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Feasibility of An Introductory Chemistry for Cultural Heritage E-course for Museum Professionals in the Philippines

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ABSTRACT

Chemistry knowledge is fundamental in preserving and comprehending the tangible nature of museum collections. Despite chemistry's importance in cultural heritage, a gap exists between the chemist's knowledge and the accepted competencies of museum workers. This paper describes an initial study on introducing museum professionals with no formal scientific training in basic chemical thinking and research. A two-hour online session was conceived, comprising two separate lectures emphasizing the concepts, instrumental techniques, and example of a case study of an application of chemical analysis on a local heritage material. An open discussion and exchange of ideas followed the lectures. Feedback from the participants was very positive, and they described the online course as informative and valuable for their museum work. The qualitative evaluations obtained from this paper can serve as baseline information for developing a more extensive e-course in the future.

Keywords: *museum education; cultural heritage; chemistry education; teaching; online course*

INTRODUCTION

Online learning platforms have gained tremendous popularity lately due to the COVID-19 pandemic. Countless webinars, web-based training and workshops, and other MOOC-type (Massive Online Open Course) with cultural heritage themes have been regularly offered by academic institutions, professional organizations, business providers (i.e., Coursera and edX), government and private institutions, and intergovernmental organizations such as UNESCO and ICCROM, among others. Despite the abundance of these platforms, only some would tackle the outcomes from chemistry research applied to the needs of museum professionals with no

scientific training. This is expected since not many chemists work in the heritage field, and there are also few chemical laboratories associated with museums or art institutions, primarily in the Philippines. Added to it is the usual notion that chemistry is viewed as a challenging subject, too abstract, and only for a select few (De Quadros et al., 2011; Sanchez, 2017; Carvajal, 2020). Although chemical knowledge of heritage materials is vital, museum workers may find the scientific concepts detached from their usual daily routine mainly due to different viewpoints with scientists (Jarman, 2015).

This article addresses the motivation for developing an introductory e-course in the Philippines on chemistry for museum professionals with no formal training in scientific techniques and principles. An online platform was chosen due to its suitability to reach more participants. It also offers convenience and flexibility, considering the Philippines is mainly archipelagic. Furthermore, we will discuss the evaluation of selected museum professionals on the preliminary application of this e-course. The central goal of our contribution is not to make conservation chemists out of these museum workers but rather to empower them with a general knowledge of the chemistry discipline and encourage them to know more about the materials they will be encountering.

METHODOLOGY

Course Description and Organization. The modern-day museum is not only limited to the repository of artifacts and other collections but also functions as a source of education and research. As part of the museum code of ethics, they are responsible for establishing evidence, furthering the knowledge, and presenting accurate information on the objects they have in their possession and care (ICOM, 2017). The increasing complexity of understanding the material composition in museum collections highlights the need to strengthen the partnership between chemists and museum professionals. Analytical techniques developed from chemistry principles provide an evidence-based approach to unraveling issues related to material analysis of ancient and art objects, which aids in explaining its manufacturing history and proper interpretation of the human cultural context (Artioli, 2010). Knowing the material changes through time using scientific analysis will also assist in crafting appropriate protocols for the eventual preservation and conservation of these artifacts and artworks.

From this context, a two-hour long single-session online course was implemented. Two lectures were designed to achieve the objectives. The first lecture provides sufficient background on the fundamentals of chemistry research applied to cultural heritage materials (40 mins). The second lecture is a case study on an analysis of an actual heritage material guided by the scientific method of thinking (20 mins). The talks were followed by a 15 mins breakout group session, where the participants applied the scientific method to an object in their respective museums and were tasked to choose a representative material to report during the session. This part fosters the exchange of best practices in the participant's museums. Lastly, an open discussion and exchange of ideas between the lecturer scientists and the participants were done (45 mins).

The first lecture attempted to bridge the gap between the point of view of chemists and the museum professionals, either representing a conservator or a curator, on their approaches to addressing museum problems. For example, a conservator is interested in the effects of time on an object. Some of the key questions are: How the material was produced and the manufacturing process used? What physical or chemical changes have occurred in the present time, and eventually, how to stop or slow down the degradation process? (Lithgow, 2015). In all these aspects, chemical techniques are essential in providing practical information for the conservator. Furthermore, analytical instruments commonly used in cultural heritage material analysis and available in the Philippines were introduced lightly, as well as their classification as either destructive or non-destructive, ability to analyze organic and inorganic compounds, and

detection abilities (i.e., elemental, mineralogical, and physical). An activity designed to enhance problem-solving skills using the scientific method was also introduced as preparation for the second part of the lecture (Idelson, 2011). The second lecture focuses on how the scientific method facilitated the analysis of a brick material made during the Spanish Era in the Philippines and is one of the projects the authors are currently working on. Research questions were formulated by observing a brick material (i.e., What is the brick made of? Can a modern-day brick replace it during conservation work?), afterward a hypothesis was made about its possible composition. Lastly, the appropriate analytical techniques were discussed to validate these assumptions.

Learning Outcomes and Instructional Strategy. The learning outcomes developed by the primary author in the *"Chemistry of Cultural Heritage Materials"* graduate course at the University of Santo Tomas (UST) in Manila, Philippines were generally adopted (Cayme, 2021). However, due to time constraints, limitations have to be implemented. The minimum expectations after completing the e-course are for the participants to explain the general relevance of basic chemical research in museum studies and to implement the scientific method in identifying general material problems in their museums. These outcomes are enough to give the participants a general impression of some of the tools and techniques chemists use for material analysis.

To facilitate a better understanding, the entire e-course was explained mainly in the local language *(Tagalog)* to create a more comfortable environment for learning chemistry concepts. However, all technical chemistry terms and PowerPoint presentations were not translated into *Tagalog* but were retained in English. Examples and the case study used in the lectures reflect the local Philippine situations and build upon the author's research experiences and peer-reviewed publications. About a week before the start of the online course, registered participants were provided with a reading article about the tools of cultural heritage science (Gates, 2014) to familiarize themselves with some of the general techniques to be discussed. Furthermore, to maximize the intended group activity, the participants were provided with guide questions. They were tasked to bring a photo or think of a heritage material in their respective museums that could be shared during the discussion.

A pre-activity questionnaire that came together with the online registration form includes information about the participant's background and experience, as well as questions about their personal perspective on the significance of chemistry to cultural heritage. After the e-course, the participants who attended were asked to evaluate the event based on a 5-point Likert scale (i.e., strongly disagree to agree strongly) regarding the delivery, content and scope, and the application or transference of learned knowledge.

RESULTS AND DISCUSSION

Demographics of Participants. Selected professional museum workers (n=18) from different museum sectors, shown in Table 1, were invited to participate and evaluate the e-course. Of the total invites, 12 museum workers signed their interest and responded to the online registration. The registered participants (n=8) are classified as mid-career professionals with 5-10 years of experience in the cultural heritage field (Table 2). The museum professionals are either the head of their respective museum divisions, a curator, or conservator. Only a few registered (25%) and attended participants (33%) have master's degrees, and most have bachelor's degrees. In terms of age groups, most are within the 30-40 age range, and the participants are primarily females, as seen in Table 2. During the scheduled event, only 6 participants managed to attend. A participant represents at least each museum sector.

Table 1. **Invited participants for the online course.**

Museum Sector	No of invited participants	Registered participants	Attended participants
National government	5	3	2
Local government	8	5	2
Non-government	2	2	1
Academe	3	2	1
Total	18	12	6

Table 2. **Background information on the registered and attended participants.**

	Registered participants (n=12)	**Attended participants** (n=6)
Years in the heritage field		
5 years and below	1 (8%)	-
6 to 10 years	7 (58%)	3 (50%)
11 to 15 years	2 (17%)	2 (33%)
greater than 15 years	2 (17%)	1 (17%)
Highest educational attainment		
Bachelor's degree	9 (75%)	4 (67%)
Master's degree	3 (25%)	2 (33%)
Age group in years		
20-30	1 (8%)	-
30-40	7 (58%)	3 (50%)
40-50	2 (17%)	1 (17%)
50-60	2 (17%)	2 (33%)
Gender		
Male	4 (33%)	2 (33%)
Female	8 (67%)	4 (67%)

Pre-Activity Questionnaire. Registered participants were inquired about their impression of chemistry. In general (n=7), retention of fundamental terms such as the periodic table, chemical elements, molecules, chemical reactions, and stoichiometry are some concepts the participants remembered about chemistry during their academic years. There was also a mention that chemistry is "interesting" and "useful and fun." These beliefs and attitudes are considered positive overall and a good starting point for introducing a more specific application of chemistry to museum work. However, a few (n=3) have expressed their uneasiness with chemistry topics stating it is "hard, literally and figuratively." These comments are not surprising since chemistry is complex and involves abstract thinking that non-science individuals may find hard to grasp.

All (n=12) agree that chemistry is integral to cultural heritage research in the Philippines. When asked to identify the practical application of chemistry to museum-related problems, the terms preservation, conservation, and restoration of heritage materials, knowing the provenance and manufacturing technology, chemical composition, and easy identification of materials were identified. Despite knowing its relevance, one museum professional could not provide a practical application of chemistry research to heritage materials or, more likely, opted not to answer. These answers clearly show that the teaching approach should be at the level of general appreciation and more practical applications.

Post-Activity Feedback. Since a relatively small sample set of professional museum workers (n=6) attended the introductory e-course and gave online feedback, the results are reported based on the individual respondent's specific opinions. The input of the participants was very positive and encouraging. All affirm that collaborative work between chemists and museum professionals is vital in understanding the museum's material problems. Collaboration work should be increased, and there should be a platform for efficiently exchanging ideas.

Delivery. All the participants agree that conducting the workshop in their native language (i.e., *Tagalog*) made them comfortable with the chemistry concepts introduced during the discussion. Although the discussion is in *Tagalog*, technical chemistry terms used in the presentation, such as "electromagnetic radiation", "atomic absorption spectrometer" and "gas chromatography-mass spectrometer", among others, were not translated anymore. Studies have shown that using the local language has generated interest and a proper understanding of the subject matter, especially at the introductory level (Sumardani, 2021). In the Philippines, chemistry and science, in general, are all taught in English, making the subject matter hard to grasp. Using a language familiar to the students has boosted productivity and understanding of the subject matter. The participants perceived the level of discussion and delivery to be very good. The use of simple words and analogies is also helpful.

Content and Scope. The content for an introductory and appreciative e-course is adequate for the participants to understand the crucial role of chemistry in cultural heritage. Activities have provided them with time to interact and discuss with other museum workers and for them to ask the lecturers specific questions regarding their particular conservation problem. Overall, the content and scope made the participants satisfied. Some room for improvement was expressed, which included more case studies and more time for the breakout sessions. Another suggestion is that concepts should be broken down into a series of short courses. This would give the participants enough time to digest the information presented in the lecture.

Application and Future Direction. Their high school chemistry background is insufficient for the participants to follow the concepts discussed in the workshop. The central theme of the discussion is the use of the scientific method as the first line of analysis and provides a general overview of how chemists can be involved. The participants find the implementation of the scientific method in museum practice to be difficult at the moment. The concept discussed in the seminar, especially the instrumental methods, are new to them, and the facilities in the museum are not ready to go towards a more scientific-based direction. Other factors, such as the lack of budget and expertise in the Philippines, also added to these issues. The museum professionals would also need more time to understand the concepts presented. The important thing is that they have a particular appreciation of chemistry work.

The approach of the e-course, even though limited in scope and the number of participants, impacted those who attended. Some of the comments are shown below:

"The speakers were able to explain scientific matters in a manner more understandable to people outside the field of chemistry. It was delivered in a relaxed manner but very informative. Thank you very much. Hope to participate in your next activities."

"An excellent exercise in analytical problem solving in the museum setting using chemistry and other sciences."

"I have learned interesting knowledge on how to use the scientific approach in dealing with some problems we usually encounter in museums (e.g. dating the object, material composition, effect of not using similar material in conservation/restoration)."

CONCLUSIONS

All the participants strongly agreed that the proposed e-course had helped them better understand chemistry's contribution to solving museum-related problems. Even though this paper is limited to a few participants' feedback, it is evident that chemistry is essential, and non-science museum professionals are open to collaboration. The e-course is found to be feasible and has the potential to be developed further.

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