

Retraction

Retracted: Discussion on Teaching Method of Digital Image Processing Technology Based on PBL

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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- [1] L. Chen, "Discussion on Teaching Method of Digital Image Processing Technology Based on PBL," *Wireless Communications and Mobile Computing*, vol. 2021, Article ID 2348258, 8 pages, 2021.

Research Article

Discussion on Teaching Method of Digital Image Processing Technology Based on PBL

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A required course for students majoring in digital media technology, computer science and technology, or artificial intelligence is “digital image processing technology.” Aviation, medical image processing, intelligent manufacturing, and many more fields may benefit from the knowledge and skills gained in this course. It contains the qualities of “many conceptions, numerous principles, and various formulae,” according to the curriculum. As a result, traditional teaching techniques only pay attention to the explanation of theoretical information, which may easily lead students to create uninteresting feelings; they have abandoned the in-depth investigation and learning of the course material. The PBL approach is used to provide an interest-driven and problem-solving-driven grounded teaching technique that naturally connects the theoretical foundation with real-world examples and problems. We utilize case teaching to assist students better comprehend theoretical information and to teach them how to apply theoretical knowledge to actual difficulties they encounter in their lives. During the course of many semesters of practice, we discovered that our teaching approaches are quite popular with students. The deployment of a teaching style focused on problem-based learning has resulted in significant improvements in students’ learning initiative, practical ability, and innovative ability.

1. Introduction

“Digital image processing technology” is a core course for digital media technology, computer science and technology, and artificial intelligence. We analyze and summarize the syllabus and related reference textbooks of the “digital image processing technology” courses of multiple universities. The main knowledge points of the “digital image processing technology” course include the following:

- (1) *Basic Knowledge*. This refers to the basic background, basic concept, and the most advanced technology.
- (2) *The Basic Operation of the Image*. This includes the different file types to read and store images, images of geometric transformation, and image algebraic operations.

- (3) *The Color Mode of the Image*. This includes the conversion of color and gray scale, color and binary conversion, gray and binary conversion, and different color model conversion.
- (4) Image enhancement, image segmentation, image compression, and so on.

The course involves many algorithms and principles. Under the traditional teaching mode, teachers are the leaders of classroom teaching. In classroom teaching, teachers only monotonously explain the theoretical knowledge, which is divorced from the application of students’ life world. Many classroom teaching have these problems: (1) teachers only emphasize the derivation process of the algorithm and ignore the specific application of the algorithm, which makes the algorithm abstract and difficult for students

to understand; (2) teachers only consider the independence of curriculum knowledge but do not consider the coherence and continuity between courses, resulting in students' poor comprehensive application ability of knowledge; (3) teachers only emphasize the authority of teachers [1] and lack of guidance to students, so students do not have a sense of identity, and they are easy to lose learning motivation. If we are purely theoretical teaching, students will easily become bored and lose interest in learning. Even if students master the theory, they still do not know how to apply the theory.

According to several recent teaching study findings, project or case teaching into technical theory instruction may greatly increase students' learning interest, knowledge comprehension, and application skills. Li [2] said that the project-driven case teaching technique may increase students' interest in learning, improve students' capacity to evaluate and solve practical issues, and foster a sense of collaboration awareness in the students who use it. As Yang [3] has pointed out, the project-driven teaching technique may enable students to autonomously investigate and fulfill tasks in learning while engaging them in practical activities. Tong et al. [4] noted that project-based learning (PBL) is a teaching paradigm that is extensively utilized all over the globe, and that it is particularly effective. Students are more easily able to establish the habit of self-inquiry and have the capacity to solve difficulties when this teaching approach is used [5, 6]. Students' interest in learning has grown as a result of the implementation of the "interest + problem-driven" teaching style, according to Song and Wang [7], which has turned the phrase "push me to study" into the phrase "I want to learn." Cheng et al. [8] stated that problem-based learning (PBL) is a modern teaching philosophy and model for the development of learning, innovation, and problem-solving abilities in medical students. According to Peteranetz et al. [9], explicitly linking the information and abilities taught in a course to their applicability in a range of professional situations is a crucial part of maintaining students' motivation in the long run. According to Santos et al. [10], the use of PBL in computer education may increase students' engagement and learning capacity, as well as assist them develop skills such as teamwork, overall vision, critical thinking, and problem-solving. Several researchers, including Song et al. [11], have noted that students who participate in project-based learning obtain greater application experience and abilities. According to Huang et al. [6], the project-driven teaching methodology may increase students' enthusiasm in learning while also allowing them to use their knowledge to address real-world issues via collaboration. It has been pointed out by Calvo et al. [12] that correct implementation of the PBL teaching style might motivate students to study thoroughly [13]. In addition to assisting engineering students in better planning their future careers [14, 15], a curriculum based on the PBL teaching mode may increase students' learning passion and enhance students' capacity to solve issues [16, 17].

In summary, we propose an anchored teaching method of "Problem (or/and case) driven theory, theory guided application" and adopt the theme of multiple stepped practice content and a multidimensional evaluation system to promote students' active learning.

2. The Implementation Process of Teaching

In order to stimulate students' learning initiative, we are based on the PBL teaching model, using questions and cases to guide students to learn actively. The teaching implementation process is shown in Figure 1.

We will use two scenarios in the implementation process of the PBL-based teaching mode: one case and issue will entail the acquisition of new information, and the other case and problem will involve the thorough application of knowledge. We should take a different approach in each of these two situations. With regard to the first scenario, teachers should use cases to guide students through the learning of new technologies, and they should employ a variety of methods to explain in detail the difficulties and key points of new technologies in order to help students deeply comprehend and master new knowledge. In the second scenario, instructors should encourage students to think critically about issues and to use their knowledge to address them.

Based on the PBL teaching style, we split the teaching process into three stages: before class, during class, and after class (or postclass). When the instructor assigns issues to be covered in class, students preview and collect data based on those problems before class; when the teacher assigns problems, students preview and collect data based on those difficulties. Instructors begin class by introducing examples in conjunction with difficulties, guiding students to think, and asking them how to actualize instances. They next present new knowledge points of the course and explain them and ultimately organize the practical materials that correspond to the cases. After class, professors will provide some cutting-edge technological materials that are pertinent to the topic. Students will consolidate the information gained in class via practical material, think about new approaches, and grasp new technologies through the use of cutting-edge technology, all of which will help them to improve their overall performance.

In classroom teaching activities, we adopt teaching activities that are tailored to the characteristics of knowledge points, such as lecture-style teaching that integrates lecture and practice, discussion-style teaching that promotes cooperative learning, and debate-style teaching that encourages students to move from passive learning of "waiting to rely" to active learning of "I want to learn."

3. Sources of Interest

Interest is the driving factor behind learning, as Shakespeare once stated: "Learning must be in harmony with their own interests, only may benefit." Douglas and colleague [18] argue that students are the primary recipients of instruction, but that learning algorithms are tedious and difficult to understand; if we continue to use the traditional teaching method, the majority of students will abandon learning because they are tedious and difficult to comprehend. As a result, over the course of the instructional process, we must endeavor to activate students' learning interest, allowing them to transition from passive to active learning.

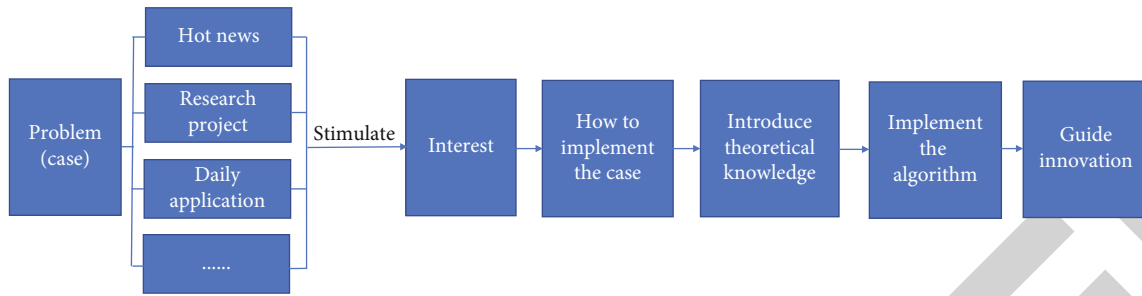


FIGURE 1: Teaching model base on PBL.

According to many instructors, investing significant effort in the first enthusiasm drive will result in the theoretical understanding of the course professor being unable to complete it.

In contrast, if they teach course theory in a blind and hasty manner in the classroom, how many students will really comprehend the master, how many students will truly listen to the instructor, and how many will participate in extracurricular activities is something they have not thought about.

An appropriately lathered beard is half shaved; instructors should devote more time to guiding and stimulating interest; once pupils get interested in the idea of learning and mastery, it becomes a natural thing.

3.1. Source One: The Problems Encountered in Real Life. In our daily life, we often encounter some problems related to digital image processing. For example, college students often play with WeChat and microblog and take and post selfie, so they often need to repair the photo, but the photo software always has some limitations. We can lead into problems in our class, such as follows: (1) When sending pictures on WeChat and microblog, do you modify the pictures? (2) What software is used to modify? (3) Can these software functions meet your requirements? When we ask these questions, it will stimulate students' interest, so students are eager to know how to solve these problems. At the time if we tell students that we can use image enhancement algorithm to solve these problems, then most of the students can listen carefully and take the initiative to practice after class.

Try to find some of the knowledge of the course is similar to some of the problems associated with student life, to arouse their sympathy and interest. Table 1 shows the actual problem corresponding portion of the course knowledge.

Table 1 only contains a few examples of related scenarios. Teachers may combine students' majors to uncover challenges that are more suited for their pupils since the use of image processing technology can be observed everywhere around them. The method of drawing conclusions from one instance may also be used by instructors to help students identify issues that are connected to knowledge points and then to assist students through the process of analyzing and solving those difficulties.

3.2. Source Two: Hot News. Now college students have mobile phones, they will watch the news through mobile phone applications. When we explain the course knowledge,

we can combine some hot news to arouse students' interest and then export the related theory research. For example, (1) when explaining segmentation, we first introduce the news of the new face recognition jointly launched by link-face, cup, and com to arouse students' interest and let students understand the face recognition process. Then, we introduce the principle and application of image segmentation algorithm. (2) In order to explain image scaling, we first introduce a new superresolution (SR) image scaling algorithm proposed by Weizmann Institute of Science in Israel. At the same time, combined with mobile phone display, students can understand the meaning of image geometric transformation.

Searching for hot issues requires teachers' attention to cutting-edge research. We also mobilize students to search for research and news in related fields, which can not only enrich hot issues but also improve students' ability to collect data.

3.3. Source Three: Typical Case. A well-designed case exhibit may not only pique students' interest in studying, but it can also assist them in comprehending the practical application of their new information. At the same time, these instances may not only assist students in better understanding how their concepts are implemented, but they can also serve as a useful reference for them while tackling practical difficulties. Because of this, while picking an example, the following factors should be taken into consideration:

- (1) Cases are popular and practical
- (2) Cases are closely related to curriculum knowledge points

Several typical cases are as follows:

Case 1. Adobe photoshop ("PS") software.

After preliminary investigation, we found that most students are familiar with the PS software and have experience in using it. The software is closely related to the algorithm of digital image processing technology. As shown in Figure 2, some functions of the software correspond to the knowledge points of the course.

When we explain the course algorithm, we adopt the teaching mode of comparison method. We compare the functions realized by the course algorithm with the corresponding functions of the PS software, so that students can

TABLE 1: Correspondence between knowledge points and practical problems.

Knowledge points	Practical problems
Smooth filtering	Blur photos to enhance haziness, remove freckles on the face
Algorithm for converting color image to gray image	Photo style transformation (retro style, sketch style, etc.)
Image addition algorithm	Add text, border, and other decoration operations to the photo Image stitching
Geometric transformation of image	Adjust the angle of the photo, zoom in and out of photos
Image sharpening	Image matting, composite photo
Image segmentation	

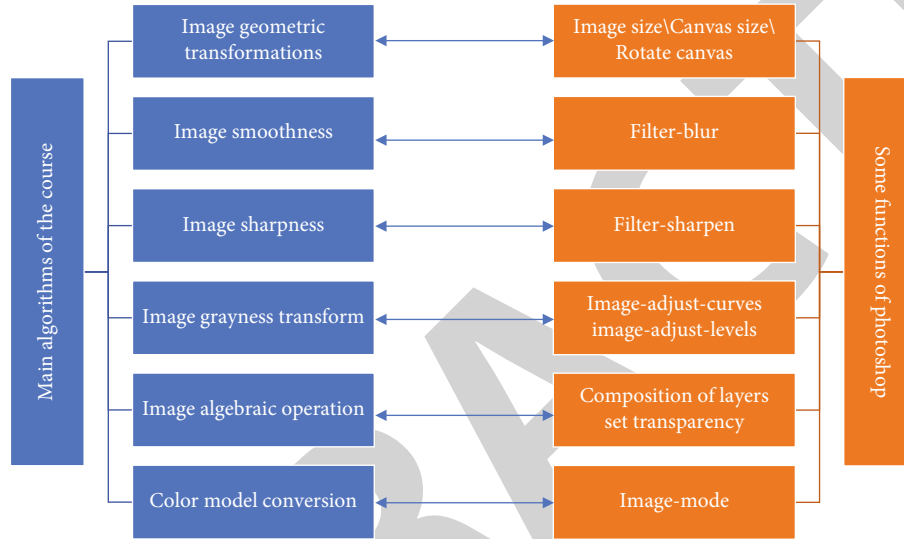


FIGURE 2: Display of key knowledge points of digital image processing technology course corresponding to partial functions of PS.

intuitively feel the implementation and application of the algorithm. For example, when explaining image scaling, we first demonstrate the software functions programmed using the course algorithm. At the same time, we demonstrate the corresponding functions of PS. Then, we explained the image scaling algorithm and related technologies and finally guided the students to add more excellent interpolation algorithms to improve the image magnification effect and guided them to improve the interactive design.

Case 2. Mobile phone panoramic camera function.

All the mobile phones we use have the function of taking panoramic pictures. As shown in Figure 3, the panorama taken by mobile phone, as shown in Figure 4, is the panorama of Mont Blanc (led by photographer Filippo bringing of five international photography teams to create a 353 billion pixel (353 billion pixel) panorama of Mont Blanc). We take these two panorama examples and explain the image synthesis algorithm in combination with the effect of image synthesis. We start with the simplest image addition algorithm, as shown in Figures 5(a) and 5(b) are the original images, and (c) are the effect images realized by the simple addition algorithm. Then, we expand the explanation of the image fusion algorithm, as shown in Figures 6(a) and



FIGURE 3: Panoramic photos taken by mobile phone.



FIGURE 4: Mont Blanc panorama.

6(b) are the original images, and (c) are the effect images realized by the image fusion algorithm. Finally, we leave two questions for students:

- (1) Why are there many restrictions on panoramic shooting by mobile phone? How to improve it?
- (2) How to realize video synthesis?



FIGURE 5: The example of simple addition operations.

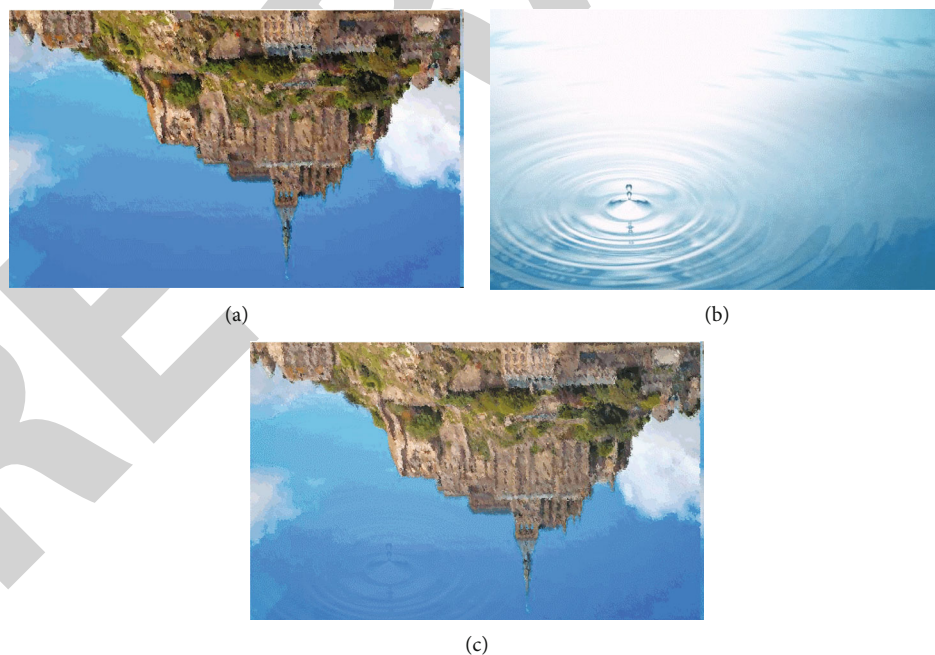


FIGURE 6: The example of image fusion algorithm.

By doing so, students get very interested in debating the application of algorithms and even self-studying fantastic advanced algorithms, which helps to increase students' learning passion and practical competence.

Case 3. License plate location system.

License plate positioning system is a typical application of image processing and analysis, the implementation of

the system not only contains most of the core algorithm in the curriculum, but also a complete image processing process and the whole process of license plate recognition system as shown in Figure 7.

The course knowledge points mainly involved in license plate location include the following: image gray transformation, image frequency domain transformation, histogram equalization, image sharpness, image smoothness, image segmentation, image feature description, and expression.

The main purpose of converting color image to gray image is to reduce the amount of calculation in later processing. The knowledge points involved include color model, conversion between color models, and image color and gray conversion algorithm.

In order to make the gray distribution of an image balanced and to widen the grey range of a specific area of interest, image gray stretching is used to achieve this goal. Gray linear stretching method, gray nonlinear stretching algorithm, histogram equalization and normalization, and other picture enhancing techniques are some of the knowledge points that are engaged in this process.

The purpose of image binarization is to simplify the subsequent calculation, which mainly involves the selection algorithm of threshold.

The purpose of image gradient sharpening is to extract edge information. The knowledge points involved include gradient operator, contour tracking, and region segmentation.

The purpose of threshold segmentation is to remove some interference areas, so that the area of license plate can be better determined.

License plate location mainly involves knowledge points, including image segmentation, image feature description, and expression.

Students may not only master the fundamental information of the course via the study and implementation of this case, but they can also get a thorough understanding of the complete application of course knowledge, which will serve as a strong reference for inventive application in the future.

The instances will be adjusted throughout the course of the training to take into account the students' current circumstances and the advancement of modern technologies as it occurs. Meanwhile, we will choose some examples of works created by past students while taking the course as instances. The goal of case selection is to assist students in comprehending and mastering the content provided, as well as in using that knowledge in subsequent research and invention.

4. Multistep Thematic Practice Content

Good practical content can help students better master theoretical knowledge. Because each student's learning ability is different, we set up a ladder of practical content. The practical content of the course is set by topics. Each topic is divided into two parts: basic questions and improvement questions, including verification design questions, engineering questions, and optional questions. The basic questions directly reflect the knowledge points of the course and belong to the verification design type, while the

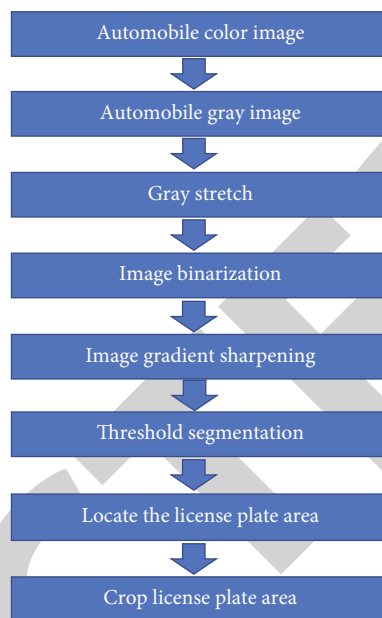


FIGURE 7: The whole process of license plate recognition system.

improvement questions are the comprehensive application of the knowledge points, which are generally set in combination with the actual engineering application. Optional topic means that students can determine the items related to the course knowledge points according to their own interests and complete the practical requirements in the form of project.

5. Multidimensional Examination Score Evaluation System

In higher education, there are just a few standardized assessments that may be used to directly assess the effectiveness of teaching [19]. The test paper examination is the most common method of examination in the conventional style. The students' attitude and mastery of some fundamental concepts, knowledge, and theories can be reflected by this evaluation method; however, it does not fully reflect the students' comprehensive ability to apply knowledge, and it pays little attention to the students' usual practical ability, which causes the students to develop the habit of rote memorization. They are aware of what it is but are unable to explain why, and they have inadequate practical competence. Yang [3] argued that we should pay more attention to students' performance across all learning domains, and that the implementation of assessment should take into account all of the students' diverse talents. A good curriculum assessment may not only objectively reflect students' understanding of the curriculum, but it can also foster students' excitement for active learning by encouraging them to participate in class activities.

We offer a technique for evaluating examination scores on many dimensions. In addition to assessing students' usual practical ability and self-study ability, the evaluation also assesses students' innovation ability and knowledge application ability. The evaluation runs throughout the

TABLE 2: “Digital image processing technology” questionnaire.

Questions	Average score		
	1603-1604	1701-1702	1801-1802
Q1. Do you like the case teaching method base on PBL?	4.89	4.92	4.95
Q2. Can case teaching enhance your learning interest and initiative?	4.87	4.89	4.91
Q3. Can case teaching enhance your ability to analyze and solve problems?	4.91	4.95	4.89
Q4. Is case teaching helpful for you to understand the content of the course?	4.97	4.92	4.93
Q5. Do you think case teaching is helpful to your application of knowledge?	4.85	4.71	4.89
Q6. Have you improved your ability to cooperate with other students in the course?	4.83	4.82	4.91
Q7. Are you satisfied with the classroom teaching of this course?	4.95	4.96	4.98
Average score	4.90	4.88	4.92

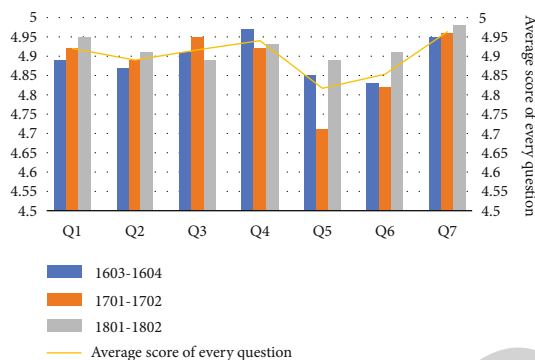


FIGURE 8: The visual display of Table 2.

entire learning process, with a particular emphasis on assessing students’ innovation ability and knowledge application ability. The completion of the preclass preview, classroom performance, after-class practice, and the completion of the final project assignment are all included in the evaluation material. To give a more specific breakdown, 10 percent is attributed to answering reserved questions; 10 percent is attributed to classroom performance and attendance; 10 percent is attributed to the effect of discussion class; 30 percent is attributed to completing experimental content and extended content; 40 percent is attributed to large homework assignments. Each semester, modifications will be made in accordance with the actions of the teaching faculty.

6. Effectiveness of Teaching Method Reform

We found that when we implemented the anchored teaching method based on PBL in the digital image processing technology courses of classes 1603-1604, 1701-1702, 1801-1802, and 1901-1902 of digital media technology (School of artificial intelligence and computer of Jiangnan University), the students’ learning enthusiasm and practical ability both increased significantly, as did their overall performance. Table 2 contains the questions that we created for the questionnaire and their answers. Students are scored based on their answers to the questions, with a maximum of 5 points and a minimum of 1 point awarded to each. Table 2 shows the average score for each of the items in

the list. Figure 8 depicts a visual representation of the data of Table 2.

From the results of the questionnaire, question 6 “Are you satisfied with the classroom teaching of this course?” scored the highest, and it shows that most students like the new teaching methods very much; questions 1-5 show that students think that the cases and questions designed in the course are very interesting and can be used well. The average score of every class (the last row) also reached more than 97% of the total score.

7. Conclusion

The technique of digital image processing is used in a broad variety of applications. In many undergraduate majors (such as computer science and technology, digital media technology, and artificial intelligence), as well as graduate programs across the globe, it is a required subject. Nonetheless, the time-consuming theory of digital image processing technology makes it difficult for both instructors to teach and students to learn effectively. It is proposed that students learn more effectively when theory and practice are combined. This strategy not only increases students’ learning interest, but it also helps students get a better grasp of the practical application of information, laying a stronger basis for future creativity. The hybrid style of instruction is an important study area in the field of higher education reform. It blends the benefits of offline face-to-face instruction with the advantages of internet instruction [20]. In the future, we will investigate the hybrid teaching style based on problem-based learning (PBL) in order to give learners with additional auxiliary situations and examples.

Data Availability

The dataset used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgments

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