



Citation: Basset, C.A., Spatola, G.F., Uzzo, M.L., Jurjus, A.R., & Leone, A. (2024). Evaluating the effectiveness of drawing as a pedagogical tool in teaching histology and human anatomy to dental and allied health sciences: a three-year observational study. *Italian Journal of Anatomy and Embryology* 128(1):93-99. doi:10.36253/ijae-15212

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Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

Evaluating the effectiveness of drawing as a pedagogical tool in teaching histology and human anatomy to dental and allied health sciences: a three-year observational study

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Abstract. Anatomical sciences are visual sciences that deal with the structure at gross and microscopic levels. Throughout history, drawing has served as a prominent tool for learning and teaching anatomical sciences, tracing back to notable figures such as Claudius Galen, Andreas Vesalius, Leonardo Da Vinci, and Henry Vandyke Carter's illustrations in Gray's Anatomy among others. In this observational pilot study spanning over three years, we investigated the efficacy of utilizing drawing as a pedagogical tool for learning histology and human anatomy. This study involved 201 participants comprising dental, and allied health sciences. Pre- and post-activity surveys were administered to assess students' perceptions and attitudes towards incorporating drawing as an adjunctive method for teaching and learning structural sciences, particularly histology and anatomy. Analysis of the survey data revealed a significant level of appreciation and interest in the drawing approach, with 80% of participants expressing a positive inclination towards its future integration into educational practices. The significance of drawing as a pedagogical approach for anatomical sciences, drawing upon insights from previous research and observations gleaned from our surveys. In conclusion, on this basis we recommend further development and implementation of drawing-based teaching methodologies in future educational contexts.

Keywords: teaching, anatomy, histology, drawing.

PREAMBLE

This study was conducted under the guidance of Professor Abdo Jurjus, Professor of Anatomical Sciences at the American University of Beirut. Professor Jurjus emerged as one of the pioneering anatomists within Mediterranean universities to recognize the existing challenges in the teaching of morphological sciences. He advocated for a critical review of teaching methodol-

ogies, particularly given the prevalent absence of practical exercises in histology laboratories and gross anatomy classrooms in many universities. For more than four decades, Professor Jurjus initiated an innovative, interactive approach to teaching within his anatomy courses to medical and paramedical students at the American University of Beirut. Given his expertise and innovative teaching methods, our research group deemed Professor Jurjus as the most suitable individual to provide guidance and mentorship for our study in this domain.

INTRODUCTION

Over the centuries, the integration of art into scientific disciplines has demonstrated its significance as a valuable educational tool for teaching and learning morphological sciences, particularly visual sciences like anatomy and histology. Despite its deeply rooted historical utilization within medical education for the study of the human body and its structures, the role of drawing art has somewhat diminished in modern dental and medical curricula (Goetz, 1991). This oversight is notable, especially within fields like dentistry, “Art Dentaire” as used to where students engage in cosmetic procedures that demand acute observation of intricate details. Dentists rely heavily on manual dexterity, color and pattern recognition, and visual acuity to discern clinical examination findings, establish diagnoses, and execute aesthetically pleasing dental restorations. Research suggests that exposure to fine art not only fosters clinicians’ intellectual curiosity and critical thinking but also enhances diagnostic skills and cultivates empathy towards patients (Katz & Khoshbin, 2014; Schaff, Isken & Tager, 2011; Shapiro, Rucker & Beck, 2006). Concurrently, amidst the rapid advancements in information technology, visual art has been proposed as an effective pedagogical tool for learning sciences, particularly in the realm of structural and anatomical sciences such as histology and anatomy (Elmongi, 2019). The impact of visual aids, including pictures, on learning and knowledge retention has been the subject of numerous previous research endeavors, consistently demonstrating positive outcomes when pictorial elements are incorporated into relevant teaching materials (Alesandrini, 1981; Alesandrini, 1984; Larkin & Simon, 1987; Vorstenbosch et al., 2013). The cognitive processes underlying the beneficial effects of images and audiovisual strategies on text comprehension have been explored extensively. Glenberg and Langston (1992) conducted a series of experiments to assess these effects, revealing that pictures facilitate the construction of mental models by learners, thereby improving the retention of learned material (Balemans et

al., 2016). Further investigations into this phenomenon led Mayer and Anderson (1991) to propose the integrated dual-code hypothesis, positing that learners construct both visual and verbal mental models and establish connections between them. In this study, we present a pilot observational investigation into the utilization of drawing as an educational tool for learning human anatomy and histology among dental and allied health sciences students. Our aim is to assess students’ perceptions and attitudes towards this approach and to explore its potential for future development and reintegration into histology and anatomy teaching strategies.

MATERIALS AND METHODS

One hundred ninety-nine first-year students, 25 on the first year, 80 on the second year and 94 on the third year enrolled in the School of Medicine at the University of Palermo in Italy, comprising students from the following fields: dental, dietitian, neurophysiopathologists technicians, and prevention technicians in the workplace. Students voluntarily participated in this study, they were concurrently attending the Human Anatomy and Histology module as part of their curriculum. The module, inclusive of Human Anatomy, Histology, Cytology, and Embryology, constitutes an integral component of the first-year dental curriculum and is mandatory for progression to oral examination assessments. The Human Anatomy module encompasses the study of various systems, while the Histology module encompasses units such as General Histology and Cytology. Participants were invited to partake in this observational pilot study during designated free learning hours. They were requested to bring their preferred drawing materials, including paper and pencils.

During the study, students were tasked to draw a histological or anatomical structure of their choosing, focusing on cellular structural elements such as organelles, tissues, or organs. The activity spanned over a duration of three hours, during which participants were granted complete autonomy in selecting their preferred drawing style and techniques. Notably, the workshop was conducted subsequent to the delivery of the Anatomy and Histology (Cytology) content, assuming an optimal level of familiarity with cytological structures among participants.

Upon completion of the workshop, all drawings were collected for further analysis, as depicted in Figures 1 to 9.

Pre-activity and a post-activity survey were conducted among the participants. In the pre-activity survey 3 questions were asked. These questions covered the

(1) willingness to participate and explore new learning methods, (2) could drawing interest you as a new learning tool to study histology, cytology, and gross anatomy, (3) whether the participant already had experiences where drawing was used to learn science topics.

Similarly, 3 questions were asked in the post-activity survey. They covered (1) the interest in this artistic experience, (2) usefulness of the workshop to learn histology, cytology, and gross anatomy, and lastly (3) if art should be integrated in such learning.

RESULTS

Observation and Reflection on Conducted Surveys:

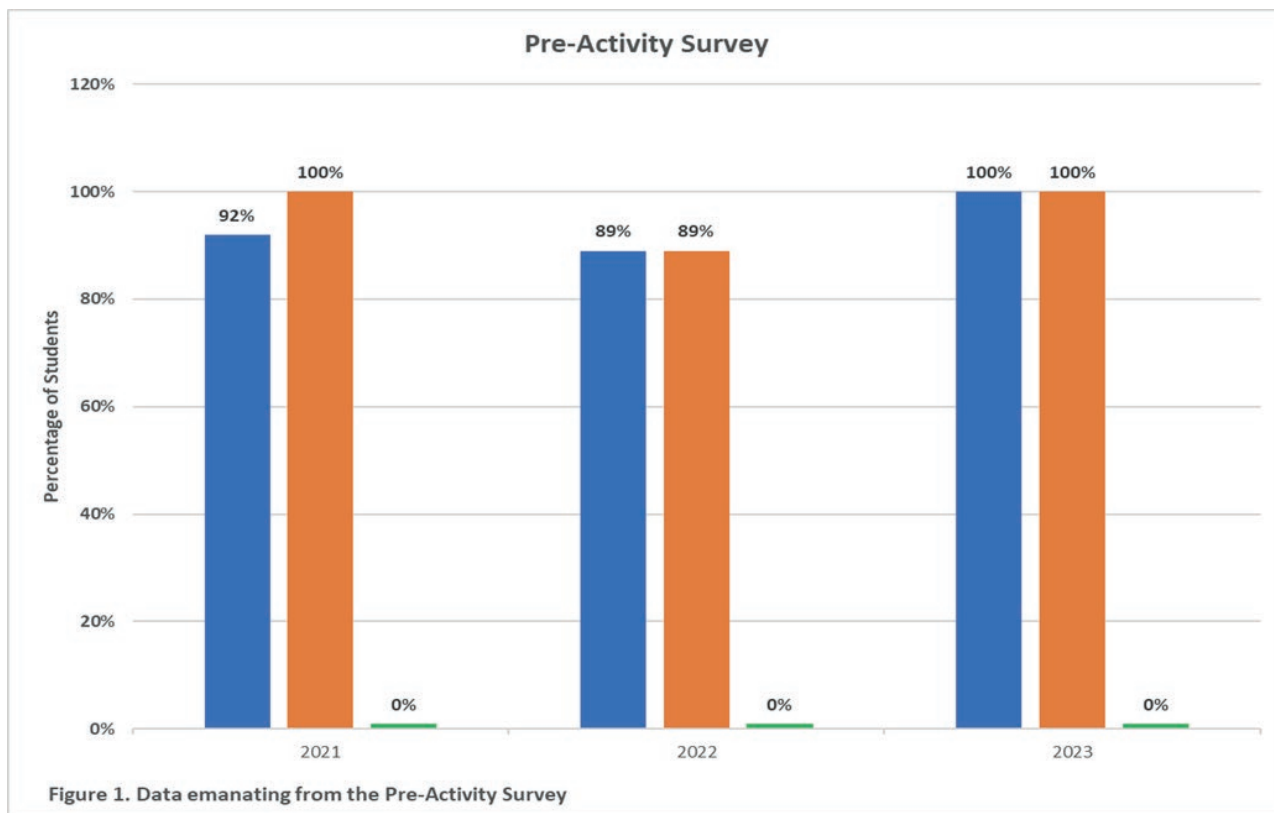
A total of 199 students actively participated in the workshop, contributing their artwork, and diligently responded to both pre- and post-workshop surveys. Surveys were conducted anonymously to safeguard participant privacy, and no personally identifiable information

was collected. The pre-workshop survey aimed to assess students' perspectives and interest in utilizing drawing as a learning tool, as well as their prior exposure to this instructional method.

Conversely, the post-workshop survey aimed to evaluate students' appreciation of the artistic activity, their perception of its effectiveness in enhancing histology learning, and their likelihood of recommending such activities as an integrated component of gross anatomy and histology teaching.

A summary of students' responses to the pertinent survey questions is provided in Table 1.

Figure 1 shows data from the pre-activity survey over 3 years in response to the 3 questions: (1) willing to explore the new learning method, (2) expressing interest in the learning tools for anatomical sciences, and (3) if the student had experiences using artistic drawings to learn science. In the year 2021, 92% of the students were willing to participate in the survey and explore new learning methods, and 100% were inter-



- Question 1: Would you be willing to participate in and explore new learning methods?
- Question 2: Could drawing interest you as a new learning tool to study histology, cytology, and gross anatomy?
- Question 3: Have you already had experiences where artistic drawing was used to learn science topics?

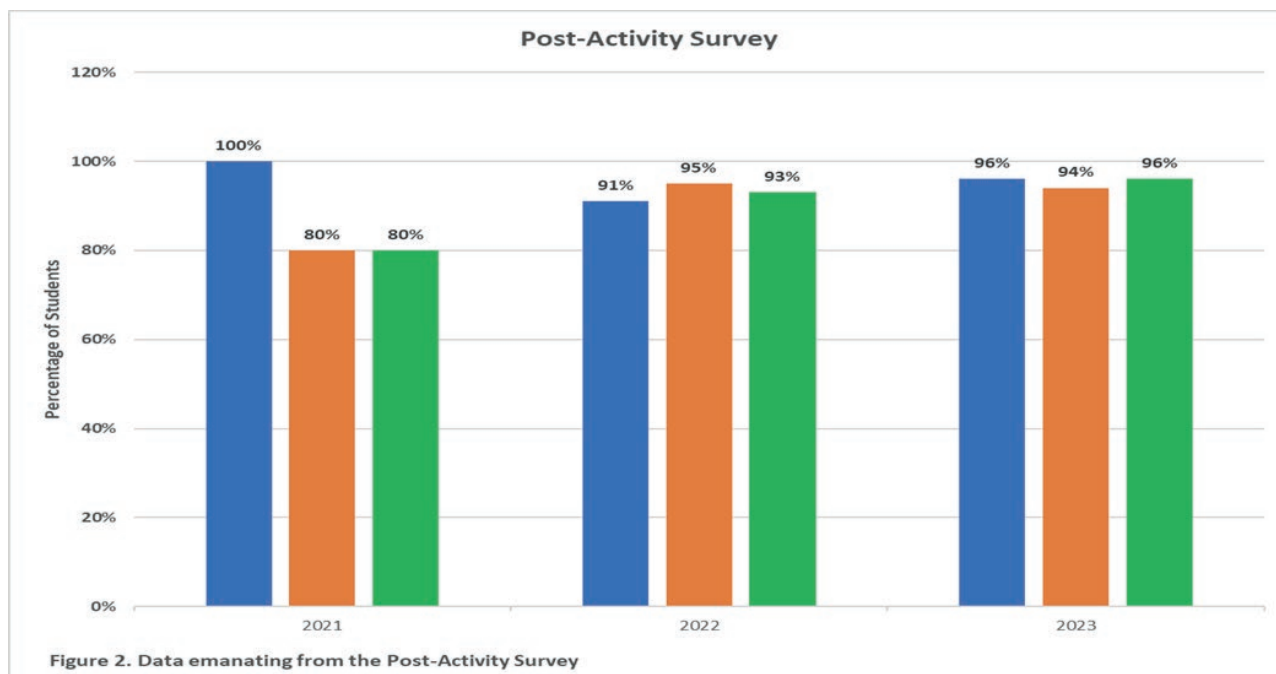
Figure 1.

Table 1. Summary of the data collected over 3 years.

Pre-activity survey questions	Post-activity survey questions
First Study 2021	
Would you be willing to participate in and explore new learning methods? Yes: 23/25 (92%) No: 02/25 (8%)	Did you find the artistic experience interesting? Yes: 25/25 (100%) No: 00/25 (0%)
Could drawing interest you as a new learning tool to study histology/cytology and gross anatomy? Yes: 25/25 (100%) No: 00/25 (0%)	Was the organised drawing workshop useful to learn histology/cytology and gross anatomy? Yes: 20/25 (80%) No: 05/25 (20%)
Have you already had experiences where artistic drawing was used to learn science topics? Yes: 0/25 (0%) No: 25/25 (100%)	Should art be integrated as a tool for histology/cytology learning? Yes: 20/25 (80%) No: 05/25 (20%)
Second Study 2022	
Would you be willing to participate in and explore new learning methods? Yes: 71/80 (88,75%) No: 09/80 (11.25%)	Did you find the artistic experience interesting? Yes: 73/80 (91.28%) No: 07/80 (08,72%)
Could drawing interest you as a new learning tool to study histology/cytology and gross anatomy? Yes: 71/80 (88,75%) No: 09/80 (11.25%)	Was the organised drawing workshop useful to learn histology/cytology and gross anatomy? Yes: 76/80 (95%) No: 4/80 (05%)
Have you already had experiences where artistic drawing was used to learn science topics? Yes: 0/80 (0%) No: 80/80 (100%)	Should art be integrated as a tool for histology/cytology learning? Yes: 74/80 (92,50%) No: 6/80 (07,50%)
Third Study 2023	
Would you be willing to participate in and explore new learning methods? Yes: 94/94 (100%) No: 0/94 (00%)	Did you find the artistic experience interesting? Yes: 90/94 (95,74%) No: 04/94 (04,25%)
Could drawing interest you as a new learning tool to study histology/cytology and gross anatomy? Yes: 94/94 (100%) No: 0/94 (00%)	Was the organised drawing workshop useful to learn histology/cytology gross anatomy? Yes: 88/94 (93,61%) No: 06/94 (06,38%)
Have you already had experiences where artistic drawing was used to learn science topics? Yes: 00/94 (00%) No: 94/94 (100%)	Should art be integrated as a tool for histology/cytology learning? Yes: 90/94 (95,74%) No: 04/94 (04,25%)

ested in drawing as a new tool to learn, however none of them has had any previous experience in drawing as a tool for learning science topics. In the year 2022, 89% were willing to explore this new method of learning, and the same percentage also were interested in this

new learning tool, again none of them had prior experience to artistic drawing as a learning tool. This percentage increased in the year 2023 in which 100% were willing to participate and explore the use of artistic drawings as a new learning tool for scientific topics, although



- Question 1: Did you find the artistic experience interesting?
- Question 2: Was the organized drawing workshop useful to learn histology, cytology, and gross anatomy?
- Question 3: Should art be integrated as a tool for histology, cytology learning?

Figure 2.

none of them had previous experience in artistic drawing as a learning tool.

In Summary, practically all the populations in the 3 years were consistently willing and enthusiastic to participate in the new teaching and learning method, from 89% to 100% of students.

On the other hand, in Figure 2 the data showed the response of students to the post-activity questions in the same 3 years 2021, 2022, and 2023. In this survey, all of them (100%) did find that this artistic experience was interesting in the year 2021, while 91% in 2022, and 96% in 2023. In contradistinction, only 80% of the students in the year 2021 found this workshop useful in the learning of histology, cytology, and gross anatomy, and the same percentage (80%), think that art should be integrated as a learning tool for histology, cytology learning. Data in the year 2022 was also close. The results showed that 91% found the artistic experience interesting, while 95% found it useful as a learning tool for histology, cytology, and gross anatomy, and 93% think that art should be integrated as a tool for, histology, cytology and anatomy learning. In the year 2023, the greatest majority, close to 100%, found this experience interesting, 94% found the workshop use-

ful for learning, and 96% think that artistic drawings could be integrated as a learning and teaching tool for anatomical sciences.

In Figure 3, the authors selected 9 representative drawings performed by the students. In brief, the drawings indicated the level of retained knowledge by the students to construct and reproduce the microstructure of subcellular components (1-4), the histological microscopic details of tissues and organs like esophagus (5), skin (6), stomach (7), large intestines (8), and the brain (9)

A closer look at the drawings will enable the instructor to evaluate the effectiveness of the drawings in reflecting the degree of achievements by the students in grasping the learning student outcomes relevant to the course objectives and to the expected competencies to be achieved by the end of the learning sessions. It is believed that the photos convey clearly the message that the students retained optimal knowledge, improved their skills in reproducing the acquired knowledge and in expressing a positive attitude towards this learning approach and teaching strategies.

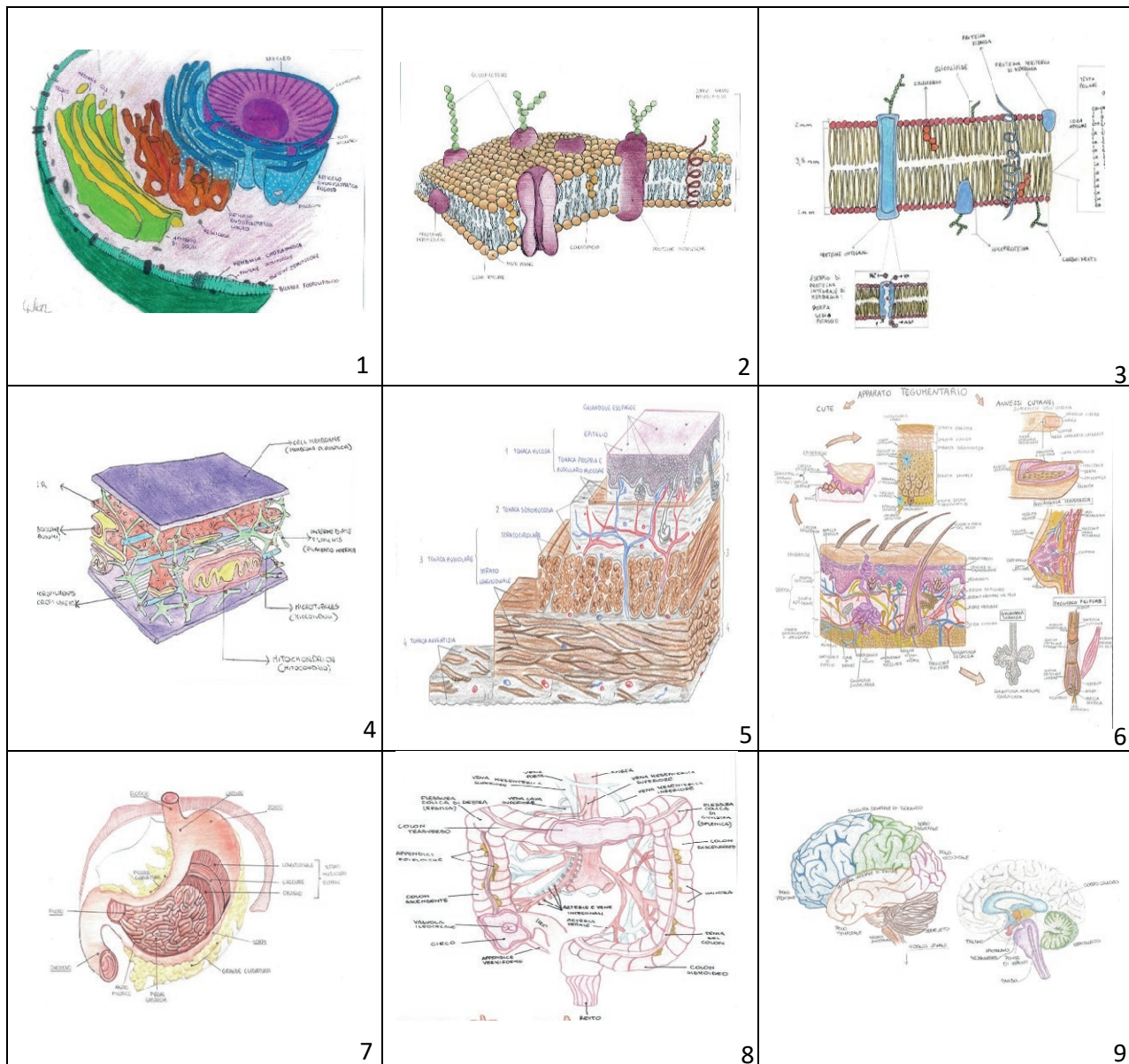


Figure 3. Selected drawings prepared by the targeted students covering Cytology, Histology and Gross Anatomy. The identity of the students were hidden.

DISCUSSION

Data in this study show clearly with a significant agreement from the students over the 3 year period that teaching and learning by drawing could be considered as an optional methodology among our teaching strategies in anatomy despite the booming advances in information technology and the availability and accessibility of students to interactive audiovisual educational programs, teaching and learning by drawing could have a

place as an adjunct teaching resource next to the cadaver, the original source of information.

In multiple occasions, in the dissecting room, students go to the white or black board to make drawings of the region being dissected and make the effort to reproduce and discuss what they discovered in the cadaveric specimens among the team members. Making such drawings constituted an excellent resource to share and discuss among the students in the team, thus promoting interaction, team work, and enhancing profes-

sionalism among colleagues, future medical and paramedical graduates.

For those of us who had their anatomy before the seventies of the last century, in the American and especially in the European curricula, drawings were used and considered as an essential tool to learn anatomy. However, teaching our students human anatomy in the last 50 years has moved away significantly from drawings. The prime movers of such changes were the constraint of time allocated to anatomical sciences and the booming of the audio visual, information technology-based programs.

In conclusion, such preliminary data shed light on the potential positive role of using drawing in our teaching strategies. The use of computers, tablets and even all phones could make such drawings fast, accessible, and more useful as learning and teaching tools.

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