



IDEALOGY

JOURNAL



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An Investigation into Safe Printmaking Methods. With Etching Without Acid, for Art & Design for Higher Education Institutions in Pakistan

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ABSTRACT

The purpose of this research was to explore healthy, environmentally friendly, effective, and economical alternatives to traditional acid-base printmaking practices. The research took place in Pakistan, where chemicals and acids are widely used for printmaking in Art & Design higher education institutions as well as in artist's workshops. These approaches pose serious health and safety issues for teachers, students, and practitioners alike as well as causing environmental damage. However, no research on safer alternatives had been previously carried out in the country. The investigation filled this gap using a mixed-methods research design: a practice-led project focused on the design, development, and testing of an electro-etching machine made entirely from economical and locally available components; the opinions and ideas of experts and practitioners were gauged through questionnaires and structured interviews; and, finally, the technical and aesthetic qualities and possibilities of the proposed machine were tested and evaluated through a print workshop involving students, professors, and print artists. The research found that the proposed method met the inquiry's main objectives, namely: to produce high-quality artistic prints using a safe and economical alternative to acid. The researchers conclude by arguing that the research has the potential to move educational and artistic practices in Pakistan away from unhealthy and damaging methods and towards safe and sustainable forms of print production.

Keywords: Printing acid-free, Health and Safety, Electro etching, Sustainability



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1. INTRODUCTION & BACKGROUND TO THE PROJECT

This research investigated and evaluated healthy, environmentally friendly, effective, and economically viable alternatives to traditional acid-based and toxic printmaking practices in Higher Education. According to University (2003) guidelines “A toxic substance is a poison that can damage your body's organ systems when you are overexposed to it. Some substances are so toxic that just one exposure to a tiny quantity can produce harmful effects.” Many art institutions worldwide have adopted safe printing techniques and opted to use safer etching methods. For example, Groce (2016) “reports on developments in the USA: “The big news on this end is that the new University of Maine Print Studio dedicated to safer printmaking is up and running beautifully – we're thrilled! We're set up for Acrylic Resist Etching, Photopolymer Films, Water Based Screen (photo and handwork), Polyester Plate Litho, Relief, Letter Press, Monoprinting, Collagraph, Digital applications, etc. And we're also making use of

the IMRC [Innovative Media Research and Commercialization] labs next door – laser cutters and CNC (wood and metal)”.

This inquiry was conducted in Pakistan, a country where chemicals and acids are still used widely for printmaking both in Art & Design institutions as well as in artist's workshops. The use of these methods poses serious health and safety risks to students, teachers, and practitioners, as well as causing environmental damage. Despite this, however, no research has previously been conducted in the country that would suggest or argue for the need to introduce safer alternatives. As a result, students, faculty, and technicians working in Pakistani print studios and classrooms are adversely affected by the toxic environment created by printmaking materials and processes and suffer from a range of potential health problems.



Figure 1: Common side effects of toxic materials
(Source: First Author)

For example, the first author is a printmaker and has been involved in the field of printmaking for sixteen years. The researcher exhibits at national and international art fairs and teaches printmaking graduates as well as participating in domestic and international printmaking workshops. Chemicals used in traditional printmaking affected the researcher's health. In June 2017, the researcher suffered breathing difficulties, burning eyes, and skin allergies from acid etchings. Despite this, the researcher was not able to protect himself as the current curriculum requires the use of traditional printing methods. Likewise, the researcher observed health issues that have arisen after students used traditional toxic mediums to make etchings in educational institutions aiming to specialize in this field. Whilst existing safety measures such as the use of goggles, gloves, and protective aprons mitigate the effects to some degree, they are ineffective in the face of prolonged exposure.

The aim of this research was to address this problem by investigating alternative printing technologies, materials and processes suitable for use in Pakistani higher education institutions. In particular, the inquiry explored the potential of a new hybrid/modified method of printmaking (Electro Etching) through research, analysis, and experimentation. The project is the first initiative in Pakistan to research, develop and test safe, healthy and sustainable printing methods for students, educators, and artists. It is hoped that the outcomes of the research will make a significant contribution to the understanding and practice of safe printing in education and practice in Pakistan.

2. LITERATURE REVIEW

Print art is traditionally made using a variety of chemicals and acids. However, as noted above, the use of these substances is unsafe for students, artists, and professionals. For example, nitric acid is widely used in print studios as part of the etching process yet according to the Centre for Safety in the Arts “concentrated nitric acid is a strong oxidizing agent and can react explosively with other concentrated acids, solvents, etc. Nitric acid gives off various nitrogen oxide gases, including nitrogen dioxide which is a strong lung irritant [though odourless] and can cause emphysema. Large acute overexposures may cause pulmonary edema (chemical pneumonia), and chronic exposure may cause emphysema. During the etching process, flammable hydrogen gas is also produced.” Along with these health issues a number of researchers also point to the environmental problems caused by toxic print materials. Ademeyer and Özsoy (2020), for example, discuss the negative ecological effects of a variety of printing materials. However, as Jemai et al (2021) note, “In general, organic solvents are one of the most underrated hazards in art materials. Organic solvents are used in printmaking to dissolve and mix with oils, resins, varnishes, and inks, and to clean plates, rollers, tools, and even hands.” As a result, the researcher’s inquiry focuses in particular on solvents.

In the late 1990s, a number of researchers and practitioners began to question the health and ecological problems associated with fine art printing. According to Pengelly (1997), for example, “There is generally a recognition that safe handling and good work practices are a key to minimizing the risks associated with known hazardous materials” and that, “an increasing awareness of health and safety issues has consequently called into question the appropriateness of many printmaking materials and methods currently in use in practice.” However, Pengelly (1997) also notes that “The researcher would suggest that the onus for change must therefore ultimately rest with the individual, at a personal level but based on an increasingly informed understanding of the risks and hazards which link current legislation to their own creative process, in order to establish one's own 'reasonably practicable' practice.” This suggests that whilst practicing printmaking in a studio with traditional hazards, it is crucial to address health and safety issues whilst taking into account local needs and constraints.

In higher education institutions of art and design in Pakistan, traditional printmaking methods are still used and there is no research available into safer alternatives for the country. So, whilst it is clear that unhealthy materials and processes should be replaced with safe alternatives, the question remains which of these are practicable in the Pakistani context? Widely used alternative methods like photopolymer and solar plates are effective but expensive and rely on supplies delivered from overseas. The literature review suggested that electro-etching might offer an economical, sustainable, healthier, and safer alternative. According to Alfonso & Noone (2018), for example, “Electro-etching [...] is an electrical etching technique that can be practiced conveniently and safely at home without the need for expensive equipment or the use of harmful acids.” Moreover, as Green (2013) noted, “The greatest advantage of electro-etching etching is that with the same equipment, plates can be either bitten down or built up to give a much wider variety of results and that qualities of tone and texture can be produced that are not possible with other methods of etching.”

The literature did point to some potential problems associated with the method. For example, Alfonso & Noone (2018), noted that “The fact that it does not use resin dust or asphalt dust limits the possibility of achieving a flat, even tone of different intensities as with traditional aquatint, which we have used for several centuries.” The researcher noted these disadvantages as challenges to be addressed through practice and experimentation with electro-etching.

3. METHODOLOGY

The research topic formed a complex problem that combined health, environmental, economic, technological, and aesthetic dimensions. As a result, the researcher adopted a research design that combined various methods that would enable these issues to be addressed individually and as a whole (see Figure 2, below). At the heart of the research design was a practice-led approach to inquiry.

According to Candy (2006), practice-led research occurs more commonly in programs of the arts in higher education, where practice-based research is conceived in order to answer specific research questions. Such a research method is considered capable of inquiring in an imaginative and insightful manner. “Is concerned with the nature of practice and leads to new knowledge that has operational significance for that practice.” In this inquiry, the practice of printmaking was, therefore, both the subject of and a major method in the inquiry, and the knowledge produced was intended to contribute to the development of printmaking in Pakistan. This meant that the researcher’s own printmaking practice and those of other experienced and novice printmakers were used to test the processes and outcomes that the researcher proposed and developed in response to other methods.

The research design consisted of three main areas of inquiry. Firstly, expert interviews about health and safety issues in regard to printmaking. Secondly the design and production and testing of a non-hazardous printing apparatus (electro-etching machine). Thirdly, the exploration of the creative possibilities of this apparatus through a creative workshop. In this section, I will discuss each of these methods in turn.

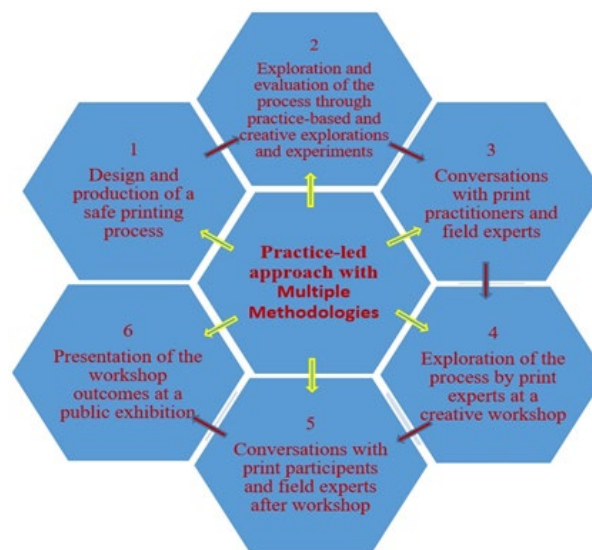


Figure 2: Practice-Led Approach with Multiple Methodologies

3.1 Expert Interviews

The researcher carried out semi-structured interviews online with three leading Pakistani printmaking practitioners and educators. The interviews explored health and safety issues associated with traditional printmaking methods. Firstly, the researcher wished to gauge the current state of knowledge about the health and environmental hazards posed by traditional printing methods. Secondly, the researcher wanted to find out the state of knowledge about alternative safe printing technologies and processes. And, thirdly, the researcher wanted to generate interest in his research by connecting with opinion formers in the discipline.

According to Pathak & Intratat (2012) “semi-structured interviews are used when the research would benefit from a fairly open framework. They are also used when more useful information can be obtained from focused yet conversational two-way communication with the participants.” Semi-structured interviews are a flexible and reliable way to conduct conversational research. Unlike structured interviews that use fixed questions, semi-structured interviews are more open and enable ideas and issues that are raised by the participants to be recognized and explored further. The researcher felt that this approach was important because this method provides more useful data when the sample size is relatively small. In addition, it allows for thematic analysis of qualitative data. Interviews took place online using Zoom, the reason for this was due to covid situation the researcher was unable to meet experts face to face. Interviews lasted for one hour and data was captured using an audio recorder. All

participants were fully informed about the nature of the research and were offered the opportunity to be anonymized in any final publications.

Recorded data were transcribed, typed, and printed out. The researcher analysed the data in the following way: Firstly, data from the expert interviews were transcribed carefully using MS Word, after that it was categorized into three major themes and several codes were generated manually. The process included highlighting the keywords in the transcribed data. Secondly, all the selected data through the above-mentioned process were analysed to answer the research questions.

3.2 Design, Production, and Testing of The Electro Etching Machine

In order to assess the feasibility of safe printing methods in Pakistan the researcher needed to be able to test the technical and aesthetic possibilities of non-toxic printing processes. Based on the information identified in the Literature Review, the researcher hypothesized that the most appropriate safe printing method for the Pakistani context was electro-etching. Essentially, electric etching is a hybrid etching method that uses an electric current in conjunction with electrolyte water for etching onto a variety of plates. This method is not only safe and healthy, but it is also environmentally friendly and cost-effective. Unlike alternatives such as solar plate and photopolymer printing, this method does not require the use of expensive imported material but is possible with locally sourced and relatively cheap components.

The researcher's electro-etching unit is a modified version of existing approaches (see, for example, (Alexander, 2008)). The system is made up of a number of the readily available components shown in Figure. 3. After the system was designed, the researcher scoured local markets to identify candidate components. The researcher selected zinc plates for etching as these are readily available on the local market and cheaper than alternatives. In terms of method, it was decided to examine the electro-etching machine using the intaglio technique of line etching. Line etching is the basic technique of intaglio printmaking and can be investigated by focusing on the line quality of the etching. The plate making process involved the following steps:

- 1) An etching test was done on a plate that was 3 x 6.5 inches in size.
- 2) An anode metal strip was connected to a matrix, and the reverse side and anode strip were covered with plastic stickers. A steel needle was used to transfer the line drawings onto the front side of the matrix with single and crossed lines. The front side of the matrix was covered with stopping-out varnish.
- 3) The researcher measured the current and voltage using a DC power supply. The voltage was measured in volts (V) and the current was measured in amperes (amps). The first test was started with 1.0 V and 1.5 amperes.
- 4) The interval (bath) timing was set for 30 minutes for the first test.
- 5) The matrix was positioned six centimetres away from the cathode grid in the vertically oriented PVC tank already filled with an electrolyte solution.
- 6) The matrix anode strip was connected to the (+) anode crocodile clip, and the cathode grid was connected to the (-) cathode crocodile clip.
- 7) Both negative and positive current cables were connected to the DC power supply
- 8) The interval of time for biting was set for 30 minutes for the etching experiment.
- 9) After 30 minutes, the researcher verified that the test had been successful, and the matrix had been etched.
- 10) The results of this experiment were evaluated and modifications to variables in the above process were adjusted accordingly.

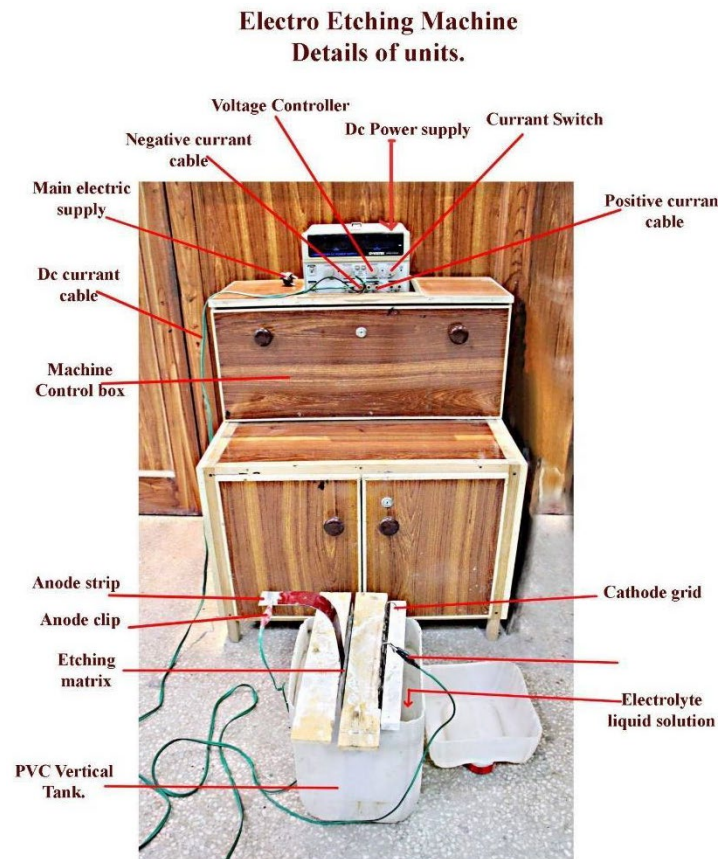


Figure 3: The researcher's Electro Etching Machine

During this stage of the inquiry, the researcher tested the technical components and aesthetic possibilities of the unit by producing a series of experimental prints using plates made using the unit. In terms of the former, the researcher examined the efficiency and safety of the unit. In terms of the latter, the researcher carried out five etching experiments that aimed to discover if the machine was capable of producing the range of formal properties required for fine art printing, for example, areas of flat solid colour, fine lines, subtle gradients, and so on.

Figure 4, for example, shows the outcomes of visual experiments that explored line quality and texture. The researcher conducted a detailed analysis of the results of these experiments and sought comment on and verification of the quality of the prints from subject experts. With the results of these experiments in mind, the researcher conducted experiments using a range of common printing techniques such as open bite, soft ground, and bubble drop (see Figure 5). Again, the researcher analysed the results of these experiments and sought professional feedback from others. Throughout this period the researcher made minor modifications to the system in response to these experiments and suggestions from peers.

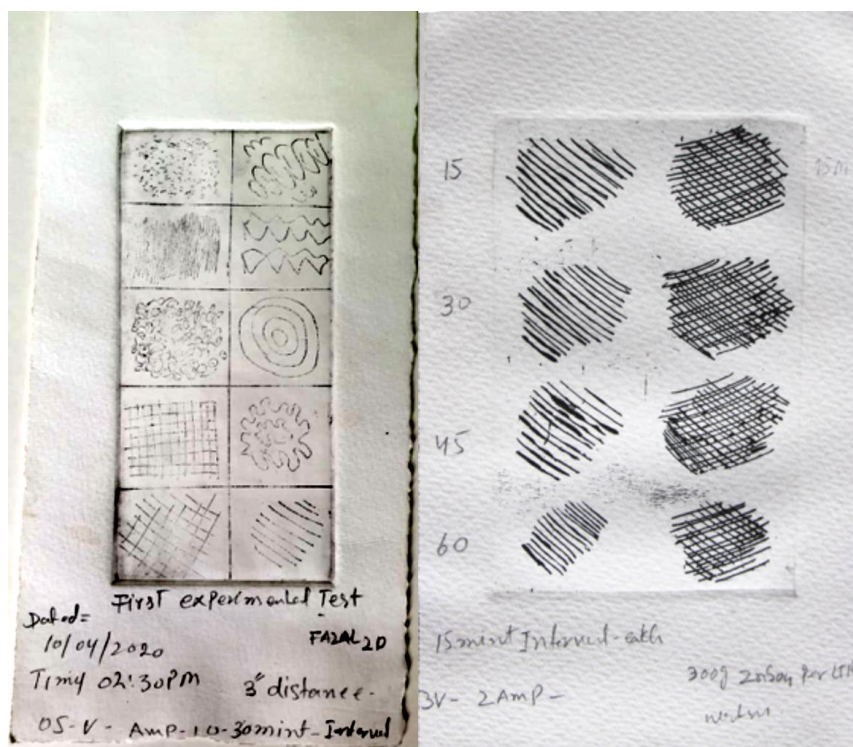


Figure 4: Visual Experiment to Test Print Quality



Figure 5: Visual Experiment to Test Print Quality

3.3 CREATIVE WORKSHOP

The researcher designed a ten-day workshop to explore the creative and aesthetic possibilities for the electro-etching machine (see Figure 6). The workshop took place at Shaheed Allah Buksh Soomro University of Art, Design and Heritages in Jamshoro, Sindh province. Ten printers from various locations in Pakistan took part in this workshop – three renowned artists/ experts, three university professors, and four print students.



Figure 6: Creative Workshop: Explaining the Process

The workshop consisted of an introduction to and demonstration of the electro-etching process. This was followed by daily creative activities in which participants created print responses to creative prompts from the workshop leader. Each participant was invited to create and print images using A4 zinc plates using intaglio techniques. These prompts encouraged participants to produce works that tested the aesthetic potential of the machine by, for example, printing fine lines, complex textures, and flat blocks of ink. After the workshop was complete, the researcher gathered further data from the participants by using a simple questionnaire. This method was completed by a public exhibition of the outputs of the workshop.

4. FINDINGS

Overall, the research demonstrates that moving away from traditional arts printing methods and towards safer alternatives in Pakistan is necessary and feasible. Moreover, the results of the researcher's own experiments with electro-etching and those of workshop participants, show that such a move can be achieved without sacrificing the aesthetic qualities associated with traditional methods. In this section, I will discuss how the major findings from each phase of the research support this claim.

4.1 Expert Interviews

The researcher found that most respondents were aware of health & safety concerns regarding chemicals and their effect on health, but they were not aware of safe alternatives to traditional printing. According to Interviewee 3, for example, "I have been involved with printmaking for fifteen years". I work in my studio and teach students of printmaking and like other printmakers have problems using chemicals and acids, the same issues and problems that I have faced during studio practice are due to lack of opportunities in Pakistan". Interviewee 1 reiterated this point: "But despite all our efforts in Pakistan, we have not yet been able to take any significant steps for health and safety, which poses an alarming threat to artists, especially printmakers' health in Pakistan". For one participant – Interviewee 2, the health issues associated with the traditional print studio had led them to avoid the practice altogether: "I have stopped using traditional methods of printmaking. For health reasons I could not work with more chemicals, so today I use digital technology to create my artwork."

In general, there was a positive response to the researcher's work in addressing health and safety issues in the printmakers' studio. For example, Interviewee 2, was clear about the potential value of the research: "It is good that after a long time, I have seen that an artist is researching safe studio practice in the field of art and design especially, for safe printmaking studio practice. As a printmaker and teacher, I am happy to see this research in Pakistan and believe it can [...] play a significant role in securing the health of printmakers in Pakistan and beyond,"

Overall, the expert interviews demonstrated that serious concerns about traditional printing materials and methods already exist amongst leading artists and teachers in Pakistan. In other words, the field is ready to explore alternatives to toxic materials and processes. Likewise, the interviewees expressed strong support for the research project and its potential to provide an alternative approach that would fit local needs.

4.2 Design, Production, and Testing of The Electro Etching Machine

Through the construction and testing of the electro-etching machine, the researcher demonstrated a safe and environmentally friendly alternative to traditional acid-based printmaking is feasible. The new methods do not require any chemicals or solvents for the etching process. Based on non-toxic elements such as DC electric current and water-based electrolytes, the approach is totally safe for health and makes a minimum ecological impact. Moreover, the development and realization of a design that relied on economical and locally sourced materials, demonstrated that such an approach is suitable for the Pakistani context. As a result, the researcher argues that two of the major aims of this project has been met. This stage of the research also suggested strongly that the third aim of this inquiry – the production of prints of a high technical and aesthetic quality – was also feasible. Comparisons between traditional methods and electro-etching demonstrated that quality prints could be produced using the researcher’s electro-etching system (see Figures 7 and 8). With these results in mind, the researcher was able to test findings of the technical and aesthetic potential of the proposed system through the Creative Workshop.

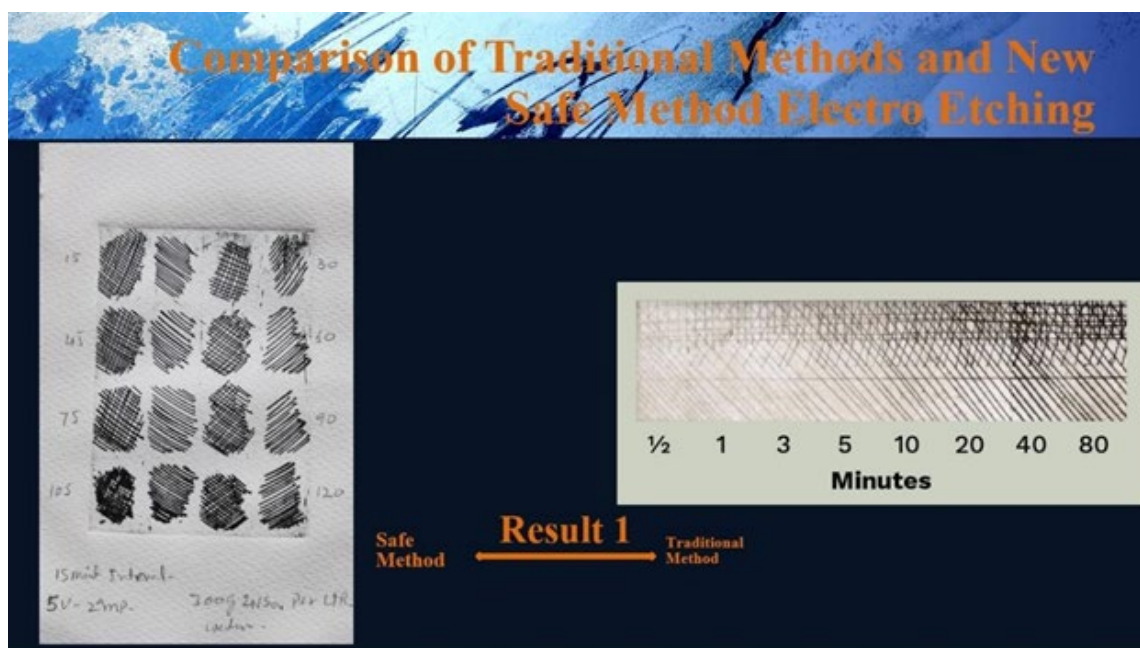


Figure 7: Comparison Traditional Methods Line Etching Result with Electro Etching



Figure 8: Comparison Traditional Methods Soft Ground Result with Electro Etching

4.3 Creative Workshop

The Creative workshop provided the researcher with the opportunity to test the aesthetic potential of the innovative method of electro-etching. Overall, this workshop demonstrated that the method was capable of producing high-quality print outcomes that met the aesthetic needs of the printmaking community. During the workshop, the researcher analysed these outcomes with the help of experts, teachers, and students participating in the workshop. Once the workshop was complete, the researcher gave participants a further opportunity to comment on their experiences using the process and, therefore, contribute to the inquiry. Respondents largely agreed that the electro etching method can replace acids in Pakistani printmaking studios. Respondent 3, noted, “I have learned a different process of etching without acid.” Respondent 4, also described how he had learned “new mediums and techniques so I could now do my work safely at home.” Respondent 5’s contribution was even clearer: “Yes, this electro-etching method can replace the role of acid in the printmaking studio practice, and I say this as a printmaker that uses traditional acid-based methods which are so damaging to our health. So, electro etching is a unique alternative to acid and can be adopted [...] to save our lives and the environment.”

In terms of print quality, there was a general agreement that the new method delivered results that were as good as or, in some cases better than, traditional methods. For example, Respondent 5, argued that “The line quality of line etching is unique as compared to acid-base etching and the soft ground technique results more than meets expectations of print quality standards.” She continued, “As a printmaker, I prefer electro etching for my practice with a safe environment.” Respondent 9, agreed, suggesting that “The quality achieved by electro-etching is almost the same as achieved through traditional printmaking.” However, the workshop did reveal a number of concerns for the participants. For example, a number of respondents commented that the electro-etching process was somewhat slower than traditional methods. Respondent 9, for example, noted that the process was “a little more time consuming than etching using acids that act very fast but are health hazardous.” This issue will be discussed briefly in the conclusion.

5. CONCLUSION AND SUGGESTIONS FOR FURTHER DEVELOPMENTS

In conclusion, the research demonstrates that the proposed electro-etching system enables a safe, environmentally friendly, economical printmaking method that also provides a high level of aesthetics in prints. Given that the proposed system is constructed entirely from easily available, locally sourced, and relatively inexpensive materials, the system has the potential to make a significant contribution to the development of the field of healthy printmaking in Pakistan and other similar countries. The researcher proposes to build upon the success of the inquiry so far in a number of ways. Firstly, by addressing concerns raised by workshop participants, for example, the speed of the process compared to traditional methods by consolidating and improving the performance of the machine. Secondly, by using the results of this research to demonstrate that safe alternative to traditional methods is not only possible but essential. Fears that loss of tradition might somewhere harm creative approaches to printmaking are addressed by Sabour (2017), who argues that “non-toxic printing methods have opened the door wide for the imagination of the contemporary artist.”

CONFLICT OF INTEREST

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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