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The "Mantle of the Expert" as a didactic method in the context of teaching History of Science to elementary school children

Simos Papadopoulos^a, Evi Mamali^b, Anastasia Filippoupoliti^c

^a Democritus University of Thrace / Department of Elementary Education

^b Democritus University of Thrace / Department of Elementary Education

^c Hellenic Open University / School of Humanities

Abstract

This paper discusses the implementation of a didactic intervention of a two-cycle Action Research to nineteen sixth-grade students, aiming at teaching elements of physical sciences through the History of Science lens. Using the "Mantle of the Expert" as a teaching method, the intervention is based on a cross-curricular and project-based approach in a dramatic context. Based on the 'Mantle of the Expert' stages, enriched further with specific drama techniques, concepts and themes from the History of Science are examined experientially. In addition, a moral and critical evaluation of Science regarding human life is attempted. The evaluation of the intervention is conducted regarding the effectiveness of the "Mantle of the Expert" as a didactic method as well as the level of achieving the learning goals.

Keywords: mantle of the expert, drama project method, history of science

Περίληψη

Στο άρθρο αυτό παρουσιάζεται η εφαρμογή μιας διδακτικής παρέμβασης, μιας Έρευνας-Δράσης δύο κύκλων σε δεκαεννέα μαθητές Έκτης δημοτικού. Η έρευνα αυτή στοχεύει στη διδασκαλία βασικών στοιχείων των Φυσικών Επιστημών, μέσα από το πρίσμα της Ιστορίας των Επιστημών. Με την αξιοποίηση της διδακτικής μεθόδου του «Μανδύα του Ειδικού», η παρέμβαση βασίζεται στη διαθεματικότητα και στη δημιουργία σχεδίων εργασίας σε δραματικό περιβάλλον. Έννοιες και θέματα από την Ιστορία των Επιστημών εξετάζονται βιωματικά, βάσει των σταδίων της μεθόδου του «Μανδύα του Ειδικού», εμπλουτισμένα με επιπλέον θεατρικές τεχνικές. Επιπλέον, επιχειρείται μια ηθική και κριτική αποτίμηση των Επιστημών σε σχέση με την ανθρώπινη ζωή. Η αξιολόγηση της παρέμβασης πραγματοποιείται με βάση αφενός την αποτελεσματικότητα του «Μανδύα του Ειδικού» ως διδακτικής μεθόδου και αφετέρου το επίπεδο επίτευξης των μαθησιακών στόχων.

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Introduction. The "Mantle of the Expert" Method

The Pioneers of the "Mantle of the Expert" Method

The "Mantle of the Expert" (MoE) educational approach was pioneered by Dorothy Heathcote in collaboration with Gavin Bolton during the latter half of the 20th century. Heathcote, a leading figure in drama education, conceptualized this method as an innovative way to integrate drama into pedagogical practice. Her groundbreaking work was complemented by Gavin Bolton, whose expertise

Contact person: Simos Papadopoulos, sypapado@eled.duth.gr

URL: <http://ejournals.epublishing.ekt.gr/index.php/hjre/index>

in educational drama further refined the theoretical and practical dimensions of MoE. Together, their collaboration established a foundation for employing role-play as a central pedagogical tool, emphasizing active learning and inquiry-based education (Heathcote & Bolton, 1995). Later, Brian Edmiston expanded upon their work, incorporating contemporary educational theories to adapt MoE to modern classrooms. Edmiston's contributions have highlighted the method's relevance in fostering critical thinking and collaboration among students (Edmiston, 2003).

Principles, Features, and Stages of Implementation

The "Mantle of the Expert" method operates on the principle of positioning students as active participants in a fictional professional scenario. They adopt roles such as scientists, historians, or engineers, and are tasked with solving complex, realistic problems. This immersive framework promotes experiential learning and situates knowledge acquisition within a meaningful context (Heathcote & Bolton, 1995).

Key features of MoE include its reliance on drama as an educational medium, the integration of multidisciplinary content, and its emphasis on collaborative problem-solving. The method unfolds in distinct stages: first, the teacher sets the fictional context and assigns roles to the students. Next, through guided improvisation and structured inquiry, students explore the scenario, analyze challenges, and propose solutions. Finally, reflective activities allow learners to synthesize their experiences and draw connections between the fictional tasks and real-world applications (O'Neill, 1995). These stages ensure a holistic learning process, balancing creativity, critical inquiry, and curriculum integration.

Pedagogical Benefits of the "Mantle of the Expert" Method

The "Mantle of the Expert" method offers substantial pedagogical benefits by transforming traditional teacher-centered classrooms into dynamic, student-driven environments. It enhances engagement by immersing students in roles that require active participation and decision-making. Through role-play, learners develop critical skills such as problem-solving, teamwork, and effective communication (Edmiston, 2003). Furthermore, the method encourages students to view knowledge as interconnected and context-dependent, facilitating deeper conceptual understanding.

In addition to fostering cognitive growth, MoE supports socio-emotional development. By navigating ethical dilemmas and collaborative tasks, students gain empathy and a greater appreciation for diverse perspectives (Aitken, 2013). Research has also shown that the method improves motivation and self-efficacy, as students experience the empowering effects of being treated as capable "experts" (O'Neill, 1995). Overall, the Mantle of the Expert method not only enhances academic outcomes but also prepares students for the complexities of real-world problem-solving.

Mantle of the Expert: The Drama Project Method

This research draws upon an adapted version of the "Mantle of the Expert" method (Heathcote & Bolton, 1995), as proposed by S. Papadopoulos in "Mantle of the Expert: The Drama Project Method" (Papadopoulos, 2011). This model integrates project-based learning into a dramatic environment, structured through ten developmental stages:

This structured approach encompasses preparatory stages outside the role, thematic exploration within the role, creative presentation, and evaluation of the outcomes. The model combines project-based learning principles with the "Mantle of the Expert" methodology, creating a dynamic and effective learning environment. While the traditional project method involves students conducting research as learners, in this model, it occurs within a role, aligned with the "Mantle of the Expert" framework.

Table 1. Mantle of the Expert: The Dramatic Project Method

Summary of Developmental Stages

1. Identifying the field's problem
2. Defining the topic
3. Highlighting thematic units
4. Determining the experts' task
5. Introducing the dramatic environment
6. Selecting thematic units for the experts' task
7. Data collection
8. Data processing
9. Presentation of the experts' work
10. Evaluation of the experts' work

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In a dramatic environment, students adopt a role and embrace the responsibilities associated with it. They actively and collectively investigate, undertaking a task that, while embedded in a fictional narrative, feels real. Within their role, students engage as "experts" tasked with solving a problem, addressing the fictional "reality" critically and creatively. According to S. Papadopoulos (2011), this approach enables students to:

- Utilize their full range of expressive tools to articulate perspectives on the issues they investigate.
- Think and communicate from multiple viewpoints, facilitated by the dramatic tension inherent in their roles.
- Reflect both in-role and out-of-role, engaging interpersonally through debates and intrapersonally through self-reflection.

This model ensures a critical element of learning: accountability within a dramatic environment. Students, in their roles as experts, report to the person who assigned them the task. This transition –from merely completing a task to internalizing a sense of responsibility for their assigned work– deepens their engagement.

Through this process, students experience the gravity of their task and its potential implications for themselves and others, all while remaining emotionally safeguarded by their role. The model thus fosters a balance between critical engagement and emotional security, making the learning experience both meaningful and transformative (Papadopoulos, 2010).

The History of Science

The Scope of the History of Science

The History of Science is an interdisciplinary academic field that examines the development of scientific knowledge, practices, and institutions across different historical periods and cultures. It seeks to understand how scientific ideas originate, evolve, and interact with social, political, and cultural contexts. This field explores the lives and works of scientists, the processes of scientific discovery, and the ways scientific knowledge has influenced, and been influenced by, broader societal changes (Kuhn, 1962). Central to the History of Science is the investigation of paradigmatic shifts—moments when prevailing scientific theories are challenged and replaced by new frameworks of understanding.

Additionally, the field critically evaluates the role of science in shaping human experiences and its ethical implications. From the Copernican Revolution to modern genetics, the History of Science

highlights how advancements in science have redefined humanity's place in the natural world and offered solutions to complex problems. This discipline is inherently reflective, encouraging scholars and learners to consider the contingent and dynamic nature of scientific progress rather than viewing it as a linear trajectory of inevitable advancements (Shapin, 1996).

Teaching the History of Science in Primary Education

History of Science is related to formal education in three distinct ways (Filippoupoliti & Koliopoulos, 2014): a. Approaching science teaching through a humanistic lens in order to cultivate the scientific literacy of students as future citizens, b. Making the nature and special characteristics of scientific knowledge accessible to younger people and c. Seeking the cognitive development of students through shifting interest from methodology to the concepts underpinning scientific knowledge.

In primary education, the History of Science can be effectively introduced through storytelling, role-playing, and hands-on activities that connect historical scientific events with students' everyday experiences. For instance, dramatizing Galileo's trials or exploring the invention of the compass can make historical narratives engaging and relatable (Heathcote & Bolton, 1995). The primary educational goals of teaching the History of Science include fostering an appreciation for the iterative nature of scientific discovery, promoting critical thinking, and encouraging students to question how scientific advancements shape and are shaped by human society. These objectives aim to develop scientifically literate individuals who can contextualize science within broader historical and ethical dimensions.

Methodology

Research Purpose and Questions

The initial problem that motivated this research was the observed difficulty students face in understanding specific concepts and topics in the sciences—both natural and social-humanistic. The comprehension of these topics is often dependent on their evolutionary development within historical contexts. In traditional teaching, it was noted that understanding occurred at a basic level, addressing the objectives of individual instructional units in isolation. However, the investigation revealed that students struggled to connect new knowledge to broader contexts or to identify the causal relationships between various concepts and topics. Consequently, the need arose to create a learning environment conducive to highlighting these connections and causal relationships, thus expanding learning beyond the isolated objectives of individual educational content within the field of historical continuity.

The purpose of this study is to assess the effectiveness of utilizing the "Mantle of the Expert" (MoE) as a teaching method in an instructional intervention aimed at exploring concepts and topics from the History of Science. Specifically, the study seeks to determine the extent to which this experiential method can make the processing of topics from the History of Science more accessible to children and enhance their understanding.

The research questions derived from the study's purpose are as follows:

- i. How can the drama-based "Mantle of the Expert" method serve as a teaching approach for achieving educational objectives related to the History of Science?
- ii. To what extent is the "Mantle of the Expert" method effective in achieving learning goals related to the cognitive content of the History of Science?

Research Method

The research method adopted to address these questions is action research. According to this approach, the teacher assumes the role of a researcher (Costello, 2011), enabling an in-depth exploration and understanding of the emerging problem and the on-site application of proposed solutions (Papadopoulos,

2021a). The primary assumptions of action research are, first, that taking action on a specific issue is likely to yield greater insights into it, and second, that when researchers actively engage and reflect on their actions, subsequent actions are based on more valid information (Stringer & Aragon, 2020). This process is conducted on-site, guided by specific objectives, and organized into iterative cycles of action (Cohen et al., 2008). These cycles include phases of action, during which researchers test practices and collect data, and phases of reflection, during which they evaluate the data and redesign their actions based on emerging findings (Bradbury, 2015). These iterative cycles originate from specific questions and focus the research on them (Efron & Ravid, 2019).

Research Participants

The study participants comprised 19 sixth-grade students from a public primary school in the southern suburbs of the Attica region. The research was conducted by the classroom teacher.

Data Collection and Analysis

In action research, the researcher has access to a wide range of tools, which may include both open-ended and structured, quantitative techniques (Altrichter et al., 2001). Research tools may vary across research cycles, depending on the objectives each cycle aims to address, and to enhance reliability in data collection (McNiff & Whitehead, 2010).

The tools employed in this study included the researcher's diary and the students' written outputs. Data analysis was carried out through a thematic or semantic analysis of the students' written records, combined with the researcher's observations of the students' interactions and activities during the two workshops. This process involved qualitative content analysis. To extract precise and detailed data concerning the educational goals of the History of Science in relation to the "Mantle of the Expert" method, specific analytical categories were developed. These categories addressed the second research question, while the analysis for the first question emerged from the researcher's diary and the students' written and project-based outputs.

To facilitate qualitative triangulation, two additional tools were incorporated into the workshops. In the first workshop, creative writing was introduced, allowing students to voluntarily submit prose and poetic texts that reflected their thoughts, concerns, and emotions regarding their experiences and discussions. In the second workshop, an essay was introduced as a mandatory written exercise for all students, capturing reflective conclusions about their experiences and discussions.

Limitations and Reliability of the Research

Although action research is scientifically validated as a methodology, it is generally subject to certain limitations, which also apply in this specific study. The subjectivity of the researcher's judgment significantly impacts the generalizability of the results. Beyond this overarching observation, the reliability of this particular action research is mitigated by the small sample size of participants and the short duration of its application.

Research Process

The research process was conducted in two workshops, organized into two corresponding research cycles. Prior to the main intervention of the two drama-based educational workshops, preparatory, intermediate, and concluding activities were designed to serve as preparatory, reinforcing, and summarizing phases of the drama activities (Papadopoulos, 2007). The overall design of the instructional intervention was aligned with a series of curriculum subjects to ensure thematic consistency with formal instruction and coherence with its content. Specifically, the design of the research intervention was linked to the following:

- "Natural Sciences": Magnetism and the compass
- "Geography": Latitude and longitude, Earth's coordinates, sky observation, orientation, navigation, Earth's sphericity
- "History": From the Age of Exploration to the Enlightenment (Unit A, Chapter 2), thematic relevance to the Era of Discoveries and Colonialism + Alexander the Great (added as a contrasting example regarding his treatment of other peoples he encountered)
- "Language": Anthology, literary text "Astrolabe" (F. Kontoglou) + Language, Volume A, Unit "Life in Other Lands", text "Our Home is Earth" by Chief Seattle
- "Social and Political Education": Unit "The Individual and the International Community – Global Organizations and Human Rights". Topics selected included: Fair Trade – Racism – The Right to Self-Determination

These curriculum subjects, along with their selected themes, were taught either before the intervention, during the workshops, or afterward. Topics that were part of the official curriculum were delivered within the regular flow of the lesson, while supplementary material was assigned as independent research and project-based work. The detailed research process is outlined below:

Introductory Activity

The class participated in a 90-minute teleconference with a researcher from the National Centre for Scientific Research "Demokritos". The topic focused on the early scientific efforts recorded post-Medieval Europe to develop technologies that improved navigation and the efficiency of long-distance maritime travel. This teleconference served as a replacement for the initial dramatic inquiry phase of the "Mantle of the Expert" method and as a means of familiarizing students with the topic under investigation. The expert presented fundamental concepts and essential information about the invention of the compass, the Age of Exploration, the history of navigation tools, and methods of orientation through a combination of visual aids and verbal explanations. Following the presentation, students were encouraged to pose questions and were provided with explanations on the technical and scientific aspects of the subject in an accessible manner.

As a continuation of this introduction to the history of scientific inventions related to navigation and maritime travel, a podcast was uploaded to the "e-me" digital platform in the class's digital hub. This podcast narrated the story 'Scientists Who Innovated for Humanity: Eratosthenes of Cyrene', produced by the Eugenides Foundation. Additionally, a literary text from the sixth-grade Anthology, titled "The Astrolabe" by F. Kontoglou (Skotinioti, 2009; Papadopoulos & Skotinioti, 2009), was read and analyzed.

First Cycle

The first workshop, titled "An Invention - A Turning Point for Civilization", began with a research project focused on the history of the compass. To ensure the students had a foundational understanding of the compass, they created this project, which was later utilized in role-play rather than being presented in the conventional manner.

Specifically, within the framework of the "Mantle of the Expert" method, a fictional scenario with defined parameters was established:

Expert Team: Scientists who invented a new, promising type of compass.

Client: The Emperor.

Commission: Exploration of new lands with high expectations → Christianizing "lesser" cultures and increasing resources (food and metals).

Other Characters / Roles: Sailors; European explorers and adventurers; and indigenous populations.

Inquiry: In an effort to bypass the maritime dominance of the Venetians and Genoese in the Mediterranean and to discover new sea routes across the Atlantic, the team of specialists—scientists

and inventors—presented the potential applications of the compass to the Spanish emperor. They proposed it as a tool to support a new, shorter voyage to the Americas, with the prospect of exploring its interior regions.

Fictional Context for Drama and Learning:

Setting: a) Reception hall of the palace, in front of the emperor's throne; b) Onboard a caravel; c) The American interior.

Time Period: Late 15th century, during a subsequent voyage to the Americas after its discovery.

Characters: Inventor-scientists; sailors; and the emperor.

Events: Invention of an advanced compass; assignment of a mission; mission success; reception; conquest; and profitable transport of goods

Tension: Reception and conquest.

Stimulus: Online resources from the Science Museum in London featuring the magnetic compass were used as visual stimuli displayed on an interactive whiteboard during the workshop.

At the start of the workshop, the class was immersed in the fictional scenario through role cards. Students were asked to choose between two roles: the Spanish emperor or an inventor-scientist. Two groups—each representing a collective role—were formed accordingly, and the role cards provided the fictional context for their actions. Three scenes were enacted during this workshop:

i. Scene A

In this scene, the emperor meets at the reception hall of the palace with the expert team of inventors and scientists. Both the emperor and the experts play as collective roles. Having recently learned that they had developed a more advanced and reliable compass than the one previously known from China, the emperor offers to fund a voyage to the Americas. However, given the significant financial cost, he demands guarantees from the experts that the sailors will reach their destination. His ultimate goal is to explore the interior regions to exploit land and resources. A dynamic dialogue ensues, involving improvisation, as the emperor attempts to persuade the experts to dedicate their invention to the empire's interests, promising them substantial financial rewards. The debate results in a thorough argumentation for and against this decision, with some experts expressing ethical concerns about using their compass to exploit other peoples.

ii. Scene B

Onboard a caravel, two experts accompany the European explorers and aspiring colonizers on their journey. Their roles include using and repairing the compass as needed and exploring its potential applications for inland expeditions in the Americas. One night, during the long voyage across the Atlantic, the two experts meet on the ship's deck. They represent contrasting characters: one is ambitious and pragmatic, believing that the Europeans' superior tools justify their use for personal gain. The other views the invention as an opportunity to learn about and establish relationships with other cultures, avoiding harm wherever possible. Using spatial positioning, the two groups representing these roles stand opposite each other in the classroom, engaging in a dialogue that evolves into a mild debate with arguments and counterarguments exchanged.

iii. Scene C

The third scene featured the students collectively taking on the role of Europeans who had disembarked from their caravel and were advancing on foot into the interior of the Americas. Through dramatized narration, the group enacted the journey into the natural environment, portraying minor incidents that arose, the reactions of individuals, their decisions, and actions based on their character traits and perspectives on unfolding events and anticipated scenarios. The dramatized narrative halted at a moment of heightened tension: the Europeans suddenly spotted, through the foliage, a toddler playing on the

riverbank and a mother washing clothes nearby. This deliberate ending presented the explorers with a moral dilemma regarding their potential actions toward these individuals. The scene also served as a medium for capturing the group's emotions in response to the situation they faced.

iv. Writing in Role

Following the scene, students were tasked with writing journal entries for the two compass experts from Scene B. They reflected on what each expert might have recorded that evening, based on their dialogue and interactions on the ship's deck.

Second Cycle

The second workshop, titled "Compass on the Ship, Chocolate in the Cup," began with a project investigating the history of cacao and chocolate. Students prepared this project to gain a foundational understanding of chocolate, which they then utilized during role-play rather than presenting it in the traditional format.

Within the framework of the Mantle of the Expert method, a fictional scenario with specific parameters was developed:

Expert Team: Botanists tasked with evaluating the conditions for establishing large-scale cacao plantations in Africa.

Client: The Emperor.

Commission: Assessing soil suitability for plantation development.

Other Characters / Roles: Sailors, merchants, and enslaved indigenous populations.

Inquiry: Knowledge of botany, suitability of climate and soil for cacao trees, colonial practices toward native populations, and exploitation through enslavement.

Fictional Context for Drama and Learning:

Setting: A region in Ghana, Africa.

Time Period: Late 18th century.

Characters: Botanists, sailors, the emperor, indigenous people, and merchants.

Events: Conquest of African territories, enslavement of indigenous populations, assessment of soil for systematic cacao cultivation, and profitable transport of cacao.

Tension: Uprisings by indigenous populations.

Stimulus: A photograph sourced online and a painting displayed on an interactive whiteboard served as visual stimuli during the workshop (see photos a, b.).

Through dramatized storytelling, role-playing, and inquiry-based exploration, this workshop allowed students to engage deeply with the complex historical, ethical, and cultural issues surrounding the cultivation and trade of cacao.



Image 1. Caravel and compass



Image 2. Giuseppe Bonito, *Infanta Maria Josefa of Spain*, 1759

At the beginning of the second workshop, the class was immersed in the fictional scenario through the use of role cards. Students were invited to choose one of two roles: either the botanist or the compass specialist. Two corresponding groups—collective roles—were then formed, and each group received role cards detailing the fictional conditions of their participation. The following scenes were enacted during the second workshop:

i. Scene A

The experiential process began with a ritual of physical expression. Using a series of verbs that depicted the daily life of indigenous people—such as "digging", "planting", "harvesting", "carrying", and "loading"—one group of students physically enacted these actions without dialogue, relying solely on bodily expression. This performance created an intense atmosphere, deeply impacting both participants and observers. As a result, the students proposed dramatizing not the scenario as written in the role cards, but a dialogue between the botanist and the leader of an enslaved indigenous community working under European colonizers.

In this scene, the indigenous leader pleaded with the colonial botanist to listen to the grievances of his people, who could no longer endure the conditions of exploitation and enslavement. An intense exchange of arguments and counterarguments unfolded, with the two collective roles positioned opposite each other in the space, separated by a black curtain that symbolized their division.

ii. Scene B

This scene evolved directly from the first. Drawing upon the role cards and the events of the previous scene, the facilitator informed the group that the compass specialist had been accompanying the mission during various expeditions into the interior. Having closely observed the treatment of the indigenous people by the Europeans, the specialist had begun to question the morality and justice of their actions.

Using the observation technique supported by the facilitator's narration, a group of students, representing the compass specialist in a collective role, revisited the dramatization and dialogue between the indigenous leader and the botanist. This time, the events were reenacted by a smaller number of students in a condensed and focused manner. The scene concluded with a freeze frame, where all participants adopted a pose that captured the emotional intensity of the moment.

iii. Scene C

The interactive whiteboard displayed a new juxtaposition of images. One showed a European 18th-century salon where chocolate was being served, and the other depicted a child in Africa carrying a heavy sack of cacao beans. Employing the "hot seat" technique, the group interrogated the botanist about his choices and actions on

iv. Writing in Role

With a provided starting prompt, students wrote a letter in the role of the compass specialist, addressed to the emperor. In the letter, the specialist requested permission to return to Europe, explaining why they no longer wished to be part of the mission on the cacao plantations in Ghana.

Intermediate Activities

As part of the "Mantle of the Expert" methodology, two project-based assignments were implemented to provide students with essential background knowledge required for the experiential workshops. The first assignment was designed to familiarize students with the history of the compass, enabling them to effectively engage in the dialogue with the Spanish emperor about the upcoming voyage to the newly discovered Americas. Similarly, in the second workshop, students needed sufficient information about how Europeans managed the wealth of the American continent. To address this, a project was devised focusing on the cultures oppressed by European colonizers—such as the Aztecs, Incas, and Native

Americans—as well as the history of cacao trees and cacao seeds, and how Europeans came to learn about chocolate. This topic was deemed particularly engaging for students and highly likely to encourage their involvement. Furthermore, it was linked to Fair Trade practices, providing an extension into the 'Political Citizenship' curriculum.

To further stimulate reflection, a text from the 'Language' textbook titled "Our Home is Earth" by the Chief of Seattle Indians was read and analyzed. This served as an additional prompt for critical thinking within the context of "Life in Other Lands".

The "Mantle of the Expert" approach was enriched with two creative writing activities. Following the first workshop, students wrote two short diary entries. One entry captured the thoughts of one of the compass specialists accompanying the Spanish explorers to the Americas, while the other reflected the perspective of the second specialist. These diary entries adhered to the roles the students had performed during the ship deck dialogue scene, representing two European experts in compass use and repair. The characters were intentionally distinct, with differing mindsets and expectations regarding the voyage.

Additional intermediate activities included optional creative writing pieces, such as poems and prose, where students personified the cacao bean or the compass. Some students also created visual art projects that combined their reflections and ideas from the workshops and the project-based assignments.

Concluding Activities

To summarize and consolidate the learning activities, a digital museum was created to showcase the students' projects and actions. Among the displayed works was a "Charter for Coexistence" between European explorers and Native Americans. Drawing from the in-role dialogues during the drama-based workshops, students were encouraged to envision an ideal scenario in which the compass could have served as a tool for unity and cooperation rather than subjugation and exploitation of indigenous populations. One group of students drafted the charter, outlining the conditions for harmonious coexistence and mutual benefit, thereby linking the educational intervention to the objectives of 'Political Citizenship' courses.

Additionally, students were tasked with writing a short reflective essay. In this essay, they were asked to record their thoughts on "Science and Scientists", drawing on their experiences in the drama-based workshops and their understanding gained through the project-based research activities. This exercise encouraged students to synthesize their learning and articulate their insights on the ethical dimensions of scientific exploration and discovery.

Results

Based on the qualitative analysis of the researcher's diary entries and the students' written outputs, it was determined that the "Mantle of the Expert" method can serve as an effective approach to achieving learning objectives related to the History of Science.

First Research Question

From the researcher's diary entries, the 'Mantle of the Expert' was found to create a highly dynamic, experiential framework that fosters high levels of student engagement. This was evidenced by the following:

- High levels of participation were observed in dialogues and argument exchanges, which were consistently replicated across other experiential activities within the 'Mantle of the Expert' framework.
- The roles and techniques employed maintained strong student interest in the subject matter, specifically the compass and its historical uses.

- Exploring different roles across various historical periods heightened students' sense of the historicity of scientific creation and its impact on human destiny.
- The inclusion of physical expression contributed to the understanding of abstract concepts in the History of Science, such as evolution and exploitation.
- The experiential techniques allowed students to develop moral judgments about how science is utilized by humans, compare the beneficial and harmful uses of science, and gain a deeper appreciation of its value while exploring the conditions for its responsible application.

In addition to the high level of student engagement, the instructional framework of the "Mantle of the Expert" supports multimodal learning. By prioritizing experiential learning through theatrical action, it creates a dynamic environment for short- and medium-term research projects that enrich and consolidate new knowledge.

During the workshops, students not only engaged with theoretical knowledge in experiential terms, enhancing their cognitive understanding through sensory-motor and emotional awareness, but they also created new knowledge. This enrichment was achieved by integrating cross-disciplinary connections and conceptual associations (Kousoulas, 2011), fostering higher-order cognitive skills such as critical thinking, creative thinking, analysis, synthesis, and evaluation.

Students made connections between the Natural Sciences and Historical Science, linking concepts such as scientific invention, progress, exploitation, and freedom. They critically evaluated the invention of the compass in comparison with the history of chocolate. The observations recorded in the research diary and the outputs of the workshops indicate that the "Mantle of the Expert" can be effectively used as a teaching method to address learning objectives in the History of Science.

Second Research Question

The results from the two workshops demonstrate that the "Mantle of the Expert" is an effective teaching method for achieving specific objectives in the History of Science. The analysis categories established for evaluating these objectives were as follows:

- i. *Understanding through Historical Analogy*: References indicating familiarity with science inspired by a historical episode. The student shows an understanding of science by relating it to a past event.
- ii. *Science and Socio-Historical Context*: References demonstrating an understanding that science is shaped by the historical and cultural context in which it operates.
- iii. *Historical Processes of Scientific Practice*: References highlighting the specific historical processes and conditions surrounding a scientific practice.
- iv. *Scientist Characteristics and Historical Period*: References depicting the particular role of scientists within a given historical era.

Regarding these categories, the "Mantle of the Expert" was deemed effective, with specific outcomes observed in each workshop.

First Cycle: Analysis of Responses

Understanding through Historical Analogy:

Six out of nineteen students referenced the role of science in their written outputs, using the historical event as a point of reflection. However, most students focused on the event itself without explicitly addressing its historical timeline. This limited response is attributed to the type of activity, which was not specifically designed to emphasize this objective. Nevertheless, the experiential activity inherently served as a re-enactment of a historical episode, indirectly enabling students to derive insights into the meaning and value of science.

Science and Socio-Historical Context:

Eleven out of nineteen students indirectly connected the invention of the compass to cultural factors and societal norms of the time, influencing human actions. Their references highlighted the compass's usage, shaped by the emperor's reception, its application, and the societal perception of the invention during that era.

Historical Processes of Scientific Practice:

Fourteen out of nineteen students discussed the conditions of the time and how these shaped the actions and decisions of the compass experts regarding its use.

Characteristics of Scientists and Historical Period:

All written activities reflected this objective. Students contrasted two types of scientists of the era: an ambitious scientist advocating for European superiority over indigenous populations and a more humanitarian scientist envisioning the compass as a tool for intercultural connection and cooperation.

Creative Writing

Topics included "A Compass Confides", "A Cacao Bean Confides", and poetry related to the compass. Four students participated, submitting a total of seven works (three on the compass, three on the cacao bean, and one poem on the compass).

Understanding through Historical Analogy:

All seven works demonstrated a reflective stance stemming from the dramatized historical events, contributing to broader insights into the application of scientific achievements.

Science and Socio-Historical Context:

Five works indicated a temporal awareness, linking the invention of the compass to its responsible usage across time.

Historical Processes of Scientific Practice:

Six of the seven pieces highlighted the specific historical conditions influencing the use of the compass and cacao bean, excluding the poem, which lacked such references.

Characteristics of Scientists and Historical Period:

All seven writings critiqued how scientists operated during the historical period, portraying the compass as a tool for domination, oppression, and exploitation.

Second Cycle: Analysis of Responses*Understanding through Historical Analogy:*

Three out of nineteen students referenced the temporal phase before the Europeans' arrival in Africa to establish cacao plantations. By contrasting past and present scenarios in their letters, they demonstrated an understanding of the subject through temporal juxtaposition. This lower percentage is attributed to the activity type, which was less focused on this aspect.

Science and Socio-Historical Context:

Seventeen out of nineteen students (excluding one who mistakenly wrote from an incorrect role and another who did not address the objective meaningfully) made explicit connections between science and the historical-cultural context. Their reflections either portrayed or critiqued societal norms of the era.

Historical Processes of Scientific Practice:

Fifteen out of nineteen students discussed the historical circumstances shaping decisions about the use of science. The writing task in this workshop, being more suited to the objective, encouraged frequent references to historical processes influencing scientific practice.

Characteristics of Scientists and Historical Period:

Twelve out of nineteen students expressed clear opinions on how a scientist should act within the historical context. Embedded in their fictional letter-writing task, these reflections conveyed ethical judgments about the scientist's responsibilities.

Essay Writing: Analysis of Responses*Understanding through Historical Analogy:*

Sixteen out of nineteen students explicitly referenced the historical event of colonialism to articulate their perspectives on science and scientists.

Science and Socio-Historical Context:

Seven out of nineteen essays contained clear references to the historical-cultural context, linking scientific knowledge to its application in the era's events. These essays led to broader conclusions about the role of science within its socio-historical framework.

Historical Processes of Scientific Practice:

Twelve out of nineteen essays referred to historical conditions affecting scientific practices.

Characteristics of Scientists and Historical Period:

Thirteen out of nineteen essays included implicit references to how scientists operated during the time frame explored in the workshops. These conclusions primarily addressed how scientists ought to act, critiquing historical practices and offering ethical considerations.

Summary of Findings

The analysis across both cycles and creative writing tasks reveals that the 'Mantle of the Expert' is a highly effective teaching method for addressing learning objectives related to the History of Science. Students demonstrated varying degrees of engagement with historical contexts, ethical considerations, and the role of science in shaping human history, indicating that the method successfully fosters critical thinking and historical understanding.

Conclusion

This study comprehensively examined the application of the "Mantle of the Expert" as a teaching method, particularly in its adaptation as the "Dramatic Project Method", to address learning objectives in the History of Science. Drawing upon Heathcote and Bolton's original methodology (1995) and S. Papadopoulos's structured adaptation (2011), the study integrated project-based learning with dramatic role-play to create a dynamic, interdisciplinary educational framework. Through its qualitative analysis of experiential workshops, creative writing tasks, and student reflections, the study offers valuable insights into the effectiveness and versatility of this approach.

The findings demonstrate that the "Mantle of the Expert" method fosters deep engagement by immersing students in fictional scenarios, where they adopt expert roles. This dramatic framework not only enhances participation but also encourages students to grapple with historical, scientific, and ethical complexities in a meaningful way. The ten-stage developmental model proposed by Papadopoulos was instrumental in structuring the learning process, from problem identification to the evaluation of the

students' work as "experts". This systematic approach facilitated both cognitive and emotional engagement, enabling students to critically explore the historical significance and ethical implications of scientific advancements.

Overall, the research highlighted several key benefits of this method:

1. *Interdisciplinary Learning*: Students made connections between science, history, geography, language, and social studies, enriching their understanding of the socio-cultural contexts of scientific progress.
2. *Higher-Order Thinking Skills*: Activities such as role-playing, reflective writing, and project-based research fostered critical thinking, analysis, synthesis, and evaluation, empowering students to develop nuanced perspectives on the intersection of science and society.
3. *Moral and Ethical Reflection*: Students engaged in debates and reflections that enabled them to critique historical practices and consider alternative, more equitable applications of scientific discoveries.
4. *Experiential Engagement*: The dramatic environment provided a safe yet immersive space for students to take responsibility for their roles, enhancing their sense of accountability, while protecting them emotionally through the fictional framework.

While the study affirmed the method's effectiveness, it also acknowledged certain limitations. The small sample size and the short duration of the intervention constrain the generalizability of the findings. Moreover, the lack of a quantitative evaluation framework limited the ability to measure the impact of the method in more objective terms. These limitations underscore the need for further research, including larger-scale studies and the incorporation of quantitative tools to complement qualitative findings.

In conclusion, the "Mantle of the Expert" and its adaptation as the "Dramatic Project Method" offer significant potential for innovative education, particularly in exploring complex subjects such as the History of Science. By blending experiential learning, interdisciplinary inquiry, and ethical reflection, this approach equips students with the tools to critically engage with the past, understand the present, and envision a more responsible application of scientific knowledge in the future. As a result, this method represents a promising direction for pedagogical innovation, with the capacity to transform classrooms into vibrant spaces for critical inquiry and active learning. Future studies should explore its application across diverse educational contexts and disciplines to further substantiate its transformative potential.

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