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1 Hand drawing as a tool to facilitate understanding in undergraduate human
2 biology: a critical review of the literature and future perspectives

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18 Hand drawing as a tool to facilitate understanding in undergraduate human
19 biology: a critical review of the literature and future perspectives

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21

22 Science and drawing have been paired for hundreds of years, and this synergy is still
23 prevalent in research investigating the role of drawing for developing and assessing
24 understanding. However, despite research at the primary and secondary levels of
25 education, there is limited research on whether drawing facilitates learning at the
26 undergraduate level, particularly in human biology. This subject specifically is
27 important to focus on as it can be a core subject on some multidisciplinary programmes
28 that do not require a science background at entry. The literature reviewed in this paper
29 highlights that drawing tasks are well received by students and that they perceive the
30 tasks to be helpful for their understanding. There is also some evidence that it might
31 improve learning. However, this cannot be concluded with confidence due to some
32 limitations with respect to comparison groups, including such a group being absent,
33 using retrospective cohorts as a control, and not controlling for instruction between
34 groups. Furthermore, some of the reported improvements in tests are practically very
35 small. More work is warranted in this area as there is a risk that misconceptions can
36 be passed on to students and between students using this type of teaching activity.

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38 Key words: Teaching; anatomy, physiology, draw, art

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43 Introduction

44

45 There is a long held association between science and art when it comes to learning about the
46 human body, developing largely during the renaissance period as a means to understand the
47 human form and map out its internal structures (Mavrodi et al., 2013; Rifkin et al., 2006). An
48 example familiar to most is Leonardo Da Vinci's Vitruvian Man, originally drawn in the late
49 fifteenth century, but still used in some classrooms in the modern day (Babaian, 2009; da Silva
50 et al., 2010). Developments in techniques and technologies mean that illustrations are no longer
51 the sole medium by which knowledge of the human body can be shared, but drawing is still a
52 widely used tool to teach science.

53 It is thought that drawing might aid memory and information recall (Heideman et al.,
54 2017), encourage students to pay attention to the finer details (Dempsey & Betz, 2001), help
55 understand the development of a structure as opposed to being presented with the completed
56 image (Lysek & Gernot, 1981), identify misconceptions or promote deeper understanding of
57 processes that written or verbal recall cannot (Murtonen et al., 2020), and encourage students
58 to challenge and explore their representations of science to help them make meaning of the
59 topic (Prain & Tytler, 2012). There is an abundance of examples of using drawings in primary
60 and secondary science education such as to assess informal learning on field trips (Cainey et
61 al., 2012), improve observation skills (Weekes, 2005), and to understand ideas about human
62 biology (Granklint Enochson et al., 2015). Ainsworth et al (2011) offer a review of relevant
63 research in this area and explore further ways in which drawing may help learning in science.

64 Despite the wealth of research at the lower levels of education, there is much less at the
65 undergraduate level. This is perhaps because it is assumed that more mature students have
66 already learned the fundamentals in preparation for more advanced study. This is not

67 necessarily true though, particularly in the area of human biology. Some undergraduate
68 programmes such as medicine, dentistry and physiotherapy require a suitable scientific
69 background for entry to the programme. However, there are other programmes on which human
70 biology is a core topic, but a science background is not required for entry, such as sport and
71 exercise, health and social care, some allied health professions such as nursing and midwifery,
72 and aesthetic professions such as health and beauty. In these latter subjects, other elements of
73 biology such as cytology and genetics are often taught within physiology modules, so this paper
74 uses the term human biology to reflect a broader scope than physiology alone. The majority of
75 the research at Undergraduate level aims to use drawing to identify misconceptions in trainee
76 science teachers (Bahar et al., 2008; Dikmenli, 2010; Kunt, 2016; Kurt et al., 2013; Pelaez et
77 al., 2005), or to assess knowledge (Chang et al., 2020). There is very little in terms of
78 implementing drawing as a strategy to improve understanding.

79 The aim of this paper is to critically review the existing literature on the use of drawing
80 as a tool to improve understanding in undergraduate human biology, and to provide
81 recommendations for future research.

82

83 Literature Search

84

85 Relevant literature was identified by searching ERIC (Education Resources Information
86 Centre), British Education Index, Scopus and Web of Science with the following search term;
87 (biology OR physiology) AND (“higher education” OR college* OR undergrad* OR “K-12”
88 OR kindergarten* OR “primary school*” OR “middle school*” OR “high school*” OR
89 “elementary school*” OR “vocational education” OR “adult education”) AND (Drawing or
90 doodl* or sketch*).

91

92 Six inclusion criteria were applied to the retrieved studies:

- 93 1. The authors measured either the student perception of learning or took an objective
94 measure of learning after the drawing intervention. Papers were excluded if the only
95 provided a description of teaching practice or a lesson plan.
- 96 2. The student(s) participating in the study produced the drawing themselves.
- 97 3. The drawing was a still image with no dynamic element, either labelled or unlabelled.
- 98 4. The subject matter was related human biology.
- 99 5. The intervention used aimed to progress learning rather than assess current
100 understanding or misconceptions.
- 101 6. Participating students are studying at the undergraduate level.

102

103 The workflow of study retrieval is presented in Fig 1. The key information extracted from the
104 remaining studies were (i) the students, (ii) the topic, (iii) the intervention, (iv) the findings.

105 This key information is outlined in Table 1.

106

107 Drawing as a Tool for Learning the Representational Aspects of Human Biology

108

109 Musculoskeletal (MSK) anatomy is a classic example of where art and science have
110 crossed over for learning, gaining particular ground during the renaissance years (Mavrodi et
111 al., 2013; Rifkin et al., 2006). Phillips (2000) exploited this relationship literally, inviting
112 medical students to partake in a three hour life drawing class. The objectives were to (i) help
113 students learn the basics of life drawing, (ii) apply knowledge in a more holistic context and

114 increase enjoyment of the anatomy course, (iii) consider the human body from an artistic rather
115 than medical point of view, and (iv) provide an opportunity to observe a naked human body in
116 detail. This is an interesting intervention that appeared to be well received by the students.
117 Unfortunately, the author did not track the students after the course as it would have been
118 beneficial to gain a deeper understanding about any impact that the class had on their
119 subsequent studies. Also, as the objectives were relatively holistic the application to learning
120 internal anatomy is limited.

121 Focusing more on the internal structures, and therefore the assessed content of most
122 anatomy classes, Naug et al (2011) implemented drawing activities into a session for a
123 multidisciplinary allied health cohort consisting of over 600 students. The class was delivered
124 as a rotation of 10-15 minute activities, one of which was titled 'blank page'. This activity
125 required students to draw and label a component of the MSK system without access to other
126 learning materials such as manuals or texts, and then revise their drawings after revision or
127 discussion with a tutor. A survey was distributed after the session, and the 282 respondents
128 overwhelmingly agreed that the activity assisted their learning and ranked the learning tool as
129 good or very good. The authors concluded that the favourable responses were due to the active
130 nature of the task and that it encouraged reflective observation of learning, conclusions
131 supported by students identifying that the session was 'fun', 'stimulating', 'challenging' and it
132 'made me think'. These are encouraging perceptions and identify the class as an example of
133 good practice for student engagement. However, it is difficult to identify the direct effects of
134 the activity on learning, as the pilot nature of the project meant that no outcome related to
135 learning was measured. Furthermore it is not described how the students chose a topic to draw
136 so they could have selected a topic they were more comfortable with, and less than half of the
137 class responded to the survey, so those with a negative view of the activity may have chosen
138 not to answer it. In the context of this review it should also be noted that some students opted

139 to complete a clay modelling exercise instead, and the respondents are not separated in the
140 results, so it is not clear how many of the respondents were referring directly to the drawing
141 activity.

142 Borrelli et al (2018) also investigated the effects of drawing on learning MSK anatomy,
143 but unlike Naug et al (2011) attempted to measure learning by implementing a test pre and post
144 intervention. A group of 49 students from mixed scientific backgrounds were invited to take
145 part in an extra-curricular anatomy drawing workshop. In the first half of the session students
146 conducted a live drawing task imitating an instructor who was drawing on a whiteboard in front
147 of the class. There was also some drawing instruction for aspects such as line formation and
148 layering. The second part of the session consisted of copying structures from a cadaver
149 specimen rather than from the instructor's drawing. The average test score increased
150 significantly from 4.93 to 6.04 out of 20 after the session, but the practical relevance of this
151 increase is questionable when considering that the upper confidence interval was an
152 improvement of 1.7 marks. Moreover, there was no control group so the minor improvement
153 in grade could have been down to any element of the class. The students perceived that their
154 knowledge of anatomy improved as a result of the session, possibly due to learning how to
155 simplify complex anatomy and how to recognize key features. However, it is difficult to affirm
156 how true these perceptions are due to the underlying limitations of the study.

157 The need of a control group for comparison was partially addressed by Joewono et al
158 (2018) by comparing the test results from three different undergraduate physiotherapy cohorts
159 (2012, 2013, 2014; n = 147). The 2012 and 2013 cohort were taught by traditional methods
160 incorporating group lectures and clinical practice, whereas the 2014 cohort also had added
161 drawing activities. When analysed using inferential statistics the 2014 class scored significantly
162 higher than the previous two cohorts. The average of the 2012 and 2013 class scores was 33.62
163 compared to 45.00 in the intervention group, meaning that the 2014 class demonstrated an

164 approximately 34% increase. This appears to be a large increase, but this could have been put
165 into better perspective if the authors had clarified the maximum score for the test. It would also
166 have been beneficial if the authors had identified if any specific content was facilitated more
167 by the drawing activity. Whilst the improved scores in this study are likely due to the
168 intervention, the drawing intervention is not well described so the contribution of other factors
169 to the improved score cannot be discounted. There is an example of one student's work in the
170 paper, but it is unclear if it was done in class, out of class, with instruction, with notes, or what
171 areas of the body were covered. Without this detail it is difficult to ascertain whether any effects
172 would be due to the drawing activity *per se* or simply a case of extra instruction. The time
173 difference between the drawing classes and the exam has not been described, so it is not known
174 how well the students retained the information.

175

176 Drawing as a Tool for Learning Biological Processes

177

178 Understanding the anatomy of the MSK system is an important fundamental of many
179 professions, but student understanding is limited without the ability to apply the knowledge.
180 Murtonen et al (2020) argue that some knowledge can be memorised without the need of a
181 deeper understanding of the content, but drawing can help to identify misconceptions and learn
182 processes beyond static anatomy. Such research is limited in an MSK context. One paper
183 looked to use an eight-week art observation class called 'Training the Eye' to improve the
184 medical observation skills of medical students (Naghshineh et al., 2008), however the students
185 did not actively take part in the drawing, so it is beyond the scope of this review. To examine
186 the effects of drawing on applying knowledge then we must look wider than the MSK literature
187 to the more abstract concepts of physiology.

188 Strand and Boes (2019) and Ylostalo (2019) describe some example interventions
189 including drawing tasks for teaching biological processes, but do not evaluate their
190 effectiveness. Rotbain et al (2005), on the other hand, implemented a drawing intervention with
191 the aim of improving student understanding of DNA structure and replication. Biology majors
192 (n = 187) were separated into a control and intervention group. The control group undertook
193 traditional classroom teaching, whereas the experimental group also completed a drawing task
194 that consisted of activities such as completing and labelling figures. Both groups sat a multiple-
195 choice question (MCQ) exam at the end of the scheme of work (20 hours), with the
196 experimental group scoring higher than the control group on all aspects of the test. It is difficult
197 for an MCQ exam to test the application of knowledge to processes, however the students
198 reported to find the task particularly beneficial for understanding the process of DNA
199 translation. The study suffers from some limitations, the main one being that the improved
200 scores may have been the result of extra instruction rather than the drawing task *per se*, as the
201 authors themselves state that, “... *and also enabled teachers to pay attention to the individual*
202 *progress of each student, which is especially important in heterogeneous classes*”. Moreover,
203 the absence of a retention test means that it is unclear if the task helped the students to recall
204 the information later in the course, and an MCQ test does not necessarily challenge
205 misconceptions. Nevertheless this study did successfully implement a controlled trial in the
206 same cohort of students, marking an improved research design from the MSK research
207 described in the previous section and making the paper more informative than the example
208 classes from other authors (Strand & Boes, 2019; Ylostalo, 2019).

209 Research has also been conducted on the use of drawing interventions to facilitate
210 learning of cell structure and division (Bell, 2014; Murtonen et al., 2020). Bell (2014) taught
211 the fundamentals of cell structure and mitosis to 33 students enrolled on an introductory college
212 biology course. The class was split into two groups after the taught session, with one group

213 undertaking a more passive drag and drop set of activities on an interactive PowerPoint, and
214 the other group a more active drawing task requiring them to copy and label from stock images.
215 The groups were inverted, so one group did the drawing task for cell structure and the other
216 one for mitosis so that both groups took part in the intervention. This allowed a crossover
217 design, and to partially account for the absence of a control for prior knowledge and therefore
218 the risk of one group performing better than the other group irrespective of an intervention.
219 Learning was assessed at the end of each task using a quiz. The results demonstrated an
220 improved average grade in the hand drawing group for the cell structure quiz, but there were
221 no differences between groups for the mitosis quiz. However, whilst statistically significant,
222 the difference between the groups in quiz one translated to an average improvement of only
223 1.6 marks out of 20. Therefore, in practice the hand drawing intervention could be argued to
224 be of no greater value than the PowerPoint exercise. However, an alternative form of
225 assessment may have helped better identify the effects of the drawing activity. For example the
226 mitosis quiz asked students to '*draw a cell in a particular phase of mitosis, labelling specified*
227 *structures*', so in the absence of any further detail this appears to be as fundamental a question
228 as the cell structure quiz, without asking the students to apply their knowledge to a process.
229 The quizzes were also completed only immediately after the class, so any instruction is likely
230 to have been of acute benefit, and the real interest is in whether the interventions help student
231 retain the knowledge for future application. Despite the criticisms of this study the design is an
232 advancement on Rotbain et al (2005) in terms of matching the level of instruction so any
233 changes are more likely to be directly due to the intervention.

234 Similar to Bell (2014), Murtonen et al. (2020) was interested in the use of drawing to
235 help the understanding of cell division, this time meiosis. An intervention group completed a
236 drawing task to act as a prompt for comparison against a model answer and to discuss
237 misconceptions. This task took place pre-session and acted as an extra activity compared to the

238 control group, so the fact any findings may be due to extra instruction, and that the drawing
239 task was more to initiate a future exercise, means that this study falls outside of the scope of
240 this review.

241 Progressing from cellular biology, there is very little research examining the effects of
242 drawing activities on understanding of more complex systems physiology. One study did
243 implement such a task to teach an element of renal physiology, specifically the function of a
244 nephron (Robinson et al., 2018). A class of medical students were issued with a large poster of
245 a nephron developed by staff and refined by students in a previous cohort. The self-directed
246 problem-based learning pedagogy employed by the course required students to work in groups
247 to research a particular section of the diagram and to peer educate others in the group. The
248 effectiveness of the task was evaluated by comparing the test scores of the cohort with previous
249 classes who did not have access to the drawing task. Statistical analysis identified an overall
250 significant F value for the ANOVA, but post hoc tests were absent so significantly different
251 pairings were not elucidated. In context, whilst statistically significant, the overall average
252 score for the intervention group was less than two marks higher than the control cohort with
253 the lowest score. This is possibly because the students appeared to do well on the test before
254 the intervention, with the control years scoring 89.3 and 88.4%. Therefore, either the test
255 employed (retired medical exam questions) was not sensitive enough to identify a gap in
256 learning, or the topic in question was not sufficiently challenging enough to require an
257 intervention. In addition, despite the task being associated with a drawing the students could
258 complete the task without drawing themselves. Thus, meaning that the application of the
259 findings to understanding the benefits of drawing for systems physiology is limited. Of interest
260 though is that the students did perceive the drawing to be helpful in the initial stages of learning
261 as it gave them an immediate framework of understanding and was copied and posted in rooms

262 to serve as a reference and became more useful as the degree went on. This raises a
263 consideration for knowledge retention, which was unfortunately not measured in his study.

264

265 Summary and Recommendations for Future Research

266

267 This review identifies that there is a relatively small body of literature investigating the benefit
268 of drawing activities for learning human biology at undergraduate level. It is difficult to
269 conclude from the existing literature that drawing activities facilitate learning at this level due
270 to limitations including in some cases an absence of outcome measures related to learning, no
271 student follow up to identify retention, and inappropriate comparison groups. Some of the
272 issues with the comparison groups included not having comparable levels of instruction so any
273 changes may not be due to drawing *per se*, and using previous cohorts as a comparison where
274 it cannot be guaranteed that previous experiences or instruction on other parts of the course
275 were comparable to the intervention group. Admittedly it is difficult to include a genuine
276 control group as for ethical reasons no student group can be purposely disadvantaged if it is
277 believed an intervention group will have greater achievement. However, based on current
278 literature this greater level of achievement cannot be assumed, and if it was true then a
279 comparison group could be exposed to the intervention post study to ensure an equitable
280 learning experience on the course. Taber (2019) offers recommendations for selecting control
281 groups in a recent review.

282 These limitations are important to address as one could argue that drawing activities
283 could be detrimental to learning when considering that drawings have been shown to unearth
284 misconceptions in students and trainee teachers. Such misconceptions could inadvertently be

285 passed on through such teaching activities (Bahar et al., 2008; Dikmenli, 2010; Kunt, 2016;
286 Kurt et al., 2013; Pelaez et al., 2005).

287 Below are some suggestions for future directions to help address some unanswered
288 questions and control for some of the discussed limitations.

289 (1) Prospective studies should be designed whereby a cohort is split into relevant
290 experimental groups at the start, controlled for academic ability and experience.
291 This will prevent the need for retrospective comparison to previous cohorts.

292 (2) Students should be tracked prospectively to measure knowledge recall later to help
293 identify false positives and negatives. For studies attributing an improved score to
294 drawing activities it cannot be ruled out that any benefit was only acute. Conversely
295 studies reporting no benefit of the activities cannot be certain that the same level
296 knowledge was not retained for longer in the intervention group. Student
297 perceptions should also be collected at a later date to ensure that any perceived
298 benefit of learning was not a result of the novelty of the task.

299 (3) Current research tends to focus on static elements on human biology such as MSK
300 anatomy or components of a cell. Future research should apply drawing tasks to
301 processes that require an understanding of location in space such as integrative
302 systems physiology.

303 (4) Several studies in this review are ran with medical students who would be expected
304 to already have a level of understanding of fundamental human biology. As a
305 generalisation, this population is arguably not where this research should be
306 targeted as they may learn irrespective of intervention, as witnessed by Robinson
307 et al (2018). Future work should be applied to undergraduate students on courses
308 that may not have required a fundamental level of science knowledge for entry, but
309 for which human biology is an important element e.g. sport and exercise, health and

310 social care, some allied health professions such as nursing and midwifery, and
311 aesthetic professions such as health and beauty.

312 (5) It is the author's opinion that future research should first aim to identify if drawing
313 is an effective learning tool at the undergraduate level before more detailed
314 research. A proposed research design is outlined in Table 2. If drawing activities
315 are found to be beneficial to learning then further research is needed into styles of
316 delivery from the teacher, or drawing competence of the student, in order to prevent
317 inadvertent passing of misconceptions. It could also lend from existing work that
318 aims to set conditions under which the learning technique may be most efficacious
319 (Tytler et al., 2020).

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323

324 Disclosure statement

325

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327

328

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330

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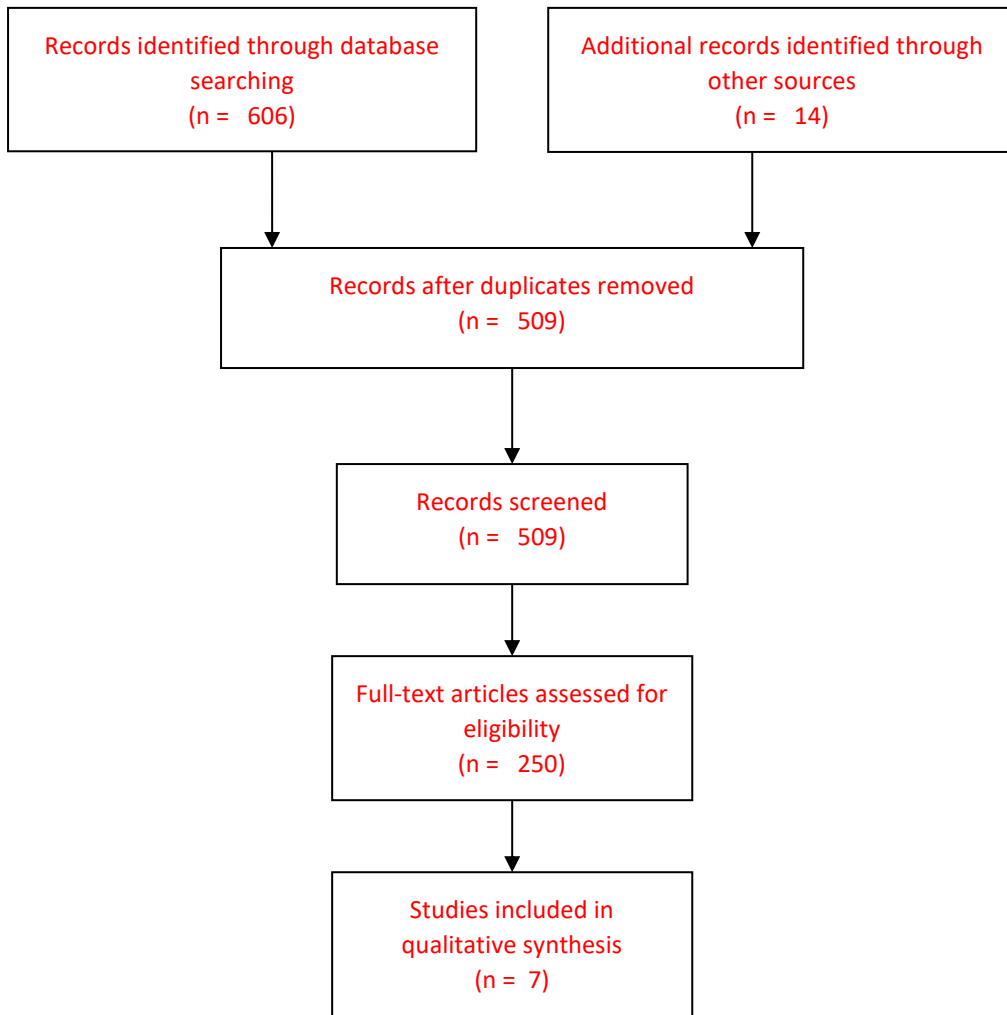
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414 Fig 1. Workflow diagram of study selection

415 Table 1. Retrieved studies that matched the inclusion criteria for the review

Study	Level	Topic(s)	Intervention	Findings
Bell (2014)	33 students from a pre-university science programme	Cell structure Cell division	All students attended the same taught session and were then assigned to one of two intervention, (i) interactive drag and drop images on PowerPoint, (ii) traditional drawing copying from stock images. The groups were inverted so they were in a different intervention group for the cell structure and cell division topics. Learning was assessed via a quiz following the intervention.	The hand drawing group scored better in the structure quiz (statistically significant), but there was no difference in results for the cell division quiz.
Borrelli et al. (2018)	49 undergraduate students enrolled on medicine, dentistry or allied health science degrees	Musculoskeletal anatomy	In the first half of the session students followed live instruction and imitated the image created by an instructor. This included some instruction on drawing e.g. line formation, layering. In the second half of the session students created drawings from observing cadaver specimens. All students sat a test before and after the session.	Test scores were significantly improved after the intervention. The students perceived an increased knowledge of anatomy, attributed to learning how to simplify complex anatomy and how to recognize key features.
Joewono et al. (2018)	147 undergraduate physiotherapy students over three different cohorts	Musculoskeletal anatomy	Cohorts from 2012 and 2013 were taught via traditional means including lecture classes and clinical practice. The 2014 class had an additional drawing class where they were encouraged to hand draw the relevant region of the body on an A3 page. The first semester module mark was used as the main study outcome measure.	There was a statistically significant increase in the average test score in 2014 which was not observed between 2012 and 2013.
Naug et al. (2011)	282 undergraduate students from mixed allied health programmes	Musculoskeletal anatomy	Students took part in a class rotation of activities which included a task named 'blank page', where they were instructed to draw or model an element without notes. They then worked with tutor to identify errors.	There was no objective measure of learning, but students were found to perceive the activity as having helped their learning. Positive comments included that it was 'fun', 'stimulating', 'challenging' and it 'made me think'.
Phillips (2000)	Undergraduate medical students	Musculoskeletal anatomy	Students attended a 3-hour life drawing class with a life drawing tutor and an anatomist.	Student perspectives are not described in detail, though the author's commentary suggested that feedback was generally

				positive, and offered that it may be good for students to see things from a new point of view.
Robinson et al. (2018)	Undergraduate medical students	Renal physiology	The class was issued with a large poster of a nephron to learn about renal physiology and histology. Students worked in groups to study a section of the diagram in detail and peer educate each other. The students did not necessarily have to conduct any drawing themselves. The efficacy of the intervention was evaluated by asking students to sit a test consisting of retired questions from the medical examination.	<p>Test scores were significantly improved in the second year of utilizing the intervention (following some edits suggested by the first cohort).</p> <p>The students perceived the drawing as being beneficial as it (i) gave them an immediate framework for understanding the histology, pharmacology, and physiology of the nephron, (ii) it did not allow them to neglect the learning of renal physiology, (iii) was always present in the study rooms and it served as a reference that became more useful as the course went on.</p>
Rotbain et al. (2005)	187 biology major students	DNA structure and replication	Students were separated into a control or intervention group. The control group undertook traditional classroom teaching, whereas the experimental group also completed a drawing task that consisted of activities such as completing and labelling figures. Both groups sat a multiple-choice question (MCQ) exam at the end of the scheme of work (20 hours),	The intervention group scored higher than the control group on all aspects of the test.

417 Table 2. Proposed research design to investigate the effects of drawing on learning at the undergraduate level

Element	Recommendation
Participants	Students enrolled onto undergraduate programmes that may not have a pre-entry science requirement, but for which human biology is a key element. See recommendation 4 in the text.
Subject matter	A topic with a spatial and temporal element and which requires interaction of different systems to allow the assessment of both information recall and application of knowledge. See recommendation 3 in the text. For clarity, the digestive system will be used as an example here, focusing on the path of food and water through the system, and the interaction with other systems for absorption and excretion.
Study groups	<p>Study group 1 (control): Taught the digestive system content using traditional means. The taught content should include images like those that group 2 will draw to ensure that any differences can be attributed to the drawing, and not the use of images.</p> <p>Study group 2 (intervention): Taught the same digestive system content as group 1 by the same teacher, but they are required to add to a drawing as they move to a new aspect. For example, they may start with a large outline of the human body and then add the internal structures with some additional representations of biological processes such as amylase activity in the buccal cavity. This design would control for the level of instruction, ensuring that differences between the groups is not a result of extra instruction in the drawing group. It also ensured that the drawing task is complementing rather than replacing other forms of instruction to promote student accessibility. In follow up work study group 2 could be adapted as per recommendation 5 in the text, or additional groups may be added whereby the drawing task is completed under different conditions or following some basic drawing instruction.</p>
Group allocation	Rank assign students to each group based upon either (i) their performance in a recent summative assessment, (ii) a pre-test on the topic of question, or (iii) a combination to account for academic ability (using (i) as a proxy measure) and prior understanding of the topic. See recommendation 1 in the text.
Outcomes	<p>Objective measurement: A summative exam with questions aimed at assessing both information recall (e.g. name one portion of the small intestine) and application of knowledge (e.g. imagine somebody has eaten a bowl of cereal with milk, explain how, when and where the respective nutrients are absorbed by the body).</p> <p>Subjective measurement: Collect student perceptions of whether they found the drawing task beneficial for their learning using qualitative methods. Study groups 1 and 2 could be inverted at the end of the study to allow perceptions from both groups.</p> <p>Retention of knowledge and changes in perceptions: The test should be repeated at a later date to understand if any differences are acute or continue after a period of time, and allow students to reflect on the drawing task (see recommendation 2 in the text).</p>

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