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Development of visual representation skills assessment for animal biosystematic subject

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ABSTRACT

Objective and consistent assessment is an important component in the learning process, especially in higher education. In practical courses such as animal biosystematics, students are not only required to understand theoretical concept, but also develop visual representation skills. Standardization in assessment is very necessary to ensure that each student is assessed fairly based on the same criteria. This study aimed to development of visual representation skills assessment for animal biosystematics subject. This research was conducted at a university in Bandung. Held in lectures in the even semester with involving 37 students, 4 lectures, 4 practicum assistants, and 1 laboratory assistant. This visual representation skills assessment was develop using the ADDIE model. Data is strengthened through interviews and questionnaire. The analysis process consists of collecting information, simplifying information, presenting information, and drawing conclusions. This study successfully developed a visual representation skills assessment instrument for the Animal Biosystematics subject. The instrument comprises three rubrics morphology, anatomy, and skeleton each with indicators evaluating proportional accuracy, characteristic features, descriptive clarity, and proper annotation. These rubrics provide a structured and comprehensive tool to assess the accuracy and clarity of students' scientific drawings.

INTRODUCTION

Objective and consistent assessment is one of the important components in the learning process, especially in higher education. In practical courses such as Animal Biosystematics, students are not only required to understand theoretical concepts but also to develop visual representation skills. In biology books, images, photos, and diagrams are widely used as examples of visual representation. Visual representations are important for use as scientific communication. Images could support arguments from explanations that emphasize time-limited sequences and dynamic processes (Tang, 2023). Research shows that visual representations can help students understand scientific texts (Mayer, 2014). Visual representations also play a role in improving students' academic performance (Khan & Masood, 2012). This ability is important for accurately depicting the structure, classification, and interspecies relationships.

Images play an important role in displaying biodiversity and taxonomic relationships, and the ability for visual representation is considered crucial in the context of animal biosystematics. This is supported by research findings that show that Visual aids such as images are important for detailed analysis based on aspects of animal morphology that cannot be directly identified. For example, in classifying ground beetles, the results show 94-97% accuracy in identifying up to the genus and species level (Rayeed et al., 2025). Because there are limitations such as the availability of limited specimens, preservation issues, or logistical and ethical problems when handling rare or live animals, not all specimens can be directly observed during practical sessions. In these situations, visual aids such as scientific morphology images, anatomical systems, or skeletal structures are needed to enhance observation, interpretation, and analysis. In addition, the ability to distinguish and compare morphological and anatomical differences is very important for taxonomy. However, in practice, the assessment of this visual representation ability often lacks standard guidelines. This leads to differences in interpretation when assessing the quality and accuracy of students' work, which has the potential to affect the consistency and objectivity of the evaluation.

Currently, there are no standard assessment guidelines for visual representation skills in the Animal Biosystematics course yet. Previous studies have been conducted on the analysis of visual representation in high school biology textbooks regarding the structure and function of plants. The research analysis focused on two main aspects, namely the function of visual representation and the categories of its modes. The findings indicate that explanatory, illustrative, and complementary visuals are more prominent in Textbook B, while decorative visuals appear in both Textbooks A and B (Utami & Subiantoro, 2021). Additionally, an assessment has been conducted using Likert scale items to determine whether students experience visualization difficulties related to Analyze, Explaining, Illustrating, Concluding, and Outlining content related to mitosis as depicted in animations and static 2D diagrams (Mnguni & Moyo, 2021).

Standardization in assessment is essential to ensure that every student is evaluated fairly based on the same criteria. With the existence of standardized guidelines, lecturers and teaching staff will have clear instructions for objectively and measurably evaluating students' visual representation skills. On the other hand, students will also better understand the aspects being evaluated, allowing them to focus more on developing their skills according to the expected criteria. The preparation of these standardized assessment guidelines is also in line with the needs of the Biology Education to improve academic quality and professionalism in the teaching and evaluation process.

The existence of standardized assessment guidelines can help ensure that the teaching and learning process runs more effectively and efficiently, and is capable of producing graduates with adequate visual representation competence in the field of animal biosystematics. Previous research has shown that the lack of widely accepted standards often results in subjectivity and discrepancies in evaluation procedures, especially in visual-based or drawing activities (East et al., n.d.; Sadler, 2009). Furthermore, a more rigorous and uniform evaluation framework is needed

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due to the increasing importance of visual media in biology classification and communication (Jain, 2024; Rayeed et al., 2025). Therefore, the preparation of this standardized guideline is a strategic step to create consistent, objective, and reliable assessments in evaluating students' visual representation abilities. This effort is expected to contribute to the overall improvement of academic quality, both for students and for the teaching staff in the Biology Education Study Program.

The purpose of developing standardized guidelines for assessing students' visual representation skills in the Animal Biosystematics course is to create a consistent and standardized evaluation system for assessing students' visual representation abilities, ensuring that evaluations can be conducted fairly and objectively. This will assist lecturers and instructors in providing more focused and targeted assessments, which in turn can enhance the quality of the learning process and students' competencies in the Animal Biosystematics course. It will also provide clear guidance to students on the aspects being evaluated in visual representation skills, enabling them to understand and meet the expected criteria. Additionally, it supports the creation of assessment standards that align with the principles of professionalism, transparency, and accountability, ultimately improving overall academic quality. Furthermore, it will help produce graduates with visual competencies that meet the demands of the field of animal biosystematics, which will be beneficial for their academic and professional careers in the future.

METHODS

This study used the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (Figure 1) to develop the assessment tool systematically. Participants included 37 second-year biology education students enrolled in the Animal Biosystematics course, 4 lecturers, 4 practicum assistants, and 1 laboratory assistants. The participants were selected using a purposive sampling technique. This method was chosen to ensure that the individuals involved had direct experience with visual representation practices in the Animal Biosystematics course. Students who had completed relevant prerequisite courses and were actively participating in the ongoing semester's practicum were prioritized. Likewise, lecturers and assistants who were directly involved in teaching, guiding, and assessing students in the course were intentionally selected to provide relevant and in-depth insights. This sampling strategy ensured that data collected reflected authentic classroom and laboratory experiences, which is essential for developing a contextually valid assessment instrument.

Data were collected using structured interviews, questionnaires, and document analysis. Interviews were conducted with lecturers and assistants to identify competencies and criteria for visual representation in biosystematics. This instrument includes a rubric with indicators that assess clarity, accuracy, proportionality, annotation, and completeness. The design process involves feedback from experts in biology education and instructional design. Qualitative data from interviews were analyzed through coding, reduction, and synthesis. The questionnaire was administered using Google Forms to facilitate efficient and accessible data collection from students, lecturers, and assistants. It was designed using a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree) to avoid neutral responses and encourage clearer opinions from participants. The questionnaire items focused on the practicality, clarity, relevance, and usability of the visual representation assessment rubric. In addition to closed-ended items, open-ended questions were included to capture qualitative feedback and suggestions for rubric improvement. The use of an online format allowed for rapid distribution, anonymous responses, and ease of data compilation for analysis. Questionnaire data were analyzed descriptively to assess the practicality and usefulness of the instrument.

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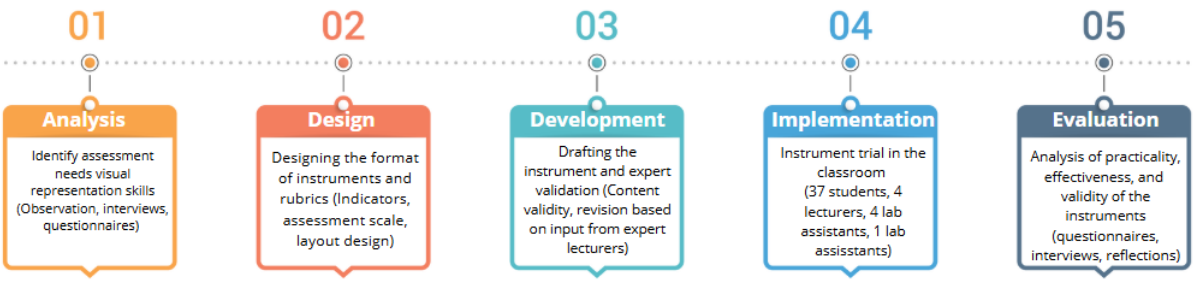

Figure 1. ADDIE model (analysis, design, development, implementation, and evaluation)

The development process of the visual representation assessment instrument follows a systematic model consisting of five main stages: Analysis, Design, Development, Implementation, and Evaluation (Figure 1).

1. Analysis
   In this initial phase, the need for assessing students' visual representation skills is identified. Data are collected through observations, interviews, and questionnaires to explore the types of visual skills required and the context in which they will be applied.
2. Design
   This phase involves designing the structure and components of the assessment instruments and rubrics. Key elements include the formulation of indicators, development of the assessment scale, and the layout or visual format of the instrument.
3. Development
   In this stage, the first draft of the instrument is created, followed by expert validation to ensure content validity. Revisions are made based on input and feedback from subject matter experts and experienced lecturers.
4. Implementation
   The revised instrument is then tested in a real classroom setting involving 37 students, 4 lecturers, 4 laboratory assistants, and 1 laboratory technician. This stage aims to observe how the instrument functions in practice and to collect data for refinement.
5. Evaluation
   The final stage focuses on analyzing the instrument's practicality, effectiveness, and validity. Data are gathered through questionnaires, interviews, and reflections to assess whether the instrument meets its intended purpose and how it can be improved further.

RESULTS AND DISCUSSION

Visual representations are important for scientific communication, and visual representations can help students understand scientific texts (Mayer, 2014). The results and discussion in this research are presented based on the ADDIE stages (Analysis, Design, Development, Implementation, and Evaluation).

1. Analysis: Identifying assessment needs

Animal biosystematics is a mandatory course in the biology education study program. The learning outcome in the animal biosystematics course is that students are able to classify invertebrate and vertebrate animals according to their similarities and differences in terms of morphological structure, anatomy, skeleton, habitat, and phylogeny based on their DNA. In the analysis phase, interviews with lecturers and laboratory assistants revealed that visual representation skills are very important for students to accurately depict the morphology, anatomy, and skeleton of animals and their relationship with classification. It was found that until now there has been no

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standard assessment guideline for visual representation in the animal biosystematics course. When conducting assessments, each person has different assessment guidelines. For example, some people are guided by scientific journals, online databases, websites, last year's images, and self-created indicators.

Differences in these assessments lead to subjectivity and discrepancies in evaluations for each student. It was found that during the assessment, there was a significant variation among instructors, often relying on subjective judgment without a standardized rubric. This inconsistency highlights the need for valid and reliable assessment tools. Additionally, based on the data, there is no specific criteria for assessing images in the syllabus or learning outcomes. without a rubric, the assessment is subjective because the evaluator tends to make decisions based on personal perception, not standardized criteria (Virk et al., 2020). These findings are consistent with previous research that states the lack of assessment standardization results in inconsistent feedback and learning outcomes (Black & Wiliam, 2009). Therefore, standard guidelines for assessing students' visual representation skills in Animal Biosystematics are necessary to ensure a fair and objective evaluation of visual representation competence.

At the analysis stage, data regarding the challenges in assessing students' visual representations were also found. This data can be seen in the Figure 2.

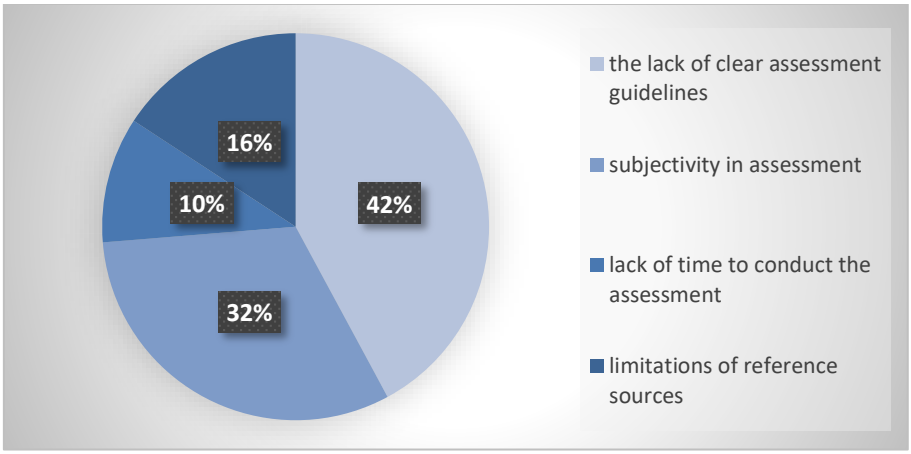

Figure 2. The challenges in assessing students' visual representations

Based on figure 2, it is evident that the biggest challenge in conducting visual representation assessments lies in the guidelines, which are still unclear. Additionally, the time required to conduct the assessment is also a factor. The more images there are, the more that need to be assessed. Therefore, all parties believe that the guidelines for assessing visual representation are expected to provide clear, objective, and easily understandable criteria. Standard assessment guidelines can facilitate objectivity in evaluation and accurately measure students' visual representation skills. The assessment process can be conducted consistently (minimizing bias) and helps identify areas that need improvement in teaching and learning. The absence of shared assessment criteria can lead to indeterminacy and subjectivity, especially in open-ended tasks like drawing or diagramming (Sadler, 2009). Moreover, without well-defined visual assessment rubrics, educators tend to rely on aesthetic judgments rather than scientific content accuracy, which may compromise fairness (Fenwick & Unsworth, 2023). Well-structured rubrics also promote transparency and support metacognitive development in learners by clarifying what constitutes quality work (Brookhart, 2013; Joo et al., 2021).

At the analysis stage, in addition to gathering information from lecturers, lab assistants, and laboratory technicians, information was also gathered from students regarding their experiences and initial knowledge about the morphology, anatomy, skeleton, and classification of animals. Based on the students' experiences, the sources used for drawing varied (Figure 3).

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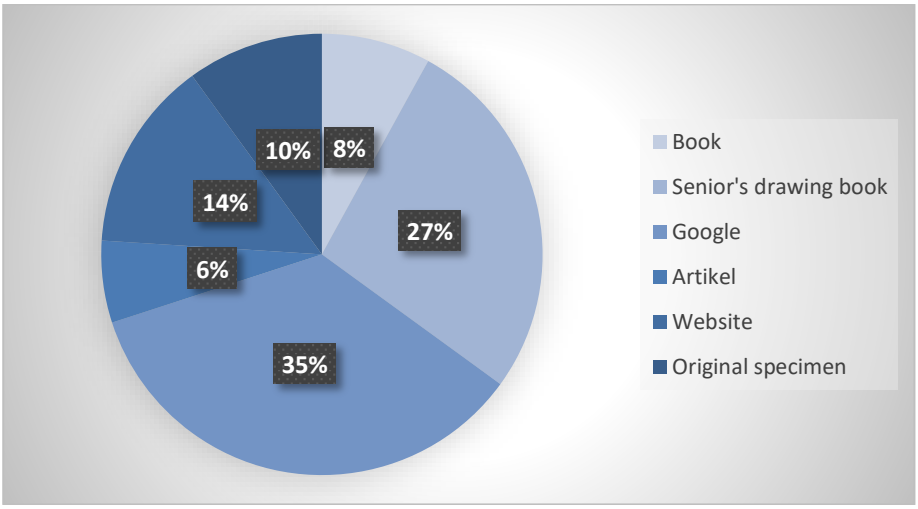

Figure 3. The sources used for drawing

Figure 3 illustrates the distribution of reference sources used by students when creating scientific drawings. The most frequently used source is Google, accounting for 35% of the total. This indicates a strong reliance on internet search engines for finding visual materials. The second most common source is the Senior's drawing book, used by 27% of students, showing that peer work remains a significant reference point. Website references follow at 14%, while original specimens are used by 10%, suggesting a moderate level of engagement with direct observation. Meanwhile, Books are referenced by only 8% of students, and Articles are the least used at 6%, indicating a lower preference for academic or textual sources in constructing visual representations. Overall, the data show that digital sources (Google and websites) dominate students' reference habits, while primary and academic sources are less frequently consulted. Students should draw directly when identifying animals during practical hours. These findings are consistent with previous studies showing that students in the digital age often favor easily accessible online images over primary resources or scientific literature, even when the latter provide more accurate biological depictions (Ealy, 2018; Zhang & Jenkinson, 2024).

After conducting a needs analysis for the visual representation assessment guidelines, the next step is the design phase. In the design phase, the first step is to create objectives that refer to learning outcomes based on the curriculum. The purpose of assessing students' visual representation skills in the Animal Biosystematics course includes:

1. Measuring the ability to illustrate animal morphology: Assessing students' ability to depict the external characteristics of animal species, including body shape, size, colour, and other structures accurately and clearly.
2. Assessing animal anatomy understanding: Measuring students' ability to represent the internal structure of animal bodies, including organ systems, tissues, and their functions, through easily understandable illustrations.
3. Measuring ability in taxonomic classification: Assessing students' ability to describe taxonomic relationships between species, showing classification characteristics that differentiate groups of animals based on morphological and anatomical traits.
4. Developing visual communication skills: Helping students develop visual communication skills through images to clearly convey scientific information about identified animal species.
5. Encouraging critical and analytical thinking: Developing students' ability to think critically in identifying and analyze animal characteristics through accurate and scientific visual representations.

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Through this assessment, students are expected to demonstrate a deep understanding of the concepts of animal biosystematics, as well as enhance their ability to present and communicate information visually in the study of animal taxonomy and anatomy.

2. Design: Design format assessment and rubric indicator

In the design stage, a visual representation assessment rubric was created based on key indicators identified during the analysis: clarity, accuracy, proportionality, annotation, and completeness. These indicators were operationalized into measurable criteria with a 4-point Likert scale (1 = very poor to 4 = excellent). The rubric was reviewed by two experts in biology education and one instructional designer to ensure content validity and alignment with learning objectives. The rubric's structure was also informed by literature in visual literacy and scientific communication (Ainsworth, 2006; Treagust & Tsui, 2013), which emphasize that scientific drawings should not only be aesthetically pleasing but also convey accurate structural and conceptual meaning. The assessment rubric created consists of a rubric for evaluating the ability to visually represent the morphology, anatomy, and skeleton of invertebrate and vertebrate animal species. The indicators for the visual representation rubric can be found in Table 1, 2, 3.

Table 1. The indicators for the visual representation morphology rubric

No	Indicators
1	Proportions of the length and width of animal body part images.
2	The shape of the animal is drawn with the identified real animal.
3	Characteristic morphological features.
4	Morphological characteristic description.
5	Location of morphological characteristic descriptions.
6	Caption line morphological characteristics.

Table 2. The indicators for the visual representation anatomy rubric

No	Indicators
1	Proportions of the length and width of anatomical part images.
2	The anatomical form of the animal is illustrated with the identified original animal.
3	Characteristic features of anatomy.
4	Anatomical characteristic description.
5	Location of anatomical characteristic descriptions.
6	Caption line anatomical characteristics.

Table 3. The indicators for the visual representation skeleton rubric

No	Indicators
1	Proportions of the length and width of animal skeleton images.
2	The shape of the animal is drawn with the identified real animal.
3	Characteristic skeleton features.
4	Skeleton characteristic description.
5	Location of skeleton characteristic descriptions.
6	Caption line skeleton characteristics.

The visual representation rubrics for morphology, anatomy, and skeleton are developed to assess students' ability to accurately and meaningfully representation biological structures (Table 1, 2, 3). Each rubric contains six indicators that focus on the quality of drawing, morphology and anatomical element accuracy, and clarity in annotation and description. Annotations can be obtained by matching with the original characteristics of the animal (Chen & Zhai, 2025). The indicators for visual representation of morphology are shown in Table 1. Based on actual specimens, this rubric evaluates how effectively students represent the animal's general form and shape. Proportionality of body parts, recognizable animal shapes, and the presence and positioning of distinctive morphological traits with appropriate captions are important.

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Table 2 outlines the indicators for visual representation of anatomy. The focus is on internal anatomical structures, such as organs or systems. The indicators evaluate the accuracy of anatomical proportions, the authenticity of the depicted animal's internal form, and the clarity of descriptions and labelling. Table 3 provides the indicators for visual representation of skeleton structures. This rubric target students' abilities to depict skeletal frameworks accurately. It includes indicators on proportion, identification of skeleton features, detailed descriptions, and the correct placement of labels and captions describing skeletal characteristics. Each rubric helps assess students' visual literacy and biological understanding through drawing-based tasks that emphasize scientific accuracy and communication. Visual representation needs to be supported by the meaning of what is represented (Fenwick & Unsworth, 2023).

3. Development: Rubric and expert validation

At the development stage, the indicators that were created in the design stage are then detailed and formulated operationally. Next, the completed rubric underwent expert validation testing and revisions based on feedback from the experts. The complete rubric can be seen in Table 4.

Table 4. Complete rubric for the visual representation

No	Indicators	Scale	Achievement criteria
1	Proportions of the length and width of animal body part images.	2	The proportion of the length and width of the animal body part image according to the criteria.
		1	The proportion of the length and width of the animal body part image does not meet the criteria.
		0	Does not depict the proportion of the length and width of the animal's body parts.
2	The shape of the animal is drawn with the identified real animal.	2	The shape of the animal drawn matches the observed original animal.
		1	The shape of the animal drawn does not match the observed original animal.
		0	Not drawing the species of the animal.
3	Characteristic morphological features.	2	Describing distinctive morphological characteristics that lead to classification.
		1	Describing typical morphological characteristics, but not leading to classification or the described typical characteristics are inaccurate.
		0	Does not describe the typical morphological characteristics.
4	Morphological characteristic description.	3	Writing 2 or more morphological characteristic descriptions accurately.
		2	Writing 1 morphological characteristic description accurately.
		1	Writing 1 description of morphological characteristics but not accurately.
		0	Not writing the morphological characteristic description.
5	Location of morphological characteristic descriptions.	2	The location of the indicated morphological characteristic is correct.
		1	The location of the indicated morphological characteristic is incorrect.
		0	Not writing the morphological characteristic description.
6	Caption line morphological characteristics.	4	A straight line to the right or left, up or down. The line does not cross or cover the image of the species organelle. Using arrow/dot lines at the end of the line. Using black/dark colors for annotation lines.

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No	Indicators	Scale	Achievement criteria
		3	Straight lines to the right or left, up or down. The line does not cross or cover the image of the species' organelle. Do not use arrow lines for annotating morphological features.
		2	The annotation line is straight to the right or left, up or down. The line does not cross or cover the image of the organelle species.
		1	Lines cross or cover the image of the organelle species.
		0	Does not depict the characteristic morphological description.

Table 4 is an example rubric for assessing students' visual representation skills in depicting animal morphology. The assessment rubric for visual representation of animal anatomy and skeleton is the same, but the criteria are adjusted according to the anatomy and skeleton of the animal. In this assessment, the scores generated from the rubric are then analyzed quantitatively using the following formula:

$$\text{Score} = \frac{\text{Score obtained}}{\text{Score maximum}} x100$$

The final score is then categorized. the categorization can be seen in Table 5.

Table 5. Categorization of visual representation ability assessment results

Score	Categories
90-100	Very good
85-89	Good
80-84	Sufficient
75-79	Poor
70-74	Very Poor
<70	Unsatisfactory

A draft of the assessment rubric was developed and iteratively revised based on feedback from content experts. The experts who validated this rubric revised the indicator section. The expert's revision can be seen in Table 6.

Tabel 6. Indicator before and after revision

Expert	Indicator before revision	Indicator after revision
1	Morphological part	Morphological characteristics
2	Number of morphological characteristics	Proportions of the length and width of animal body part images
3	Location of morphological feature annotations	Location of morphological characteristic descriptions
4	Morphological annotation line	Caption line morphological characteristics

Table 6 presents the revised indicators based on expert input to enhance clarity in morphological analysis. Previously general terms, such as "Morphological part" and "number of morphological characteristics," have been refined to be more specific, such as "Morphological characteristics" and "Proportions of the length and width of animal body part images." Other revisions emphasize the accuracy of the description location and the importance of captions on

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annotation lines. These changes aim to make the indicators more operational and relevant to the visual representation of morphology. This stage confirmed that expert involvement is critical in developing valid assessment tools (Fraenkel et al., 2012). By incorporating expert review, the instrument gained theoretical robustness and practical relevance for biosystematics courses.

4. Implementation: Trial assessment visual representation in class

The developed instrument was implemented during the Animal Biosystematics practicum involving 37 students, 4 lecturers, 4 practicum assistants, and 1 laboratory technician. Students were asked to submit drawings of various animal taxa (e.g., Pisces, Amphibi, Reptil, Aves, and Mammalia), which were evaluated using the rubric. One way to improve visual representation skills is by drawing. Drawing provides a strong memory boost to working memory (Tytler, 2020). In parallel, a questionnaire was administered to teaching staff to assess the usability and practicality of the rubric. Results from the pilot showed that the rubric was well-received. 100% of lecturers and assistants agreed that the rubric made assessments more objective. 93% of students reported that having a clear rubric helped them focus on essential visual elements during drawing tasks. This suggests that rubric-guided assessment can serve as a formative tool that supports both teaching and learning (Brookhart, 2013).

The implementation of a standardized assessment guideline for visual representation skills (specifically drawings of invertebrates and vertebrates) in the Animal Biosystematics course was generally well received by students. Most students expressed that the presence of clear assessment criteria made the grading process more objective, fair, and transparent. They appreciated how the rubric helped eliminate subjectivity in scoring and ensured that every student's work was evaluated based on the same standards. Many also noted that the structured guidelines improved their understanding of what aspects to focus on—such as anatomical details and distinguishing characteristics of different animal groups—resulting in higher-quality scientific drawings and deeper comprehension of biological concepts. Others suggested that the guideline should be clearly communicated at the beginning of the course to help students better prepare and understand expectations early on. Effectively designed representations help students focus on the most important details (Joo et al., 2021).

Overall, the majority of students viewed the standardized assessment rubric as a positive innovation that improves the quality of learning, supports fairness in grading, and promotes scientific visual literacy.

Table 7. Categorization and percentage of visual representation ability assessment results

Categories	Percentage (%) of visual representation		
	Morphology	Anatomy	Skeleton
Very good	51	38	25
Good	30	57	32
Sufficient	16	5	27
Poor	3	0	16
Very Poor	0	0	0

Table 7 provide the information about distribution of students' visual representation abilities in three domains: morphology, anatomy, and skeleton. In the morphology domain, over half of the students (51%) demonstrated a very good level of representation, with an additional 30% categorized as good. Images that contain interesting elements will be easily understood by students (Menendez et al., 2024). Only 16% and 3% fell into the sufficient and poor categories, respectively, while none were classified as very poor. For anatomy, the majority of students (57%) achieved a good level of representation, followed by 38% in the very good category. The student's ability to understand each element of the given information supports their visual representation skills (Knain et al., 2021).

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A small proportion (5%) demonstrated sufficient ability, with no students falling into the poor or very poor categories. In contrast, the skeleton domain showed lower performance, with only 25% of students categorized as very good and 32% as good. Notably, a relatively high proportion of students (27%) exhibited sufficient representation ability, and 16% were categorized as poor. These findings indicate stronger student performance in representing morphology and anatomy compared to skeletal structures, highlighting the latter as a potential focus for instructional improvement. Students who tend to copy and paste images from books or other sources, rather than from observing original species, will likely find it difficult to encode informational elements on other objects (İnaltekin & Goksu, 2019).

The results are consistent with the finding that students find it more difficult to represent the skeleton. This is because the skeleton contains more components of information and shapes that need to be represented. when given an image with high complexity, initial knowledge is needed to understand the image (Juanengsih et al., 2021; Yang et al., 2025). The ability of students to represent visually is influenced by the complexity of the information elements. The more complex the information elements, the more difficult it is to visualize and process them in working memory.(Ladisa et al., 2020; Tang, 2023). High-complexity and challenging images can influence students' capacity to reason and explain the visual (Langbeheim et al., 2022). In addition, students who fall into the very good category also achieve good results in concept understanding. Students' reasoning and knowledge-building during class discussions were significantly supported by visual representations, which extended knowledge and reasoning from the individual to the social level (Yoon et al., 2021).

5. Evaluation: Evaluation practically, effectiveness, and validity rubric

The evaluation stage focuses on analyzing the practicality, reliability, and usability of the assessment tool. Qualitative data obtained from post-implementation interviews revealed that lecturers stated the instrument was easy to use and adaptable for various animals, laboratory assistants appreciated the clarity in expectations and consistency in assessment, and students expressed increased confidence in creating visual representations that aligned with the assessment guidelines and the presence of fair evaluations. Rubrics can be used to assist student learning, evaluate student work consistently and transparently, and assess the quality of instruction in courses, programs, and institutions (Olson & Krysiak, 2021). Minor revisions were made to the rubric based on this feedback, such as incorporating clarity for each indicator and achievement criterion. To assess its impact on conceptual understanding, pre-test and post-test (Table 6) activities were conducted where students were asked to draw vertebrate animals before and after using the rubric. The comparison of the drawings shows an improvement in the accuracy and completeness of the representations of morphology, anatomy, and skeleton, indicating the potential of this instrument to support learning. The success of assessment using rubrics is also supported by the role of teachers in facilitating students' learning. This helps students obtain important elements of information (Ling, 2024).

CONCLUSION

Using the ADDIE model, this study successfully developed an assessment instrument for visual representation skills in the Animal Biosystematics course. This instrument is designed to achieve the research objectives: (1) to create a rubric that is theoretically valid and practically applicable, and (2) to evaluate its effectiveness in supporting the skill of drawing vertebrate animals. The results show that the developed rubric meets both of these objectives. This provides a consistent and objective assessment method by incorporating well-defined characteristics such as clarity, accuracy, proportionality, annotation, and completeness. The involvement of lecturers, assistants, and students throughout the development and testing stages ensures that this assessment rubric can be beneficial and support transparency in grading for students. The rubric improves the

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consistency of assessments and enhances students' ability to produce accurate scientific visualizations. Therefore, the research objectives have been fully achieved. This visual representation assessment rubric significantly contributes to the teaching and learning of animal biosystematics courses by applying transparency, objectivity, and alignment with assessment standards. Future studies are encouraged to test its scalability in a broader educational context and explore digital integration for more effective feedback.

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Authors' Note

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