Fairness of Assessment: An Essential Component of Academic Performance

Lim Kyuson*

Department of Mathematical and Computational Sciences, University of Toronto Mississauga, Mississauga, Ontario L5L 1C6, Canada

Abstract

During the COVID-19 period, the sudden change of an alternative mode for an educational delivery had caused difficulties to a majority of students at the higher educational institution for statistics/mathematics courses worldwide. In paper, we aim to find out factors suggested to be influenced by the alternative mode of delivery during COVID-19 period including a delivery of course components, the fairness of assessment and a relative quality difference of an education, an experience of mood swings, a preference of offline mode, a difficulty with access to courses, a family support and the residential difficulty, a financial support, and a financial reliability. Most importantly, we analyze associated components of the fairness of grades that students rated in courses for a quality assurance purpose of statistics/mathematics courses during the COVID-19 crisis. The results of the survey clearly illustrated the dissatisfaction ratings for the fairness of grades and the association with a relative quality difference compared to the offline delivery, thus allowing us to critically think of an improvement of an alternative educational delivery in a continuation of COVID-19 period.

Keywords: Mathematics; Fairness of grades; Quality; Statistics; Ratings; Diagnosis; COVID-19

Introduction

A fast transmission of the COVID-19 virus hindered the traditional face-to-face educational communication between people and changed the educational delivery system of courses [1]. In most cases, an incomplete learning process for students was provided by the result of unplanned online learning as instructors could not offer students an optimal implementation of what was planned [2]. This affected the university education to face with unplanned, unwanted, unexperienced, and tense assessment for students due to the lack of online educational delivery during COVID-19 period [3]. Also, the online assessment in which university students faced with lots of trials and errors for many factors of uncertainties in a preparation of the assessment brought up a biased evaluation to both instructors and students without a managerial interaction between them [4]. A similar study from India pointed out the relation between the uncertain state of educational delivery and the unfairness of assessment due to the alternative delivery mode during COVID-19 period [5-7].

For most students, a determination of fair assessment by instructors comes from an expectation of a high performance that is based on the interactive learning communication between students and instructors [5]. Clearly, the sudden migration to an online learning implemented by the outbreak of COVID-19 crisis without educational instruction to both professor and student in most places resulted in obstacles of the high achievement for university students [6]. Therefore, a lack of interaction due to an immediate change of an alternative mode of delivery did not guarantee high grades, which is the success of students and a satisfaction, with an incomplete learning process during COVID-19 period [7].

Additionally, the insufficient interaction between students and instructors is suggested to be caused by the problem of basic technical guarantees for students to access in the environment of large-scaled lecture of the online delivery system [9,10]. This introduces another main challenge for most self-isolated students by the online educational delivery system which is the technical

operational obstacles [2]. The technical challenges generally relate to disadvantages to students during the delivery of online educational environment, resulting in insufficient technical support for the assessment of the course [9]. Understanding the importance of this problem, one example to introduce which try to cope with problems is educational policies in China during COVID-19 period, where policies include the support infrastructure of delivery by the alternative mode and the technical guidance of learning tools for methods of learning process [11].

General technical challenges also relate to the preference of mode to be offline for course components including office hours, course materials and assessments, as the choice of learning environment is a subject of a matter [12]. Unlike traditional classroom environment that naturally establishes the learning process with the social presence of educators, the online course learning lacks with the facial contact and social presence of educators so that the course components including live sessions, live office hours, material delivery, and communication is challengeable for students [13].

On the other hand, the focus of diagnoses for students includes the different mental conditions students suffers due to the duration of quarantine that mainly break off the physical relationship between people. This is a global phenomenon that mental health problems including panic, boredom, loneliness and depressive symptoms in the quarantine with a previous psychiatric disorder lead to an extreme thoughts and heavy stress for adults [14]. In most cases, the mental interruption of academic assessments such as final exam was directed by the huge concern of grades and overloads of assessments with a high-level stress for university students in an unfavorable environment due to COVID-19 crisis [15]. Understanding the cause and effect relationship of a mental health care, a proper counseling service is urgently demanded for majority of students including academic accommodations especially for mentally vulnerable students within closer attentions to academic performance [15].

The overall educational advices from the diagnosis of experts includes not only academic concerns but also financial issues including reliability and support, which cause distress to mental health of students [16]. Taking into account of a sudden outbreak of COVID-19 crisis and societal changes, the financial effects and family support were correlated ultimately with the academic performance of students, as signifying factors that influence the stress of students [17]. Hence, the immediate consequence of sudden COVID-19 outbreak include financial problems for most families of students which critically influence the regular support of students received so that demands for governmental and institutional support is urgent to cope with financial reliabilities of student during COVID-19 crisis [17].

In this paper, we define factors that are substantially and academically changed by the COVID-19 crisis analyzed from the survey based on satisfaction of student rating and a diagnosis. This include the main goal of identification in satisfaction ratings for fair grades and the associated factor of relative quality difference, addressing causation components and surrounding frames of

opinion that students concern in higher educational mathematics/statistics courses. Considering the extension of COVID-19 pandemic period, the result of a survey aims to provide acceptable opinions of students toward a development for better educational outcomes to both students and stakeholders of higher educational institutions.

Motivation and Objective

This study uses a student satisfaction and diagnostic tool developed for students from higher educational institutions at UAE and Canada. Student satisfaction scores of the fairness in the assessment were the lowest compared to other polychotomous rated questions, suggesting that students have unmet expectations of grades received at the higher educational institution during COVID-19 period. The outcome of survey is expected to show that the rapid change of online assessment tools is severely associated with the relative quality of a learning environment. To confirm this observation, the factor analysis was considered on mixed ratings of questions. Also, other factors of questions are considered to figure out frames of similar idea that students have.

Background: Developing Questionnaire

This study was based on the conceptual performance evaluation of student satisfaction ratings and self-diagnosis. The basic dimensions of idea include self-awareness, course components, course delivery satisfaction, quality of teaching and feedback, and roughly student advising [18]. The survey has 26 questions where each question refers to the satisfaction and diagnosis of statistics/mathematics courses with 5 demographic questions. The questions were developed to be precise and accurate with similar questions to be grouped to provide adequate information as possible. Mainly, the questionnaire comprised 4 sections; the first contained items related to student demographics.

The second section comprised of items assessing the aspect of course components in statistics/mathematics courses. A three-point Likert-type scale was used to assess satisfaction levels of components with answers ranging from satisfaction to dissatisfaction: satisfaction or agree = 2, no opinion = 1, dissatisfaction or disagree = 0. This scale has been found to produce mean scores closer to the midpoint of the scale and higher correlation with the intentional behavior of individuals [19].

The third section explored items for an assessment of conditions and opinion expressions in online educational environment during COVID-19 pandemic period. A tetrachoric type scale was used to assess conditions and expressions of opinion of statistics/mathematics courses with answers: yes = 1, no = 0. This scale has been found to produce categorical votes for which expressions or opinions being more preferable than the other, based on frequencies. The fourth section contained items to find out satisfaction ratings of overall opinions in courses with a three-point Likert-type scale that is same as the second section. A copy of questionnaire is attached in the Appendix.

## Background: Participants and Data Collection

From simple random sampling of university students in UAE and Canada, 416 voluntary responses are collected from official

university course website. The instructors of this paper emailed and posted the survey on their course's websites via Blackboard for students to fill out anonymously. This urges them to fill out the questionnaire. Also, the survey was share by other mathematics instructors. Each respondent belongs to a designated official university at UAE and Canada, taken at least one statistics/ mathematics course at the belonging higher educational institution. Students were provided with English written survey to answer questions in the designated course website including Blackboard/ CANVAS/Quercus/ WebCT/iLearn. This approach was considered necessary in the absence of a reliable and effective way to do survey in both Canada and UAE after taking different courses.

Data Analysis and Methodology

Data were entered into Microsoft Excel, cross checked for accuracy and analyzed using R version 4.0.0 (The R foundation, Vienna Austria) and SPSS version 19 (SPSS, Inc., Chicago IL). Descriptive statistics were calculated for participant demographic information, categorical frequencies and satisfaction scores [20].

A factor analysis was undertaken as part of questionnaire validation so as to define constructs factors, and its related items. Prior to conducting factor analysis, the suitability of the data for factor analysis was assessed in terms the strength of inter-correlation among the 26 items on the scale. The measure of Cronbach's alpha is used to assess the internal consistency in the reliability of relevant questions, with the preferred value is greater than 0.7 [21]. Factors including the delivery of course components (0.82), offline mode preference (0.7), fairness of assessment and quality difference (1.0) show reliable groups of items. A factor analysis was performed using maximum likelihood under the Promax rotation of factors that had eigenvalues greater than 1.0. Items with factor loadings 0.40 were considered to be "significant" and loadings of 0.50 or greater were considered to be "very significant" [20]. To retain an item on scale, the factor loading of the item should be higher than 0.30 and no higher loading another factors [20]. Then, the result of a scree plot for the parallel analysis of samples is provided below (Figure).
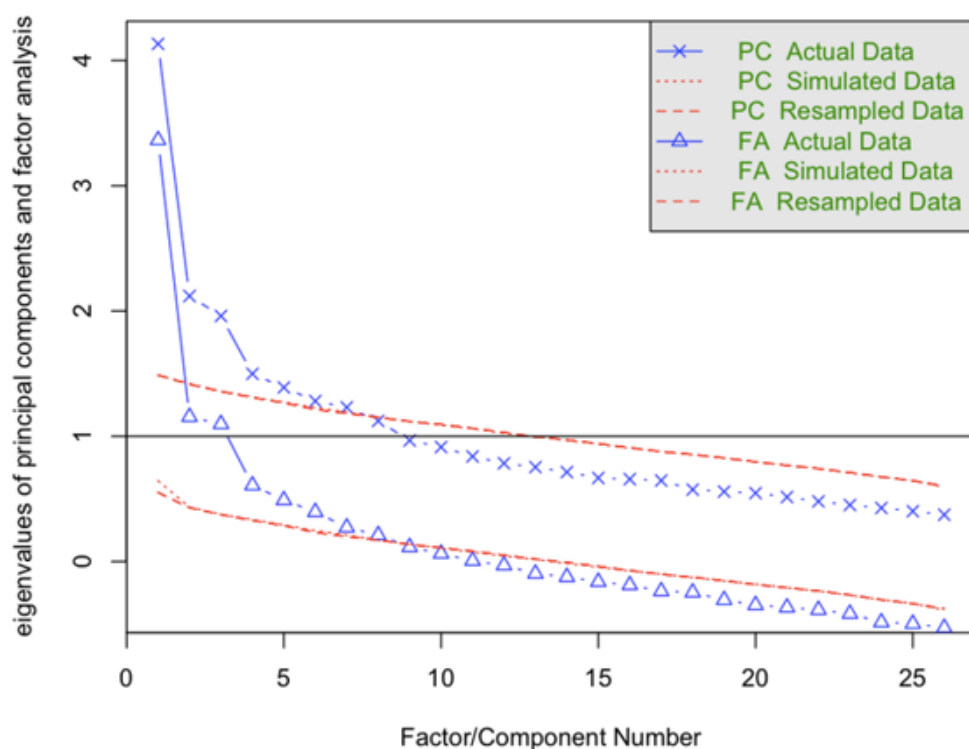
Parallel Analysis Screen Plots.

The parallel analysis performs a full model fit of the resample data on the original dataset, which is known as bootstrap, as well as random, uncorrelated data matrices drawn from normal distribution [22]. One of the criteria in a determination for number of factors is the eigenvalue, which is larger than 95% quantile (dashed line) of those obtained from random or resampled data, which are considered to be statistically significant [22]. In this study, the suggested number of factors by the parallel analysis is eight according to the output of program R, given maximum

likelihood method for a factor analysis.

Results

In total of 416 questionnaires were returned, participants' demographics and other academic information are shown in the Appendix Table 1. Student satisfaction and diagnosis with items representing current statistics/mathematics courses during COVID-19 pandemic period is reported using descriptive statistics (Appendix, Table 2). The Kaiser-Meyer-Olkin measure of sampling

adequacy for the factor analysis was derived to be 0.75 [22]. Considering less than 0.5 is unacceptable and larger than 0.9 is marvelous, derived value of 0.75 is considered adequate [22].

Promax rotation of all items improves stronger loadings (> 0.3 = 'distinguishable') of each of one factor (Table 1) for all items [20].

Table 1: The factor 1 is about the delivery of course components, the factor 2 is about the offline mode preference, factor 3 is about mood swings, factor 4 is about a difficulty with access to the course, factor 5 is about a fairness of assessment and quality difference, factor 6 is about a financial support, factor 7 is about a financial reliability, factor 8 is about a family support and residential difficulty (in the table).

Item	Factor[a]							
	1	2	3	4	5	6	7	8
Factor 1. Delivery of course components								
1-1. Live sessions	0.534	*	*	*	*	*	*	*
1-2. Live Office Hours	0.525	*	*	*	*	*	*	*
1-3. Material Delivery: lecture notes, practice problems	0.662	*	*	*	*	*	*	*
1-4. Instructor flexibility	0.606	*	*	*	*	*	*	*
1-5. Communication: Email, Discussion board, What's app	0.589	*	*	*	*	*	*	*
1-6. Rate student satisfaction with MATH/STAT instructor during this online delivery as compared to student's other instructors	0.455	*	*	*	*	*	*	*
Factor 2. Offline mode preference								
2-1. Does student prefer offline mode for attending office hours?	*	0.629	*	*	*	*	*	*
2-2. Does student prefer offline mode for receiving course materials?	*	0.697	*	*	*	*	*	*
2-3. Does student prefer offline mode for assessments: quiz/exams/assignments?	*	0.707	*	*	*	*	*	*
Factor 3. Mood swings								
3-1. Did student experience any form of panic during COVID-19 period?	*	*	0.506	*	*	*	*	*
3-2. Did student experience any kind of depression?	*	*	0.757	*	*	*	*	*
3-3. Did student experience loneliness?	*	*	0.646	*	*	*	*	*
3-4. Did student experience boredom?	*	*	0.371	*	*	*	*	*
Factor 4. Difficulty with access to the course								
4-1. Due to this period of COVID-19, did student face any frequent challenges related to access of the course website: Blackboard/CANVAS/Quercus/WebCT/iLearn?	*	*	*	0.584	*	*	*	*
4-2. Due to this period of COVID-19, did student face any frequent challenges related to INTERNET?	*	*	*	0.641	*	*	*	*
4-3. Due to this period of COVID-19, did student face any frequent challenges related to devices?	*	*	*	0.585	*	*	*	*
Factor 5. Fairness of assessment and quality difference								
5-1. Assessment Components: assignment, quiz, exams	*	*	*	*	0.429	*	*	*
5-2. Due to this period of COVID-19, does student believe grades received for MATH/STAT courses have been fair?	*	*	*	*	0.736	*	*	*
5-3. Based on student's experience, does the quality of student's alternative mode of education for MATH/STAT courses feel the same as of face to face learning.	*	*	*	*	0.519	*	*	*
Factor 6. Financial support								
6-1. Does student receive any COVID-19 related financial support?	*	*	*	*	*	0.47	*	*
6-2. Does student receive any additional COVID-19 financial support from belonging educational institution?	*	*	*	*	*		*	*
Factor 7. Financial reliability								
7-1. Is student self-financing individual education, including scholarship?	*	*	*	*	*	*	0.357	*
7-2. Is student's education at risk due to any financial issues cause by COVID-19?	*	*	*	*	*	*	0.676	0.358
Factor 8. Family support and residential difficulty								
8-1. Is student living away from the family?	*	*	*	*	*	*	*	0.318

| 8-2. Due to COVID-19, is student unable to receive the regular financial support from the family? | * | * | * | * | * | * | * | 0.407 |
| 8-3. Due to this period of COVID-19, did student face any frequent challenges related to Time Difference (due to not being able to be close to belonging educational institute such as traveling back to country)? | * | * | * | * | * | * | * | 0.32 |

Accordingly, the 26 items on student course satisfaction and diagnosis were grouped into eight factors: Delivery of course components, Fairness of assessment and quality, Mood swings, Offline mode preference, Difficulty with access to the course, Financial support, Financial reliability, Family support and residential difficulty. Items associated with each of eight factors are shown in the Appendix Table 3. The validation process resulted in eight significant factors, where all items are at least moderately loaded on each factor, indicating items were validly grouped into their corresponding factors. A first criterion considered in the analysis is the very simple structure (VSS), and the higher the value means the better fit of simple loadings to represent the data [22]. The maximum VSS value is achieved at the 8-factor model. Another criterion to be considered is the Tucker-Lewis index (TLIp = 0.91), where the larger value is better within the interval [0, 1], which compares a worst-case model and the best-case model with our fitted model [22]. The last criterion is the root mean squared error of approximation (RMSEA = 0.03),which resulted in good fit as the value smaller than 0.05 indicates a good fit [22].

The table introduced below presents factor analysis by the Promax rotation with loading that are higher than 0.30 where loadings of value lower than 0.30 is not shown in the table and hidden away. The purpose of this table to find the grouped items that has the higher numerical loading values within each factor in order to comprehend the related matters of subject. For example, the first item of a live session rating has the highest numerical value of loading for the factor of the delivery of course components (Table 1).

Discussion

The factor analysis of collected data suggested items to be grouped for each factor, showing frames of associated matters that students take similarly in comprehension of subject. Throughout the organized items of each factor, the association of items signifies the similarities between items which is considered to be influential to each other, based on the correlation structure of input variables [22]. The analysis pointed out a clear associated relationship between the subject of fairness of grades, assessment components and relative quality difference from the consequence of online educational environment. This achieves our goal of comprehension importance to increase satisfaction ratings for the quality of an education during COVID-19 period toward better outcomes of fair grades that students receive, throughout more proactive interaction between instructors and students.

Since the sample is a randomly sampled, the generalization of data samples is possible with no specific indications of sample size, but we try to overcome the issue of a limitation for overall effectiveness in a quantitative study by bigger sample size and more factors. Consequently, the factor analysis of items was successful in reduction of dataset for eight generalized factors in understanding the relation of educational matters.

Fairness of assessment and quality

From result of a factor analysis, the dissatisfaction of fair marking that was supposed to be unexpected due to change of interactive communication between instructors and students had relatively lowered the relative quality of online educational delivery. Within the same factor, it is expected that forms of assessment component are relative to the dissatisfaction of fair grades, suggesting some dispute for students in taking online delivery of assessment during COVID-19 period. In terms of educational quality improvement, the engagement practice is suggested for an online learning environment, where students have some disagreement in taking online assessment and dispute over expected fair grades to be received [23]. In online asynchronous environment, the presence of an instructor of engagement learning process helped students to build up the knowledge and achieve the focus of statistics/ mathematics courses study [24].

Mood swings

The associated items of mood swings include depression, panic, boredom and loneliness, which are severely relevant to stress levels of young adults in combat for psychological impact during COVID-19 crisis [25]. The psychiatric symptoms developed from mood swings are prevalent among students with higher expected impact in daily life, implying the urgency of improvement of mental health care and psychological resilience during COVID-19 period [26]. Under the prevalence of mental health problems to majority of students, the only suggested way is to reduce the stress factors, which comes from academic complexity, in order to avoid the emergency situation [27].

Delivery of course components

There are several suggested influences by the change of delivery components in courses, which include the weakness of the online teaching infrastructure, the inexperience of teachers, the information gap, and the complex environment at home [28]. Considering the change of educational delivery components such as office hours, communication and live sessions, adequate informative learning process that is directed to grades is expected to be supplemented by instructors during extension of COVID-19 period [29].

Limitations and Conclusion

Under the anonymous distribution of surveys around UAE and Canada, the different level of statistics/mathematics course experience differs across all individuals to subjectively rate the satisfaction with some biases and misconceptions. The current study of analysis is only limited to statistics/mathematics courses and students who have taken courses.

Upon the extension of COVID-19 pandemic period, it is expected for this study to provide some understandings of educational environment in statistics/mathematics courses that students face. Although the grades reflect the fulfillment of students, a desirable assessment is expected for both instructors and students. With consideration of surrounding factors, a more important goal is the process of adequate learning for students to fulfill what is needed in each statistics/mathematics course even the continuation of COVID-19 period. Not only the elaborated process and interactional learning provided by the instructor could help student achieve high grade, but also the hard working and willingness of learning of students is an ultimate success for fair grades that can satisfy themselves with better outcomes.

Acknowledgement

Conflict of Interest

No conflict of interest.

References

1. Liu S, Yang L, Zhang C, Xiang YT, Liu Z, et al. (2020) Online mental health services in China during the COVID-19 outbreak. The Lancet Psychiatry 7(4): e17-e18.

2. Hodges C, Moore S, Lockee B, Trust T, Bond A (2020) The difference between emergency remote teaching and online learning. Educause Review, 27.

3. Nabukeera M (2020) The COVID-19 and online education during emergencies in higher education. Archives of Business Research 8(5): 183-190.

4. Burgess S, Sievertsen HH (2020) Schools, skills, and learning: The impact of COVID-19 on education. VoxEu. org, 1.

5. Wendorf CA, Alexander S (2005) The influence of individual-and class-level fairness-related perceptions on student satisfaction. Contemporary Educational Psychology 30(2): 190-206.

6. Bao W (2020) COVID-19 and online teaching in higher education: A case study of Peking University. Human Behavior and Emerging Technologies 2(2): 113-115.

7. Sawant A, Balasubramanian A, Narayanan GB (2020) Education during Pandemic: A Study from a Students' Perspective in India. Available at SSRN 3609085.

8. Dwi S, Prima SR, Nur F, Dikdik Baehaqi Arif DBA, Fuad S (2020) Learning analytics to predict student achievement in online learning during Covid-19 mitigation. International Journal of Psychosocial Rehabilitation 24(10): 1844-1861.

9. Şanli R (2003) Students' perceptions about online assessment: a case study (Doctoral dissertation, Middle East Technical University).

10. Zhou L, Wu S, Zhou M, Li F (2020) 'School's Out, But Class' On', The Largest Online Education in the World Today: Taking China's Practical Exploration During The COVID-19 Epidemic Prevention and Control As an Example. But Class' On', The Largest Online Education in the World Today: Taking China's Practical Exploration During The COVID-19 Epidemic Prevention and Control As an Example (March 15, 2020).

11. Huang RH, Liu DJ, Tlili A, Yang JF, Wang HH (2020) Handbook on facilitating flexible learning during educational disruption: The Chinese experience in maintaining undisrupted learning in COVID-19 Outbreak. Beijing: Smart Learning Institute of Beijing Normal University.

12. Cole MT, Shelley DJ, Swartz LB (2014) Online instruction, e-learning, and student satisfaction: A three-year study. The International Review of Research in Open and Distributed Learning, 15(6).

13. Bowers J, Kumar P (2015) Students' perceptions of teaching and social presence: A comparative analysis of face-to-face and online learning environments. International Journal of Web-Based Learning and Teaching Technologies (IJWLTT) 10(1): 27-44.

14. Chatterjee SS, Malathesh Barikar C, Mukherjee A (2020) Impact of COVID-19 pandemic on pre-existing mental health problems. Asian Journal of Psychiatry 51: 102071.

15. Sahu P (2020) Closure of universities due to Coronavirus Disease 2019 (COVID-19): impact on education and mental health of students and academic staff. Cureus 12(4).

16. Zhai Y, Du X (2020) Mental health care for international Chinese students affected by the COVID-19 outbreak. The Lancet Psychiatry 7(4): e22.

17. Cao W, Fang Z, Hou G, Han M, Xu X, et al. (2020) The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry research, 112934.

18. Letcher DW, Neves JS (2010) Determinants of undergraduate business student satisfaction. Research in Higher Education Journal 6(1).

19. Ware Jr JE, Snyder MK, Wright WR, Davies AR (1983) Defining and measuring patient satisfaction with medical care. Evaluation and program planning 6(3-4): 247-263.

20. Fabrigar LR, Wegener DT, MacCallum RC, Strahan EJ (1999) Evaluating the use of exploratory factor analysis in psychological research. Psychological methods 4(3): 272.

21. Santos JRA (1999) Cronbach's alpha: A tool for assessing the reliability of scales. Journal of extension 37(2): 1-5.

22. Mair P (2018) Modern psychometrics with R. Springer International Publishing.

23. Glass J, Sue V (2008) Student preferences, satisfaction, and perceived learning in an online mathematics class. MERLOT Journal of Online Learning and Teaching 4(3): 325-338.

24. Lee J (2014) An exploratory study of effective online learning: Assessing satisfaction levels of graduate students of mathematics education associated with human and design factors of an online course. International Review of Research in Open and Distributed Learning 15(1): 111-132.

25. Ho CS, Chee CY, Ho RC (2020) Mental health strategies to combat the psychological impact of COVID-19 beyond paranoia and panic. Ann Acad Med Singapore 49(1): 1-3.

26. Wang C, Pan R, Wan X, Tan Y, Xu L, et al. (2020) Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. International journal of environmental research and public health 17(5): 1729.

27. Liang L, Ren H, Cao R, Hu Y, Qin Z, et al. (2020) The effect of COVID-19 on youth mental health. Psychiatric Quarterly 91(3): 841-852.

28. Zhang W, Wang Y, Yang L, Wang C (2020) Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 Outbreak.

29. Alshare KA, Freeze RD, Lane PL, Wen HJ (2011) The impacts of system and human factors on online learning systems use and learner satisfaction. Decision Sciences Journal of Innovative Education 9(3): 437-461.