and other technological products demonstrates that learning was mediated through the creation of meaningful artefacts rather than the memorisation of technological concepts. Learners did not merely acquire technology knowledge; they constructed knowledge through designing, making, testing, and refining authentic products.²⁵ This process reflects the central principle of Constructionism that understanding is strengthened when learners create publicly shareable artefacts that can be evaluated and improved through continuous interaction and reflection. These findings therefore extend Constructionism beyond its theoretical propositions by illustrating how it can be operationalised within Grade 7 Technology classrooms through authentic artefact production.

The study further revealed that teachers consistently implemented the Design Process as an iterative rather than linear process. Learners repeatedly evaluated, modified, and improved their artefacts following performance testing, peer discussions, and teacher feedback. This iterative refinement emerged because teachers deliberately created classroom environments in which mistakes were viewed

²⁴ Nyamboga, "Sustainable Development through Competence-Based Education Strategy: Empowering Learners' Progression for Self-Reliance."

²⁵ Sawyer et al., "Design Process Framework for the Definition and Conceptual Design of Structurally Transforming Multi-Mode Products."

as opportunities for learning rather than indicators of failure.²⁶ Such classroom practices encouraged learners to experiment with alternative solutions, justify design decisions, and refine their technological products until they met the intended design specifications. This explains why learners demonstrated sustained engagement throughout the Design and Make stages instead of merely completing prescribed classroom activities. Previous studies similarly acknowledge the educational value of iterative design and authentic artefact construction; however, the present findings provide empirical evidence of how these practices are enacted by teachers within everyday Technology Education classrooms.

Another important finding concerns the role of authentic artefacts in promoting deeper conceptual understanding. The artefacts produced by learners served not only as completed products but also as visible representations of learners' reasoning, creativity, and technological thinking. As learners manipulated materials, tested prototypes, and justified design decisions, teachers were able to observe misconceptions, provide formative feedback, and guide conceptual development throughout the Design Process. This finding explains why authentic artefacts became effective assessment tools rather than simply practical activities.²⁷ The study therefore demonstrates that authentic artefacts support assessment for learning by making learners' thinking explicit and enabling teachers to respond to learning needs during the construction process.

The findings also have important implications for classroom practice. Firstly, Technology teachers should move beyond demonstration-based teaching by designing learning activities that require learners to solve authentic technological problems through the production of meaningful artefacts. Classroom activities should provide opportunities for learners to investigate problems, generate multiple design ideas, construct prototypes, evaluate performance, and refine their products through iterative testing. Cognitive benefits of authentic production tasks.²⁸ Such learner-centred pedagogical practices are likely to strengthen creativity, critical thinking, collaboration, and technological capability while ensuring that the Design and Make stages remain central to Technology Education rather than becoming peripheral practical exercises.

From a curriculum implementation perspective, the findings suggest that successful implementation of the Curriculum and Assessment Policy Statement (CAPS) depends not only on curriculum coverage but also on the quality of pedagogical practices employed during the Design Process. Although CAPS identifies the Design Process as the foundation of Technology Education, the findings indicate that meaningful implementation requires teachers to contextualise learning through authentic design challenges that reflect learners' everyday experiences.²⁹ Authentic artefacts therefore provide a practical mechanism for translating curriculum intentions into classroom practice while strengthening the relationship between theoretical knowledge and technological application.

The findings further highlight important implications for teacher professional development. The successful implementation of authentic artefacts observed in this study suggests that teachers require continuous professional learning opportunities that extend beyond curriculum orientation towards practical pedagogical competence.³⁰ Professional development programmes should therefore focus on strengthening teachers' capacity to design authentic technological challenges, facilitate iterative Design Process activities, utilise locally available materials creatively, and assess authentic artefacts using formative assessment strategies. Such capacity-building initiatives would contribute towards more effective implementation of learner-centred Technology Education.³¹

A significant contribution of this study lies in demonstrating how authentic artefacts can be systematically utilised to enhance the Design and Make stages of the Design Process within Grade 7 Technology classrooms. While previous research has largely established the educational value of

²⁶ Abdurahim-Salain, "Analysis of Portfolio for Critical Thinking and Creativity Development among Education Students."

²⁷ Bouwer, "The Effect of Using a Measuring Instrument to Analyse the Level of Creative Thinking of Visual Arts Students from a Teaching Perspective."

²⁸ Nieminen, Haataja, and Cobb, "From Active Learners to Knowledge Contributors: Authentic Assessment as a Catalyst for Students' Epistemic Agency."

²⁹ Parveen et al., "Enhancing Classroom Equity Through the Integration of Digital Technology."

³⁰ Lin et al., "Effects of Infusing the Engineering Design Process into STEM Project-Based Learning to Develop Preservice Technology Teachers' Engineering Design Thinking."

³¹ Hamilton, *Integrating Technology in the Classroom: Tools to Meet the Needs of Every Student*.

authentic artefacts, comparatively little empirical evidence has been available regarding the pedagogical practices through which teachers utilise authentic artefacts during classroom instruction. This study extends existing knowledge by identifying authentic problem framing, iterative prototyping, collaborative critique, performance testing, formative feedback, and reflective revision as interconnected pedagogical practices that strengthen learner engagement and technological understanding. In doing so, the study moves beyond confirming the value of authentic artefacts to explaining how they can be operationalised to enhance classroom practice, curriculum implementation, and learner outcomes within Technology Education.

RECOMMENDATIONS

The recommendations presented below are derived directly from the findings of this study, which demonstrated that authentic artefact-based pedagogies enhance learner engagement, critical thinking, collaboration, and applied problem-solving when deliberately integrated into the Design and Make stages of the IDMEC Design Process.

Firstly, the findings revealed that teachers successfully implemented authentic artefacts following the professional development intervention, resulting in learner-centred, inquiry-driven lessons characterised by active learner participation and iterative design practices. Based on this finding, sustained professional development programmes should be institutionalised to strengthen teachers' capacity to design, facilitate, and assess authentic learning experiences. Ongoing support through professional learning communities, lesson study, peer collaboration, and mentorship would reinforce pedagogical confidence and promote consistent implementation of the Design Process across Technology classrooms.

Secondly, the study found that learners demonstrated deeper engagement and conceptual understanding when sufficient time was allocated to the Design and Make stages for prototyping, testing, evaluating, and refining their artefacts. It is therefore recommended that curriculum implementation and school timetabling deliberately protect these stages by providing adequate instructional time for iterative design activities. This would enable learners to move beyond superficial task completion towards meaningful technological problem-solving.

Thirdly, the findings showed that authentic artefacts provided teachers with valuable insights into learners' thinking, creativity, and problem-solving processes throughout the Design Process. However, the study also confirmed the need for more structured approaches to evaluating authentic artefacts. It is therefore recommended that standardised assessment guidelines and analytic rubrics be developed to assess both the design process and the final product. Assessment criteria should explicitly evaluate creativity, functionality, design justification, collaboration, iterative improvement, and reflective thinking to strengthen assessment validity and support assessment for learning.

Furthermore, the study demonstrated that contextualising learning through authentic, real-world technological problems significantly enhanced learner participation, motivation, and the relevance of classroom activities. Consequently, Technology Education teachers should deliberately design learning activities around local community needs and authentic technological challenges that learners can relate to and solve through the Design Process. Such contextualisation is likely to strengthen learner ownership, meaningful learning, and the transfer of technological knowledge to everyday situations.

Finally, the findings demonstrate that authentic artefact production provides a practical mechanism for strengthening the Design and Make stages of the IDMEC Design Process. Given these findings, it is recommended that the Department of Basic Education (DBE) incorporate exemplar authentic artefact tasks, assessment rubrics, and implementation guidelines into CAPS support materials and teacher professional development programmes. Such resources would promote greater consistency in the implementation of authentic artefact pedagogies across schools while supporting teachers in translating curriculum intentions into meaningful classroom practice.

Collectively, these recommendations demonstrate that strengthening the Design and Make stages through authentic artefact production requires coordinated support at classroom, school, curriculum, and teacher development levels. Their implementation has the potential to promote the systematic integration of authentic artefact pedagogy across classroom practice, curriculum implementation,

teacher development, and educational policy, thereby strengthening Technology Education as a learner-centred discipline that effectively integrates theoretical knowledge with authentic technological practice.

CONCLUSION

This study has explored how Grade 7 Technology teachers utilise authentic artefacts to enhance the Design and Make stages of the IDMEC Design Process. Through document analysis and classroom observations of seven teachers in the Manthole Circuit, the study demonstrates that, with targeted support, teachers can effectively translate the theoretical principles of the Design Process into meaningful classroom practice, even within resource-constrained settings. By providing contextualised empirical evidence of how authentic artefacts can be utilised to enhance the Design and Make stages of the Design Process, this study extends current scholarship by demonstrating practical pedagogical approaches that strengthen learner-centered Technology Education through the integration of conceptual understanding, authentic technological practice, and applied problem-solving

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