Cultivating curiosity by integrating art in science through photography

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ABSTRACT

Arts-integrated science is a tantalizing educational approach that captures the attention of scientific learners through the lighter side of science. This study describes the findings of a school-based applied research study conducted to develop public school students’ curiosity and their aesthetic qualities by exploring scientific knowledge using photography. This study incorporated photography as a learning aid in STEAM workshops for 386 high school students, including 220 males and 166 females from 19 schools, and tested methods for enhancing the curiosity or interest of students to explore the workshop context more deeply. The analysis of our methods discusses the results using pre- and post-method questionnaires and the evaluations of 816 scientific images captured by the students. The key aim of this research involves cultivating curiosity in students as they analyse captured images, which results in positive outcomes, such as increased engagement in scientific workshops, thereby inspiring them to more thoroughly explore the science behind each image.

Key words: Curiosity, creative thinking, art, science, photography.

INTRODUCTION

Curiosity is one of the necessary elements that plays an inevitable role in the mental and intellectual development of a child. Curiosity improves children’s minds and encourages them to be active and innovative, thereby encouraging effective exploration of their surroundings (Barell, 2003). Starko (2013) defines curiosity as one’s strong desire to know how things work. The five Ws (what, who, when, where, why), considered to be one of the basic tools that promote curiosity, can be stimulated by constructed situations and exercises for students, such as scientific events and physical activities, to assess their sensory responses (Conklin, 2012; Dischler, 2010; Engel, 2013). Starko (2013) and Sternberg (1999) considered employing creative processes to encourage inspiration and to stimulate curiosity in exploring new and broad areas for knowledge development. They also confide that a creative setting will aid in broadening a child’s imagination and creativity, which is believed to be the positive outcome of bolstering curiosity in them.

Scientific settings that inhabit inquiry culture have the capability of inducing a longing or craving to know more, to explore the meaning behind a data, and to find evidence and reason to support their claims (Lawson, 2009). Lawson (2009) states that “fostering science as a way of thinking” (p. 5) provides an environment in the classroom to generate the 5Ws and imagination, cultivating curiosity and critical thinking. However, a different perspective was also studied by Luce and Hsi (2015), who stated that science discipline essentially requires curiosity to instigate students to develop their scientific literacy (Higgins and Moeed, 2017; Spektor-Levy et al., 2013).

The different factors that influence this interrelation could be attributed to the pedagogical approaches that could be implemented in classrooms to improve both scientific literacy and curiosity. Our research mainly focuses on the pedagogical approach of employing scientific settings to cultivate curiosity. The following question has been raised often in different research studies, which again led to our research hypothesis:

How do different pedagogical approaches in learning science influence the cultivation of curiosity?
Engaging learners in science years (aged 11-14) to different pedagogical approaches is paramount (Allchin, 2014). We also studied school-related variables, such as teaching methods and sociological factors, including student demographics, which are key predictors of interest and curiosity (Hasni and Potvin, 2015; Krapp and Prenzel, 2011). Rhodes (1961) also emphasized that teaching material or approach is crucial in the development of creativity evolution, with supporting findings by Treffinger et al. (2000) portraying the priority of teaching creativity to encourage innovation and revolutionary thinking. Research studies have found that limitations on developing creativity in schools are the pivotal elements of creativity – curiosity, imagination and creative thinking are separately and inadequately developed, in addition to the negligence of the latter in upper education levels (Engel, 2013; Robinson, 2010; Sahlberg, 2009; Starko, 2013).

Our background study on the findings of Said et al. (2016) on the attitudes of Qatari students from grades 3 - 12 towards science disciplines indicate dismaying performance due to different catalysts, one of which is the teaching method. Therefore, we conducted research on students from high schools in Qatar by integrating an innovative approach of delivering information through STEAM workshops. This innovative approach introduces photography as a teaching tool in attracting students to improve their outlook on science by unveiling the beauty behind the science.

**Integrating art in science through STEAM**

In the 1990s, as the U.S. and the Soviet Union competed for world dominance, the National Science Foundation proposed that integrating Science, Technology, Engineering, and Mathematics would be an effective teaching model (English, 2016). This model came to be known by the acronym STEM. Some educators have begun to infuse artistic creativity into a new iteration of STEM, adding an “A” to the acronym to make STEAM, which integrates the disciplines of science, technology, engineering, art, and mathematics (Graham and Brouillette, 2016), thus establishing the crucial contribution of art in education for the expansion of creativity (Hadzigeorgiou et al., 2017). The combination of art and science through STEAM pedagogy is a fun experience for all, including children, to learn about science and boost their creativity. Peng and Chen (2016) stated that creativity nurtured through hands-on experience in science and art, along with curiosity, agility, critical thinking and problem-solving, are among the key techniques that could construct a better tomorrow of an â€œ generation. Creativity is often related by researchers to curiosity, or exploring and imagining based on one’s knowledge to build innovative products or solutions (Tran et al., 2018; Runco et al., 2012; Sternberg, 1999; Vygotsky, 2004), an outcome of curiosity driven by STEAM.

In 2007, Girod argued that aesthetic understanding, or imagination and creativity, is vital in the development of science education. In addition, the National Research Council (NRC, 2012, p. 30 claimed that scientific inquiry, vital in science education, includes the ‘cognitive, social, and physical practices’ that scientists employ when they investigate, model, and theorize knowledge and concepts. Other researchers, in contrast, have expressed doubts on the strength of research studies showcasing students’ outcomes such as creativity, critical thinking, persistence, motivation and self-concept as a result of art-integrated education (Winner et al., 2013). We also examined the arguments of De bono (1970) and Moran (2010) on the adoption of creative tools and techniques for developing creative skills such as curiosity and imagination, thereby encouraging the consideration of building creative environments for teachers and students in schools (Moran, 2010; Starko, 2013). Thus, we focused our study on expressing art in science, a discipline to express creativity (Chen and Chen, 2008) to improve curiosity and scientific knowledge through our novel approach.

Art integration in science implements different forms of art, such as literature, drawing/painting, photography, drama, and music, which help to acknowledge scientific content in different ways (Reif and Grant, 2010). Visualization methods such as photography are important tools in the creative education of scientific micro-disciplines for the accurate depiction of scientific work. Images are beneficial in a way that neither tables of data nor equations can match. Photographs often have multiple implications depending on the moment and ambience and when viewed from unexpected perspectives (Wildier, 2011). Photography provides illustrative documentation on material aspects of the learning concepts and complements the student’s engagement with the environment to which they are subjected (Tok et al., 2010). Apart from nurturing engagement in data collection and experiment documentation, photography can also develop interests related to science (Zimmerman and Weible, 2018). Students can reinforce their scientific knowledge through visual arts (Mathewson and Weible, 2011). Photography may provide students the opportunity to reflect, reinforce and remember what they have learned in the classroom and can bridge theoretical concepts with everyday life while exploring the beauty of science and enhancing the curiosity to seek newer horizons in learning science.

**Art in science**

Art in science is a unique methodology in creative education in which many artistic compositions of scientific phenomena effectively aid the integration of STEM into the curriculum. Scientific images captured through leading-edge imaging tools can function as a medium for conveying ideas and possess the aesthetic qualities that mould them
into interesting visual artefacts. The images, when observed through a lens, may enhance our appreciation of the real world and the further understanding of scientific concepts. This approach thus combines beauty and aesthetics with a broad acumen that undoubtedly proves the authenticity of our pedagogy, opening eyes and minds to reflect on the work that we are undertaking. Ultimately, art in science has ignited contradictions in the concept of art, opening scientists to an innovative way of seeing their own research, and can serve as a democratic window through which the public can appreciate both art and science (Ione, 2011).

Previous research studies showing that photography is being used in education settings justified the design of this study (Ching et al., 2006; Lee, 2014; Rivet and Schneider, 2004; Stevens and Hall, 1997; Stevens and Martell, 2003; Tatar and Robinson, 2003). In scientific educational settings, photographs have captured learners’ observations from a learning experience so that they could review it later (Lee, 2014; Stevens and Hall, 1997; Stevens and Martell, 2003; Sung et al., 2014; Zacharia et al., 2016), a strategy that is reflected in our methodology. Rivet and Schneider (2004) had students share the images captured on websites, but the students did not convey their perspectives while sharing these images; in contrast, we encourage the students to share their perspective while providing captions to the photos when sharing on websites.

Our review of the literature discovered three purposes for integrating photography into science experiment settings: recording, observations and procedure, and increasing interest in scientific exploration. Our study focused on integrating art in a scientific program through photography with the purpose of appreciating the beauty of science. Amazed by the charm of science, the curiosity-inspired students pictured their scientific workshop activities for community sharing, thereby infusing art (A) into STEM, modifying the pedagogy into STEAM. We quantitatively analysed the questionnaires provided through our scientific program to observe the effectiveness of scientific photographs in inspiring students to visualize the beauty of science. While acknowledging the instrumentality of science, the role of photography in enhancing students’ curiosity in science is not supported in standard documents; consequently, we rely on research findings, rather than standards documents, to understand how art through photography can support inquiry in science education. Moreover, measurement of curiosity cultivated in students is performed qualitatively, considering their different perspective to capture the maximum number of photographs, rather than quantitatively assessing their academic performance out of curiosity.

**METHODS**

As the essence of art lies in its ability to inspire, to provoke thought and discussion, and to enrich our world, this quasi-experimental study is aimed to inspire students to discover the artistic elements behind the science, thereby enhancing the students’ excitement and curiosity in scientific knowledge. The experiment was conducted during a series of STEM workshops during which students express their ideas spurred from the excitement for scientific exploration in the form of exquisite images. We also investigate how the art-inspired curiosity of students could be transmitted to the community.

**Sample**

Research participants were 386 students from 19 public schools in Qatar (220 males and 166 females, from grades 10 and 11) who were engaged in a program entitled ‘I am Discovery Materials’, 13th cycle, in the fall of 2017, conducted by the Center of Advanced Materials, Qatar University. This program implements STEAM workshops in schools in which students are familiarized with scientific topics through hands-on activities. These activities were designed to follow STEM pedagogy; however, by implementing photography to capture images of the same concepts, the research infused the ‘Art’ into STEM pedagogy. The data collected from the student's program includes questionnaires and photographs, creating opportunities for quantitative and qualitative analyses, respectively.

**Research design**

The program takes place for three months (a cycle) in each school and is designed in the following steps (Figure1):

**Stage 1: Pre-questionnaire**

The questionnaire was designed to understand the impact of scientific photographs on engaging students to explore the beauty of science and was provided to the students before and after the scientific workshop. At this stage, the students are completely unaware of the program method. The questionnaire consists of three statements for choosing different levels of agreement in context to their outlook on the influence of photography in assisting them to learn and explore the beauty of science. The students choose their opinions from options from a Likert-type scale on which the choices are agree, neutral, disagree and do not know. The questionnaires are evaluated by using pre- and post-tests as a part of standard Monitoring and Evaluation (M&E) procedures. The mean percentages of agreement of the pre and post-questionnaire answers are compared to assess the outcome of the program.

The analysis of the questionnaire was in accordance with Likert - scale methods (Likert, 1932), which is a
Academia Journal of Educational Research; Al-thani et al. 004

Figure 1: Flowchart of the research methodology.

Table 1: Questionnaire design.

<table>
<thead>
<tr>
<th>Questions</th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
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</thead>
<tbody>
<tr>
<td>Observing a scientific photo attracts you to visualize the beauty of science.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Observing scientific photos helps in learning faster &amp; easily.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to join a scientific specialty in the university.</td>
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</table>

Psychometric response scale primarily used in questionnaires to obtain participants' preferences or degree of agreement with a statement or set of statements. Likert scales are unidimensional (only measure a single trait) in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale. For analysis, each level on the scale was assigned a numeric value, starting at one and incremented by one for each level. Agree corresponds to one, neutral corresponds to two and disagree corresponds to three (Table 1).

Stage 2: Photography workshop and science activities

The students were provided a photography workshop before the scientific activities, thereby gaining knowledge about how to produce beautiful photographic renditions on scientific details. The students first worked with professional photographers who addressed the technical details and the obligatory features of good photographs. The students learned different lighting conditions that can be used to achieve the best effects in photos. By the end of the workshop, the students had been familiarized with the basics of photography, including ISO (the camera setting that will lighten or darken an image), aperture, shutter speed, and exposure.

The students were then grouped and asked to perform various scientific experiments in six different material science modules (polymer, concrete, manipulation of light, bio-degradable materials, smart sensors, and composites). The students could use any type of camera, ranging from basic mobile phone cameras and digital cameras to high-end professional Digital Single Lens Reflex (DSLR) cameras (Figures 2 and 3). The students had the freedom to use all of the probes and ambiances available in their surroundings (laboratory) to amplify the quality of their photos. As they experimented and performed activities during the scientific workshop, they were provided opportunities to take photos. The students were exposed to various ambiances in the workshop-laboratory, encouraging them to explore each frame of the captured photographs. They applied what they had learned in the photography workshop for image acquisition.

Students were encouraged to add captions to their pictures to reinforce the acquired knowledge from the scientific activities. The purpose of this activity was to encourage students to become curious about the photos and to think deeply about the subject of the photograph, leading to research, enquiry and scientific discussion among peers. The captions of these photographs highlight the knowledge acquired from curiosity, leading to hunting, collecting data and making hypothesis.

Stage 3: The post-questionnaire

In the next stage, students are provided with the
questionnaire post-activities to document their opinions about the impact of science through art. The questionnaire was similar to that provided during pre-activities. The data collected from the pre- and post-activities questionnaires were then quantitatively analysed. The analysis from the questionnaire results measured the influence of the program on the participants. The results of both the pre- and post-questionnaires were compared for each question using the Normalized Learning gains equation, which was introduced by Hake (1998).

**Stage 4: Evaluation through competition and exhibition**

Qualitative data were gathered through the process of subjecting the photographs to an Art in Science competition. The competition provides the scale in measuring the photographic craft of the individual student through integrating art in science. A panel of professional photographers used criteria such as scientific specification, originality, artistic and visual impact and the connection to the workshop to choose 100 photos from among the 816 photos produced in the project to be placed for the Art in Science exhibition in the public gallery in the country’s high-profile cultural village.

**RESULTS AND DISCUSSION**

**Qualitative evaluation of student photos**

The aim of the study, to ignite student curiosity in science
through photography, was clearly demonstrated in the 816 photos captured by the students after careful observation and study during the workshops. As the images were the result of different ambiences contributed from different laboratory settings of different modules, we hereafter provide a brief discussion on the sample photos (Figures 4 – 7) from the different topics. The attached scientific images show diverse levels of technical expertise and scientific engagement. The photo in Figure 4, from the lab setting of the “Dye-sensitized solar cell” topic, defines distinct layers in different colours of a solution, capturing the colours of the pigments, which contribute the electrons, whereas Figure 5 is a photo-collaage of sample images by students from the same setting. The electrons induced from the dye due to the photo-electric effect produces electricity, leading to the operation of the dye-sensitized solar cell; the dye is one of the common picks of the student photographers when it came to photography during the workshop. By capturing the most important element of the experiment, the student demonstrated curiosity to acquire scientific knowledge behind the image.

The module on biodegradable materials is a photographers’ paradise, as the setting provides vibrant colours and art for imaging. Figure 6 visualizes the art of highlighting the transparency of the solution and the degradation of alginate beads and dye-release, where a brilliant display of colours is observed and captured. The photo was captured during the design project at the end of the workshop. The picture captures the simulation of drug release from a bio-degradable capsule, which sparks students' curiosity and is converted into queries justifying the research question. We also showcase a sample collage photograph (Figure 7) combining sample photographs from the same setting.

Students also engaged during the “manipulation of light” workshop, which familiarized them with different light sources (Figure 8). Under normal lighting conditions, the iridescent properties of a peacock feather are not observable, but when subjected to UV light, the varying colours on the feather may be observed. The other
Figure 6: Simulation of drug release showcasing the dilution of colored alginate beads.

Figure 7: Sample photograph collage from biodegradable materials activity.

Figure 8: A UV light source used in visualizing iridescence of peacock feather in the manipulation of light module.
Figure 9: Collage of sample photographs from "Manipulation of light" activity.

Figure 10: The entire set up to construct a microphone from smart sensors module is seen in the image.

perspectives of the same object can be found in the collage photograph (Figure 9) of sample images by students from the lab setting of the "Manipulation of Light" activity.

Other photos were descriptive of the process, such as when in the "Smart Sensors" activity, the picture captured describes the entire procedure setting to make a microphone (Figure 10). In Figure 11, a collage image of sample images by students provides insight into the different perspectives of the same object during the "Smart Sensors" activity.

We also observed that the students develop a situational interest from the activities performed with peers, as evidenced by photos focused on students’ spontaneous observations (Figure 12), which stand out from the activity procedure (Ardoin et al., 2013). We also observed that photography provided our students the liberation to review a moment by editing it to look through a different perspective (Ardoin et al., 2013). Figure 12 shows one such photo, edited by the student photographer, offering a different perspective of the subject of the image.

Bianchini (1997) and Holthius et al. (2013) suggest that peer interactions positively influence exploration and learning. We also observed this effect, as the activities were performed in groups, which had a great influence on students’ attitudes regarding photography. The perspective of the individual may vary from those of the other contributing group members, producing completely different images of the same subject, leading to the exploration of the subject from two different angles.

When we as researchers analyse their artistic renditions, we may also experience newer perspectives (Rockwell et al., 2011; Stedman et al., 2004). One of the challenges we faced during the workshop was that students frequently focused on capturing the artistic rendition rather than performing the activity as designed. As Louv (2005) suggests, the cohesiveness between youth and technology may create a barrier in observing the authentic experience in its true form, and we observed students tending to deviate from the activity as designed, as the photography, mediated through the digital device and shared through social media, prompts the students to slow down and take notice of otherwise fleeting moments (Turkle, 2011).

The project encouraged students to upload photos on social media websites such as Instagram, where these
photos became a sensation to create ripples among viewers to develop a huge interest in the scientific subject. The followers were inspired by the magnificence of these photos to develop fruitful discussions to create a trend among the community, especially young scientific influencers. A competition was held to award the photo with the maximum number of followers.

The fascinating photos generated from the students’ creativity and experience solidified the results obtained from the post-questionnaire.

Quantitative analysis of the survey results

The questionnaires were completed by 386 students in both pre- and post-tests. The pre- and post-survey results were compared using the Normalized Learning Gains (NLG) equation, which can be represented as 

$$NLG = \frac{(Post-test\% - Pre-test\%) \times 100}{100 - Pre-test\%}.$$  

The questionnaire results were drawn through the detailed analysis of agreement on the three statements:

1. Observing a scientific photo attracts you to visualize the beauty of science.
2. Observing scientific photos helps in learning faster and more easily.
3. I would like to join a scientific specialty in the university.

We received 386 comments in relation to the first statement, in which the students rated their agreement to the statement that observing a scientific photo helped them to visualize the beauty of science. Students’ agreement shifted from 40.2% in the pre-test to 76.7% in the post-test (Table 2, Figure 13). Gender did not affect the students’ agreement.

These data showed that the majority of students succeeded in visualizing the art found in the scientific environment after having participated in the project, which
Table 2: Number and percentage of participant at each level of agreement on question 1 (N = 386).

<table>
<thead>
<tr>
<th></th>
<th>Pre-test</th>
<th>Post-test</th>
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<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>A- Agree</td>
<td>Count</td>
<td></td>
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<tr>
<td></td>
<td>90</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40.9%</td>
<td>39.2%</td>
</tr>
<tr>
<td>B- Neutral</td>
<td>Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.0%</td>
<td>36.1%</td>
</tr>
<tr>
<td>C- Disagree</td>
<td>Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.1%</td>
<td>10.2%</td>
</tr>
<tr>
<td>D- Do not know</td>
<td>Count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15.0%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td></td>
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<tr>
<td></td>
<td>220</td>
<td>166</td>
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<tr>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Figure 13: Observing a scientific photo attracts them to visualize the beauty of science (N = 386).

strongly established the purpose of the study.

We also have similar data supporting the statement, “Observing scientific photos helps in learning faster and more easily.” The analysis for this statement focuses on the role of photography as a tool in education. Table 3 and the graphical representation in Figure 14 show that the student agreement shifted from 40.4% pre-test to 78.0% post-test.

We also observed that the percentage of agreement shifted from 43.3% pre-test to 60.9% post-test on the statement, “I would like to join a scientific specialty in the university.” The agreement on this question supported an aim of the study, to increase interest in scientific careers (Table 4). There were no differences in the opinion on the basis of gender. Figure 15 shows a graphical representation of the respective quantitative results.

The final outcome of the research study was a creative work in the form of an exhibition, entitled Art in Science Gallery (Figure 16), displaying 44 images from 25 schools at a public gallery in the country’s cultural village (Katara). The exhibition was open to the public and generated much public interest in the artistic renditions of the students’ activities. The exhibition explored the interplay between science and art and presented an artistic interpretation of the concept of scientific inquiry. The student photographers were present in the gallery to speak with the spectators. They explained the process of creation, beginning with the motivation to take the particular still, the ambiance provided to create the still, and his determination to execute the photography. The public had fruitful conversations with the image creators about the subject of the image, the circumstances that led to creating the particular shot and the intellectual perspective from which
Table 3: Number and percentage of students at each level of agreement on statement 2 (N=301).

<table>
<thead>
<tr>
<th></th>
<th>Pre-test</th>
<th></th>
<th>Post-test</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
<td>Male</td>
</tr>
<tr>
<td>A- Agree</td>
<td>Count</td>
<td>92</td>
<td>64</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>41.80%</td>
<td>38.60%</td>
<td><strong>40.40%</strong></td>
</tr>
<tr>
<td>B- Neutral</td>
<td>Count</td>
<td>66</td>
<td>53</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>30.00%</td>
<td>31.90%</td>
<td><strong>30.80%</strong></td>
</tr>
<tr>
<td>C- Disagree</td>
<td>Count</td>
<td>21</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>9.50%</td>
<td>9.00%</td>
<td><strong>9.30%</strong></td>
</tr>
<tr>
<td>D- Do not know</td>
<td>Count</td>
<td>41</td>
<td>34</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>18.60%</td>
<td>20.50%</td>
<td><strong>19.40%</strong></td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>220</td>
<td>166</td>
<td>386</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
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</tbody>
</table>

Figure 14: Observing scientific photos helps in learning faster and easily.

the image was born. Discussions to explore the meaning behind the photo help in resolving the students’ representation of their art (Bernard, 2002; LeCompte and Goetz, 1982). These discussions seemed to have nurtured the public’s eagerness to know more about the various materials and scientific subjects and to increase the curiosity of the photographer student (as they browsed other images), their families and the wider community.

Photographs are a representation of the taker’s identity, and the focus of the students was on presenting this identity to others rather than capturing a memory (also seen in van Dijk, 2008). The exhibition tastefully depicted the beauty of science as experienced by the students. By doing so, the display encouraged students to enjoy the subject of science, rather than studying it vaguely to improve scores. The work of the students was recognized on a public platform, thereby conveying the purpose of the research study to a larger audience.

The students confirmed their agreement when they captured 816 beautiful renditions of the scientific ambiance in incomparable scale that no ordinary eye could perceive. Accordingly, students succeeded in exploring new boundaries and in gaining higher levels of observation, thinking, analysis, and execution. Moreover, their scientific photographs were perceived and applauded by the larger community and led to scientific and meaningful discussions radiating from the focal subject of the image to a broader spectrum of knowledge.
Table 4: Number and percentage of students at each level of agreement on statement 3 (N=386).

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A- Agree</td>
<td>Count: 93, %: 42.30%</td>
<td>Count: 74, %: 44.60%</td>
<td>167</td>
<td>129, %: 58.60%</td>
<td>106, %: 63.90%</td>
<td>235, %: 60.90%</td>
</tr>
<tr>
<td>B- Neutral</td>
<td>Count: 79, %: 35.90%</td>
<td>Count: 62, %: 37.30%</td>
<td>141</td>
<td>52, %: 23.60%</td>
<td>31, %: 18.70%</td>
<td>83, %: 21.50%</td>
</tr>
<tr>
<td>C- Disagree</td>
<td>Count: 43, %: 19.50%</td>
<td>Count: 30, %: 18.10%</td>
<td>73</td>
<td>21, %: 9.50%</td>
<td>14, %: 8.40%</td>
<td>35, %: 9.10%</td>
</tr>
<tr>
<td>D- Do not know</td>
<td>Count: 5, %: 2.30%</td>
<td>Count: 0, %: 0.00%</td>
<td>5</td>
<td>18, %: 8.20%</td>
<td>15, %: 9.00%</td>
<td>33, %: 8.50%</td>
</tr>
<tr>
<td>Total</td>
<td>Count: 220, %: 100.00%</td>
<td>Count: 166, %: 100.00%</td>
<td>386</td>
<td>220, %: 100.00%</td>
<td>166, %: 100.00%</td>
<td>386, %: 100.00%</td>
</tr>
</tbody>
</table>

Figure 15: Responses to the statement, “I would like to join a scientific specialty in the university” (n = 386).

Figure 16: Art in Science exhibit in the gallery of the cultural village.
Conclusion

This research study focused on using photography to inspire students and to help them to visualize the beauty of science. Students successfully completed STEAM activities and used ambiance, instruments, and content to create curiosity-inducing photographs, which led to increased agreement about the ability of photographs to foster students’ awareness of the beauty of science, with 80% of students supporting this statement in the post-workshop questionnaire. Next, 816 photos were judged by an expert panel, who identified 44 photos that were exhibited in a public gallery. The exhibition projected the findings of our research and generated fruitful discussions among the student photographers and the community. We believe that curiosity radiated from the students to the community, hopefully inspiring others to investigate scientific subjects. In addition, the students showed higher satisfaction in the program as they gained understanding, analysis, and evaluation skills. This study could be extended in the future to address improvements in learning following art in science workshops.

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