

Assessing Chinese anatomists' perceptions and attitudes toward blended learning through faculty development training programs

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Backgrounds: Due to the COVID-19 pandemic, the faculty development program has partially shifted to online formats over the past two years and has concentrated on professional training related to blended learning. The training outcomes directly relate to the trainees' perceptions and acceptability of blended learning. The views of teachers regarding the blended learning strategy were assessed to ascertain the efficacy of faculty training programs.

Methods: Anatomical teachers were chosen as an example since they constitute a sizable portion of medical science educators. Chinese anatomists were invited to participate in a survey on their attitude and readiness for blended learning.

Results: A total of 297 responses were received, covering all the provinces in mainland China. The survey results demonstrated that learning flexibility was ranked highest among all aspects of blended learning by Chinese anatomists. Meanwhile, the most crucial factor affecting the anatomists' perception was a connected learning community, which accounted for 14.77% of the total variance. Further analysis showed that the anatomists' attitudes toward blending learning differed significantly based on job titles, guidance from mentors, and support from in-service institutes. Lecturers were more involved in the connected learning community than teachers with other job titles. Generally, anatomists who received more institutional support showed superior learning management skills.

Conclusion: This survey revealed that Chinese anatomists regarded learning flexibility, a connected learning community, and learning management as valuable features of online/blended learning. Support from mentors/institutes would contribute to positive attitudes toward blended learning, thereby predicting better training outcomes. The observed characteristics of Chinese anatomists regarding blended learning will help make faculty training programs more successful by facilitating an understanding of teaching strategies in the future.

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20 **Abstract**

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33 total variance. Further analysis showed that the anatomists' attitudes toward blending learning
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39 connected learning community, and learning management as valuable features of online/blended
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43 by facilitating an understanding of teaching strategies in the future.

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45 *Keywords:* faculty development, blended learning, anatomy education.

46

47 **1. Introduction**

48 Medical education has undergone a gradual transformation, evolving into a distinct and
49 autonomous discipline. Previously, the prevailing assumption was that proficient healthcare
50 professionals could effectively engage in teaching once they specialized in their respective fields
51 and joined academic institutions. However, the implementation of faculty development programs
52 has demonstrated significant potential in enhancing the pedagogical effectiveness of medical
53 educators, thereby yielding improved learning outcomes for students. These comprehensive
54 faculty development activities aim to equip participants with the requisite knowledge, skills, and
55 competencies to excel as teachers, leaders, and researchers. Over the past decade, the critical
56 importance of faculty development has garnered widespread recognition, prompting numerous
57 medical schools and affiliated hospitals to establish sustainable training frameworks that
58 facilitate the systematic design and implementation of tailored faculty development programs
59 (Bligh, 2005; Hueppchen et al., 2011; McLean et al., 2008). Despite these efforts, faculty
60 development remains a challenging endeavor that necessitates various forms of support,
61 including visionary institutional leadership, adequate allocation of resources, and recognition for
62 teaching efforts (McLean et al., 2008).

63 Faculty development is an effective method for augmenting the expertise of faculty
64 members across various disciplines. Within authentic environments, faculty development
65 encompasses cultivating innovative teaching approaches, improved course structures,
66 strengthened teacher-student relationships, and the recognition and reward of exceptional

67 teaching performance (Trowbridge et al., 2011). In this particular context, the term “faculty
68 development” primarily refers to the concept of “instructional development” (Camblin and
69 Steger, 2000). The main objectives of faculty development in professional health education are
70 to enhance faculty competency within their respective positions, such as patient care for
71 clinicians, healthcare management for administrators, and teaching effectiveness for medical
72 educators (Camblin and Steger, 2000; Steinert et al., 2003; Brinkley-Etz Korn, 2018). The
73 effectiveness has been consistently reaffirmed through repeated investigations into educators’
74 perspectives on professional training (Avramidis and Norwich, 2002; van Aalderen - Smeets and
75 Walma van der Molen, 2015). Consequently, faculty development has gradually been
76 incorporated as part of the medical education framework. Almost all medical schools provide a
77 diverse range of flexible faculty training programs, which aim to foster an environment that
78 dramatically promotes faculty teaching excellence to the ultimate advantage of medical students
79 (Burgess et al., 2019; Crown et al., 2011; Pan et al., 2020).

80 Unfortunately, the unexpected COVID-19 pandemic posed a challenge. The faculty
81 development work arrangements were abruptly disturbed (Buckley, 2020; Eltayar et al., 2020;
82 Kachra and Ma, 2020). During the past two years, university teaching staff around the world
83 have attempted to adapt to the new situation: online-only education or blended online and offline
84 learning implemented for a specific period to continue normal teaching activities as much as
85 possible (Cheng et al., 2021). The demand for training on effectively delivering online or
86 blended courses increased significantly. During the COVID-19 pandemic, the faculty

87 development program enhanced the abilities of university faculty to provide effective online
88 teaching using various digital strategies (Swaminathan et al., 2021).

89 What is the most effective form of professional training for teachers in online/blended
90 learning? Before addressing this issue, the acceptance of blended learning among teachers is well
91 worth considering, as it directly influences the efficacy of the training. Despite the frequent use
92 of the term “blended learning”, there remains ambiguity regarding its precise definition. There is
93 a general consensus that blended learning is the combination of face-to-face and online
94 instruction or learning (Hrastinski, 2019). Unfortunately, despite their inherent
95 interconnectedness, blended learning researchers often overlook the teaching and learning
96 aspects. In university education, educators should embrace the dual roles of teacher and learner,
97 gaining comprehensive experience of both facets of blended learning. To illustrate, anatomists
98 represent a significant population of medical educators and can serve as an exemplar.
99 Anatomical educators constantly strive to improve their instructional methods. However, due to
100 the reliance on hands-on experience and dissection in anatomy, online learning has raised
101 concerns about learning outcomes, thereby impeding the progress of blended learning before the
102 COVID-19 epidemic (Harmon et al., 2021). Additionally, Chinese anatomy education, like that
103 in other countries, faces numerous challenges, including reduced course hours, a scarcity of
104 donated bodies, and an increasingly imbalanced teacher-student ratio (Pan et al., 2020). To
105 address these issues effectively, blended learning or online courses present viable solutions as
106 they offer unrestricted access to learning materials

107 In the current educational landscape, a pivotal aspect to consider is the effective practical
108 professional training of faculty members to facilitate the transition from traditional education to
109 blended learning. Based on the intrinsic interconnectedness between cognition and behaviors, the
110 effectiveness of teacher training is contingent upon the perceptions of academic staff regarding
111 blended learning. This study focused on Chinese anatomy educators as the target group and
112 aimed to examine their perspectives on blended learning, while also investigating potential
113 variations in these perspectives based on factors such as gender, age, years of teaching
114 experience, and institutional support. By conducting a comprehensive analysis of responses
115 obtained from a survey administered to anatomical educators, this study contributes to the
116 broader discourse on enhancing the efficacy of blended anatomy education delivery.

117

118 **2. Materials and methods**

119 *2.1. Survey participants and context*

120 The survey instrument was designed to collect information on the attitudes of Chinese
121 anatomy educators toward blended learning. The survey included the following aspects: the
122 demographic data of the respondents, their experience as anatomical educators, their professional
123 training as both teachers and researchers, and their readiness toward blended learning. These
124 questions were derived from the previous literature and slightly modified (Tang and Chaw, 2013).
125 A Likert scale was used with a 1-6 rating scale, ranging from “1=strongly disagree” to
126 “6=strongly agree”. The questionnaire contained 59 questions and required 8 to 10 minutes to
127 complete. The survey instrument items were developed in Chinese (see Appendix 1 for the

128 English translation). The survey was piloted with seven faculty members from the institution of
129 the first author to ensure its clarity and then revised based on the feedback.

130 A convenience sampling was made of the anatomy departments in mainland China: the
131 majority of the directors of the anatomy departments in mainland China's medical schools were
132 in a messaging group ($n=500$) in the WeChat application (Tencent Holdings Ltd., Shenzhen,
133 China), a popular social media mobile application (Gan and Wang, 2015). Invitations to
134 participate in the survey were delivered via a group-level link. The questionnaire was
135 implemented on the SoJump (Ranxing, Changsha, China) online platform. Participation in the
136 survey was voluntary. The survey was conducted in October 2021. During the four days of the
137 36th Annual Academic Conference of the Chinese Society for Anatomy Sciences (CSAS) — the
138 national anatomists' organization, the link to the questionnaire remained active. The study was
139 conducted with approval from the Research Ethics Committee of Jinan University (No. JNUKY-
140 2021-038). A consent form and the questionnaire invitation link were sent to the participants
141 simultaneously. The recipients would be defaulted as giving consent to the study and answering
142 the survey.

143

144 2.2. Data analysis

145 All the statistical analyses were performed using the SPSS statistical package version 26.0
146 (IBM Corp., Armonk, NY). The data obtained from the questionnaires were analyzed using
147 Cronbach's α test to determine the internal consistency of the responses. Exploratory factor
148 analyses were employed to identify the factors that reflected the respondents' attitudes toward
149 blended learning. Nonparametric tests (Kruskal-Wallis tests) were used to assess the associations
150 between the items in the blended learning readiness questionnaires and the medical educators'

151 demographic characteristics and teaching/training experience of the medical educators. The
152 results of the statistical analyses are presented as the means \pm SD or medians and are considered
153 statistically significant when $P < 0.05$.

154

155 **3. Results**

156 *3.1. Survey data of the anatomists' acceptance of blended learning is representative*

157 In this survey, 297 anatomists participated and completed the online questionnaire. These
158 respondents were geographically distributed across all provinces in mainland China, making
159 their responses representative of Chinese anatomy educators. The respondents' demographic
160 information was summarized in Table 1, which served as control variables in this study. The
161 anatomists who took part in the survey exhibited the following characteristics: the number of
162 male anatomists (n=167/56.2%) slightly exceeded the number of female anatomists
163 (n=130/43.8%); a majority of the anatomists (n=131/44.1%) were within the age range of 41 and
164 50; and the majority had extensive teaching experience, with an average anatomy teaching
165 experience of 17.72 ± 9.62 years. Nearly 80% of the respondents reported having received
166 formal training in teaching, and at the start of their careers, they received guidance from senior
167 mentors. Next, the anatomy teachers were asked to provide their responses to questions about
168 their attitudes toward blended learning, based on their perceptions and perspectives as learners.
169 The Cronbach's α of the 34 items modified from Tang et al. (Tang and Chaw, 2013) was 0.93,
170 showing a high reliability of the survey instrument.

171

172 *3.2. Anatomists' priorities for blended learning: flexibility, community, and management*

173 First, the responses of the anatomists about their attitudes toward blended learning showed
174 that they highly valued learning flexibility, as indicated by the highest scores were assigned to
175 Item 1: “unlimited access to lecture materials”, along with Items 2 and 4: “can choose where and
176 when to study”, and Item 3: “study at one’s own pace” (Table 2). The second highest scores were
177 observed for items related to connected learning with a community-centered learning
178 environment, such as Item 26: “study better via classroom activities”, Item 27: “study better
179 when being guided personally”, Item 24: “prefer to receive feedback quickly in classroom
180 lectures”, Item 25: “study more effectively when collaborating with others in the classroom”.
181 Meanwhile, the respondents did not resist online learning (Item 7). They exhibited favorable
182 views toward related technologies: “I believe the Web is a useful platform for learning” (Item
183 19), and “I think we should use technologies in learning” (Item 22). The majority of the
184 responses were left-skewed (skewness < 0), indicating that the surveyed educators were
185 generally favorable toward the statements in the questionnaire (Table 2).

186 Next, a total of six factors pertaining to the anatomists’ attitudes toward blended learning
187 were identified by the principal factor analysis: connected learning (14.77%), learning control
188 (13.50%), learning flexibility (12.23%), online interaction (11.76%), mastery of related
189 technology (9.65%) and negative attitude toward online learning (7.31%, Table 3). These factors
190 reflected the most differential characteristics of the surveyed respondents. It is worth noting that
191 certain questionnaire responses showed relatively negative attitudes toward online learning and
192 were ranked as having the lowest reliability among the principal factors. Although all six factors
193 collectively accounted for 69.2% of the variance, they comprise an effective index for evaluating
194 noticeable differences among the perceptions of the surveyed anatomists.

195 A descriptive analysis was further performed based on the identified factors derived from the
196 data (Table 4). The results align with the statistical characteristics of the factors, such as learning
197 flexibility ($n=6$, 5.05 ± 0.90), connected learning ($n=7$, 4.46 ± 0.63), mastery of online learning
198 technology ($n=3$, 4.39 ± 0.99), and learning management ($n=6$, 4.32 ± 1.00). These factors are
199 ranked in descending order based on their scores.

200

201 *3.3. Anatomists' blended learning preferences were mainly associated with the support received*
202 *from their institutes and job titles*

203 A nonparametric analysis was performed to explore the demographic characteristics and
204 working experience that could influence the anatomists' perceptions of blended learning. The
205 results demonstrated that ages, gender, and working years had minimal influence on the
206 anatomists' attitudes. However, significant associations were found between their job titles, the
207 support received from mentors and institutions, and their attitudes toward blended learning. In
208 particular, the responses showed statistically significant differences when grouped by the
209 different levels of support (Table 5).

210 Given the importance of institutional support to the anatomists, its underlying mechanism
211 was investigated. Firstly, the support levels were re-coded as low (Likert scales=1 and 2),
212 medium (Likert scales=3 and 4), and high (Likert scales=5 and 6). The results of Kruskal–Wallis
213 tests indicated that the anatomists' attitudes significantly differed across the various support
214 levels. The following aspects were positively related to a high level of support from their in-
215 service institutes: a stronger preference for online learning (Table 5), better learning control
216 (Items 16-18), and proficiency in internet technology (Items 19-21). Moreover, when anatomists
217 preferred interacting with others, they were more likely to receive support from their institutions,

218 thereby constructing an appropriate learning community environment (Items 23, 26, and 29).
219 Lecturers were particularly active in the connected learning community when anatomists were
220 divided by their job titles. They preferred to engaging with mentors, colleagues, and students
221 both online and in person, demonstrating strong communicative abilities and easy connections
222 with mentors. Anatomists who received guidance from mentors tended to exhibit greater
223 awareness of learning control. Lastly, the correlation between the factors derived from
224 anatomists' attitudes and their job titles, mentor guidance, and received support were analyzed
225 (Table 6). The statistically significant differences were more pronounced when considering
226 different levels of support. Aspects significantly related to a high level of support included
227 increased learning flexibility, improved learning control, and mastery of online learning
228 technology (Table 6). Notably, the negative attitude toward online learning remained relatively
229 consistent across different job titles, mentor guidance, and institutional support.

230

231 **4. Discussion**

232 The COVID-19 pandemic has exacerbated the ongoing challenges in education, including
233 faculty development (Ahmed et al., 2020; Gallagher and Schleyer, 2020; Rose, 2020). The
234 abrupt shifts and sudden changes in teaching and assessment modalities have underscored the
235 critical and immediate need for medical educators to enhance their pedagogical skills in
236 online/blended learning, often exceeding their preparedness. This is a time calling for
237 introspection, collaborative learning, and continuous adaption to the evolving landscape. In this
238 regard, faculty development is pivotal in assisting educators in navigating uncertainty and
239 embracing change, facilitating the adaptation of educational curricula to online platforms, and
240 promoting more efficient education of future health professionals (Steinert et al., 2021).

241 The need for professional training in online/blended learning is increasingly urgent for
242 anatomists working in innovative teaching environments. A parallel study has revealed a shift
243 from predominantly face-to-face teaching to a blended learning format has occurred in anatomy
244 education across China since the onset of the COVID-19 pandemic. Blended learning has
245 emerged as a viable solution for educational institutes confronted with sudden changes and
246 seeking sustainable development in the future. Moreover, almost all medical schools in mainland
247 China have prioritized faculty professional training on online/blended learning (submitted
248 manuscript). Evaluating faculty training and development effectiveness can be achieved by
249 soliciting feedback from faculty members, as their self-perceived usefulness encourages active
250 engagement in subsequent educational practices. Furthermore, learning is contextually dependent
251 and necessitates appropriate opportunities for the application of acquired knowledge. Participants
252 can gain relevant practice in authentic environments immediately after training. Therefore, the
253 effectiveness of training is primarily associated with the anatomists' perceptions of and
254 perspectives on online/blended learning training.

255 Chinese anatomists highly valued learning flexibility as the most critical factor (Tables 2 and
256 4). The superiority of an online/blended learning framework lies in its ability to provide learners
257 with unlimited access to learning material and facilitate global communication between
258 instructors and learners through web technology (Naidu, 2019). This feature provides learners
259 exceptional convenience and the freedom to study without limitation. As educators, the Chinese
260 anatomists viewed online learning not merely as a supplement to traditional teaching but as a
261 valuable aspect in its own right. This finding greatly strengthens our confidence in developing a
262 more open and flexible online/blended learning environment for future teaching (Oliver, 1999).
263 However, despite learning flexibility being highly valued, the most important factor identified by

264 the anatomists was connected learning (Table 3). This result implies that they are enthusiastic
265 about fostering an atmosphere of community-based learning. Such an environment involves
266 purposeful connection between instructors and learners in the classroom or a virtual learning
267 setting (instructional link), learners' active participation in panel discussions or studying as team
268 members under instructors' guidance (community integration), and learners' actively engaging in
269 research projects in collaboration with scientists (community participation) (Zhu and Baylen,
270 2005). This preference for community-based learning stems from its effectiveness in promoting
271 outcome-based education, encouraging peer-to-peer learner interactions, and providing firsthand
272 experiences through pedagogically oriented activities (Chang, 2012).

273 The anatomists in this study also valued the importance of learning management in the
274 context of online/blended learning. Learning management refers to possessing good self-control
275 abilities, and are vital for achieving better outcomes in blended learning. This result reminds the
276 faculty members to design pedagogical approaches that foster internal motivation and lead to
277 improved learning outcomes for learners (Weaver et al., 2008). The results also suggested that
278 anatomists who effectively manage their online technology and hold positive perceptions toward
279 online/blended learning are likely to play a more active and positive role in delivering
280 online/blended learning (Table 4). This finding aligns with a previous report that highlighted the
281 positive impact of formally structured faculty training activities, which resulted in high
282 participant satisfaction positive changes in attitudes toward teaching, increased knowledge and
283 skills, and observable differences in teaching behaviors (Steinert et al., 2016). These results
284 evaluated the training programs using the Kirkpatrick levels of educational outcomes,
285 emphasizing the importance of strengthening healthcare professional training to enhance
286 teaching effectiveness and positively impact students (Piryani et al., 2018; Steinert et al., 2006).

287 Further exploration is needed to understand the main driving forces that influence the
288 perspectives of Chinese anatomists toward blended learning. This understanding holds
289 significance for the development of administrative policies and anatomist-specific training for
290 faculty development at medical schools. The primary factor influencing anatomists' perspectives
291 toward online/blended learning was the support they received from mentors and in-service
292 medical schools, and their job titles (Table 5). We delved deeper into the reasons underlying this
293 support as the predominant factor and found that the the anatomists' self-management abilities
294 and features played an important role. In other words, as Chinese anatomists became more adept
295 at blended learning, they were better able to access various forms of support, leading to
296 improved learning outcomes. Another valuable source of support was recognition of the learning
297 community, where anatomists with an interest in education or team study came together (DuFour,
298 2004; Shea, 2006). These findings indicated that our medical schools and administration should
299 strengthen various forms of support to ensure faculty members' dedication and commitment to
300 education. In addition to support from institutions, this study highlights the value of mentorship
301 from supportive co-teachers in facilitating faculty development (Jackevicius et al., 2014; Vitale,
302 2010). Teaching skills were largely socially constructed through observation, co-teaching
303 experience, and feedback from senior teachers, contributing to reflective observation. However,
304 this process is not easily attained through online learning, which explains why anatomy teachers
305 emphasized the significance of connected learning. The results suggest that establishing an
306 authentic or virtual connected learning community would be a sustainable approach for faculty
307 training programs, maximizing faculty development's efficacy.

308 What cannot be dismissed is the presence of negative attitudes toward online learning, which
309 ranked sixth among the factors related to blended learning. These comments suggest that face-to-

310 face education is irreplaceable in medical education, especially for anatomy education, which
311 benefits from hands-on laboratory modalities, delivery formats, and assessments. These provide
312 valuable references for determining the most effective anatomical practice for continuous
313 development. There is no doubt that face-to-face classes have a predominantly stable teaching
314 format.

315

316 **Limitations**

317 There are several limitations to consider regarding the survey and its results. Firstly, the
318 survey results may not be generalizable to all anatomists in China due to potential selection bias.
319 Secondly, the survey was designed using a cross-sectional method. We previously performed a
320 study among Chinese anatomy educators about online teaching in April 2020 (Cheng et al.,
321 2021). Although the teaching staff's perception of blended learning might have changed in the
322 two years following the COVID-19 pandemic, it is challenging to assess anatomists' attitudes
323 toward online/blended learning longitudinally, because these two surveys did not exactly use
324 similar questions. Thirdly, the survey data were analyzed quantitatively. Thus, an analytical
325 interpretation of qualitative data, such as focus groups, is missing from this study. Qualitative
326 analysis could have provided a deeper understanding of the experiences of anatomy teachers
327 regarding the "support" received at universities in China. Lastly, the survey did not delve into the
328 specific blended learning models implemented by anatomists, such as the materials and
329 platforms they used or the amount of time dedicated to blended teaching activities. These details
330 could have provided valuable insights into the practical aspects of blended learning in anatomy
331 education.

332

333 **4. Conclusion**

334 Over the last two years, the COVID-19 pandemic has greatly impacted and altered faculty
335 development, especially in training programs related to online/blended learning. Findings from
336 this survey conducted among anatomists across mainland China shed light on the perspectives of
337 Chinese anatomists regarding online/blended learning. The results indicated that anatomists
338 perceive learning flexibility, a connected learning community, and effective learning
339 management as valuable features of online/blended learning. Notably, support from mentors and
340 institutes emerges as a significant factor contributing to positive attitudes toward online/blended
341 learning, which predicts better training outcomes. The specific types of support required may
342 vary based on the anatomists' proficiency in learning management ability and the particular
343 features of the learning environment.

344

345

346 **Financial Disclosure Statements**

347 None of the authors has any potential conflict of interest.

348

349 **Ethical statement**

350 The study was conducted with ethics approval from the Research Ethics Committee of Jinan
351 University (No. JNUKY-2021-038).

352

353 **References**

354 Ahmed, H., Allaf, M., Elghazaly, H., 2020. COVID-19 and medical education. *The Lancet*
355 *Infectious Diseases* 20, 777-778.

356 Avramidis, E., Norwich, B., 2002. Teachers' attitudes towards integration/inclusion: a review of
357 the literature. *European journal of special needs education* 17, 129-147.

- 358 Bligh, J., 2005. Faculty development. Wiley Online Library, pp. 120-121.
- 359 Brinkley-Etzkorn, K.E., 2018. Learning to teach online: Measuring the influence of faculty
360 development training on teaching effectiveness through a TPACK lens. *The Internet and Higher*
361 *Education* 38, 28-35.
- 362 Buckley, H., 2020. Faculty Development in a Pandemic: So Close - Yet So Far. *Medical*
363 *Education*.
- 364 Burgess, A., Matar, E., Neuen, B., Fox, G.J., 2019. A longitudinal faculty development program:
365 supporting a culture of teaching. *BMC Med Educ* 19, 400.
- 366 Camblin, L.D., Steger, J.A., 2000. Rethinking faculty development. *Higher Education* 39, 1-18.
- 367 Chang, H., 2012. The development of a learning community in an e-learning environment.
368 *International Journal of Pedagogies and Learning* 7, 154-161.
- 369 Cheng, X., Chan, L.K., Pan, S.-Q., Cai, H., Li, Y.-Q., Yang, X., 2021. Gross anatomy education
370 in China during the Covid - 19 pandemic: A national survey. *Anatomical Sciences Education* 14,
371 8-18.
- 372 Crown, S.W., Fuentes, A.A., Freeman, R.A., 2011. A Successful Plan for Faculty Development
373 that has a Lasting Impact, 2011 ASEE Annual Conference & Exposition, pp. 22.113. 111-
374 122.113. 115.
- 375 DuFour, R., 2004. What is a "professional learning community"? *Educational leadership* 61, 6-
376 11.
- 377 Eltayar, A.N., Eldesoky, N.I., Khalifa, H., Rashed, S., 2020. Online faculty development using
378 cognitive apprenticeship in response to COVID - 19. *Medical education* 54, 665-666.
- 379 Gallagher, T.H., Schleyer, A.M., 2020. "We signed up for this!"—student and trainee responses
380 to the Covid-19 pandemic. *New England Journal of Medicine* 382, e96.
- 381 Gan, C., Wang, W., 2015. Uses and gratifications of social media: a comparison of microblog
382 and WeChat. *Journal of systems and information technology*.
- 383 Harmon, D.J., Attardi, S.M., Barremkala, M., Bentley, D.C., Brown, K.M., Dennis, J.F.,
384 Goldman, H.M., Harrell, K.M., Klein, B.A., Ramnanan, C.J., Richtsmeier, J.T., Farkas, G.J.,
385 2021. An Analysis of Anatomy Education Before and During Covid-19: May-August 2020. *Anat*
386 *Sci Educ* 14, 132-147.
- 387 Hrastinski, S., 2019. What Do We Mean by Blended Learning? *TechTrends*, 564–569.
- 388 Hueppchen, N., Dalrymple, J.L., Hammoud, M.M., Abbott, J.F., Casey, P.M., Chuang, A.W.,
389 Cullimore, A., Davis, K.R., Dugoff, L., Espey, E.L., 2011. To the point: medical education
390 reviews—ongoing call for faculty development. *American journal of obstetrics and gynecology*
391 205, 171-176.
- 392 Jackevicius, C.A., Le, J., Nazer, L., Hess, K., Wang, J., Law, A.V., 2014. A formal mentorship
393 program for faculty development. *American Journal of Pharmaceutical Education* 78.

- 394 Kachra, R., Ma, I.W.Y., 2020. Practical tips for faculty development workforce training under
395 pressure in the time of COVID-19 pandemic. *MedEdPublish* 9.
- 396 McLean, M., Cilliers, F., Van Wyk, J.M., 2008. Faculty development: yesterday, today and
397 tomorrow. *Medical teacher* 30, 555-584.
- 398 Naidu, S., 2019. The changing narratives of open, flexible and online learning. Taylor & Francis,
399 pp. 149-152.
- 400 Oliver, R., 1999. Exploring strategies for online teaching and learning. *Distance Education* 20,
401 240-254.
- 402 Pan, S.Q., Chan, L.K., Yan, Y., Yang, X., 2020. Survey of gross anatomy education in China:
403 The past and the present. *Anatomical sciences education* 13, 390-400.
- 404 Piryani, R.M., Dhungana, G.P., Piryani, S., Sharma Neupane, M., 2018. Evaluation of teachers
405 training workshop at Kirkpatrick level 1 using retro-pre questionnaire. *Adv Med Educ Pract* 9,
406 453-457.
- 407 Rose, S., 2020. Medical student education in the time of COVID-19. *Jama* 323, 2131-2132.
- 408 Shea, P., 2006. A study of students' sense of learning community in online environments.
409 *Journal of Asynchronous Learning Networks* 10, 35-44.
- 410 Steinert, Y., Irby, D.M., Dolmans, D., 2021. Reframing faculty development practice and
411 research through the lens of adaptive expertise. *Med Teach* 43, 865-867.
- 412 Steinert, Y., Mann, K., Anderson, B., Barnett, B.M., Centeno, A., Naismith, L., Prideaux, D.,
413 Spencer, J., Tullo, E., Viggiano, T., Ward, H., Dolmans, D., 2016. A systematic review of
414 faculty development initiatives designed to enhance teaching effectiveness: A 10-year update:
415 BEME Guide No. 40. *Med Teach* 38, 769-786.
- 416 Steinert, Y., Mann, K., Centeno, A., Dolmans, D., Spencer, J., Gelula, M., Prideaux, D., 2006. A
417 systematic review of faculty development initiatives designed to improve teaching effectiveness
418 in medical education: BEME Guide No. 8. *Medical teacher* 28, 497-526.
- 419 Steinert, Y., Naismith, L., Daigle, N., 2003. Executive skills for medical faculty: a workshop
420 description and evaluation. *Medical teacher* 25, 1-3.
- 421 Swaminathan, N., Govindharaj, P., Jagadeesh, N.S., Ravichandran, L., 2021. Evaluating the
422 effectiveness of an online faculty development programme for nurse educators about remote
423 teaching during COVID-19. *Journal of Taibah University Medical Sciences* 16, 268-273.
- 424 Tang, C., Chaw, L., 2013. Readiness for blended learning: Understanding attitude of university
425 students. *International Journal of Cyber Society and Education* 6, 79-100.
- 426 Trowbridge, R.L., Snyderman, L.K., Skolfield, J., Hafner, J., Bing-You, R.G., 2011. A systematic
427 review of the use and effectiveness of the Objective Structured Teaching Encounter. *Medical*
428 *teacher* 33, 893-903.

429 van Aalderen - Smeets, S.I., Walma van der Molen, J.H., 2015. Improving primary teachers'
430 attitudes toward science by attitude - focused professional development. *Journal of research in*
431 *science teaching* 52, 710-734.
432 Vitale, A.T., 2010. Faculty development and mentorship using selected online asynchronous
433 teaching strategies. *The Journal of Continuing Education in Nursing* 41, 549-556.
434 Weaver, D., Spratt, C., Nair, C.S., 2008. Academic and student use of a learning management
435 system: Implications for quality. *Australasian journal of educational technology* 24.
436 Zhu, E., Baylen, D.M., 2005. From learning community to community learning: pedagogy,
437 technology and interactivity. *Educational Media International* 42, 251-268.
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Table 1 (on next page)

Table 1 Control variables used in this study

1 **Table 1.** Control variables used in this study

2	3	4
	Variables	Values n (%)
5	Gender	
6	<i>Male</i>	167 (56.2%)
7	<i>Female</i>	130 (43.8%)
8	Age	
9	<i>21-30</i>	13 (4.4%)
10	<i>31-40</i>	81 (27.3%)
11	<i>41-50</i>	131 (44.1%)
12	<i>51-60</i>	66 (22.2%)
13	<i>>60</i>	6 (2.0%)
14	Teaching years	
15	<i><10</i>	72 (24.2%)
16	<i>11-20</i>	113 (38.1%)
17	<i>21-30</i>	73 (24.6%)
18	<i>>30</i>	39 (13.1%)
19	Job titles	
20	<i>Assistant professor</i>	18 (6.1%)
21	<i>Lecturer</i>	84 (28.3%)
22	<i>Associate professor</i>	97 (32.6%)
23	<i>Professor</i>	98 (33.0%)
24	Professional training on education	
25	<i>Formal</i>	237 (79.8%)
26	<i>Informal</i>	56 (18.9%)
27	<i>Not confirmed</i>	4 (1.3%)
28	Support from mentor	
29	<i>Yes</i>	230 (56.2%)
30	<i>No</i>	67 (56.2%)
31	Support from in-service institutes	
	<i>Low</i>	34 (11.4%)
	<i>Medium</i>	125 (42.1%)
	<i>High</i>	138 (46.5%)

Notes: *n*, number. *n* = 297/100%.

Table 2 (on next page)

Table_2-clean

1 **Table 2.** Descriptive characteristics of the anatomists' attitudes towards blended learning

Questions	Median	SD	Quartiles			Skewness
			Q ¹	Q ²	Q ³	
1. I would like unlimited access to lecture materials.	6	1.07	5	6	6	-1.52
2. I would like to decide where I want to study.	6	1.07	5	6	6	-1.38
3. I like to study at my own pace.	6	1.14	4	6	6	-1.26
4. I would like to decide when I want to study.	5	1.08	4	5	6	-1.27
5. I believe face-to-face learning is more effective than online learning.	5	1.09	4	5	6	-1.13
6. I am comfortable with self-directed learning.	5	1.14	4	5	6	-0.85
7. I do not resist having my lessons online.	5	1.14	4	5	6	-0.97
8. I like online learning as it provides richer instructional content.	5	1.25	4	5	6	-0.78
15. I can study over and over again online.	5	1.21	4	5	6	-0.98
19. I believe the Web is a useful platform for learning.	5	1.16	4	5	6	-0.77
22. I think we should use technologies in learning.	5	1.10	4	5	6	-0.67
23. I have a sense of community when I meet other students in the classroom.	5	1.10	4	5	6	-0.68
24. I like the fast feedback when I meet my lecturer in person.	5	1.01	4	5	6	-0.99
25. I find learning through collaboration with others face-to-face is more effective.	5	0.94	4	5	6	-0.94
26. I learn better through lecturer-directed classroom-based activities.	5	0.94	4	5	6	-1.01
27. I learn better when someone guides me personally.	5	1.04	4	5	6	-1.09
29. I am comfortable in using Web technologies to exchange knowledge with others.	5	1.14	4	5	6	-0.43
30. I would like to interact with my lecturer online.	5	1.21	4	5	6	-0.47
31. I would like to interact with other students outside of the classroom.	5	1.11	4	5	5	-0.56
9. I would like lecture time in the classroom to be reduced.	4	1.46	3	4	5	-0.26
11. I get bored when studying online.	4	1.40	2	4	4	-0.08
13. I am more likely to miss assignment due dates in an online learning environment.	4	1.45	3	4	4.5	-0.11
14. I organize my time better when studying online.	4	1.27	3	4	5	-0.19
16. Online learning motivates me to prepare well for my studies.	4	1.20	3	4	5	-0.27
17. Online learning encourages me to make plans.	4	1.21	3	4	5	-0.26

18. Online learning makes me more responsible for my studies.	4	1.22	3	4	5	-0.19
20. I am familiar with Web technologies.	4	1.17	3	4	5	-0.21
21. I find Web technologies easy to use.	4	1.14	4	4	5	-0.35
28. I feel isolated in an online learning environment.	4	1.45	3	4	5	-0.22
32. I find it easy to communicate with others online.	4	1.14	4	4	5	-0.21
33. I appreciate easy online access to my lecturer.	4	1.20	4	4	5	-0.42
34. I can collaborate well with a virtual team in doing assignments.	4	1.29	3	4	5	-0.34
10. I would like to have my classes online rather than in the classroom.	3	1.48	2	3	4	0.26
12. I find it very difficult to study online.	3	1.41	2	3	4	0.31

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Notes: The survey data is gained from total 297 anatomists ($n = 297$). Q¹: quartile at the 25th; Q²: quartile at the 50th; Q³: quartile at the 75th. Likert scales are 1-6 for the questionnaire items.

Table 3 (on next page)

Table 3 Summary of principal factor analysis of the questionnaire answered by the anatomists about their attitudes towards blended learning

1 **Table 3.** Summary of principal factor analysis of the questionnaire answered by the anatomists about their attitudes towards blended learning

Questions	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
24. I like the fast feedback when I meet my lecturer in person.	0.85					
26. I learn better through lecturer-directed classroom-based activities.	0.83					
25. I find learning through collaboration with others face-to-face is more effective.	0.82					
27. I learn better when someone guides me personally.	0.81					
5. I believe face-to-face learning is more effective than online learning.	0.57					
23. I have a sense of community when I meet other students in the classroom.	0.54					
31. I would like to interact with other students outside of the classroom.	0.46					
17. Online learning encourages me to make plans.		0.85				
16. Online learning motivates me to prepare well for my studies.		0.84				
18. Online learning makes me more responsible for my studies.		0.81				
14. I organize my time better when studying online.		0.64				
15. I can study over and over again online.		0.61				
19. I believe the Web is a useful platform for learning.		0.48				
3. I like to study at my own pace.			0.85			
4. I would like to decide when I want to study.			0.85			
2. I would like to decide where I want to study.			0.83			
1. I would like unlimited access to lecture materials.			0.64			
6. I am comfortable with self-directed learning.			0.56			
7. I do not resist having my lessons online.			0.47			
9. I would like lecture time in the classroom to be reduced.				0.68		
33. I appreciate easy online access to my lecturer.				0.64		
30. I would like to interact with my lecturer online.				0.61		
34. I can collaborate well with a virtual team in doing assignments.				0.61		
32. I find it easy to communicate with others online.				0.61		
10. I would like to have my classes online rather than in the classroom.				0.583		
29. I am comfortable in using Web technologies to exchange knowledge with				0.57		

others.

8. I like online learning as it provides richer instructional content.	0.44					
20. I am familiar with Web technologies.	0.81					
21. I find Web technologies easy to use.	0.79					
22. I think we should use technologies in learning.	0.50					
12. I find it very difficult to study online.	0.87					
11. I get bored when studying online.	0.76					
13. I am more likely to miss assignment due dates in an online learning environment.	0.76					
28. I feel isolated in an online learning environment.	0.50					
Reliability	0.72	0.91	0.90	0.88	0.84	0.75
% of Variance	14.77	13.50	12.23	11.76	9.65	7.31
Key Factors						Negative attitude towards online learning
	Connected learning	Learning control	Learning flexibility	Online interaction	Mastery of related technology	

- 2 Notes: Extraction methods: Principal Component Analysis. Rotation methods: Varimax Kaiser normalization (KMO = 0.92). Rotation converged in 31 iterations.
- 3 $n = 297$. The number of factors were determined by the eigenvalues extracted greater than 1. Reliability is the Cronbach α of each factor, “% of the variance” is
- 4 the percentage of the variance that the factor can explain of the data set.

Table 4 (on next page)

Table_4-clean

1 **Table 4.** Descriptive data of the identified factors

Factors	<i>n</i>	Average sum value	Mean	SD	Median	Skewness
1. Connected learning	7	31.21	4.46	0.63	5	-0.93
2. Learning control	6	25.92	4.32	1.00	4	-0.47
3. Learning flexibility	6	33.53	5.05	0.90	5	-1.28
4. Online interaction	8	33.53	4.19	0.94	4	-0.28
5. Mastery of the online learning related technology	3	13.17	4.39	0.99	4	-0.32
6. Negative attitude towards online learning	4	14.41	3.60	1.08	4	-0.07

2 Notes: *n*, numbers of the related items of the survey. Average sum value, average sum value of the factor. Mean,
3 mean of the total items of the factor. Median, the middle value of the answers to total items of the factor. Likert
4 scales are 1-6 for the questionnaire items.

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Table 5 (on next page)

Table_5-clean

Table 5. Descriptive statistics and correlative analysis of the anatomists' attitudes toward blended learning significantly related to job titles, guidance from mentors and the different levels of support from the institutes

Questions	Job titles				Guidance from mentors				Supports from institutes						
	Assistant professor <i>n</i> = 18	Lecturer <i>n</i> = 84	Associate professor <i>n</i> = 97	Professor <i>n</i> = 98	<i>H</i> <i>df</i> =3	<i>P</i>	Yes <i>n</i> = 230	No <i>n</i> = 67	<i>H</i> <i>df</i> =1	<i>P</i>	Low <i>n</i> = 34	Medium <i>n</i> = 125	High <i>n</i> = 138	<i>H</i> <i>df</i> =2	<i>P</i>
6.I am comfortable with self-directed learning.	4	5	5	5	1.04	0.79	5	5	1.34	0.25	4.5	5	5	10.72	0.01
7.I do not resist having my lessons online.	5.5	5	5	5	2.03	0.57	5	5	2.34	0.13	4.5	5	5	13.52	<0.0
8.I like online learning as it provides richer instructional content.	4.5	5	5	5	2.45	0.48	5	4	2.72	0.10	4	4	5	11.27	<0.0
16.Online learning motivates me to prepare well for my studies.	4	5	4	4	5.14	0.16	4	4	3.98	0.05	4	4	4	7.50	0.02
17.Online learning encourages me to	4	4	4	4	2.13	0.55	4	4	5.47	0.02	4	4	4	6.06	0.05

make plans.																
18. Online learning makes me more responsible for my studies.	4	4	4	4	0.33	0.96	4	4	3.14	0.08	4	4	4	6.95	0.03	
19. I believe the Web is a useful platform for learning.	5	5	5	5	0.64	0.89	5	5	1.91	0.17	5	5	5	7.72	0.02	
20. I am familiar with Web technologies.	4	4	4	4	6.54	0.09	4	4	0.78	0.38	4	4	4	10.03	0.01	
21. I find Web technologies easy to use.	4	4	4	4	4.69	0.20	4	4	1.56	0.21	4	4	4	6.86	0.03	
23. I have a sense of community when I meet other students in the classroom.	4.5	5	5	5	1.83	0.61	5	5	3.36	0.07	4	5	5	6.74	0.03	
26. I learn better through lecture-directed classroom-based activities.	5	5	5	5	1.63	0.65	5	5	0.01	0.93	5	5	5	6.54	0.04	
29. I am comfortable in using Web technologies to	4	5	5	5	1.54	0.67	5	4	1.39	0.24	5	4	5	10.63	0.01	

exchange

knowledge with
others.

30. I would like to interact with my lecturer online.	4	5	5	4	12.1 5	0.01	5	4	1.44	0.23	5	4	5	4.60	0.10
31. I would like to interact with other students outside of the classroom.	4	5	5	4	9.56	0.02	5	5	0.07	0.79	5	4	5	2.82	0.24
32. I find it easy to communicate with others online.	4	5	4	4	9.62	0.02	4	4	1.79	0.18	4	4	4	5.75	0.06
33. I appreciate easy online access to my lecturer.	4	5	4	4	15.8 9	0.01	4	4	4.70	0.03	4	4	4.5	2.30	0.32

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5 Note: The data reported are the medians of the item in each group, using nonparametric method (H : H values of Kruskal-Wallis H tests). The red colored values

6 show the statistical significant difference.

Table 6 (on next page)

Table_6-clean

1 **Table 6.** Descriptive statistics of the factors related to job titles, guidance from mentors and the different levels of support received

Questions	Job titles				Guidance from mentors				Supports from institutes						
	Assistant professor <i>n</i> = 18	Lecturer <i>n</i> = 84	Associate professor <i>n</i> = 97	Professor <i>n</i> = 98	<i>H</i> <i>df</i> =3	<i>P</i>	Yes <i>n</i> = 230	No <i>n</i> = 67	<i>H</i> <i>df</i> =1	<i>P</i>	Low <i>n</i> = 34	Medium <i>n</i> = 125	High <i>n</i> = 138	<i>H</i> <i>df</i> =2	<i>P</i>
1. Connected learning	4	5	5	5	5.01	0.17	5	5	0.54	0.46	5	5	5	3.35	0.19
2. Learning control	4	5	4	4	2.12	0.55	4	4	2.57	0.11	4	4	5	7.12	0.03
3. Learning flexibility	5	6	5	5	1.33	0.72	5	5	0.00	0.98	5	5	6	10.27	0.01
4. Online interaction	4	4	4	4	8.10	0.04	4	4	5.19	0.02	4	4	4	5.56	0.06
5. Mastery of the online learning-related technology	4	5	4	4	6.44	0.09	4	4	0.81	0.37	4	4	5	9.51	0.01
6. Negative attitude toward online learning	3	3	4	4	3.00	0.39	4	3.5	0.00	0.95	4	3	4	0.56	0.76

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4 Note: The data reported are medians of the item in each group, using nonparametric method (Kruskal-Wallis H tests). The red colored values show the
5 statistically significant difference.

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