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Psychological Research of College Students Based on Online Education under COVID-19

Xi Wang [1] and Yuntao Zou [2,3,*]

[1] School of Materials, Huazhong University of Science and Technology, Wuhan 430074, China
[2] School of Energy and Power Engineering, Huazhong University of Science and Technology, Wuhan 430074, China
[3] School of Computer of Science and Technology, Huazhong University of Science and Technology, Wuhan 430074, China
* Correspondence: zouyuntao@hust.edu.cn

Abstract: As a socially sensitive group, college students have a higher risk of mental health problems. However, because of the COVID-19 pandemic, many nonlocal college students were isolated locally and were not able to attend classes as usual. This series of protective measures to avoid the spread of the disease may bring an additional mental impact on college students' lives. As an important aspect of the sustainable development goals of quality education, education plays a central role in shaping personal and social change towards sustainability. The COVID-19 environment poses a great challenge to the education of university students. The purpose of this study is to propose a strategy to use an intelligent online learning system based on content recommendation and electronic questionnaires in the field of education. We invited 3000 isolated college students (47.6% male and 52.4% female) to participate in an internet trial. It proved to be effective in helping us intervene quickly, objectively, effectively, and in real-time in students' psychological problems. In addition, according to the data analysis collected by the intelligent online learning system, we found that the degree of isolation regarding college students' psychological problems was closely related to their grade, family background, professional category, and computer proficiency. This study shows that, during the period of isolation, the mental health of college students should be well monitored. Targeted psychosocial guidance is more needed for students with higher grades, those with low-income families, liberal arts majors, and those with weak computer skills in order to reduce the emotional impact of isolation on students.

Keywords: psychological education; recommendation algorithm; college education; e-learning

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1. Introduction

Sustainability is considered a paradigm for thinking about the future, and the COVID-19 epidemic poses a threat to global sustainability. [1]. Among the COVID-19 stressors, financial instability and uncertainty about one's future/career are considered common factors that lead to poor mental health and diminish economic sustainability. College students' academic and employment stressors are more likely to lead to psychological anxiety. Under such environmental pressures, multiple variations of psychological problems among college students emerge, requiring educators to conduct in-depth research to identify problems in multiple ways and implement sustainability interventions to help college students develop positive values [2].

1.1. Current Situation and Background of Chinese College Students

Since the COVID-19 pandemic, infectious diseases have spread to many countries around the globe. Many countries have implemented strict regulations to control the spread of infectious diseases [3–5] or at least reduce their rapid spread. For example, China has imposed lockdown controls in quarantined areas, they suspended all public transport

operations, they did not allow vehicles to drive outside, and a number of Chinese citizens had to be forced into quarantine at home [6–8].

As a result of the unique nature of university education in China, college students may live hundreds or thousands of kilometers away from their schools. Each semester, college students must travel several hours by high-speed train or airplane to reach school. Once they arrive at school, they are enrolled in a residential program where they engage in almost all of their daily living, including attending classes, eating, sleeping, and having fun. However, due to the epidemic, the school is trying to prevent college students from gathering and infecting each other to reduce the spread of the epidemic virus. Therefore, all recreational and living facilities at the school were closed. The school has also replaced in-school classes with online classes, and college students are strictly not allowed to stay at the school.

Meanwhile, under the supervision of China's epidemic protection policy, local epidemic prevention workers require that when a person is infected with the new coronavirus in a residential neighborhood, the entire neighborhood is sealed off. Residents living in the neighborhood are not allowed to go outside for any reason and are only allowed to self-quarantine at home. Access will be lifted only when all residents in the community have been tested for nucleic acid and there is no one infected with the virus. Residents in most areas have been on home lockdown for more than a month, and areas with severe outbreaks may be on lockdown for even longer.

This prevention policy results in reduced social interaction, home restrictions, and academic difficulties among college students. This sudden change in their lives may negatively affect their personalities, leading to depression and isolation [9,10]. These negative emotions are likely to cause serious psychological problems for isolated college students over a period of time [11,12]. Due to limited faculty resources, schools are unable to arrange for more tutors for one-to-one counseling with students. Since tutors are isolated from students in real time, it is difficult to detect the psychological problems of most college students in time.

After investigation, we found that long-term isolation can bring serious psychological problems to college students [13–16]. College students who are isolated for a long period of time experience significant changes in their daily lives. In addition, they are unable to participate freely in social activities and have a limited range of activities, leading to psychological problems such as loneliness and depression. Due to the specialized nature of university courses and the heavy course content, some students who are highly dependent on teachers may not be able to adapt to this type of learning environment. Due to their isolation, they feel anxious due to their inability to interact with other students [17–20].

1.2. The Epidemic Situation Brings Challenges to College Students' Education

The outbreak of COVID-19 resulted in the closure of schools/educational institutions, affecting approximately 1.5 billion people enrolled in college [21]. The closure of educational institutions mainly affected children and adolescents [22]. Among them, college students, as a socially sensitive group, are at higher risk of mental health problems [23]. According to recent studies, it is emphasized that isolated personnel may experience psychological distress [19]. This confusing and fluctuating situation causes psychological distress among college students due to post-traumatic stress symptoms [24]. It is almost impossible for college students to physically and psychologically escape the harmful consequences of the COVID-19 pandemic. For college students, the increase in psychological problems is mainly due to potential uncertainty and academic interruptions [25]. At any given moment, college students can suffer from elevated stress levels, anxiety, depressive symptoms, and other psychological problems [26]. However, in the current pandemic situation, traditional norms and related performance requirements are becoming increasingly difficult to match. It has become a pressing issue for university counselors to guide college students' emotions during emergencies and instruct them regarding how to stay away from emergency-induced misfortunes [24].

A recent study highlighted that students suffer from poor mental health and mental illness during and even after isolation [26]. Many students discussed their experiences of stress and anxiety, primarily due to academic delay and a lack of socialization [24]. The tendency to experience stress or depressive symptoms worsens due to fundamental changes in economic stability, especially in the job market [27]. According to recent findings by YoungMind through a global survey, approximately 83% of respondents perceived their mental health to be poor during isolation [28]. Furthermore, a recent study presented disturbing figures: a quarter of college students have poor mental health and psychological well-being [17].

To ensure that college students continue their studies during segregation, online learning via the internet has become an alternative to physical education classes on campus. Online learning is an effective method of learning during segregation. However, this mode of learning also has implicit psychological effects on college students. First, college students are less exposed to the new teaching methods of online learning, which are significantly different from traditional teaching methods [29]. Many college students feel uncomfortable, leading to anxiety. Second, students in the context of online learning can only communicate remotely through smart devices, which severely limits college students' ability to communicate and discuss and affects their learning efficiency [30]. Third, online learning requires students to equip themselves with smart devices such as tablets and laptops. In some cases, low-income students do not have access to devices and must borrow them from others, which limits the amount of time they can spend studying remotely. This leads to unequal learning opportunities for students from different families and an invisible psychological pressure on limited-income students. In addition, students from low-income families face many pressures as an additional expense to the cost of instruction and not a low fee [31].

1.3. Intelligent Measures to Explore Psychological Problems

In order to understand and address students' psychological problems, our instructors usually intervene in the form of questionnaires and interviews [32]. Despite this, we face a number of challenges in the epidemic environment, such as a limited number of instructors and inconvenient travel arrangements. Traditional questionnaires are difficult to administer to college students who are scattered across the country. They have long survey periods and are not available in real time. This makes it difficult to accurately measure the psychological changes of college students due to the difficult environment. As a result, tutors are unable to detect and intervene in college students' psychological problems in a timely and effective manner.

In order to improve the drawbacks of internet education, we have adopted an intelligent online learning system. The system can publish electronic questionnaires, collect data on college students' reading behaviors and preferences, and use intelligent recommendation algorithms to push corresponding learning materials. We can summarize and analyze online learning data based on system statistics. It is more efficient and accurate to discover the real-time psychological problems of college students and actively guide them.

2. Literature Review

As a result of the COVID-19 outbreak, many scholars have assessed the psycho-emotional impact of isolation on students through various studies. Several Chinese scholars have studied the effects of segregation on Chinese college students. They concluded that students have high levels of anxiety due to long-term isolation restrictions [24,33]. Typically, they used a questionnaire to collect results from a sample of segregated college students. Although this method is simple and effective, it tends to lead to inaccurate results due to the long period and limited number of studies. Therefore, in the course of our study, we not only reviewed a large number of scholarly studies on the psycho-emotional effects of segregated students during COVID-19 but also browsed through a large amount of information on the application of e-learning in college student education in order to certify

the feasibility of our intelligent measures. Finally, a systematic literature review was used to unify them [34].

2.1. The Psychological Impact of COVID-19 on Isolated College Students

We searched eight databases—JMIR, Frontiers, Academic, Sciencedirect, BMC, Spring, MDPI, and ACS—with a search strategy combining the following keywords: "psychological", "COVID-19 pneumonia" or "COVID-19" or "2019-nCOV", "undergraduate" or "academician" or "university student" or "college student" or "higher education students". The articles searched were written between December 2019 and February 2022. The search process is as shown in Figure 1.

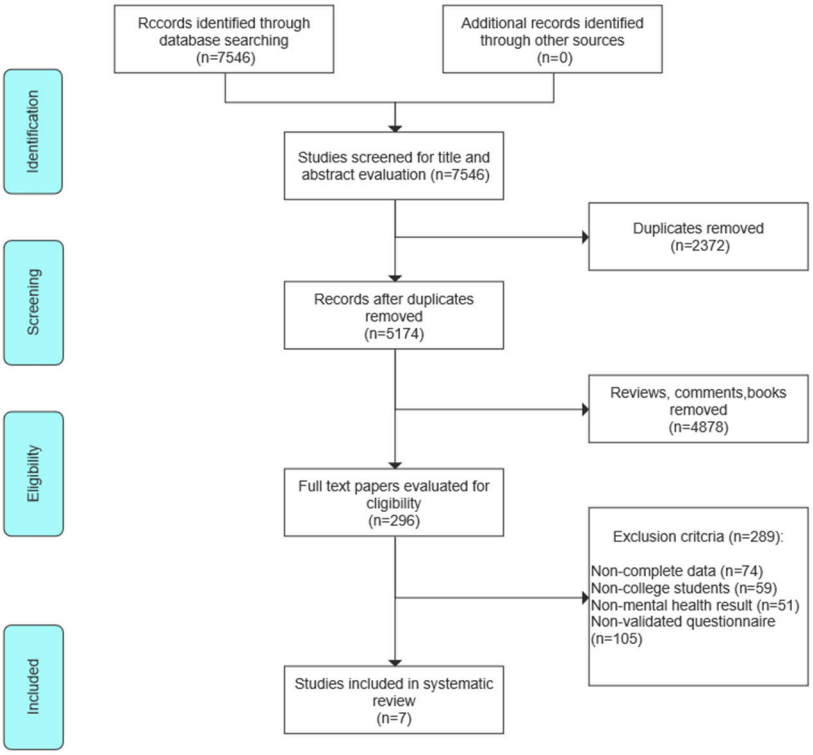

Figure 1. Flowchart of the literature search.

Eligible studies must meet the following inclusion criteria: original research on the mental health status of current college students (in this study, college students are defined as undergraduates and graduate students in higher education, excluding students who are temporarily absent from school, dropouts, etc.); observational studies measuring the mental health of college students in the COVID-19 pandemic; the mental health assessment instruments used must be validated with high a reliability and validity, such as the Self-Rated Depression Scale (SDS), Patient Health Questionnaire-9 (PHQ-9), and Generalized Anxiety Disorder (GAD-7). We excluded review studies, duplicate publications of uniform data, studies without clear published data, and studies with conflicting full-text readings.

1. Preliminary search: In the literature database, the corresponding literature was searched using keywords, and a total of 7546 articles were obtained.

2. Elimination of duplicate literature: The 7546 articles from the preliminary search were checked and processed to eliminate duplicate and similar papers (totaling 2372 articles), leaving 5174 articles

3. By reading the titles and abstracts, a total of 4878 papers with inconsistent research directions were eliminated, leaving 296 papers.

4. The seven papers that met the inclusion criteria were selected by reading the full text and following our specified inclusion criteria.

These seven pieces of literature studied and investigated the psychological problems of university students in the epidemic environment in seven countries: Italy, France, Japan, the United States, Spain, Egypt, and China [14,35–40]. The period of investigation was March 2020–July 2020, the total number of people studied was 68,595, SAS, SDS, PHQ-9, GAD-7, IES-R, DASS-21, BRS, and CSQ methods were used, and the average impact factor of the journals was 3.172.

As shown in Table 1, these seven studies investigated the psychological problems of university students in pandemic settings in seven countries: Italy, France, Japan, the United States, Spain, Egypt, and China [14,35–40]. Italian scholars [35] highlighted the uncertainty of the pandemic evolution and the potentially long-term impact on mental health, making it crucial to study the most effective interventions at the school level, to identify the most vulnerable subgroups, and to plan acute and long-term psychological services to control and reduce fear and thus the burden of psychological problems. Additionally, Egyptian scholars [39], in their study of psychological problems among Egyptian university students, suggested that psychological research on university students through questionnaires can produce bias due to the lengthy questionnaire period, and even if the questionnaire period is reduced to less than 2 weeks, there will still be a small bias that does not reflect real-time problems. Moreover, it is not possible to collect behavioral data related to students' leisure time through questionnaires, which makes the study limited.

Table 1. Literature review of college students' psychological research.

Journal	Investigation Time	Literature	Number of Respondents	Method
Globalization and Health	8 June–12 July 2020	Impact of the COVID-19 pandemic on psychological well-being of students in an Italian university: a web-based cross-sectional survey	501	SAS, SDS
Journal of Affective Disorders	27–30 April 2020	Mental health of French students during the COVID-19 pandemic	59,931	PHQ-9, GAD-7, IES-R
Journal of Medical Internet Research	8–14 June 2020	Impact of the COVID-19 Pandemic on the Psychological Distress of Medical Students in Japan: Cross-sectional Survey Study	717	PHQ-9, GAD-7
Journal of Medical Internet Research	4–19 May 2020	Investigating Mental Health of US College Students During the COVID-19 Pandemic: Cross-Sectional Survey Study	2031	PHQ-9, GAD-7
Frontiers in Psychology	17–24 March 2020	Psychological Impact and Associated Factors During the Initial Stage of the Coronavirus (COVID-19) Pandemic Among the General Population in Spain	3055	IES-R, DASS-21
Health Promotion International	1–7 May 2020	Psychological impacts of COVID-19 pandemic on the university students in Egypt	1335	Google Research
Journal of Adolescent Health	7–24 April 2020	The Psychological Impact of the COVID-19 Pandemic on Teenagers in China	1025	BRS, CSQ, IES, DASS-21

Note: SAS: Rating Anxiety Scale; SDS: Rating Depression Scale; PHQ-9: 9 patient health questionnaires; GAD-7: 7-item generalized anxiety disorder scale; IES-R: Traumatic psychological response measurement standard including 22 items; DASS-21: 21 Depression Anxiety Stress Scale; BRS: Brief Resilience Scale; CSQ: Coping Style Questionnaire.

2.2. AI Recommendation System in the Field of Education-Related Research

We searched eight databases—JMIR, Frontiers, Academic, Sciencedirect, BMC, Spring, MDPI, and ACS—with a search strategy that combined the following keywords: "e-learning" or "Online Learning, education or teaching", "artificial intelligence" or "AI" or "machine learning", "Recommendation Systems" or "recommender system" or "Personalized Recommendation Systems". Searches were conducted in December 2016 and February 2022. The search process is as shown in Figure 2.

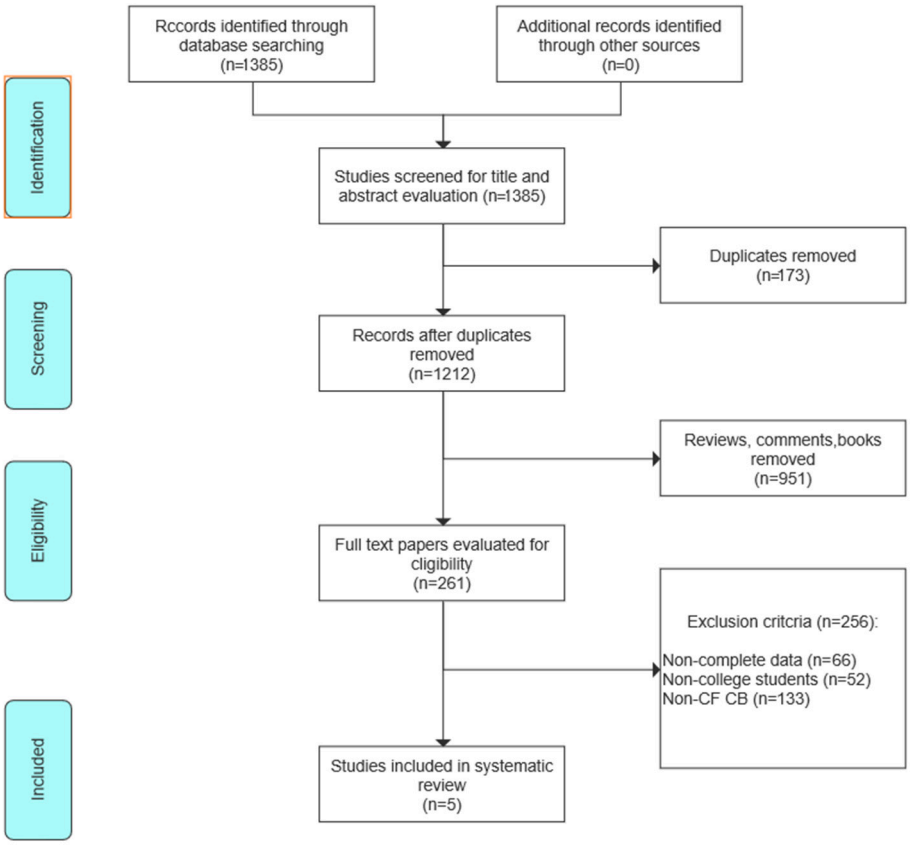

Figure 2. Flowchart of the literature search.

Eligible studies had to meet the following inclusion criteria: original research on recommender systems used for learning by university students (in this study, university students are defined as those in higher education and graduate students, excluding students who are temporarily absent from school, dropouts, etc.); research on recommender systems based on collaborative filtering, content recommendation, and user recommendation; and research on recommender systems with clearly published research data.

1. Preliminary search: In the literature database, the corresponding literature was searched using keywords, and a total of 1385 articles were obtained.

2. Elimination of duplicate literature: The 1385 articles from the preliminary search were checked and processed, and duplicate and similar papers were eliminated (a total of 173 articles), leaving 1212 articles.

3. By reading the titles and abstracts, a total of 951 papers that were inconsistent with the research direction of the articles were excluded, leaving 261 papers

4. Through reading the full text, five papers were selected according to the inclusion criteria specified by us.

These five papers used five different basic algorithms—CNN, FDTWGI-FSA, IF-THEN, Spark Hadoop, MoodleRec, and CodERS—to study recommendation systems. Articles were published between May 2017 and July 2020, and the average impact factor is 2.305.

As seen in Table 2, we have summarized five papers with the highest relevance to our study topic [41–45], indicating that the use of recommender systems in education has gradually gained popularity. The MoodleREC recommender system model was developed by Carlo et al. to determine students' learning interests by the length of their stops in each module [41], and the CodERS recommender system model was studied by Mohammad Hossein Ansari et al. In the field of education, the use of user behavior analysis [42] has proven to be highly effective in finding more suitable learning materials for students. These studies have demonstrated the feasibility of recommender systems. However, all of these studies are in the field of e-learning. Few scholars have applied recommender

systems in the field of psychoeducation to determine the psychological bias of students by monitoring their learning behaviors through recommender systems. Therefore, we decided to introduce it into the field of psychoeducation to obtain further research results.

Table 2. Literature review of AI recommendation systems in the field of education.

Journal	Date of Publication	Literature	Algorithm
Journal of Intelligent & Fuzzy Systems	17 July 2020	A content recommendation system for effective e-learning using embedded feature selection and fuzzy DT based CNN	CNN, FDTWGI-FSA
Journal of Affective Disorders	23 February 2019	An intelligent fuzzy rule-based e-learning recommendation system for dynamic user interests	IF-THEN
Journal of Big Data	8 January 2019	Large-scale e-learning recommender system based on Spark and Hadoop	Spark Hadoop
Computers in Human Behavior	March 2020	MoodleREC: A recommendation system for creating courses using the moodle e-learning platform	MoodleRec
International Conference of Signal Processing and Intelligent Systems (ICSPIS)	6 March 2017	CodERS: A hybrid recommender system for an E-learning system	CodERS

Note: CNN: Convolutional Neural Network; FDTWGI-FSA: Fuzzy Decision Tree and Weighted Gini-Index-based Feature Selection Algorithm; IF-THEN: Displays the Fuzzy Intelligent; Spark: Big data computing engine; Hadoop: Distributed system infrastructure; MoodleRec: Recommendation system based on Moodle [41] optimization; CodERS: the first recommender system for online programming learning platforms (the authors believe it could inspire researchers to develop the next generation of such systems).

2.3. Combination of Traditional Questionnaires and AI Intelligence

The field of artificial intelligence is one of the most advanced fields of computer science. There is an increasing interest in applying artificial intelligence technology to the field of mental health education for college students. He [46] proposed a deep learning-based psychological education strategy to improve the efficiency of psychological and ideological education; Tao [47] proposed a model for predicting young people's propensity to commit crimes by using an ant colony algorithm; and Shen [48] combined a gate-loop unit (GRU) with an attention mechanism to analyze emotions in ideological and political education and find hidden abnormal psychology.

This artificial intelligence-based emotion analysis can be used in the field of mental health education to identify problems. Behavioral and emotional analysis should be used to identify abnormalities in students with psychological problems and disorders and then provide psychological guidance to correct deviations. Although this is a necessary measure, it is difficult to provide counseling for those who suffer from mental disorders.

We would like to have a method to understand the trend of students' thoughts. Using this method, we can identify situations that may be causing negative emotions in students early on. Then, teachers can actively guide students. The application of the recommendation algorithm is a pre-guidance approach. We have added recommendation algorithms to our online learning system. The recommendation algorithm recommends learning materials based on basic student characteristics and online behavioral characteristics. The system observes and calculates the viewing of these materials. Teachers can analyze students' thought trends and actively guide them based on these statistics.

Looking at the above studies, we can see that researchers often use questionnaires and assessment scales to statistically analyze their research subjects. Scholars have also used artificial intelligence methods to analyze the results of questionnaires. All of these research methods have achieved successful results. Therefore, we believe that the combination of multiple research methods will produce better research results.

We used an intelligent online learning system called GIOLS (Ginkgo Intelligent Online Learning System), which incorporates AI recommendation algorithms. In addition to wired classroom teaching features, GIOLS includes electronic questionnaires and AI

recommendation algorithms. It applies a variety of psychological research methods to collect and analyze data on online learning and to provide assistance to teachers. In isolated environments, communication between teachers and students can be difficult. Teachers can use GIOLS to understand the psychological dynamics of their students and provide timely and positive guidance to improve teaching and learning.

3. GIOLS System

Due to the appearance of COVID-19, many college students are isolated at home and are unable to attend school as normal. In order to prevent the spread of the epidemic, colleges and universities have adopted an alternative classroom teaching method. As a result, online learning has become increasingly popular.

A learning system with electronic resources is called online learning. During the epidemic, classroom gatherings were considered an opportunity for virus transmission. Therefore, college students were forcibly isolated at home and were not allowed to enter school. E-learning is the best choice to ensure that the epidemic does not spread, because it ensures the space distance, and there is no close contact between students and teachers. It can complete the teaching work through information and communication technology, ensuring the students' learning progress. The online learning mode is proposed only to solve the problem of isolation. In the actual teaching work, we found that the psychological health of college students was also seriously affected because of the isolated environment. Through the traditional online learning system, it is difficult for us to easily understand the real-time psychological problems of isolated college students distributed around.

In comparison to traditional online learning systems, GIOLS makes up for its shortcomings. GIOLS is a new online learning system that integrates the recommendation system and online questionnaire functions into a traditional online learning system. The system includes the data collection of students' psychological questionnaires, online learning behavior, reading behavior, browsing behavior, and other behavioral characteristics. The personal data of students are compared and analyzed by year-on-year analysis, ring comparison analysis, and cycle comparison analysis. It is easier for tutors to find out the real-time psychological problems of isolated college students by analyzing these data.

GIOLS has an extensive learning database that includes text, images, audio, and video. In addition to learning materials for various majors at the university, the database also includes literature, film and television, news hot spots, and other materials of interest to college students.

GIOLS is primarily composed of three functional modules: online learning, questionnaire survey, and learning materials recommendation.

- Online learning

The online learning module is mainly used for real-time video teaching between teachers and students. In addition, the online learning module also counts students' class attendance, homework submission, and homework scoring. Teachers can also take electronic exams, review test papers, and publish test results.

- Questionnaire

The questionnaire module can be released by the instructor and completed by a specific group of students. The questionnaire was revised according to the Mental Health Questionnaire for College Students [49] developed by the Chinese Ministry of Education. We invited several educational experts to discuss, analyze, and revise the questionnaire. The questionnaire consisted of three dimensions: cognitive (F1), social (F2), and emotional (F3). It was the responsibility of the mentor to conduct the questionnaire and interviews. The questionnaire and interviews were severely hampered by the isolated environment. Given the limited faculty, it was not possible for us to conduct a uniform questionnaire and interview college students from all over the country. Therefore, we thought that converting the offline survey into an online questionnaire would be a very effective method.

1. Reliability test of the questionnaire

We tested the reliability of the questionnaire through SPSS 16.0 software. The Cronbach's alpha test output from SPSS includes many results. Among them, the first table is the Case Processing Summary, as shown in Table 3.

Table 3. Case Processing Summary.

	N	%
Cases Valid	1800	100.0
Excluded [a]	0	0
Total	1800	100.0

[a]: List wise deletion based on all variables in the procedure.

As can be seen from the table, there were 1800 valid data (Valid row) and no missing data (Excluded row), and the total sample size was 1800 cases (Total row) in this study.

The results of Cronbach's α coefficient are shown in Table 4.

Table 4. Reliability Statistics.

Cronbach's Alpha	Cronbach's Alpha Based on Standarized Items	N of Items
0.743	0.741	20

The Cronbach's alpha coefficient value for the 20 items measuring college students' psychological motivation in the study was 0.743, suggesting a high degree of internal consistency among the 20 items. In general, the degree of consistency of the items is related to the content of the measure, and a higher Cronbach's alpha coefficient value suggests a higher degree of internal consistency. Previous studies have concluded that we consider the consistency between entries to be good as long as the Cronbach's α coefficient is greater than 0.7.

- Learning materials recommendation

In the learning materials recommendation module, learning materials can be recommended according to the student's grade, major, and other basic characteristics. It can also recommend the most popular materials, as well as other popular materials of the same category according to the content searched and accessed by students. The materials recommendation module tracks the number of times students have browsed various materials, as well as the duration of these browsing sessions, and summarizes this information. The record of students' browsing behavior in the materials recommendation module is based on the data statistics of the reading amount of materials and the characteristics of student groups. It does not involve students' personal privacy.

Based on the above functional analysis, we can identify the following three characteristics:

(1) We can not only see the statistics of attendance, homework submission, and the homework completion rate through the system but can also obtain the behavior characteristic data of students such as the length of page stagnation, the proportion of module popularity (the frequency and number of clicks on different modules), online duration, reading behavior records, hobby bias analysis, etc.

(2) Through the online questionnaire function of the intelligent online learning system, we can solve the problem that it is inconvenient to use paper questionnaires to understand the current situation of students because of isolation.

(3) We can also receive analysis data from the learning system in real time, allowing us to identify students' problems quickly and provide targeted guidance.

After discussion and analysis between tutors and educational researchers, it was agreed that the characteristics of these GIOLS were conducive to our accurate and rapid discovery of students' psychological problems during isolation.

4. Some Research Results

For the purpose of studying the Recommended Learning System for Psychological Education, 3000 college students were invited to use the system. Among them, male students accounted for 47.6%, female students accounted for 52.4%, liberal arts students accounted for 43.7%, science students accounted for 56.3%, low-income students accounted for 18.9%, high-income students accounted for 21.6%, and normal-income students accounted for 59.5%. The average age of the participants is around 21. We hope to learn the influencing factors of college students' psychology in the COVID-19 environment. The first period is one semester (6 months). Students' data are collected during the trial period, such as teacher feedback, browsing records, browsing duration, recommended project category, active viewing project category, and other relevant data. (We have desensitized the data and only kept non-sensitive data).

Figure 3 shows the grade distribution of the 3000 subjects participating in this study: Freshman (15.3%), sophomore (19.6%), junior (16.2%), senior (10.1%), the first year of postgraduate education (14.5%), the second year of postgraduate education (12.3%), and the third year of postgraduate education (12%); males accounted for 47.6%, and females accounted for 52.4%.

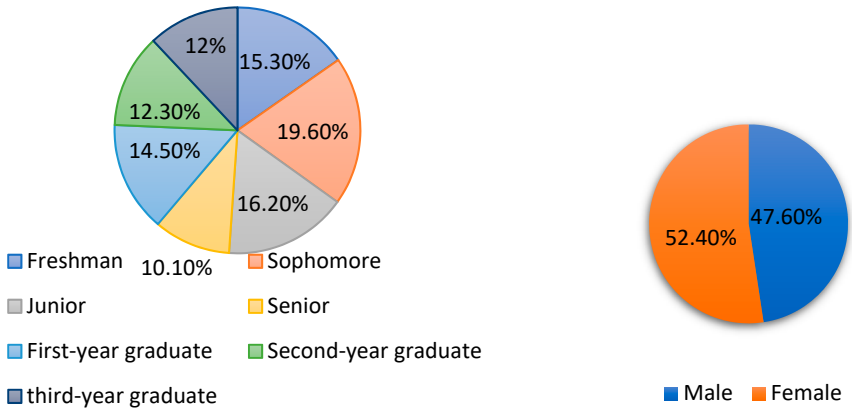

Figure 3. Composition of students participating in the GIOLS.

4.1. Analysis of the Psychological Influence of Gender

By analyzing the data from the recommendation system and comparing it to the data from history classroom teaching, we determined that the attendance rate of female students using online recommendation systems was normal, as shown in Figure 4, while the rate of homework submission was significantly lower than that of offline teaching, as shown in Figure 5. Based on the experience of teaching research, we believe that this type of performance is abnormal. As an example, some girls who actively participate in class and have a positive attitude toward learning fail to submit their homework on time. Furthermore, we conducted a detailed analysis of the data of female students in order to better understand the factors responsible for the abnormal results. There is a higher rate of online homework submission among female students living in cities compared to that among those living in rural areas. Therefore, we suspect that female students living in rural areas have limited access to electronic products and are not proficient at using online systems. This results in them spending a considerable amount of time online learning or submitting homework, thereby negatively impacting their submission of assignments.

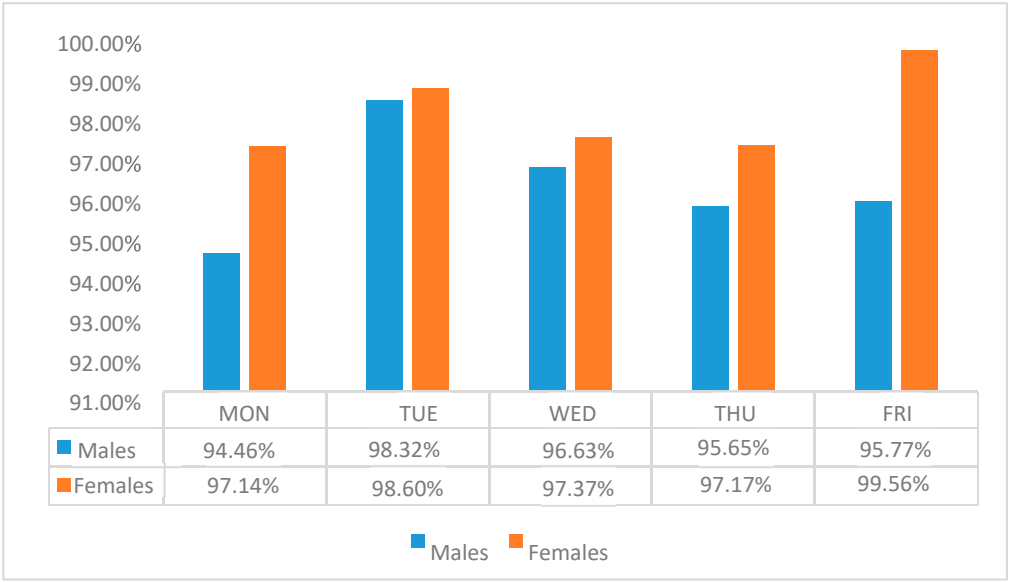

Figure 4. The attendance rate submitted in a week.

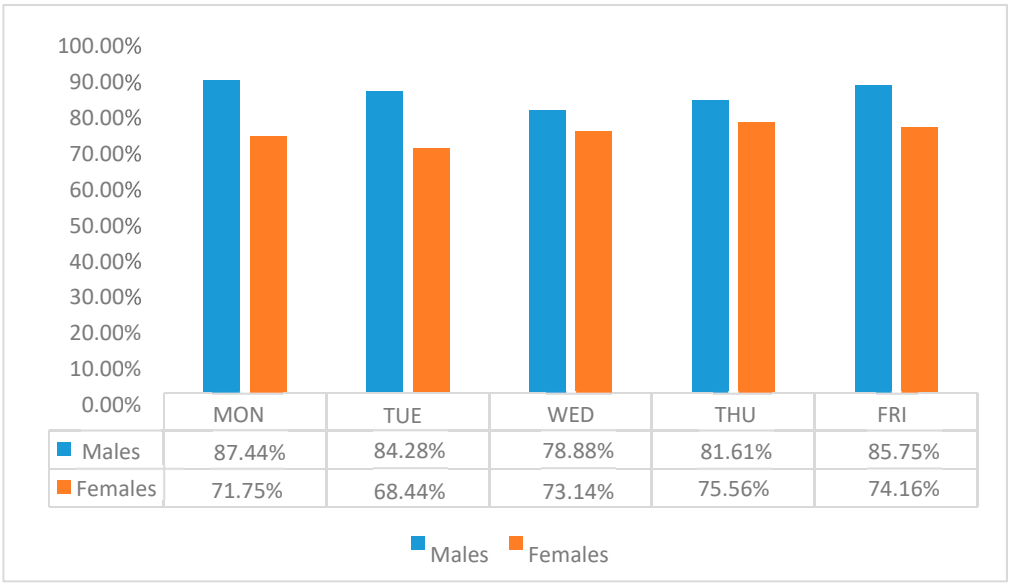

Figure 5. Assignment submission rate for a week.

As part of our research, we randomly selected dozens of female students to verify our conjecture. According to the survey results, our conjecture was supported. In addition to our conjecture, there are several other reasons.

First, some rural female students do not have the smart devices required to participate in the online teaching system. Some of them use their neighbors' devices for online learning, while others share devices with their brothers and sisters for online learning. They do not have enough time to operate the smart devices, especially in the evening. It is difficult for them to obtain enough time to use the equipment to complete the corresponding course assignments.

Second, some rural female students have poor internet conditions at home. The network bandwidth at home is insufficient to meet the needs of online teaching. Due to the limited network bandwidth, they will only be able to use the smart devices to enter the online teaching system in order to perform attendance clocking in, but they cannot watch teaching videos through their home bandwidth to complete their academic work. They were unable to complete relevant homework due to poor teaching effectiveness.

Third, some girls did not have smart devices for online learning at home before. This unexpected expenditure was caused by isolation. Expensive smart devices have brought additional economic pressure to rural female students' families.

Fourth, because some girls are isolated at home, they do not have a simple learning environment in school. They also need to do the necessary housework. This family work took up much of their study time and delayed their submission of homework.

Fifthly, some female students have less contact with electronic products and are not skilled in the use of online systems. This causes them to spend a lot of time on online learning or submitting homework, delaying the submission of homework.

Through further analysis of the above research results, we found that the five causes of data anomalies were not significantly related to gender. Therefore, we speculate whether male students will also have corresponding problems. The results of the survey showed that male students do have corresponding problems. This is because of the large range of male students' attendance rates and homework submission rates, as well as their strong exploration and adaptability. Therefore, there is no obvious deviation and abnormality in the data display. In summary, we believe that, in an isolated environment, the hardware problem of online learning is a common problem for both boys and girls.

They will be unable to complete their studies and homework because of a lack of basic teaching conditions. This will greatly trigger students' anxiety and make them doubt whether they can really adapt to college life. They are facing problems that are unprecedented in their studies and lives. However, they do not have corresponding psychologists to communicate with their classmates, which further aggravates this phenomenon. We cannot find the root of these anxieties through questionnaires. By using the intelligent teaching system, we can identify situations to which we had not been exposed before. It is a new challenge for both teachers and students. These situations that students encounter are problems that we as teachers have not found before. Without this teaching system, we need to spend more time and resources to find these problems.

4.2. Analysis of the Students' Psychological Influence in the Graduation Season

We conducted a subjective questionnaire survey on all trial students through online questionnaires. Among them, one question is "how much do you think of your psychological anxiety during isolation?" Five options are provided (Mild anxiety, Mild to moderate anxiety, Moderate anxiety, Moderate to severe anxiety, and Severe anxiety). The final result is shown in Figure 6. The data show that most students believe that their psychological anxiety is at a general level, with no apparent tendencies.

However, we obtained the access frequency of employment-related materials within ten days of each grade from the browsing behavior monitoring data of the GIOLS system. This is shown in Figure 7. We find that students in the graduation season visit employment guidance materials more frequently than those in other grades. This shows that the psychological anxiety of students in the graduation season mainly comes from employment pressure.

The analysis of behavioral psychology indicates that both college students and graduate students experience more anxiety during the graduation season. As they face academic pressures such as graduation defenses and thesis defenses, they also must deal with employment and internship issues. There is a clear distinction between the performance of senior students and that of junior students. They do not have the same educational background as graduate students. As a result of the epidemic, many companies have moved their interviews from offline to online. Considering the brand-new interview method, many seniors will be anxious and fearful of the unknown. Because of their higher education background, students in the third year of postgraduate study have certain practical experience and project experience. In addition, they have experienced the fourth stage of their college lives, witnessed numerous senior students in employment, or experienced employment pressure themselves. As a result, they appear calmer when faced with employment difficulties.

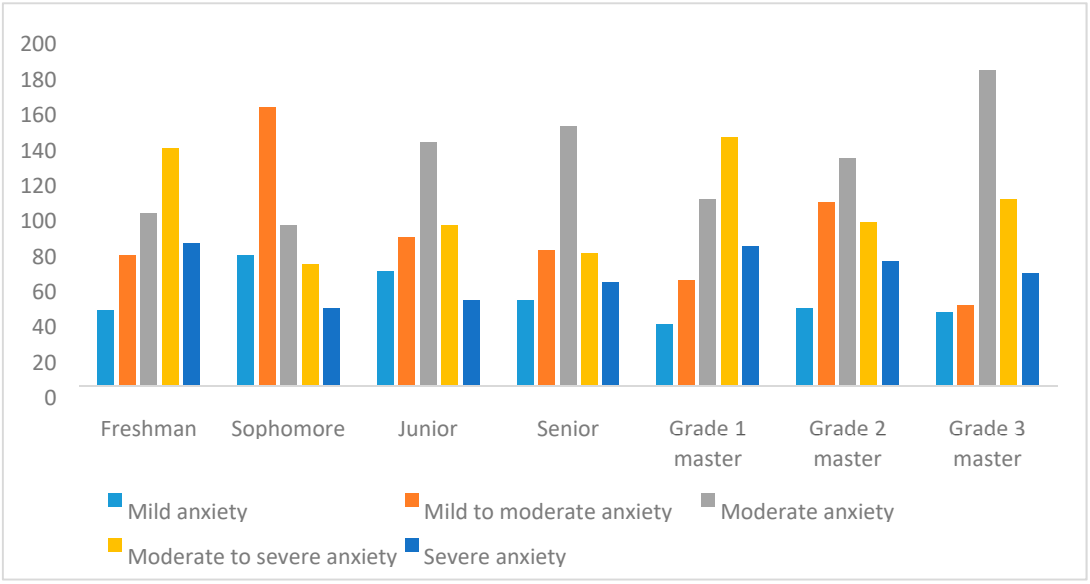

Figure 6. The degree of self-perceived psychological anxiety.

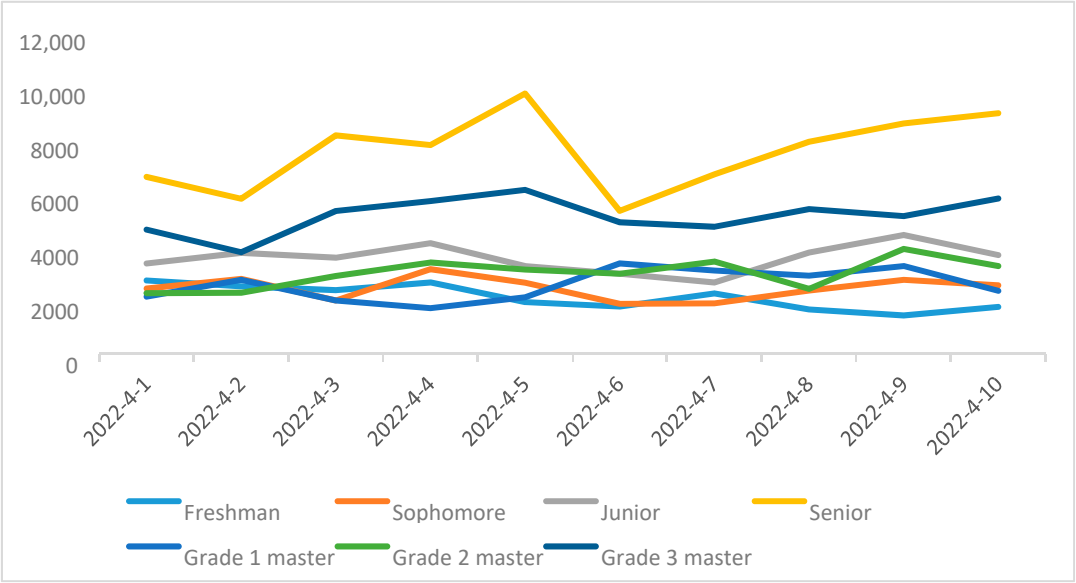

Figure 7. Frequency of access to employment-related information by students of all grades.

We compare students in the graduation season with students in the non-graduation season. Due to the impact of COVID-19, everyone's consumption level, consumption frequency, and consumption capacity have declined to varying degrees. Many enterprises are difficult to develop, and a few have even been seriously impacted. Many enterprises are also more cautious about employment and recruitment. The threshold for recruitment has gradually increased, and the frequency and number of recruiters have decreased significantly. Some have even downsized. In such an employment environment, graduates who do not have sufficient work experience are undoubtedly the group that bears the greatest employment pressure. Under the pressure of too much study and work, it is difficult for students to avoid psychological anxiety during the graduation season.

It can be seen from this case that the results of the questionnaire survey are sometimes biased. Some students may not be willing to show psychological anxiety in front of others because of their self-esteem. The browsing statistics of GIOLS can more accurately depict the emotional state of students during the graduation season.

4.3. Analysis of the Psychological Influence on the Students of Arts and Sciences

We also found that the performance of liberal arts students declined significantly compared with that of science students, which is extremely abnormal for liberal arts students with stable performance. At first, we thought that the reason for this phenomenon was related to the curriculum content of liberal arts. In order to verify our conjecture, we conducted further research on liberal arts students. From the survey results, our conjecture was only recognized by a few liberal arts students, while the vast majority of liberal arts students had more questions. Based on the feedback of liberal arts students, we summarized the following three points:

First, due to the particularity of liberal arts courses, many assignments and test papers need to be submitted with a large number of words for elaboration. Some liberal arts students' online learning is carried out through small mobile devices such as iPads. A large amount of text input on these small mobile devices brings much inconvenience to liberal arts students' learning, thus affecting learning efficiency.

Second, liberal arts learning requires a large number of books, journals, and other relevant auxiliary materials. Some liberal arts students are used to studying physical books and journals. They are not used to reading e-books online through intelligent devices, which causes them to read slowly, wasting a lot of study time and delaying their learning.

Third, some liberal arts students have less contact with computers and other electronic products and have never been exposed to online learning. The new learning method will undoubtedly present them with unknown challenges. In an isolated environment, they have no classmates or teachers to consult. Instead, they must explore and study the functions and operations of the online system on their own. Some students miss critical content when the teacher is teaching due to the inconvenience of online operation or the incorrect use of the function. This will lead to a very low learning efficiency and a decline in academic performance.

The main influencing factor of the abnormal performance of liberal arts students is not the problem of the content setting of liberal arts courses, as we suspected. It is because most liberal arts students have less contact with the use of electronic products. They do not understand the operation of intelligent systems and do not adapt to the online learning environment. Compared with science students, most of them are boys. They are more familiar with electronic devices since childhood, and their adaptability is relatively strong. In addition, some science students are information intelligence majors and can fully adapt to online learning modes. As a result, liberal arts students have exhibited abnormal academic performance.

4.4. Analysis of the Influence of the Family Environment on Psychology

We also found that the family background is one of the key factors that affect the anxiety of college students and graduate students. In the research process, we divided the family background into two parts: family economic status and parents' educational level.

From the perspective of family economics, we believe that students with poor economic conditions are more likely to have anxiety symptoms than students with higher economic conditions. During the epidemic, many companies and factories delayed their operations, resulting in lower household incomes. At the same time, many necessities of life are in short supply and the price has risen, which has led to an increase in family financial expenditure. This is a problem for students with poor family economic conditions. As a result, these students are easily perturbed by the status quo and eager to improve their economic status in order to ease their own pressures and those of their family. However, most students are unable to do so, and they tend to instinctively escape from the real anxiety in their hearts. In a situation of low incomes and rising prices during the epidemic, students with a higher family economic status can still maintain their living standards and material consumption capability. Therefore, their influence on current life pressure is not obvious, and they will have relatively less anxiety.

From the perspective of parents' education level, we also found that students whose parents have high education levels are more likely to have psychological symptoms. This is in contrast to students whose parents have low education levels. This may be just the opposite of what we think. Many scholars believe that families with highly educated parents have better economic conditions, so such students are not prone to anxiety symptoms. However, according to the research, this is not the case.

In the family culture of most Asian countries, parents and their children live together and communicate frequently. Generally, families live in small houses, so parents can easily understand their children's every move. Most students with highly educated parents have been strictly disciplined since childhood. In order to enable their children to develop in the right direction, parents will put forward requirements that are not what their children want. They were forced to isolate and stay at home during the epidemic, and they even kept in touch with their parents for weeks. The frequency and degree of discipline have been significantly improved, such as no watching TV, no playing with mobile phones, no playing games, etc. For these students, they have been under the control of non-consciousness, as if they were under "house arrest". Thus, there will be adverse psychological problems such as rebellious psychology, autism, and depression.

5. Discussion

Through our trial of the GIOLS system, we found that students' psychological problems far exceeded our expectations. It is common for psychological problems to not be fully apparent on the surface of a student's mind. This is because the student's subjective consciousness may not be able to perceive their psychological problems deeply. In order to obtain results, we must capture and analyze students' subconscious behaviors.

Many scholars [14,35–40] have used questionnaires to analyze the psychological impact of college students. Some scholars [41–45] have used artificial intelligence methods to study students' mental health, academic performance, and other performance and to analyze students' browsing behavior, reading characteristics, and hobbies. We believe that the integration of these two methods will produce better results.

The data analysis of system operation also confirmed our hypothesis. We investigated anxiety among college students through an online questionnaire, and the results showed that students in all grades had considerable levels of anxiety. However, based on the behavioral data from the GIOLS system, we determined that students' fear of employment during the graduation season was widespread. During graduation season, students are more anxious than students in other classes. Based on ten consecutive days, students visited employment-related websites more than twice as often as students in other grades during graduation season. Apparently, they are concerned about employment issues and want to improve their employment by using relevant materials. Due to a lack of self-esteem, most students are reluctant to reveal their true state of mind. Therefore, it is impossible to obtain an accurate picture of the students' mindsets with the questionnaire alone. Therefore, GIOLS can provide more objective and effective data support for our analysis of college students' psychological problems.

In addition, in an isolated environment, with the support of the GIOLS system, we can understand each student's performance, attendance, and behavioral characteristics in real time from a distance. We are able to quickly understand students' psychological problems, intervene and guide them in real time, and greatly improve teachers' performance.

5.1. Theoretical Contributions

The current study presents two main theoretical contributions.

1. The current study introduces the application of recommender systems to the field of educational psychology. Most previous studies have used recommender systems in the field of e-learning [41–45] to recommend appropriate learning materials to students through their online learning behaviors. Few studies have analyzed students' psychological activities and determined their psychological problems and potential emotions through recommendation

systems. Therefore, this study enriches the application area of recommendation systems in the education industry.

2. We also propose a more effective psychology education strategy by combining a recommendation system with an online questionnaire. We provide the student data collected by the online questionnaire to the recommender system as user base data, which solves the initial cold start problem of the recommender system. The goals of this study are to provide effective research support for cold-start solutions in psychology education.

5.2. Practical Contributions

The current study also provides a number of practical contributions.

1. We analyzed the results of the trial GIOLS system for 3000 segregated college students. We found that a number of college students in segregated settings had psychological problems of depression and anxiety. Feedback from the behavioral monitoring data of the GIOLS system showed that college students with psychological problems were mainly concentrated among three categories of college students, namely, upperclassmen, liberal arts students, and those with lower family incomes.

2. In the epidemic environment, the difficulty of tele-psychological education has increased significantly. In the traditional education industry, counselors can only collect psychological data from college students by means of questionnaires, which take long and are ineffective. However, using the GIOLS system can help teachers remotely uncover college students' mental problems, significantly reducing the cycle time. This will enable us to truly uncover subconscious mental activities through students' independent behaviors.

5.3. Limitations of GIOLS

Through the GIOLS system, researchers have identified many psychological problems. We only analyzed the common, characteristic problems, and there are many more related psychological problems. Based on our analysis, we found that the GIOLS system also has certain limitations.

This study only involved researching 3000 current college students, and the psychological problems they exhibited had limitations that did not truly reflect the psychological problems of other college students.

As the epidemic changes, the psychology of college students may also produce substantial changes, and we need to continue to use the GIOLS system to further dig into the behavior of college students and study their real-time mental health situation.

At present, the GIOLS system can greatly assist us in detecting the psychological tendencies and emotional abnormalities of college students. However, through the GIOLS system, we cannot effectively intervene in the psychological problems of college students remotely for the time being. We can only solve the problem through one-to-one counseling by the counselor to each college student.

5.4. Future Directions and Outlook

In order to ensure the sustainability and accuracy of the GIOLS system, we will continue to invite more isolated college students to conduct trials in the next study. In addition, we will discuss with professional psychology faculty whether the behavioral characteristics reflected in GIOLS can provide accurate psychological questions.

In addition, the focus of our study will shift from "identifying psychological problems" to "intervening in psychological problems." Over the course of this study, while we searched for literature on the psychological effects of COVID-19 on college students and the feasibility of a recommendation system, we also found literature on psychological interventions. For example, dCBT-I (digital Cognitive Behavioral Therapy for Insomnia) has been shown to be effective in the treatment of insomnia, and it may replace the traditional CBT-I (Cognitive Behavioral Therapy for Insomnia) provision [50] (remote behavioral cognitive therapy for obsessive-compulsive disorder [51], among others). We believe that the therapeutic effectiveness of CBT is worthy of recognition, and in the next study, we introduced remote

behavioral cognitive therapy-RCBT into our GIOLS system to intervene with psychological problems as they are identified. It makes a perfect closed loop for the telepsychological education process.

6. Conclusions

In view of the special situation of COVID-19, we have used a GIOLS system that combines intelligent recommendations and questionnaires. The system comprehensively records the online learning of students, including class time, attendance, and behavior characteristics. Unlike traditional questionnaire models, GIOLS can mine students' behavior data in order to obtain more objective and effective data. This will allow us to represent the most accurate student learning situation possible. At the same time, through the GIOLS system, we can quickly intervene and guide students accordingly.

The application of GIOLS online education has improved the work efficiency of tutors. According to the data analysis of the GIOLS system, we have discovered a lot of psychological emotions for college students due to isolation. Our follow-up research should make further use of the data provided by GIOLS to better understand the psychological dynamics of students in online teaching, guide them positively, and improve the efficiency of teaching.

The COVID-19 pandemic is slowing or undermining global health and development gains and could jeopardize progress toward achieving the Sustainable Development Goals (SDG). The devastating effects of COVID-19 on sustainable development are particularly evident in education, prompting educators to seek more effective ways to address psychological issues in college education and safeguard educational sustainability.

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Data Availability Statement: Data are not provided due to privacy.

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