



Co-funded by
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Gamification approach in human anatomy teachings

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Overview

- Gamification: what it is
- Gamification in the digital tool era: the example of human anatomy field
- Our experience

GAMIFICATION: WHAT IT IS

Understanding Gamification

What is Gamification?

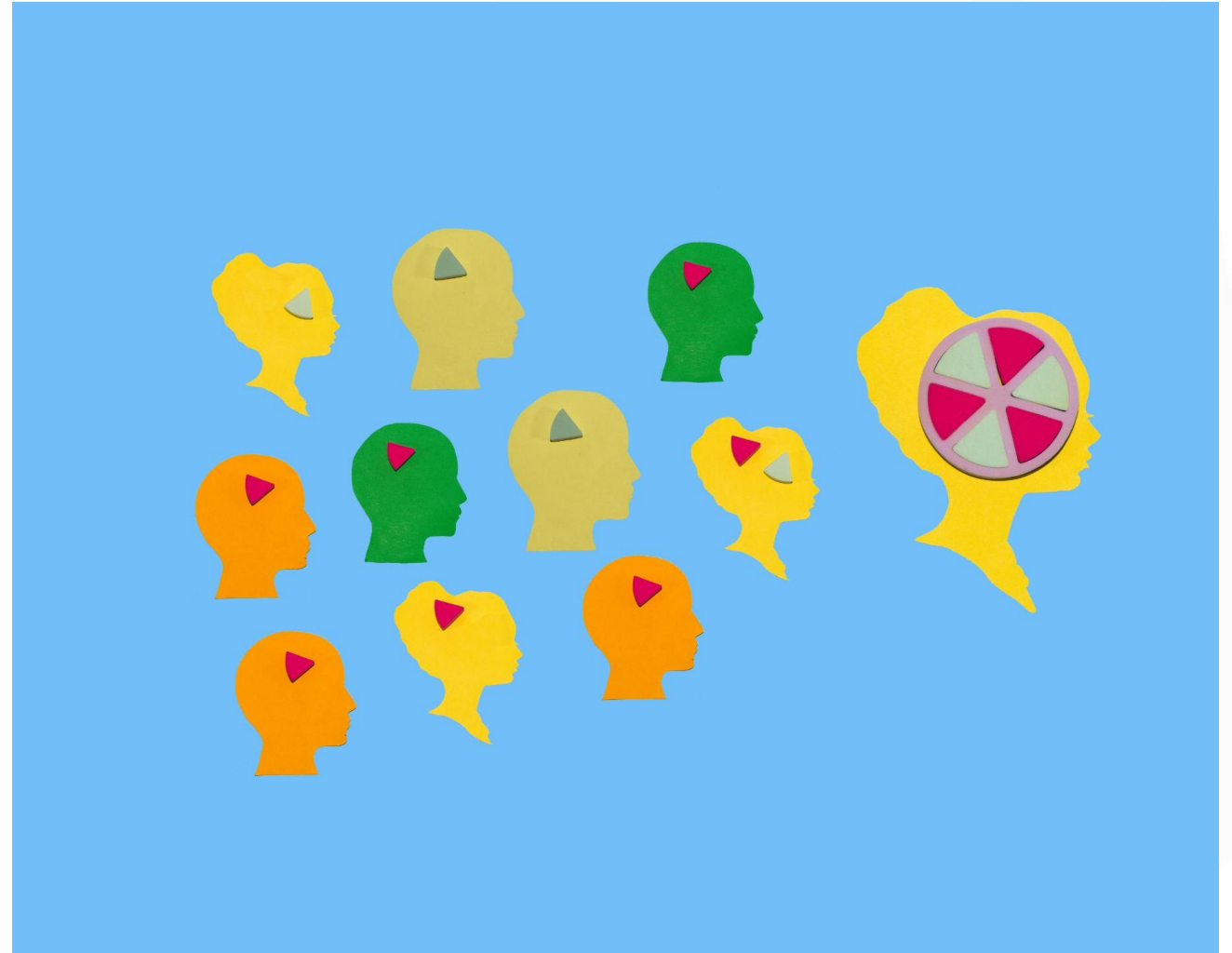
The process of incorporating game-like elements into non-game contexts to boost engagement and participation.

Purpose of Gamification

Designed to motivate people by making tasks more enjoyable and rewarding, thereby increasing involvement.

Common Elements Used

Points, badges, leaderboards, and challenges are typical components that encourage continued participation.



Gamification: What It Is and Why It Matters to Digital Health Behavior Change Developers

Brian Cugelman, PhD

AlterSpark Corp., Toronto, ON, Canada

Corresponding Author:

Textbox 1. The persuasive architecture of gamification and its 7 persuasive strategies.

1. Goal setting: Committing to achieve a goal
2. Capacity to overcome challenges: Growth, learning, and development
3. Providing feedback on performance: Receiving constant feedback through the experience
4. Reinforcement: Gaining rewards, avoiding punishments
5. Compare progress: Monitoring progress with self and others
6. Social connectivity: Interacting with other people
7. Fun and playfulness: Paying out an alternative reality

Table 1. Gamification strategies and validated behavior change ingredients.

Gamification strategies	Validated behavior change ingredients [2]
1. Goal setting	• Agree behavioral contract • Goal setting (behavior)
2. Capacity to overcome challenges	• Time management • Action planning
3. Providing feedback on performance	• Prompt self-monitoring of behavioral outcome • Prompt self-monitoring of behavior
4. Reinforcement	• Provide rewards contingent on successful behavior
5. Compare progress	• Prompt self-monitoring of behavioral outcome • Provide normative information about others' behavior
6. Social connectivity	• Social influences (norms) • Plan social support/social change
7. Fun and playfulness	N/A

Textbox 3. Criteria to consider when evaluating if gamification is suitable to a particular intervention.

1. The intervention users
2. The users' social context
3. The psychological and behavioral outcomes that are being pursued
4. How closely the intervention's logic model or theory of change fits with the persuasive architecture of gamification
5. The interactive product or platform that is being planned
6. The compatibility of the interactive product, users, and community with the 7 gamification strategies
7. The compatibility of the interactive product, users, and community with gamification tactics

Textbox 2. Popular gamification tactics.

1. Providing clear goals
2. Offering a challenge
3. Using levels (incremental challenges)
4. Allocating points
5. Showing progress
6. Providing feedback
7. Giving rewards
8. Providing badges for achievements
9. Showing the game leaders
10. Giving a story or theme

Oral Oncology Reports 9 (2024) 100209



Gamification in medical education: A new approach

ARTICLE INFO

Keywords

Gamification

Medical education

Student engagement

ABSTRACT

Gamification in medical education may improve learning, motivation, and engagement. Using decision-making cards improves clinical thinking and diagnosis. Resistance and comprehensive assessment are challenges. However, game-based learning can make medical education more engaging and effective for instructors, students, and patients

Game-based learning in medical education

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At present, medical education is rapidly evolving. Game-based learning (GBL) has been gradually used for education, and several innovations have emerged. The emergence of serious games and gamification provides alternative approaches for educators to improve the medical teaching process. Both serious games and gamification exert their education-promoting function by providing the possibility of combining learning activities such as feedback, testing, and spaced repetition with active participation and autonomy as well as positive experiences for students. Developing effective GBL modalities has the potential to bring immersive experiences for medical students and improve their study outcomes. Herein, we reviewed recent studies employing GBL in medical education, including serious games and gamification teaching. Furthermore, we also discussed the effectiveness and limitations of GBL to suggest future directions for the development and application of GBL in medical education.

CITATION

Xu M, Luo Y, Zhang Y, Xia R, Qian H and Zou X (2023) Game-based learning in medical education. *Front. Public Health* 11:1113682. doi: 10.3389/fpubh.2023.1113682

TABLE 1 Serious games in medical teaching activity.

Game name	Filed	Game type	Country and year	Game propose	Advantages	Reference
Cleft Island	Surgery	Online game	Thailand, 2019	To develop and evaluate the effectiveness of serious game to deliver knowledge	Improving students knowledge	(24)
EMERGE	Surgery	Online game	Germany, 2019	To test the effect of the game on students' declarative and procedural knowledge, as well as their satisfaction.	Increasing students declarative knowledge	(25)
PediatricSim	Pediatry	Online game	America, 2018	To teach and assess students performances on several critical pediatric scenarios	Improving students engagement and test result	(26)
NEOGAMES	Pediatry	Online game	China, 2020	To train students in neonatal resuscitation and to examine whether the game improves their long-term knowledge retention	Facilitating learning and promoting short-term and long-term knowledge retention	(27)
AntibioGame®	Lemology	Online game	France, 2019	To evaluate the usability and playability of the game	Improving students knowledge in antibiotic prescription	(28)
Hygie	Continuing medical education	Prototype video game	France, 2019	To evaluate the effectiveness and satisfaction of the game	Promoting CME in an effective, pleasant, and evidence-based way.	(29)
"spaced-education" game	Continuing medical education	Electronic questionnaire	America, 2012	To assess the efficacy of the game as a method of CME among physicians.	Substantially improving guidelines knowledge and is a well-accepted method by students	(30)
InsuOnline®	Continuing medical education	Questionnaire	Brasil, 2015	To improve the knowledge of undergraduate students and medicine residents about insulin therapy	A good option for large-scale continuing medical education on diabetes.	(31)
Fydlty	Quality-oriented education	Online game	Canada, 2017	To improve medical-based cultural competence education	Providing an engaging, easily accessible and modifiable, and cost-effective cultural competence training tool	(32)
Happy families	Physiotherapy education	Card game	Belgium, 2022	To assist learners to develop their clinical reasoning proficiency and help learners develop adaptive expertise	Improving students clinical reasoning capacity	(33)
GridlockED	Emergency	Board game	Canada, 2019	To identify teaching points to which learners are exposed while playing the game.	Creating opportunities for engaging medical learners in systems-level teaching	(34)
COVIDgame	Epidemiology	Offline Game	China, 2021	To explore the effectiveness of the game for improving medical students' COVID-19 knowledge	Improving students knowledge retention	(35)
eMedOffice	Medical practice	Computer-aided game	Germany, 2011	To teach medical students the organizational and conceptual basics of the medical practice of a general practitioner	Promoting the future development of more effective serious games	(36)
APS Game	Health care education	Online game	Brazil, 2019	To compare the influence of the game dedicated to primary health care with traditional learning methods on students knowledge	Improving the students' knowledge effectively	(37)

TABLE 2 Gamification in medical teaching activity.

Game name	Filed	Game type	Country and year	Propose	Advantages	Reference
NO	Microbiology	Online question bank	America, 2022	To promote students meaningfully engagement and increase their knowledge base	Improving students class exam scores and engagement.	(47)
NO	Microbiology	Checkerboard game	India, 2021	To assess the perception of students regarding game in enhancing learning process.	Fostering learning process and cognition of medical students in the microbiology course.	(48)
SIDRA	Anatomy of locomotor system	Online game	Spain, 2020	To engage students and improve their educational performance	Better student responses and academic performance.	(49)
NO	Anatomy	Board game	Thailand, 2021	To analysis students participation and experiences around the gamification process	Creating a fun-filled and interesting learning environment, improving students performances significantly.	(50)
Kahoot	Immunology	Online game	Sri lanka, 2022	To explore the medical students' perception using gamification teaching	Increasing the focus, understanding of the subject, helping retain knowledge, motivating students to learn and keeping them active throughout.	(51)
Stud2yBuddy	Dermatology	Card-based board game	UK, 2019	To develop an effective interactive resource, improve students confidence, encourage peer feedback and self-assessment of student in finals revision.	Increasing students confidence in revising dermatology.	(52)
Table-top	Emergency	Offline game	Spain, 2022	To evaluate the learning process of students and measure their knowledge improvement.	Improving medical studies and promoting knowledge retention	(53)
NO	Mental illness	Online game	Iran, 2019	To evaluate the implementation of a mental gamification and its efficacy on students.	Shaping the students' satisfaction and promoting teaching effect.	(54)
Escape boxes	Emergency	Offline game	America, 2022	To determine the effectiveness of the game in emergency medicine	Promoting teamwork and communication, improving didactics ratings	(55)
Spaced education (SE)	Anatomy, histology, cardiology and endocrinology	Online game	America, 2012	To investigate the effectiveness of the game on improving students knowledge	Having the potential to assess students knowledge and acting as an effective and well-accepted teaching means	(56)
Kaizen-IM software	Graduate education	Online game	America, 2013	To assess acceptance of the game and to determine retention of information presented to participants	Teaching critical medical concepts	(57)
East EMWars	Emergency	Longitudinal game	America, 2022	To investigate the impact of the game in emergency medicine residency training	Improving residents motivation, engagement, and challenge level	(58)
NO	Geriatric medicine	Electronic questionnaire	Switzerland, 2021	To evaluate the feasibility of the game on polypharmacy	Enhancing the attitudes and understanding of students	(59)
Escape room	Clinical practice	Offline game	America, 2019	To measure the effectiveness of the game intervention	Improving players clinical capacity and providing them with the opportunity to document event reports in real time	(60)

6. Conclusion

At present, medical education is rapidly evolving. Meanwhile, game-based learning has been gradually used for education, and several innovations have emerged. The emergence of serious games and gamification provides alternative approaches for educators to improve the medical teaching process. In most conditions, these teaching formats are well-received by learners and can create an immersive experience for students, considered effective, engaging, easy to understand, interesting, and educational in comparison with traditional teaching activities. Multiple teaching modalities of GBL also contribute to its further application, such as card, board, and even digital games using modern technology. As such, GBL has been recognized as a potential tool for enhancing medical education.

In summary, as a novel and promising teaching method, GBL has gradually become a popular addition to medical education curricula. It functions by providing the possibility of combining learning activities such as feedback, testing, and spaced repetition with active participation and autonomy as well as positive experiences for students. Designing a more effective GBL has the potential to bring an immersive experience for medical students and improve their study outcomes.

Advances in Health Sciences Education (2021) 26:683–711

<https://doi.org/10.1007/s10459-020-10000-3>

REVIEW



Gamification of health professions education: a systematic review

A. E. J. van Gaalen¹  · J. Brouwer² · J. Schönrock-Adema³ · T. Bouwkamp-Timmer³ ·
A. D. C. Jaarsma³ · J. R. Georgiadis¹

Abstract

Gamification refers to using game attributes in a non-gaming context. Health professions educators increasingly turn to gamification to optimize students' learning outcomes. However, little is known about the concept of gamification and its possible working mechanisms. This review focused on empirical evidence for the effectiveness of gamification approaches and theoretical rationales for applying the chosen game attributes. We systematically searched multiple databases, and included all empirical studies evaluating the use of game attributes in health professions education. Of 5044 articles initially identified, 44 met the inclusion criteria. Negative outcomes for using gamification were not reported. Almost all studies included assessment attributes ($n=40$), mostly in combination with conflict/challenge attributes ($n=27$). Eight studies revealed that this specific combination had increased the use of the learning material, sometimes leading to improved learning outcomes. A relatively small number of studies was performed to explain mechanisms underlying the use of game attributes ($n=7$). Our findings suggest that it is possible to improve learning outcomes in health professions education by using gamification, especially when employing game attributes that improve learning behaviours and attitudes towards learning. However, most studies lacked well-defined control groups and did not apply and/or report theory to understand underlying processes. Future research should clarify mechanisms underlying gamified educational interventions and explore theories that could explain the effects of these interventions on learning outcomes, using well-defined control groups, in a longitudinal way. In doing so, we can build on existing theories and gain a practical and comprehensive understanding of how to select the right game elements for the right educational context and the right type of student.

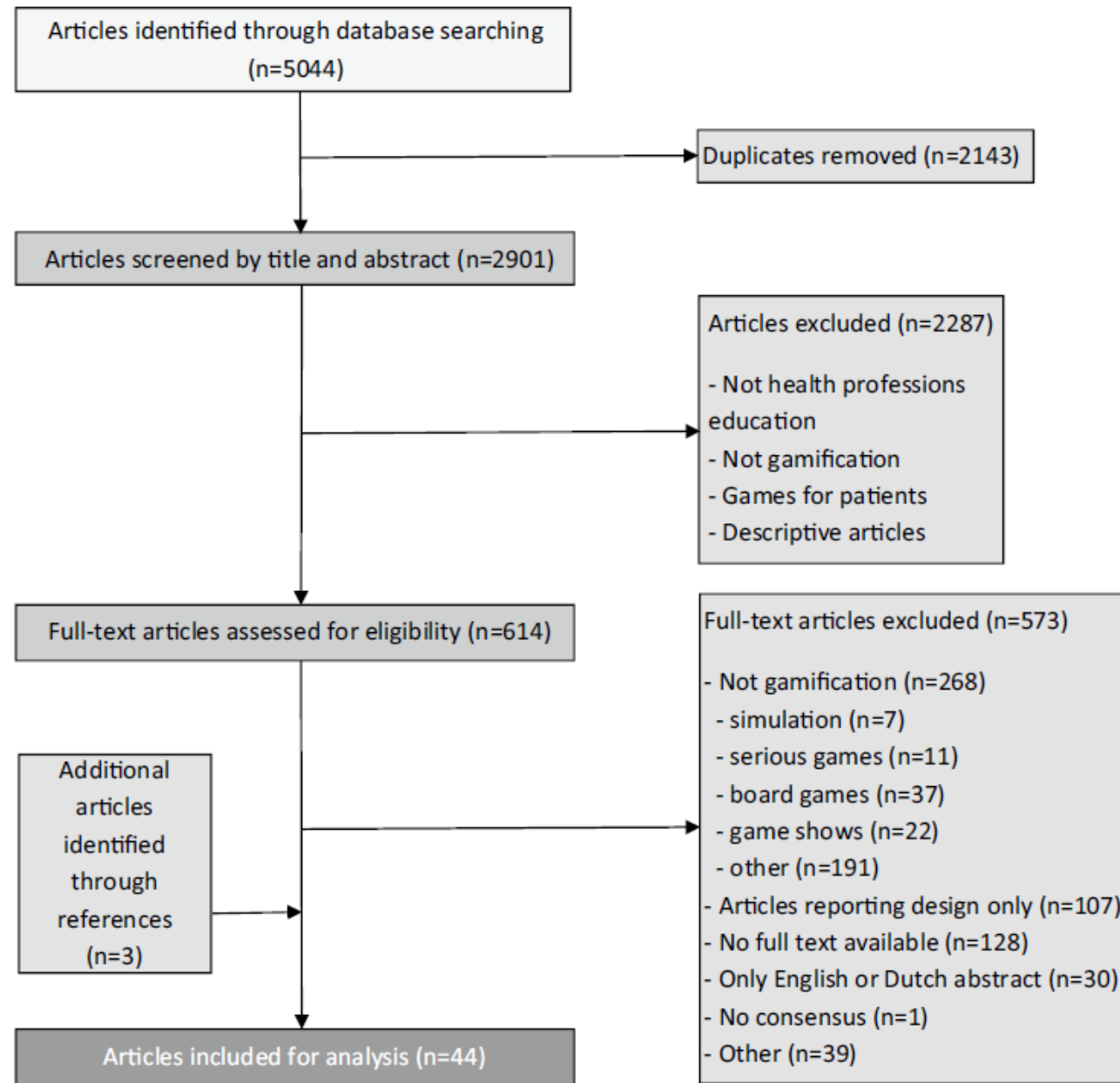


Fig. 1 Flow chart of the article selection process

Conclusion

Gamification seems a promising tool to improve learning outcomes by strengthening learning behaviours and attitudes towards learning. Satisfaction rates are generally high and positive changes in behaviour and learning have been reported. However, most of the included studies were descriptive in nature and rarely explained what was meant by gamification and how it worked in health professions education. Consequently, the current research status is too limited to provide educators with evidence-based recommendations on when and how specific game elements should be applied. Future clarification research should explore theories that could explain positive or negative effects of gamified interventions with well-defined control groups in a longitudinal way. In this way, we can build on existing theories and gain a practical and comprehensive understanding of how to select the right game elements for the right educational context and the right type of student.

GAMIFICATION IN THE DIGITAL TOOL ERA: THE EXAMPLE OF HUMAN ANATOMY FIELD

From Cadavers to Codes: The Evolution of Anatomy Education Through Digital Technologies

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Accepted: 18 December 2024 / Published online: 27 December 2024

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Abstract

This review examines the shift from traditional anatomy education to the integration of advanced digital technologies. With rapid advancements in digital tools, such as 3D models, virtual dissections, augmented reality (AR) and virtual reality (VR), anatomy education is increasingly adopting digital environments to enhance learning. These tools offer immersive, interactive experiences, supporting active learning and knowledge retention. Mobile technology and cloud computing have further increased accessibility, allowing flexible, self-paced learning. Despite challenges like educator resistance and institutional barriers, the continued innovation and integration of digital tools have the potential to transform anatomy education and improve medical outcomes.

Keywords Digital anatomy education · Interactive learning · Augmented reality (AR) · Virtual reality (VR) pedagogical strategies

Received: 8 May 2023 | Accepted: 18 May 2023

DOI: 10.1002/ca.24074

COMMUNICATION

CLINICAL
ANATOMY

WILEY

Empowering human anatomy education through gamification and artificial intelligence: An innovative approach to knowledge appropriation

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Emilio Farfán³  | Oscar Inzunza³ | Nicolás E. Ottone^{4,5,6}  | Mariano del Sol⁶  |
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Abstract

Gamification has appeared as an alternative educational methodology to traditional tools. Specifically, in anatomy teaching, multiple technological applications have emerged in response to the difficulties of accessing cadaveric material; however, there is insufficient information about the effects of these applications on the performance achieved by students, or about the best way to adapt learning to meet their educational needs. In this study, we investigated how teaching human anatomy through a mobile gamified technological tool containing recommendation systems can be combined with a virtual assistant to improve the learning and academic performance of medical students in the Anatomy Department at the Universidad de La Frontera in Temuco, Chile and the Anatomy Department at the Pontificia Universidad Católica de Chile. In total, 131 students participated in the experiment, which was divided into two case studies. The main findings led to the conclusion that gamified components support students in learning anatomy. In addition, the predictions and recommendations provided by the virtual assistant enabled the academic aspects that the students needed to improve to be extracted adequately. Future work is expected to support adaptive learning by incorporating new artificial intelligence in education elements that can generate personalized scenarios for studying anatomy based on the application.

KEYWORDS

anatomy, artificial intelligence, gamification

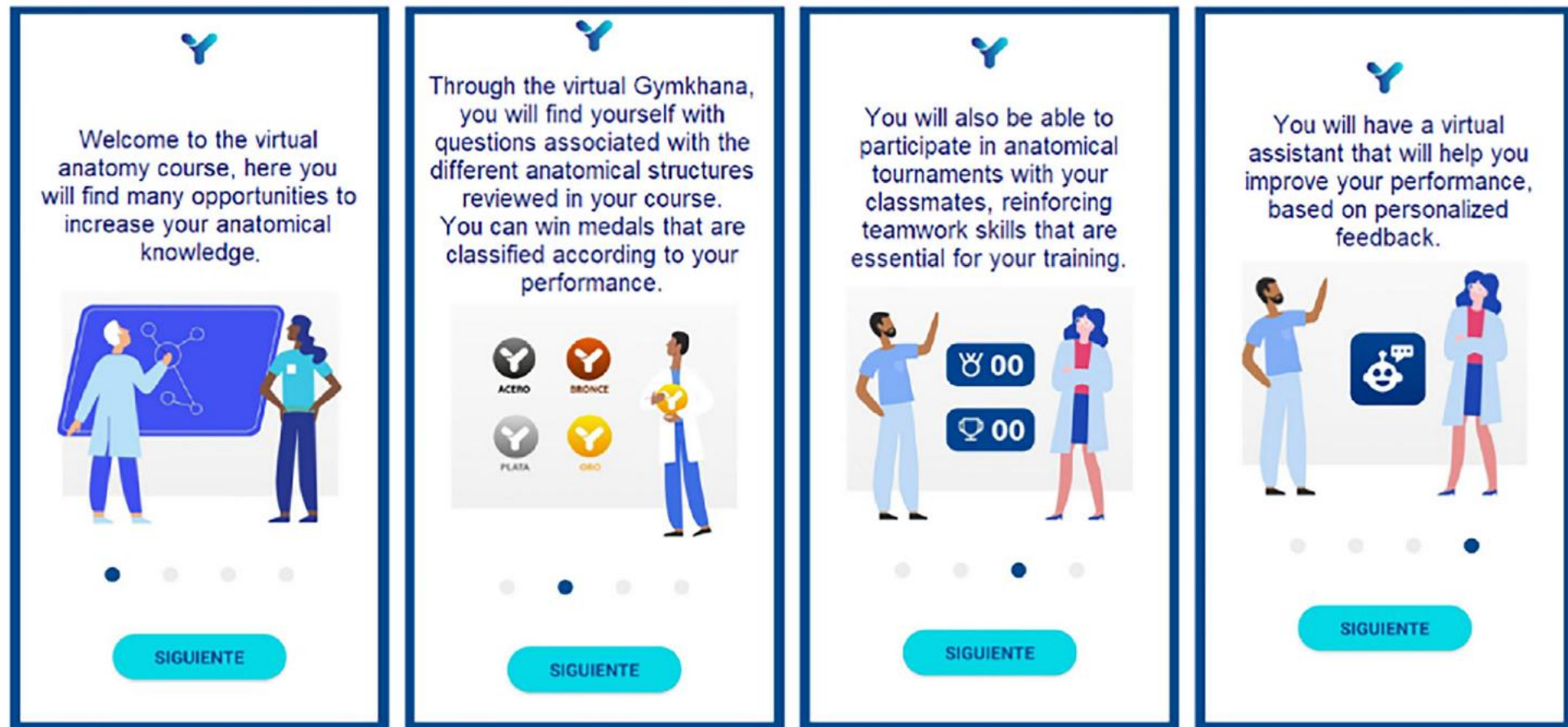


FIGURE 1 Initial views of the gamified technological tool.

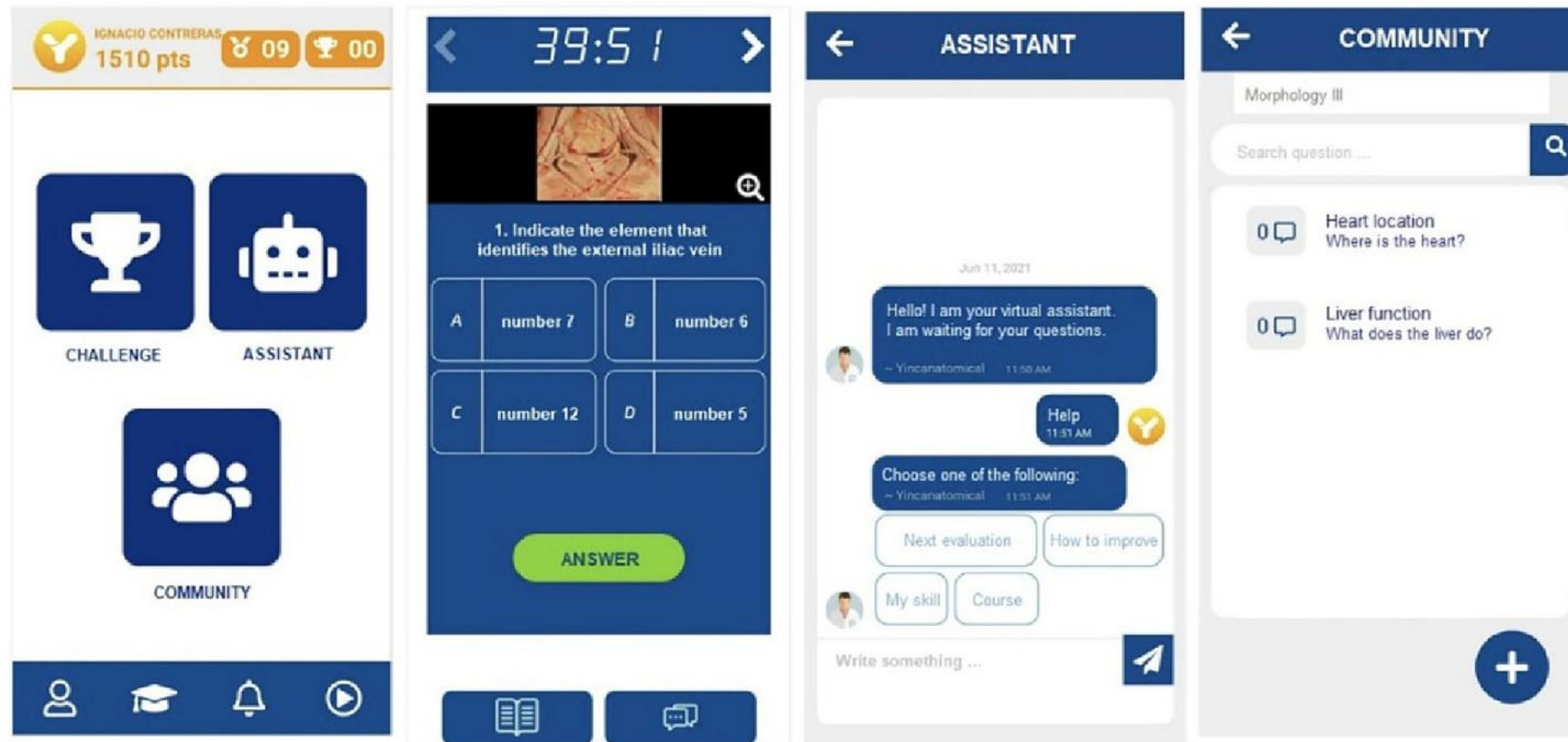


FIGURE 2 Main views: (1) Main menu, (2) Tournament view, (3) Virtual assistant view, and (4) Community view.

3 | RESULTS

Thirty-four UFRO students used the gamified technological tool and interacted 3429 times with the application components. On average, students remained connected to the application for 17.5 min. In the second case study with the PUC students, 71 users used the gamified technological tool and interacted with it a total of 9530 times. These users remained connected for an average of 25 min.

TABLE 1 Aspects to be evaluated in the recommendation component.

Aspect	Question
Relevance	I find it helpful to know how I will perform in the subsequent course evaluation.
Origin	The virtual assistant explained why I got that performance prediction.
Transparency	I understand the information the virtual assistant gave me about my succeeding assessment.
Novelty	The recommendations for improving my performance seem new to me.
Serendipity	The recommendations were varied, supporting improvement of my performance.

TABLE 2 Aspects to be evaluated in each gamified component of the platform.

Aspect	Question
Design	The design of the gamified component is appropriate.
Learning	This component facilitates my learning of human anatomy.
Usage	I would use this component frequently.
Usability	The component is easy to use.

TABLE 3 Use of the application by students taking the human anatomy courses at the UFRO and the PUC, measured by the numbers and times of interactions with the gamified component.

Main components	Number of interactions				Interaction time (s)			
	UFRO		PUC		UFRO		PUC	
	Total	Average	Total	Average	Total	Average	Total	Average
Challenges	49	1.44	171	2.41	672	19.72	2800	39.44
Chatbot	97	2.85	261	3.68	4133	121.56	9400	132.39
Tournaments	369	10.85	796	11.21	24,120	709.41	70,168	988.28
Community	98	2.88	233	3.28	283	8.32	1060	14.93
Ranking	331	9.73	838	11.80	2375	69.85	8717	122.77
Tutorials	104	3.06	225	3.17	712	20.94	830	11.69

TABLE 4 Overall evaluation of the recommender system using scores from previous evaluations and its use by UFRO and PUC anatomy students.

Case study	Relevance		Origin		Transparency		Novelty		Serendipity	
	Agree	Totally agree	Agree	Totally agree	Agree	Totally agree	Agree	Totally agree	Agree	Totally agree
UFRO	62.4%	37.6%	89.7%	10.3%	27.4%	72.6%	17.6%	82.4%	73.1%	26.9%
PUC	57.6%	42.4%	76.9%	23.1%	32.3%	67.7%	29.4%	70.6%	68.5%	31.5%

TABLE 5 Perception of the content of the recommendations for improving academic performance by students taking the human anatomy courses at the UFRO and the PUC.

About performance recommendations	UFRO perception		PUC perception	
	Agree	Totally agree	Agree	Totally agree
The areas for improvement coincide with my academic deficiencies.	17.7%	82.3%	90.2%	9.8%
I know how to apply the recommendations when I use the application.	5.9%	94.1%	88.6%	11.4%
I find the recommendations attractive to implement.	25.7%	74.3%	38.6%	61.4%
They allowed me to recognize what aspects I need to improve.	22.1%	77.9%	16.2%	83.8%
The recommendations influenced my decision to use the application.	25.1%	74.9%	27.5%	72.5%
Finding a strategy for improvement is easy because of the recommendations.	24.7%	75.3%	16.3%	83.7%
I can rely on the recommendations for improvement.	20.9%	79.1%	18.7%	81.3%

TABLE 6 Perception of the gamified components by students of human anatomy at the UFRO and the PUC.

Main components	Learning support				Usability			
	UFRO		PUC		UFRO		PUC	
	Agree	Totally agreed	Agree	Totally agreed	Agree	Totally agreed	Agree	Totally agreed
Challenge	57.8%	42.2%	53.4%	46.6%	27.6%	72.4%	16.5%	83.5%
Chatbot	87.6%	12.4%	73.8%	26.2%	23.9%	76.1%	30.2%	69.8%
Tournaments	8.4%	91.6%	3.8%	96.2%	17.7%	82.3%	11.1%	88.9%
Community	83.6%	16.4%	87.2%	12.8%	31.7%	68.3%	41.1%	58.9%
Ranking	13.9%	86.1%	8.0%	92.0%	13.8%	86.2%	2.8%	97.2%
Tutorials	–	–	–	–	5.6%	94.4%	76.4%	23.6%
Application	9.8%	90.2%	11.6%	88.4%	21.7%	78.3%	25.3%	74.7%

Note: The mean and standard deviation are shown for each component and for each case study.

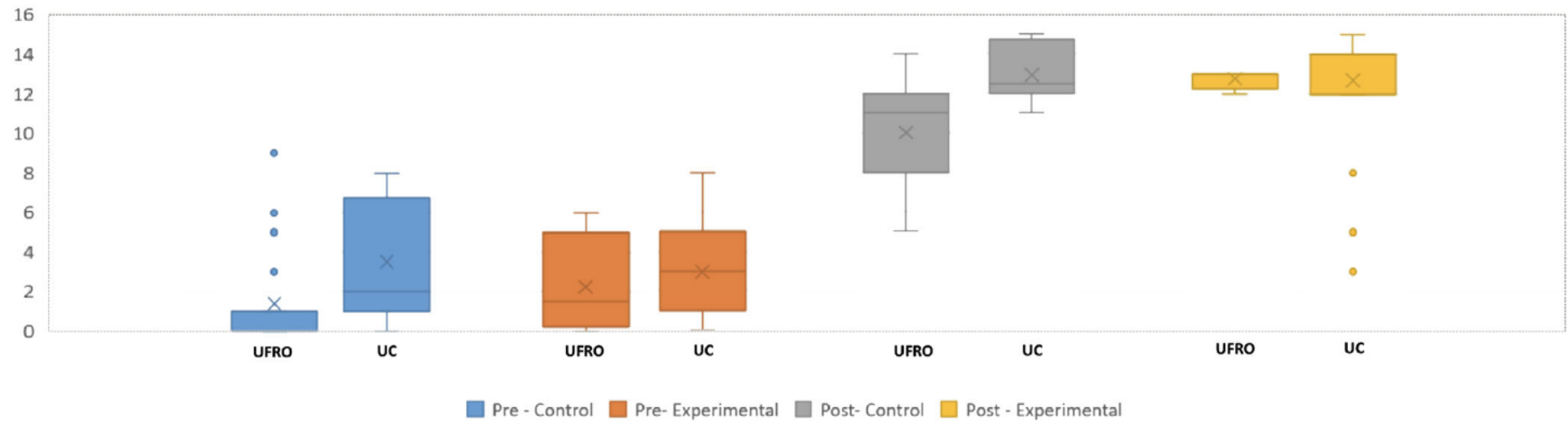


FIGURE 5 Comparative analysis: Visualizing the Pre and Post Experiment differences at UFRO and UC. Pre and Post experiment knowledge comparison of abdominal and lower limb muscles at UFRO and UC.

5 | CONCLUSION

In this study, we investigated the convergence between the learning of human anatomy through a gamified component and AIED techniques to advance the acquisition of knowledge of anatomy by first semester (first-year) medical students at the Universidad de la Frontera (UFRO) and the Pontificia Universidad Católica de Chile (PUC).

The main findings led to the conclusion that the gamified components support student learning of anatomy. This can be observed in both the usability and satisfaction achieved using components such as tournaments, ranking, challenges, and a virtual assistant. Students who used the application obtained higher and less diverse scores than the control group, and they highlighted the contribution of the gamified components in the study of anatomy.

The predictions and recommendations by the virtual assistant in relation to the artificial intelligence techniques implemented enabled students to abstract the aspects (contents) they needed to address in terms of their academic skills, allowing them to deploy this knowledge effectively in the study of human anatomy. However, to increase the use of the gamified components of the recommender system, personalization of the feedback and the types of advice to be given needs continuing work. In this way, the application is expected to contribute exponentially to students' decision-making in learning anatomy using a gamified technological tool.

OUR EXPERIENCE



Anatomy teaching courses

Courses in **Italian language**

- **Medicine and Surgery (n=180)**
- Nursing (n=315)
- Midwifery (n=50)
- Physiotherapy (n=50)
- Imaging and radiotherapy techniques (n=30)
- Dentistry (n=30)
- Dental hygiene (n=30)
- Childhood Neuro and Psicomotricity (n=30)
- Biomedical laboratory techniques (n=30)
- Optics and Optometry (n=150)

Courses in **English language** (international course)

- **Medicine and Surgery (n=50)**

Residency training programs

Medical Area

- Haematology
- Endocrinology and metabolic disorders
- Geriatrics
- Cardiovascular diseases
- Digestive diseases
- Respiratory diseases
- Emergency medicine
- Sport and exercise medicine
- Internal medicine
- Nephrology
- Neurology
- Child neuropsychiatry
- Paediatrics
- Psychiatry



Surgical Area

- General surgery
- Maxillofacial surgery
- Gynaecology and obstetrics
- Neurosurgery
- Orthopaedics and traumatology
- Otolaryngology



Clinical Services Area

- Anatomical pathology
- Anaesthesia, intensive care and pain management
- Hygiene and preventive medicine
- Occupational medicine
- Physical and rehabilitative medicine
- Nuclear medicine
- Clinical pathology and clinical biochemistry
- Radiodiagnostics
- Radiotherapy



Medicine and Surgery



Course in **Italian language**

Medicine and Surgery
(n=180)



Course in **English language (IMS)**

Medicine and Surgery
(n=50*)



Head of the teaching staff: Prof. Guido Cavaletti, MD

IMS teaching structure



Courses are delivered in English to students coming from all around the world



During the first year, IMS students are given a course named *Fundamentals of Human Morphology*, which aims to give them the foundation for their preparation



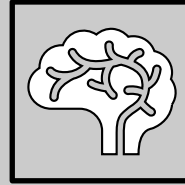
In subsequent years, they are once again taught anatomy in the so-called *vertical tracks* during which anatomy is presented in a clinically-oriented approach.



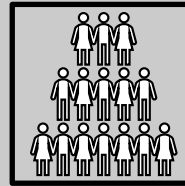
Hence, IMS was deemed as ideal to introduce and implement novel strategies relying heavily on **virtual dissections**, **gamification** and **flipped-classroom** approaches in a pilot and feasibility phase

Neuroanatomy course (30 hours)

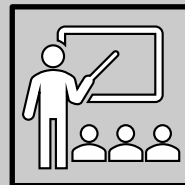
4th year, 2nd term



4-hour periods integrating **both frontal and interactive** activities.

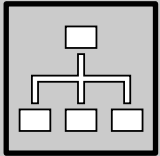


Students (n=36) were divided into 6 **teams** of 6 people, and each team was assigned a name by students' preference: these groups were meant to cooperate in the interactive breakout sessions.



At the start of the very first lesson of the course, students filled anonymously a **self-test multiple choice questionnaire accessible via a QR code**.

Lesson structure



At the top of each lessons, the class was divided into **groups** and completed these assignments rotating from one task to the other:

- 1) 8-mins dissection exercise generating a **score** for each group that was recorded via *Anatamage Table™*
- 2) exercises on *Anatamage Lessons™* platform
- 3) paper copy exercise.



Then, the **frontal** part of the lesson started: topics were presented via a combination of a virtual dissection on the Table and as little as possible use of a classic powerpoint slide deck; the latter was mostly used to convey schemes and summaries.



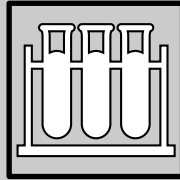
After a topic was presented, students were asked once again to cooperate into teams rotating from different **tasks**: one at the Table and others working together on paper copy exercise/*Anatamage Lessons™*.

Last course lesson



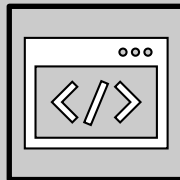
Tournament winning team:

Pooling together results from all dissections exercises the winning team was selected



Self-assessment test second trial

Students were given the opportunity to retake the same self-assessment test they did the very first lessons

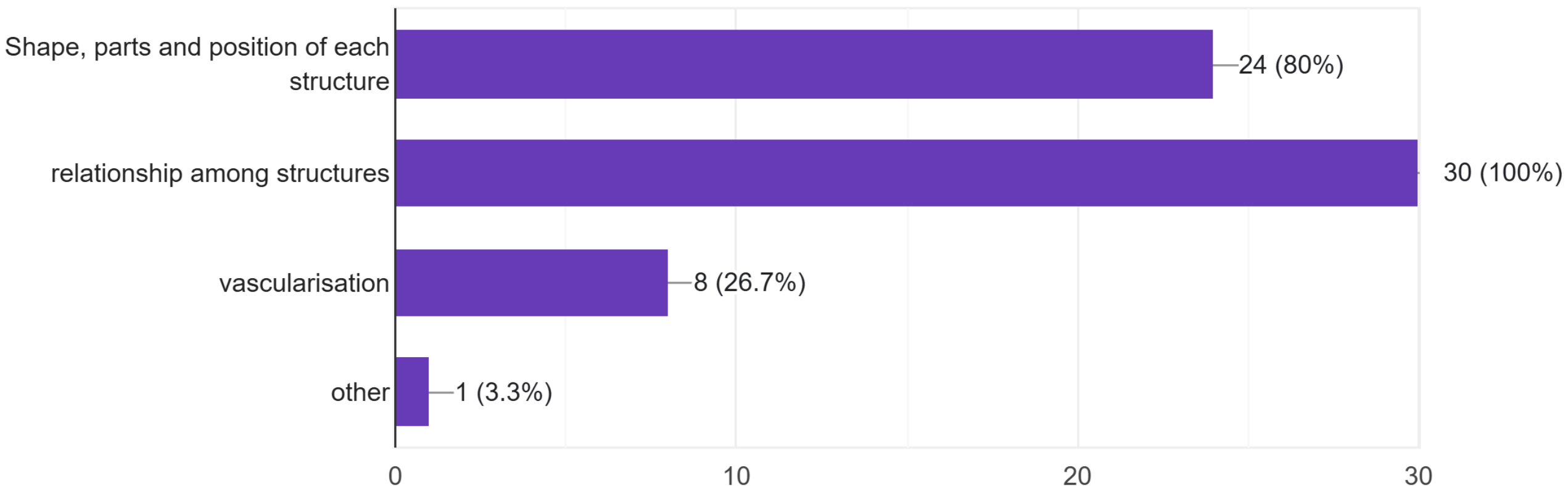


A satisfactory questionnaire was made accessible via a QR code. The standard grading system (on a 0-10 scale) used by our university to rate students' opinion on didactic activities was applied:

- 1) low (0-4)
- 2) intermediate (5-7)
- 3) high score (8-10)

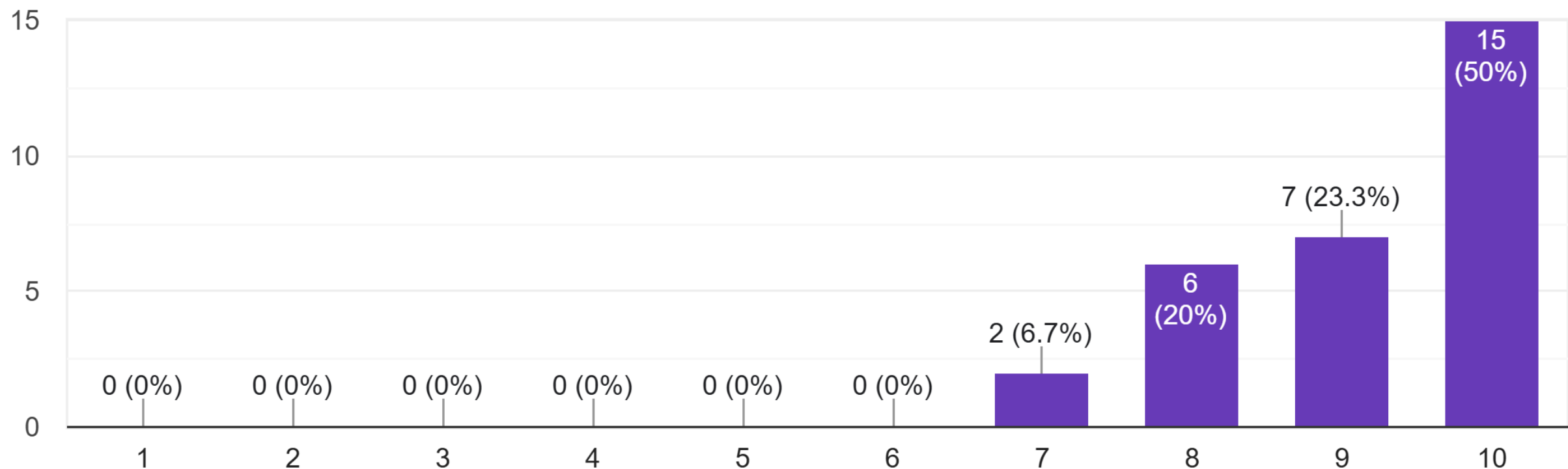
What did you better understand with the Table?

30 responses



How much do you think the table had an impact compared to a regular textbook?

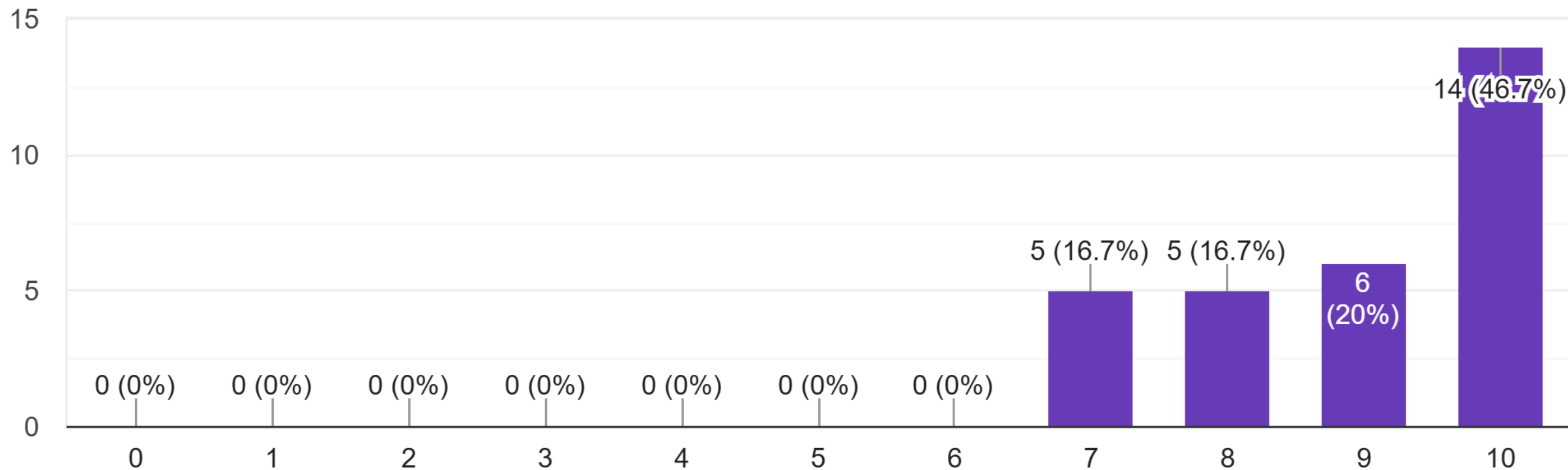
30 responses



Median score: 9.5 (Q1:8.25; Q3:10).

How useful was using directly yourself **Anatomage Table** to consolidate your learning experience?

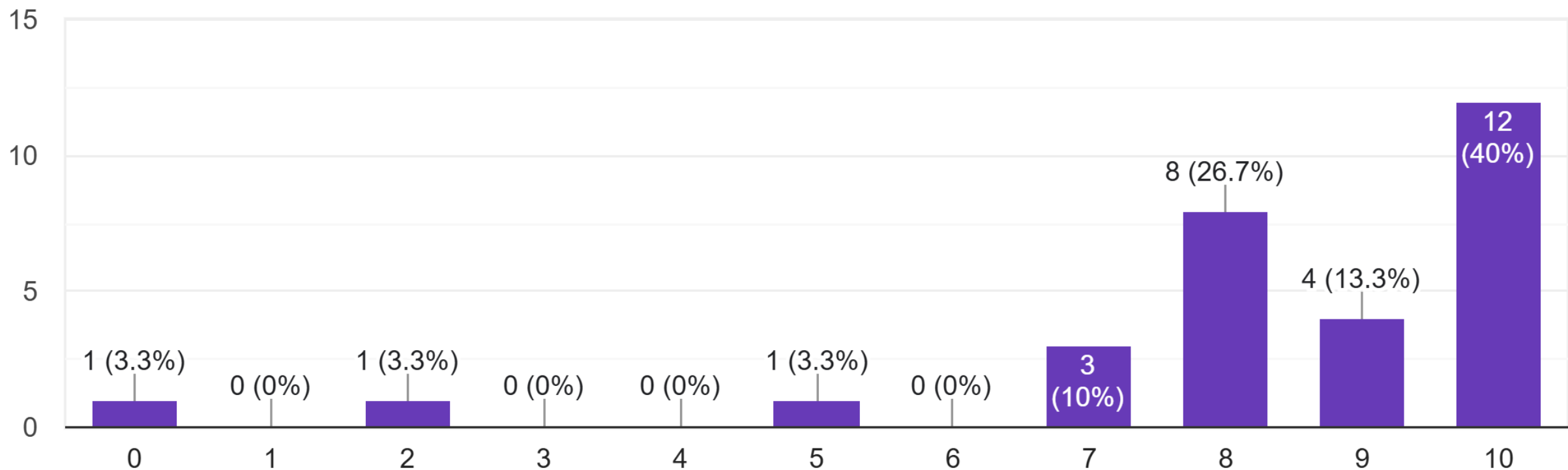
30 responses



Median score: 9 (Q1:8; Q3:10).

How useful was using Anatomage Lessons to consolidate your learning experience?

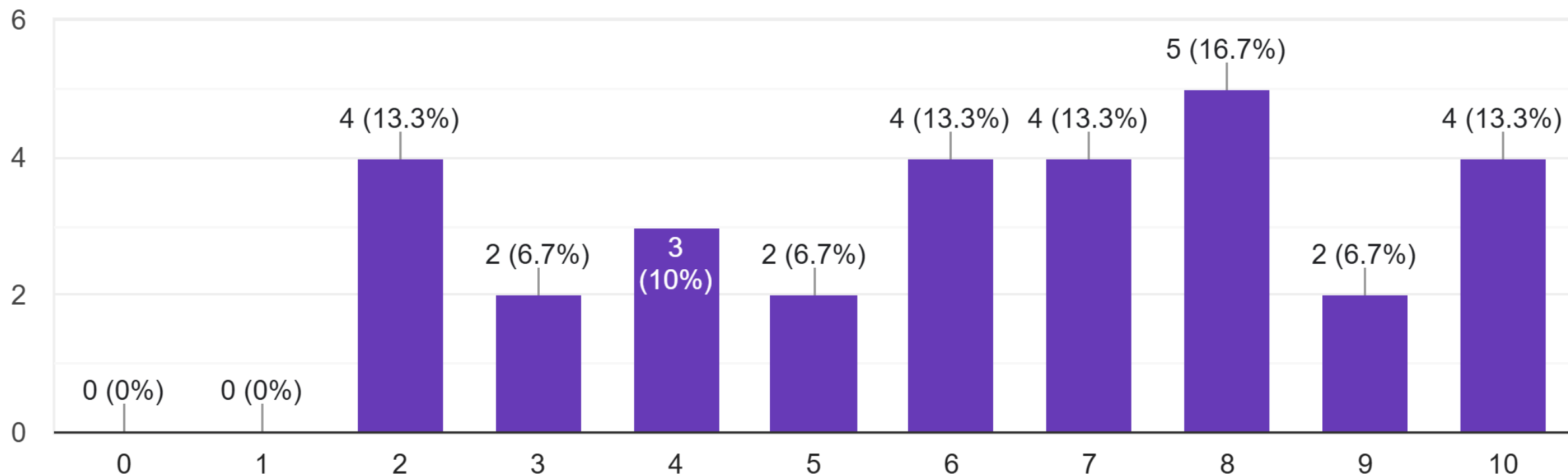
30 responses



Median score: 9 (Q1:8; Q3:10).

How useful was using paper copy exercises to consolidate your learning experience?

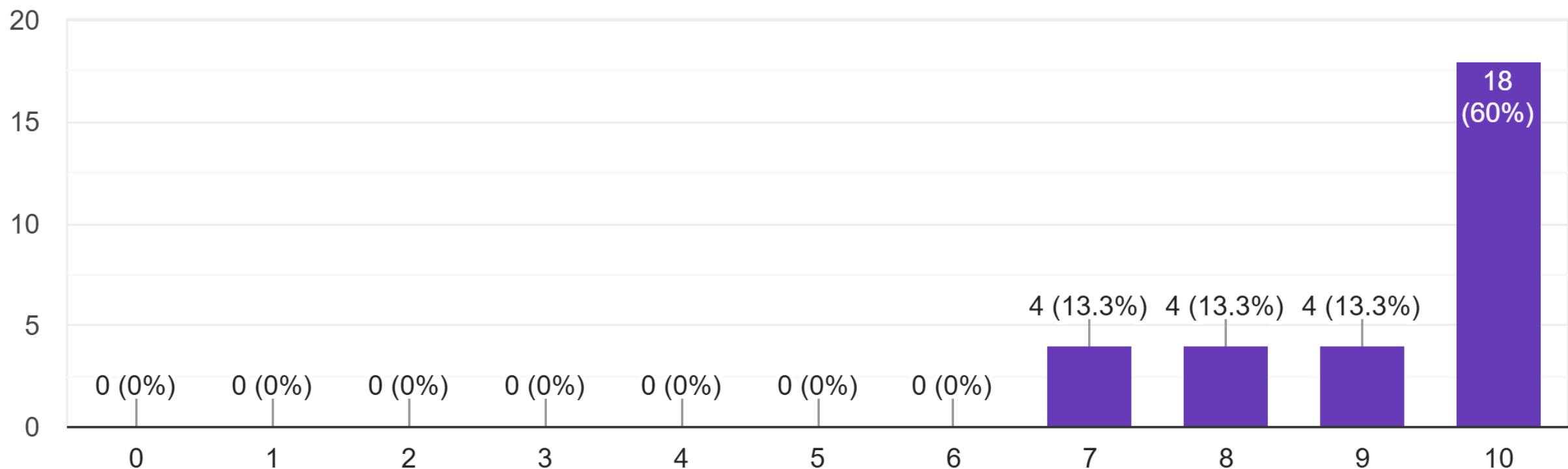
30 responses



Median score: 6.5 (Q1:4; Q3:8).

How useful was challenging yourself with the Anatomage tournament?

30 responses



Median score: 10 (Q1:8.25; Q3:10).

Self-assessment test results

Before taking the course

- At the start of the course, the mean of correct replies was **64%** overall.
- **25%** of questions were answered only by **less than 45%** of students.

After taking the course

- **more than 85%** of students were able to reply correctly to all questions
- for **25%** of the questions a correct answer was given by **100%** students
- the question with the lowest performance received a correct answer from **83%** of students

Future perspectives

- During the 1st year, one of the modules of *Fundamentals of Human Morphology* course, *Regional Anatomy*, has already been delivered similarly.
- The same goes for a course *Anatomy of female reproductive system* for 6th year students (implementation started in AA 2024-2025) as part of the *Woman and Child* vertical track.
- Similarly, the *Anatomy of the Digestive System* course (*Digestive Health* vertical track) for 5th year students is being revised accordingly starting from AA 2025-2026.
- A *Table* is now **freely available** in the library.
- We are also fostering a **peer-to-peer tutoring program** whose impactful results were already published for its pilot phase (Alberti, IJAE 2024).

Please, let us know your feedback! Thank you!



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