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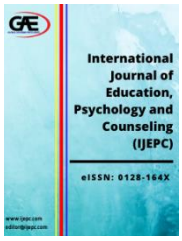

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RAT DISSECTION ALTERNATIVES IN MALAYSIAN BIOLOGY EDUCATION: A NEED ANALYSIS

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Abstract:

In rat dissection, students are found to be weak and unable to identify anatomical organs and draw and label them effectively in visual literacy. Since rat dissection is part of the Malaysian standardised curriculum, it must be preferred due to manipulative skill/dexterity acquisition. However, the problems in rat dissection persist. Many studies have suggested alternatives to replace hands-on rat dissection, aligning with humane education 3Rs principles (replacement, reduction, and refinement). Hence, there is a need to use animal-free alternatives as they allow the achievement of the learning objectives more effectively and have several advantages over animal use. Thus, this need analysis study researches the need for alternatives in sixth-form dissection practicals based on students' and teachers' perspectives. The survey involved 162 sixth-form students in the 2025/2026 batch and 86 teachers. The questionnaires have good validity and acceptable reliability. Both students and teachers agreed that rat dissection would increase one's scientific manipulative skills. However, they knew their right not to perform dissection. Moreover, both students and teachers also agreed that rat dissection is unethical. These findings from the needs analysis study proved that, although they are proponents of rat dissections, they know the ethical issues that revolve around it and can opt out of them. More than 50% of the respondents, students, and teachers, say they will opt for the alternatives. Lastly, students and teachers strongly agreed that the 3D paper model and mobile application (second choice) are their preferred choices for solving anatomical organ identification and enhancing drawing and labelling skills. They also strongly agreed that

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sustainability has to be the key feature for alternatives to be effective. These results indicate that the alternatives for rat dissection are needed and necessary to either complement or replace rat dissection.

Keywords:

Rat Dissection Alternatives, Humane Education, Need Analysis

Introduction

Despite the importance of both rat dissection and alternatives to rat dissection, proponents for these alternatives became more evident during the COVID-19 pandemic and post-pandemically. Adopting humane education, whereby 3R (replacement, reduction, and refinement) are urged, into the Malaysian education system is advocated (Chan, 2022; Ormandy et al., 2022). It is the student's right to an ethical educational experience by phasing out dissection (Buyukmihci, 2023). Equality in education, although in small proportions, whereby students against rat dissection due to ethical, religious, or cultural beliefs also can learn (Asante et al., 2021; Madhushree, 2020; Oakley, 2009, 2013; Taber et al., 2021). There will be an option available for them. Psychological, ethical, and environmental concerns are often raised when using animals in education (Omar Amahmid et al., 2019).

Since rat dissection is part of the Malaysian standardised curriculum, it must be preferred due to manipulative skill/dexterity acquisition. However, the problems in rat dissection persist. Thus, rat dissection needs redesigning in 21st-century learning (Mager, 2019), as advocated. Since then, many studies have suggested alternatives to replace hands-on rat dissection, aligning with humane education 3Rs principles (replacement, reduction, and refinement) (Osenkowski et al., 2022). Hence, there is a need to use animal-free alternatives as they allow the achievement of the learning objectives more effectively and have several advantages over animal use (Osenkowski et al., 2022). However, many issues arise regarding these alternatives, their usability, and their motivation. It is found that the primary against motivation is the lack of high-quality alternatives that seemingly highly utilise technology (Zemanova, 2022). Before this, educational technology setbacks were often suspected to be due to a lack of cognitive and motivational models (Cromley et al., 2020).

In rat dissection, students are found to be weak and unable to identify anatomical organs (Bandyopadhyay & Biswas, 2017; Kalthur et al., 2022; Lieu et al., 2018) and unable to draw and label them effectively (García Fernández & Ruiz-Gallardo, 2017, 2021; Mauch et al., 2020) in visual literacy (Susiyawati & Treagust, 2021). It is also evidently seen in the official practical examination reports (Malaysian Examinations Council, 2012-2024) on anatomical organ identification inability and from the document analysis of the school-based assessment on the inability to draw and label. From the literature review, several alternatives to rat dissection can be used in teaching or research. These alternatives include computer simulations, 3D models, virtual dissections, and plastination. All alternatives have advantages and disadvantages (Ormandy et al., 2022; Sack & Suder, 2023; Zemanova, 2022).

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Thus, this need analysis study is focused on answering the following research questions:

(a) Is there a need to develop alternatives in sixth-form dissection practicals based on students' perspectives?
(b) Is there a need to develop alternatives in sixth-form dissection practicals based on teachers' perspectives?

Literature Review

Before this, in 21st-century learning, Mager (2019) and Kalthur et al. (2022) stressed a need for school dissection redesigning. This is because dissections are often poorly delivered in the classroom and provide little benefit to student learning (Mager, 2019). The researcher suggested that to use dissections more effectively. Thus, educators need to address the purpose of performing a dissection and plan when to incorporate the activity into a larger unit (Mager, 2019). Poor delivery of rat dissection practicals leads to a lower impact on students learning. This might be due to time constraints and students' negative perceptions of rat dissection. Thus, Mager (2019) and Kalthur et al. (2022) are significant proponents of rat dissection. In addition, Zemanova (2022) and Ooi & Ooi (2020) mention that cultivating manipulative skills/dexterity in dissection is still applicable post-pandemic, although virtual dissections took off faster during the pandemic. They suggested the return to the full hands-on experience in learning through dissections (Ooi & Ooi, 2020).

Other notable proponents of rat dissection are Pokale (2019) and Fletcher (2021), who concluded that animal dissection, especially rat, is the most effective and constructive teaching aid than the alternatives. They urged educators to be aware that alternatives to dissection have their own limitations (Fletcher, 2021; Pokale, 2019). Adopting alternatives was often listed as lacking time to research other methods, high costs, and peer pressure (Zemanova, 2022). He supported the use of these alternatives as adjuncts to the educational process but not as complete replacements for the use of actual organisms (Kalthur et al., 2022; Pokale, 2019). Hence, an alternative to rat dissection is proposed to complement the rat dissection done in schools, which is aligned with one of the humane education principles, which is to reduce the usage of an actual organism. Many researchers worldwide have listed these alternatives. One of them is the virtual dissection. In addition, D. I. Lewis (2014) listed comprehensive virtual tools' pedagogical benefits and pitfalls for teaching and learning laboratory practices. Thus, this research followed the recommendation by D. I. Lewis (2014), which is only to develop resources of high quality, both educationally and technologically.

Lately, studies on rat dissection in the academic setting have been more concerned with the aspects of humane education in rat dissection. Hence, some researchers have investigated alternatives to implementing rat dissection. However, the effectiveness of these alternatives is still questionable due to the low acceptance rate of learners and educators. Hence, some believe that other options for rat dissection are less efficient in delivering student education. Indeed, many issues arise regarding these alternatives, their usability, and the motivation to use them. The primary against motivation is the lack of high-quality alternatives that seemingly utilize technology highly (Zemanova, 2022). A squeamish student is also reluctant to participate in a rat dissection (Sack & Suder, 2023). Even from the perspective of qualitative studies, little research has examined the effectiveness and impact of visual literacy in rat dissection practicals. Most recently, there is one study by Muhamad Shakir Saad et al. (2021) on matriculation education in Malaysia. However, the effectiveness study is only on the motivation aspect; hence, there is a need for an effectiveness study in performance achievement

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as well. To be more precise, the acquisition of visual literacy in anatomical organ identification and drawing and labelling skills. The researchers suggested following up with a different target group, such as sixth-form education (Muhamad Shakir Saad et al., 2021).

Besides that, researchers worldwide have many suggestions for alternatives to implementing rat dissection. However, none is in the context of Malaysia. A study designed for the Malaysian context is thus regarded as crucial since many sought to incorporate humane education into the education system. It echoed one of the proponents of humane education in Malaysian schools, Chan (2022), either by replacing rat dissection in secondary schools by using alternatives to dissection or reducing the usage of actual organisms. Group work in dissection minimises the number of organisms used (Oliveira & Gomes, 2023). Replacement, reduction and refinement (3Rs) are humane education's three core principles (Osenkowski et al., 2022). Even the Education Ministry started to pay more emphasis on humane education (Malay Mail, 2023).

The proponents for humane education in rat dissection are gaining momentum in Malaysia, especially in sixth-form, matriculation and even A-level education. Rat dissection is compulsory and can be assessed in practical examinations as part of the nationalized standardized curriculum. Hence, an alternative to dissection should be proposed to the ministry, with an actual comprehensive study in the Malaysian context. In addition, based on the systematic review by Ormandy et al. (2022), they proposed steps that educational institutions should take to phase out animal dissection. Their results provide compelling evidence in support of the 3Rs' principle of replacement in humane education (Ormandy et al., 2022; Osenkowski et al., 2022). However, the review is not only confined to rat dissection but also has a broader scope. Based on the review by Ormandy et al. (2022) and suggestions by Sack & Suder (2023), it can be concluded that the ideal alternative for rat dissection is of virtual anatomy tools and three-dimensional models.

Methodology

This research employed the survey method. The need analysis was carried out through a survey by *Google Forms* to identify the needs of sixth-form biology students and teachers faced in rat dissection. It involved 162 sixth-form students in 2025/2026 and 86 teachers. *WhatsApp* and *Telegram* applications were used as the medium to send the access link to the *Google Form* questionnaire. The details of the need analysis will be discussed in the next section. Prior to that, a concept accurately measured in a quantitative study is validity (Heale & Twycross, 2015). Instrument validity is classified into content, criteria, and construct validity. A systematic analysis of the test content to evaluate whether it covers a representative sample of the behaviours to be measured is known as content validity (Jackson, 2006). Experts in the field were consulted to determine the content validity of the need analysis questionnaires. Cohen's Kappa (k) is between 0.61 – 0.80. Thus, it is considered good on the agreement scale (Cohen, 1960).

The ability of instruments to deliver consistent results after repeated measurements in the same situation is referred to as reliability (Ary et al., 2008). The accuracy of an instrument is ensured by its reliability (Heale & Twycross, 2015). Test and retest reliability, inter-rater reliability, split-half reliability, and internal consistency are the four forms of reliability (Jackson, 2006). The reliability of needs analysis questionnaires was determined using Cronbach's alpha index. Respondents, students, and teachers were taken from the central zone of Malaysia. The Cronbach's Alpha (α) value is between 0.70 – 0.80. Hence, it is considered acceptable (George

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& Mallery, 2003).

Results of the Study

The discussion in this phase is divided into two parts to obtain answers to the research questions. The first part of the needs analysis data is about analysing the respondents' demographic distribution. The second part highlights the analysis of the perception of the needs of teachers and students. The analysis involved in the findings of the needs analysis phase includes descriptive data such as frequency, percentage, mean, and standard deviation.

Note that 162 student respondents were selected from the northern zone of Malaysia, and 86 teacher respondents from all over Malaysia. The findings on the profiles of students and teachers involved as respondents include school classification, type of school, gender, race, location of school, and state. Analysis of the demographic distribution of the study respondents is described in Table 1.

Table 1: Respondent Demography

Item No.	Item		Students n = 162 (%)	Teachers n = 86 (%)
01.	School Classification	Mode 1 Sixth-Form College	27 (16.7)	23 (26.7)
		Mode 2 Sixth-Form Centre	130 (80.2)	59 (68.6)
		Mode 3 Sixth-Form Centre	5 (3.1)	4 (4.7)
		Others	0 (0.0)	0 (0.0)
02.	Type of School	Sekolah Menengah Kebangsaan (SMK)	81 (50.0)	52 (60.5)
		Sekolah Menengah Jenis Kebangsaan	40 (24.7)	5 (5.8)
		(SMJK)	10 (6.2)	5 (5.8)
		Missionary School	4 (2.5)	0 (0.0)
		Private School	27 (16.7)	24 (27.9)
		Others		
03.	Gender	Male	42 (25.9)	15 (17.4)
		Female	120 (74.1)	71 (82.6)
04.	Race	Malay	47 (29.0)	23 (26.7)
		Chinese	84 (51.9)	38 (44.2)
		Indian	31 (19.1)	17 (19.8)
		Indigenous People of Sabah Sarawak	0 (0.0)	6 (7.0)
		Others	0 (0.0)	2 (2.3)
05.	Location of School	City	140 (86.4)	54 (62.8)
		Rural	22 (13.6)	32 (37.2)
06.	State	Perlis, Kedah, Pulau Pinang, Perak	162 (100.0)	23 (26.7)
		Selangor, WP Kuala Lumpur, WP	0 (0.0)	19 (22.1)
		Putrajaya	0 (0.0)	19 (22.1)
		Negeri Sembilan, Melaka, Johor	0 (0.0)	15 (17.4)
		Kelantan, Terengganu, Pahang	0 (0.0)	10 (11.6)
		Sabah, Sarawak, WP Labuan		

If observed, the student respondents are chosen from the northern zone of Malaysia as these states comprise the three modes of sixth-form centres, including private schools. However, there was a higher proportion of females in the student (74.1%) and teacher (82.6%) respondents selected.

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The need analysis was carried out through a survey by *Google Forms* to identify the needs of sixth-form biology students and teachers faced in rat dissection. Analysis of the students' perspectives on rat dissection alternatives (Part A) is described in Table 2. The descriptive analysis showed that the respondents, students, knew their right not to perform rat dissection (M = 4.75, SD = 0.433). They also agreed that rat dissection is unethical (M = 4.09, SD = 0.743). However, rat dissection will increase their scientific manipulative skills (M = 4.58, SD = 0.495). The students read about the alternatives to rat dissections (M = 4.21, SD = 0.625). They were interested in learning more about the alternatives to rat dissection (M = 4.00, SD = 0.370). Students strongly agree with 3D rat paper as an alternative for anatomical identification (M = 4.41, SD = 0.494) and drawing and labelling (M = 4.40, SD = 0.492). They also strongly agreed that sustainability has to be the key main feature for alternatives to be effective (M = 4.89, SD = 0.315).

In addition, the analysis of the students' perspectives on rat dissection alternatives (Part B) is described in Table 3. The descriptive analysis showed that the respondents, students, will still opt for alternatives for rat dissection (53.7%). However, their primary concern is the inability to experience executing rat dissection (40.1%).

Table 3: Students' Perspectives on Rat Dissection's Alternatives (Part B)

Item No.	Item		Students n = 162 (%)
23	What is your primary concern for executing rat dissection in school?	Nausea or disgust	21 (13.0)
		Fear or phobia	27 (16.7)
		High respect for animals (It is unethical)	45 (27.8)
		It is against my religion or cultural beliefs	51 (31.5)
		No answer	18 (11.1)
24	What is your primary concern if alternatives to rat dissection are implemented in school?	Acquisition of manipulative skills in rat dissection	40 (24.7)
		Acquisition of anatomical organ identification skills	18 (11.1)
		Unable to experience executing rat dissection	65 (40.1)
		No hands-on activity	39 (24.1)
		No answer	0 (0.0)
25	Will you opt for alternatives to rat dissection instead of conventional rat dissection?	Yes	87 (53.7)
		No	64 (39.5)
		No answer	11 (6.8)

Meanwhile, the analysis of the teachers' perspectives on rat dissection alternatives (Part A) is described in Table 4. The descriptive analysis showed that the respondents and teachers knew their right not to perform rat dissection (M = 4.67, SD = 0.562). They agreed that rat dissection was unethical (M = 3.94, SD = 0.787). However, rat dissection will increase their students' scientific manipulative skills (M = 4.67, SD = 0.471). The teachers read about the alternatives to rat dissections (M = 4.05, SD = 0.969). They were interested in learning more about the alternatives to rat dissection (M = 4.01, SD = 0.497). Teachers strongly agree with 3D rat paper as an alternative for anatomical identification (M = 4.60, SD = 0.492) and drawing and labelling (M = 4.58, SD = 0.496). They also strongly agreed that sustainability has to be the key main feature for alternatives to be effective (M = 4.86, SD = 0.349).

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Table 2: Students' Perspectives on Rat Dissection's Alternatives (Part A)

Item No.	Item	SD (1)	D (2)	N (3)	A (4)	SA (5)	Mean	SD, σ
07.	I did fish/frog dissection in secondary school	24	22	10	59	47	3.51	1.415
08.	I enjoyed fish/frog dissection in secondary school	38	11	6	53	54	3.46	1.573
09.	I'm interested in doing rat dissection	9	6	10	90	47	3.99	1.003
10.	I'm nervous and anxious about doing a rat dissection	5	10	10	127	10	3.78	0.778
11.	I will enjoy rat dissection	0	20	5	40	97	4.32	1.013
12.	Rat dissection will increase my manipulative skills	0	0	0	68	94	4.58	0.495
13.	I will carry out rat dissection because it will be evaluated in the examination	0	20	12	91	39	3.92	0.898
14.	If there is any other alternative, I would not have performed rat dissection	0	9	11	131	11	3.89	0.590
15.	I have read about alternatives to rat dissection	0	2	12	98	50	4.21	0.625
16.	I'm interested to learn more about the alternatives to rat dissection	0	0	11	140	11	4.00	0.370
17.	It is my right not to perform rat dissection	0	0	0	40	122	4.75	0.433
18.	I will not perform rat dissection due to my religious/cultural beliefs	15	25	17	51	54	3.64	1.331
19.	Rat dissection is unethical	0	0	38	72	52	4.09	0.743
20.	The alternative methods listed below are the most effective for you in anatomical organ identification:							
20a)	Plastinated (preserved) rat specimen	0	0	5	106	51	4.28	0.516
20b)	Plastic rat model/chart	0	0	0	133	29	4.18	0.385
20c)	Constructible 3D rat paper model	0	0	0	95	67	4.41	0.494
20d)	Rat clay/plasticine modelling/sculpting	0	0	17	129	16	3.99	0.453
20e)	Learning module/e-module	0	0	0	111	51	4.31	0.466
20f)	Learning video	0	6	4	107	45	4.18	0.649
20g)	Computer simulation	0	0	6	134	22	4.10	0.405
20h)	Augmented or virtual reality	0	0	0	127	35	4.22	0.413
20i)	Android / iOS mobile application	0	0	0	99	63	4.39	0.489
21.	The alternative methods listed below are the most effective for you in enhancing drawing and labelling skills:							
21a)	Plastinated (preserved) rat specimen	0	3	5	105	49	4.23	0.595
21b)	Plastic rat model/chart	0	0	0	129	33	4.20	0.404
21c)	Constructible 3D rat paper model	0	0	0	97	65	4.40	0.492
21d)	Rat clay/plasticine modelling/sculpting	0	6	24	109	23	3.92	0.659
21e)	Learning module/e-module	0	1	4	112	45	4.24	0.520
21f)	Learning video	0	5	5	107	45	4.19	0.633
21g)	Computer simulation	0	0	6	130	26	4.12	0.428
21h)	Augmented or virtual reality	0	0	1	128	33	4.20	0.415
21i)	Android / iOS mobile application	0	0	0	104	58	4.36	0.481
22.	The alternative to rat dissection, to be effective, must have the following features:							
22a)	Have a three-dimensional (3D) perspective of anatomical structures (usefulness)	0	0	0	52	110	4.68	0.468
22b)	Help in anatomical organ identification	0	0	0	61	101	4.62	0.486

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	(usefulness)							
22c)	Help in drawing and labelling skills (usefulness)	0	0	0	44	118	4.73	0.446
22d)	Highly affordable (ease of use)	0	0	0	56	106	4.65	0.477
22e)	Easily available (ease of learning)	0	0	0	44	118	4.73	0.446
22f)	Sustainable (satisfaction)	0	0	0	18	144	4.89	0.315

Table 4: Teachers' Perspectives on Rat Dissection's Alternatives (Part A)

Item No.	Item	SD (1)	D (2)	N (3)	A (4)	SA (5)	Mean	SD, σ
07.	I did fish/frog dissection in secondary school	19	14	0	28	25	3.30	1.572
08.	I enjoyed fish/frog dissection in secondary school	23	10	0	18	35	3.37	1.708
09.	I'm interested in doing rat dissection	0	0	5	50	31	4.30	0.575
10.	I'm nervous and anxious in doing rat dissection	0	0	4	73	9	4.06	0.387
11.	I will enjoy rat dissection	0	0	0	20	66	4.77	0.425
12.	Rat dissection will increase my students' manipulative skills	0	0	0	28	58	4.67	0.471
13.	I will carry out rat dissection because it will be evaluated in examination	0	2	5	48	31	4.26	0.672
14.	If there is any other alternative, I would not have performed rat dissection	0	10	4	63	9	3.83	0.770
15.	I have read about alternatives to rat dissection	0	11	5	39	31	4.05	0.969
16.	I'm interested to learn more about the alternatives to rat dissection	0	2	4	71	9	4.01	0.497
17.	It is my right not to perform rat dissection	0	0	4	20	62	4.67	0.562
18.	I will not perform rat dissection due to my religious/cultural beliefs	0	8	10	20	48	4.26	0.996
19.	Rat dissection is unethical	0	0	29	33	24	3.94	0.787
20.	The alternative methods listed below are the most effective for you in anatomical organ identification:							
20a)	Plastinated (preserved) rat specimen	0	0	0	53	33	4.38	0.489
20b)	Plastic rat model/chart	0	0	0	68	18	4.21	0.409
20c)	Constructible 3D rat paper model	0	0	0	34	52	4.60	0.492
20d)	Rat clay/plasticine modelling/sculpting	0	0	9	72	5	3.95	0.403
20e)	Learning module/e-module	0	0	0	67	19	4.22	0.417
20f)	Learning video	0	0	0	57	29	4.34	0.476
20g)	Computer simulation	0	0	5	71	10	4.06	0.416
20h)	Augmented or virtual reality	0	0	0	67	19	4.22	0.417
20i)	Android / iOS mobile application	0	0	0	52	34	4.40	0.492
21.	The alternative methods listed below are the most effective for you in enhancing drawing and labelling skills:							
21a)	Plastinated (preserved) rat specimen	0	0	2	51	33	4.36	0.529
21b)	Plastic rat model/chart	0	0	1	67	18	4.20	0.429
21c)	Constructible 3D rat paper model	0	0	0	36	50	4.58	0.496
21d)	Rat clay/plasticine modelling/sculpting	0	5	19	57	5	3.72	0.662
21e)	Learning module/e-module	0	0	8	59	19	4.13	0.549
21f)	Learning video	0	0	5	52	29	4.28	0.567
21g)	Computer simulation	0	0	5	70	11	4.07	0.428
21h)	Augmented or virtual reality	0	0	3	64	19	4.19	0.473
21i)	Android / iOS mobile application	0	0	0	56	30	4.35	0.476

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22.	The alternative to rat dissection, to be effective, must have the following features:							
22a)	Have a three-dimensional (3D) perspective of anatomical structures (usefulness)	0	0	0	18	68	4.79	0.409
22b)	Help in anatomical organ identification (usefulness)	0	0	0	28	58	4.67	0.471
22c)	Help in drawing and labelling skills (usefulness)	0	0	3	17	66	4.73	0.518
22d)	Highly affordable (ease of use)	0	0	0	19	67	4.78	0.417
22e)	Easily available (ease of learning)	0	0	0	16	70	4.81	0.391
22f)	Sustainable (satisfaction)	0	0	0	12	74	4.86	0.349

In addition, the analysis of the teachers' perspectives on rat dissection alternatives (Part B) is described in Table 5. The descriptive analysis showed that the respondents and teachers will still opt for alternatives for rat dissection (51.2%). However, their primary concern is the inability to experience executing rat dissection (38.4%). Currently, teachers use video and animation as alternatives (44.2%). 44.2% of teachers actively allowed their students to opt out of rat dissection. Out of that, female students who opted out encompass 82.6%. Among the top reasons for doing so is that the rat dissection is against the students' religion or cultural beliefs (32.6%). Besides that, the teachers felt that the primary barrier to implementing alternatives was that they believed that animal-free alternatives are not as good as the use of real animals. 34.9% of teachers expressed the need for higher-quality alternatives. For now, 38.4% agreed with rat dissection and would not change the status quo. The teachers, in the researcher's opinion, believed cost (30.2%), time (19.8%), and skill acquisition (40.7%) would be the central issue in consideration when conducting rat dissection.

Table 5: Teachers' Perspectives on Rat Dissection's Alternatives (Part B)

Item No.	Item		Teachers n = 86 (%)
23	What is your primary concern for executing rat dissection in school?	Nausea or disgust	14 (16.3)
		Fear or phobia	14 (16.3)
		High respect for animals (It is unethical)	24 (27.9)
		It is against my religion or cultural beliefs	19 (22.1)
		No answer	15 (17.4)
24	What is your primary concern if alternatives to rat dissection are implemented in school?	Acquisition of manipulative skills in rat dissection	24 (27.9)
			9 (10.5)
		Acquisition of anatomical organ identification skills	33 (38.4)
			20 (23.3)
		Unable to experience executing rat dissection	0 (0.0)
		No hands-on activity	
		No answer	
25	Will you opt for alternatives to rat dissection instead of conventional rat dissection?	Yes	44 (51.2)
		No	33 (38.4)
		No answer	9 (10.5)
26	Do you actively allow students to opt out of rat dissection?	Yes	38 (44.2)
		No	33 (38.4)
		No answer	15 (17.4)
27	What percentage of students choose not to participate in dissection?	0%	34 (39.5)
		1 – 25%	52 (60.5)
		26 – 50%	0 (0.0)
		No answer	0 (0.0)

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28	Which gender – in your experience – is more likely to ask not to participate in rat dissection?	Both gender	15 (17.4)
		Female	71 (82.6)
		Male	0 (0.0)
		No answer	0 (0.0)
29	What reasons do students have for not wanting to participate in dissection?	Nausea or disgust	20 (23.3)
		Fear or phobia	24 (27.9)
		High respect for animals (It is unethical)	14 (16.3)
		Against their religious or cultural beliefs	28 (32.6)
		No answer	0 (0.0)
30	What materials do you make available to students as an alternative?	Observing others in doing rat dissection	15 (17.4)
		Video or animation	38 (44.2)
		Photo, text, or images	20 (23.3)
		Virtual dissection	0 (0.0)
		Rat models	4 (4.7)
		Others	0 (0.0)
		No alternative	9 (10.5)
Item No.	**Item**		**Teachers n = 86 (%)**
31	What do you think are the barriers to implementing alternatives?	I don't think animal-free alternatives are as good as the use of real animals	33 (38.4)
		High costs for alternatives	30 (34.9)
		Lack of time to research appropriate animal-free alternatives	0 (0.0)
		Peer pressure to continue rat dissection as a tried and tested method	0 (0.0)
		Students prefer real organs over models	0 (0.0)
		Lack of equipment for alternatives	13 (15.1)
		Alternatives not known	10 (11.6)
		No answer	0 (0.00)
32	What would you need to include alternatives in teaching?	Higher quality alternatives	30 (34.9)
		I disagree with "no dissection", and I would not change the status quo	33 (38.4)
		Time for preparation for alternatives	0 (0.0)
		Higher budget or funding	0 (0.0)
		Better materials in school (books, models)	0 (0.0)
		Better technology or facilities	10 (11.6)
		Guideline from the ministry	13 (15.1)
		No answer	0 (0.0)
33	What are the problems encountered while preparing and conducting the rat dissection experiment in school?	From thematic coding:	
		Cost	26 (30.2)
		Time	17 (19.8)
		Skill acquisition	35 (40.7)
		Others	3 (3.5)
		No Answer	21 (24.4)

Discussions

Frogs and rats in education have been used in many countries worldwide for decades. This practice has long been the subject of heated debate due to its psychological, moral, ethical, and environmental implications. Several studies have focused on the status and implementation of dissections and the alternatives in school education in developed countries. However, little attention has been paid to this issue in developing countries, including Malaysia, which is not

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considered a priority. Implementing alternatives continues to attract scholarly interest, particularly as new regional perspectives and educational reforms emerge in Malaysia.

Thus, the need for students and teachers to analyse the situation is deemed essential. This need analysis laid a solid foundation, paving the way for deeper investigation when comparing the data side-by-side. Figure 1 illustrates the perspectives on rat dissection. Both students and teachers agreed that rat dissection would increase one's scientific manipulative skills (Kavai et al., 2015). They knew their right not to perform dissection (Buyukmihci, 2023; Oakley, 2012). However, they agreed and knew that in Malaysia, educators must carry out rat dissections because they would be tested for the examination (Malaysian Examinations Council, 2012). Both students and teachers agreed that rat dissection is unethical (Omar Amahmid et al., 2019). These findings from the needs analysis study prove that, although they are proponents of rat dissections, they know the ethical issues that revolve around it and can opt out of them.

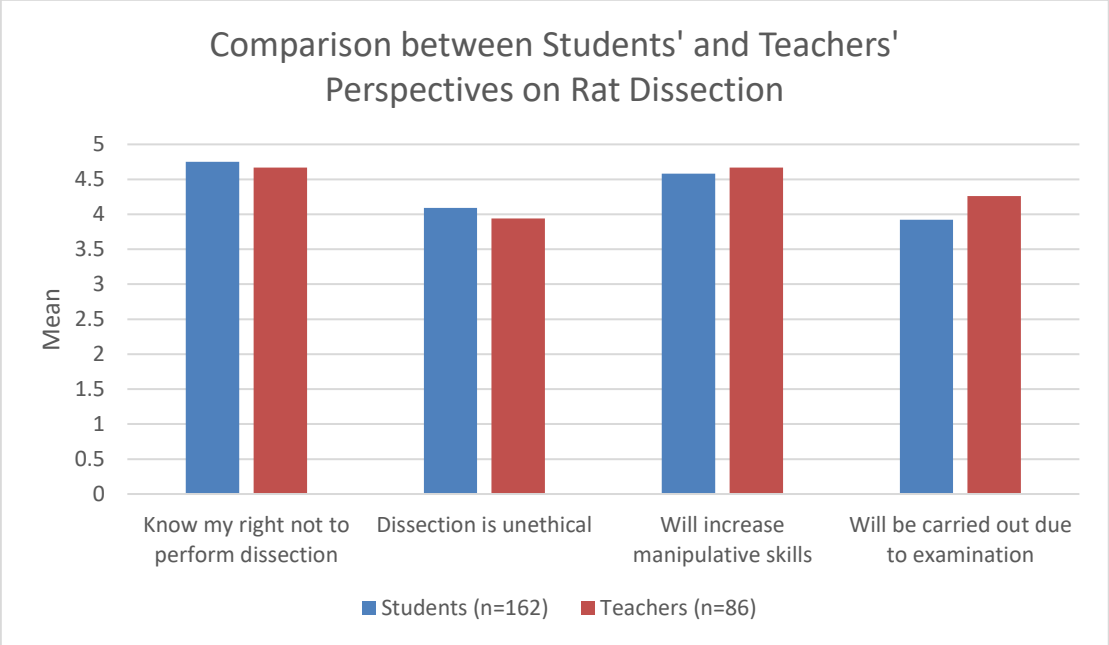

Figure 1: Perspectives on Rat Dissection

In addition, Figure 2 depicts the teachers' perspectives on the rat dissection from the thematic coding of the need analysis. Here, 40.7% of the respondents, teachers, are concerned with acquiring skills from rat dissection. These concerns align with the research by Mager (2019), who questioned whether students acquired those skills. Besides that, in the need analysis, the teachers also noted concerns about the cost to purchase (30.2%) and the time spent (19.8%) during dissection. It was mentioned before by Bolino et al. (2023). Thus, having an alternative with lower cost and sustainability would be an excellent advantage for teachers.

Meanwhile, Figure 3 portrays the perspectives on rat dissection alternatives. More than 50% of the respondents, students, and teachers, say they will opt for the alternatives. However, their concerns are mainly about the inability to experience rat dissections. The need analysis results align with studies by (Osenkowski et al., 2022). Most educators believed that learning objectives related to biology subject content could be met through alternatives. However, they preferred the hands-on experience of dissection (Osenkowski et al., 2022). Most educators

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allow students to use alternatives if requested (Osenkowski et al., 2022). Note that 44.2% of the respondents in the Malaysian teacher group allowed their students to do so. Extensive studies in Western contexts have inspired new opportunities to enrich theoretical interpretation within the Malaysian context.

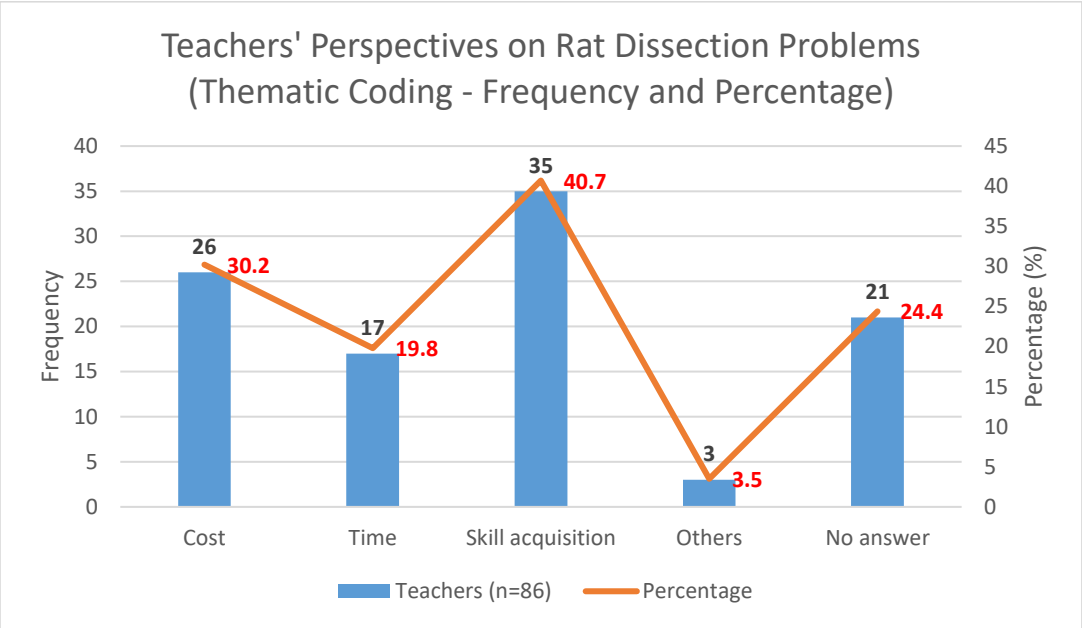

Figure 2: Perspectives on Rat Dissection Problems

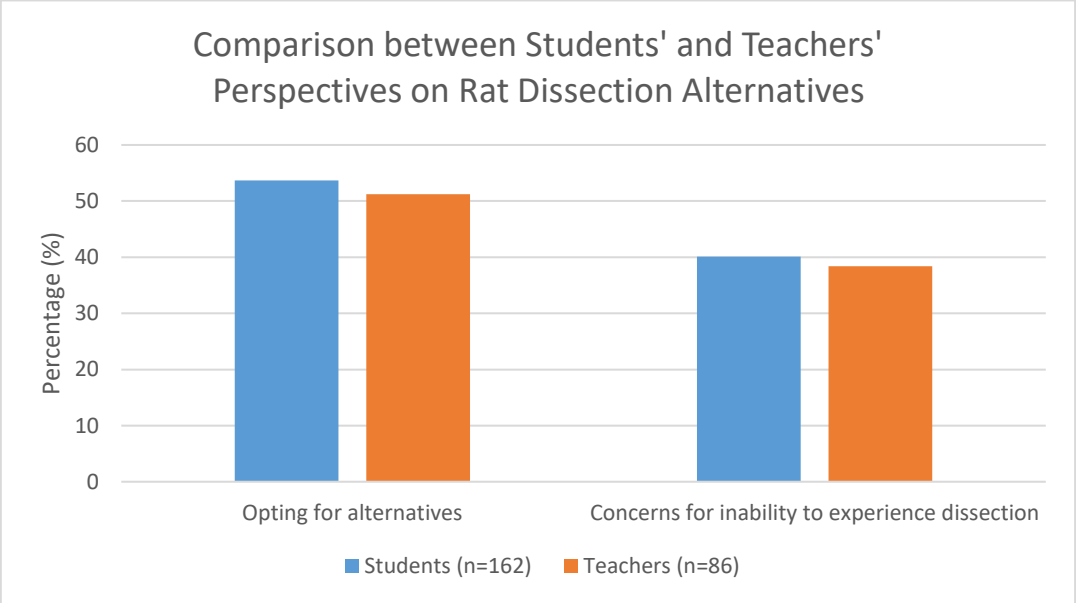

Figure 3: Perspectives on Rat Dissection Alternatives

Since alternatives can be used to meet learning objectives associated with dissection (Osenkowski et al., 2022), a proposal replacement is sought in the need analysis. Students and teachers were asked about the possible replacement for rat dissection in solving their visual literacy. Figure 4 illustrates the potential alternatives in solving the anatomical organ identification. Both students and teachers strongly agreed that the 3D paper model and mobile

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application (second choice) are their preferred choices. In addition, Figure 5 illustrates the potential alternatives for enhancing drawing and labelling skills. Both students and teachers strongly agreed that the 3D paper model and mobile application (second choice) are their preferred choices. These preferred choices align with the research by (Sack & Suder, 2023), who research papers and digital technology as alternatives to dissections.

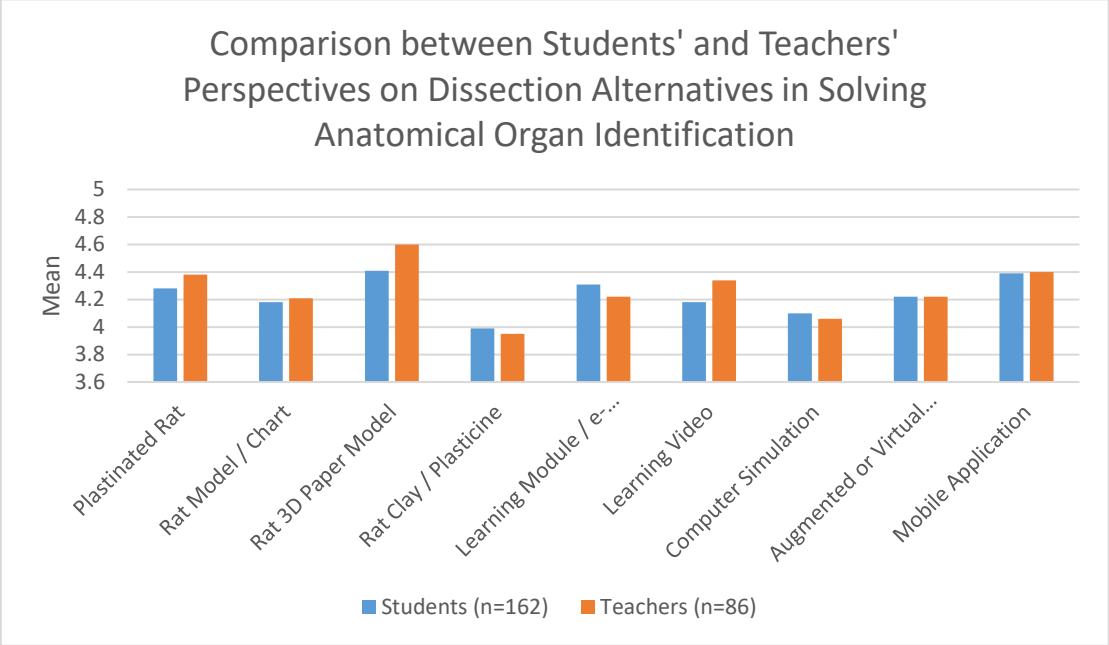

Figure 4: Potential Alternatives in Solving Anatomical Organ Identification

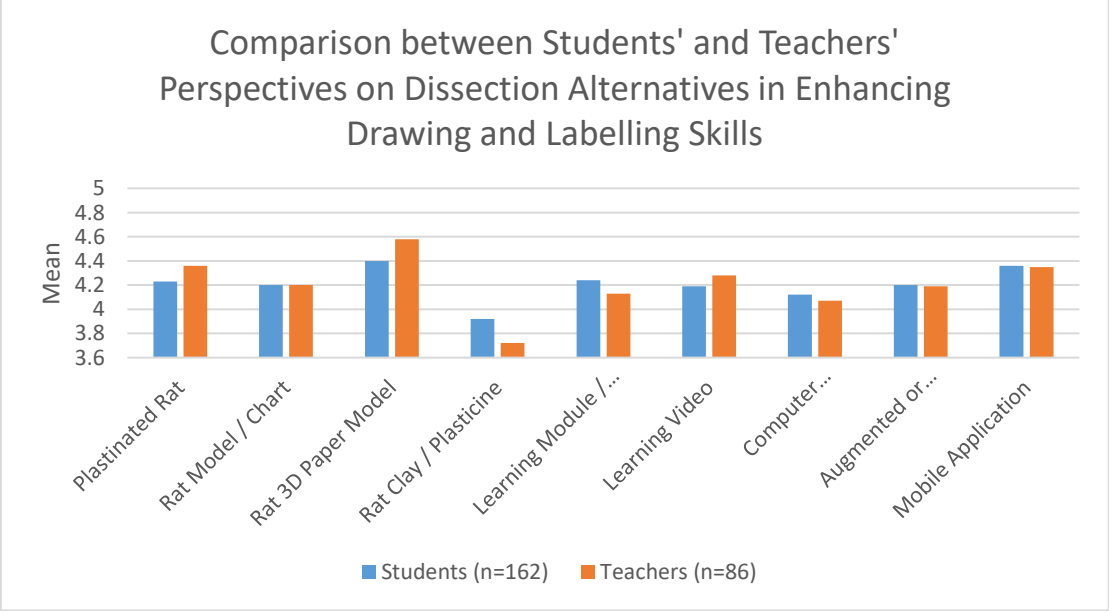

Figure 5: Potential Alternatives in Enhancing Drawing and Labelling Skills

Thus, animal-free alternatives need to be developed as they allow the achievement of the learning objectives more effectively and have several advantages over animal use (Osenkowski et al., 2022). However, many issues arise regarding these alternatives, their usability, and their motivation. It is found that the primary against motivation is the lack of high-quality

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alternatives that seemingly highly utilise technology (Zemanova, 2022). Before this, educational technology setbacks were often suspected to be due to a lack of cognitive and motivational models (Cromley et al., 2020).

Conclusion

In summary, there is a strong need to have the alternative to sixth-form dissection practicals based on students' and teachers' perspectives. The mentioned alternative, as a 3D rat paper model with virtual dissection in Android / iOS mobile application, is proposed primarily to address the problems/issues encountered. Both students and teachers also strongly agreed that sustainability has to be the key feature for alternatives to be effective. These results indicate that the alternatives for rat dissection are needed and necessary to either complement or replace rat dissection. Incorporating STEAM education and constructionism in the constructible 3D model by learners helps them to identify rat anatomy. The modules in the virtual dissection will guide them in drawing and labelling better. With the alternative designed to be robust educationally and technologically, highly usable, and motivating, educators can use the alternative to complement hands-on rat dissection in schools as a learner guide (Kalthur et al., 2022; Pokale, 2019). Ultimately, the Malaysian Ministry of Education, hopefully, one day, will replace rat dissection with alternatives in schools (Osenkowski et al., 2022) that are readily available and standardised for usage nationally, aligning with humane education.

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Conflicts of Interest

The authors disclose no conflicts of interest.

Data Availability Statement

Information accessible within the article or its additional components.

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