

Internet Use and Academic Achievement Among Chinese Adolescents: Examining the Mediating Role of Future Orientation in a Rural-Urban Dual System

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Purpose: Given its growing popularity and the richness of its content, the influence of the Internet on the academic achievement of adolescents has attracted increasing attention. However, how Internet use affects adolescents' academic achievement has not yet been fully discussed in the Chinese context. This study sought to examine the relation between Internet use and adolescents' academic achievement, as well as the mediating effect of future orientation and the urban-rural differences in this mediating effect.

Materials and Methods: Junior high-school students from three schools in Nanjing, China, were recruited to participate in a correlational survey. A total of 1381 participants aged 12–16 years completed the Internet use questionnaire, the future orientation scale, and reported their scores on the most recent grade unified examination.

Results: The analysis results revealed that, after controlling for the variables of grade and gender, (1) the Internet use significantly and positively predicted academic achievement; (2) The future orientation significantly mediated the relation between Internet use and academic achievement; (3) and the effect of Internet use on future orientation was moderated by urban and rural areas. The effect of Internet use in promoting future orientation was only significant among rural adolescents.

Conclusion: The results contribute to a better understanding of how Internet use affects adolescents' academic achievement, revealing that Internet use is of particular significance in the development of rural adolescents.

Keywords: internet use, future orientation, academic achievement, urban and rural areas

Introduction

The 47th Statistical Report on China's Internet Development Status released by the China Internet Network Information Center pointed out that, as of December 2020, there are 175 million underage Internet users, with a penetration rate of 93.1%.¹ The Internet provides three key services: entertainment, social interaction, and information acquisition.^{2,3} Previous studies have reported that the Internet has become the most important channel for adolescents to obtain information,⁴ and it has gradually become an important auxiliary tool for them to complete their extracurricular homework.¹ Adolescents also build a broader network of interpersonal relationships in cyberspace, and immerse themselves in the entertainment experience of games and short videos.⁵ Because the Internet has penetrated the daily life of adolescents, the relation between Internet use and academic achievement has attracted the attention of parents, teachers, and scholars.

Numerous studies have confirmed the positive correlation between Internet use and adolescent academic achievement,^{6–8} with the majority of them relying on self-efficacy theory to explain the correlation.^{9,10} Bandura proposed that four categories of experience contribute to the development of self-efficacy—those are mastery experience, vicarious experience, verbal persuasion, and physiological arousal.¹¹ Because the Internet provides readily available knowledge and problem solutions that help adolescents to complete academic tasks (which is referred to as a mastery experience); and because learning experiences shared on social websites by fellow students enable adolescents to acquire new skills that lead to more effective learning

(which is referred to as a vicarious experience), Internet use is thought to be beneficial for adolescents in developing academic self-efficacy and furthering their academic achievement.¹⁰ Self-efficacy theory helps understand the relation between Internet use and academic achievement, but due to a lack of exploration of the mediating variables other than self-efficacy, the existing explanatory views appear to be relatively limited. This study, therefore, explored future orientation as a mediating variable to explore the relation between Internet use and adolescent academic achievement based on the theory of ecological techno-microsystem.¹² Meanwhile, considering China's unique dual economic structure for urban and rural areas, this study also examined the differences in the mediation effect between urban and rural adolescents.

Future Orientation as a Mediator

Future orientation refers to an individual's mental process of thinking about and planning for the future.¹³ It does not focus on the realization of a specific short-term goal but rather examines how often individuals think about the future and whether they think about the future in a long-term perspective (cognitive dimension); whether the individual is able to plan and carry out the plan if a specific goal consciousness is formed (behavioral dimension); and whether the individual is optimistic about the future (emotional dimension).¹⁴ Previous studies have pointed out that adolescence is a transitional stage towards adulthood, and adolescents frequently think about their future and plan their lives during this stage of life.¹⁵

The developmental level of future orientation is influenced by an individual's living environment.^{16,17} According to ecological systems theory,¹⁸ the development background that affects one's future orientation can be divided into several nested environmental systems, including the microsystem, mesosystem, and exosystem. These environmental systems are believed to have independent and interactive effects on individual development.^{15,19} The microsystem refers to the family, school, and other environments that have the most direct impact on individual development. On this basis, Johnson and Pupilampu further proposed the ecological techno-subsystem theory, which argues that the use of electronic media should be seen as a dimension of the family microsystem environment.¹² This suggests that Internet use may have an impact on adolescents' future orientations.

Relevant empirical studies and theoretical perspectives help construct the relation between Internet use and future orientation. First, Internet, with its rich information resources, has been an important tool to enrich adolescents' imagination and creativity.²⁰ Second, in the past, adolescents mainly looked to their parents and other important people in their daily life as role models when looking forward to the future.²¹ At present, however, the popularity of the Internet has enabled easy exposure to more diverse and richer professional images and character experiences beyond the real-life environment. Bandura's learning theory points out that adolescents can acquire knowledge and social information from electronic media, which is then encoded and stored in memory to guide their behavior and motivation in daily life.²² For example, when adolescents see or hear stories about people of good character through electronic media, they are prone to imitate them in daily life.²² This indicates that the rich information resources on the Internet may become important guides for adolescents in looking forward to the future and setting goals, which means Internet use may promote the development of future orientation.

Future orientation has been an important predictor of adolescent academic achievement,^{23,24} because individuals with a high level of future orientation can look to the future from a long-term perspective and combine current learning with personal future, thus improving academic achievement by, for example, delaying gratification, self-regulation, or adopting processing strategies on learning material.^{25,26} The present study therefore hypothesizes that Internet use promotes the development of future orientation, which further promotes adolescents' academic achievement (H1).

Urban and Rural Areas as a Moderator

In the early days of the founding of China, in order to rapidly develop industry, China promulgated the Regulations of the People's Republic of China on Household Registration and related supporting systems, thus forming a unique urban-rural dual systemic structure that led to rural areas lagging far behind urban areas in terms of economic, cultural, and information resources.²⁷ The educational level of parents in rural families is generally lower than that of parents in urban families, and the economic capacity of rural families also tends to be much lower than that of urban families.²⁸ Compared with urban areas, the cultural environment in rural areas of China is more closed, and most people engaged in agricultural or physical work, while people's social networks tend to be more homogeneous.²⁹ Against this background,

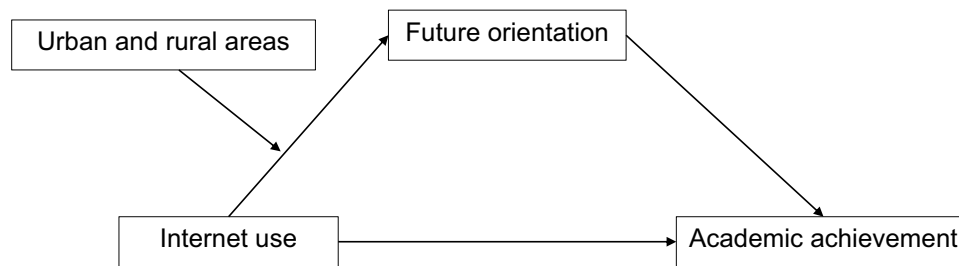


Figure 1 Hypothesized moderated mediation model.

some studies have reported that rural adolescents do not have ambitious goals for the future but instead tend to plan their future after the example of their parents, who engage in physical labor in cities.^{21,30}

In the context described above, the popularity of the Internet may be of greater importance to the development of rural adolescents. According to some survey results, the penetration rate of the Internet among adolescents in rural areas of China has reached 90.3%,³¹ which means that adolescents in rural areas have equal access to the Internet as adolescents in urban areas. However, the ecological techno-microsystem theory suggests that the characteristics of the family environment influence the effect of electronic media on individual development.^{12,32} For rural adolescents, the use of the Internet not only compensates rural adolescents for the lack of cultural information resources resulting from their rural living environment but also helps broaden their horizons by providing diverse life role models. Whether Internet use especially plays an important role in the future orientation development of rural adolescents needs to be verified and discussed. The present study therefore presumes that Internet use may be a stronger contributor to the future orientation of rural adolescents than it is to urban adolescents and, consequently, to their academic achievement (H2).

The Present Study

To sum up, based on the ecological techno-subsystem theory, the present study probed the mediating effect of future orientation in the relation between Internet use and adolescents' academic achievement, and assumed that such a mediating effect would differ between urban and rural areas. The hypothesis model is shown in Figure 1.

Materials and Methods

Participants

The survey was administered to 1381 adolescents in Nanjing, China (April 2021). To select our target subjects, first, we randomly contacted 1 public junior high school in an urban area and 2 public junior high schools in a rural area and got their permission. Then, we randomly selected 4–5 classes from each grade (7th, 8th, and 9th grade) in each school. All questionnaires were included in the analysis ($n = 1381$). Of these, 47.6% of students ($n = 657$) were from urban area, 52.4% of students ($n = 724$) were from rural area; 28.2% of students ($n = 390$) were in the first grade, 39.5% of students in the second grade ($n = 546$), and 32.2% of students in the third grade ($n = 445$); 54.0% were boys ($n = 745$) and 45.3% were girls ($n = 626$), while 0.7% of questionnaires did not contain gender information ($n = 10$). The age range was 12–16 years, with a mean age of 13.85 years and a standard deviation of 0.89.

Measures

Internet Use Questionnaire

The Internet use questionnaire was revised based on an existing scale and the survey data released by China Internet Network Information Center.^{1,33} It consisted of 15 items and three sub-scales that measured three types of Internet activities of adolescents. The three sub-scales measured information acquisition (five items, eg, “search for information and materials useful to my life”); entertainment (four items, eg, “playing online games”); and social activities (six items, eg, “online chat”). The questionnaire was rated on a 5-point response scale ranging from 1 (never use) to 5 (always use). The higher the score, the higher the frequency of Internet use. The Cronbach's alphas were 0.68, 0.77, 0.78, and 0.84 in

the study. The result of testing indicated acceptable model fit indices ($\chi^2(78) = 641.22, p < 0.001$; CFI = 0.91; GFI = 0.94; AGFI = 0.91; RMSEA = 0.07).

Future Orientation

A Chinese version of the future orientation scale developed by Liu, Huang, and Bi was used,¹⁴ which consisted of 31 items rated on a 5-point scale ranging from 1 (completely inconsistent) to 5 (completely consistent); an example is “I often think about things to do in the future.” The average score for the 31 items was calculated, with a higher score indicating a higher level of future orientation. The Cronbach’s alpha was 0.92 in the present study. The results of testing indicated acceptable model fit indices ($\chi^2(410) = 2273.81, p < 0.001$; CFI = 0.91; GFI = 0.90; AGFI = 0.89; RMSEA = 0.06).

Academic Achievement

Academic achievement was measured by students’ scores in the most recent grade unified examination for three subjects: Chinese, mathematics, and English. The average score of all test subjects was calculated and converted into standard scores by specific grades. Previous studies on academic achievement have also adopted such methods.^{9,34} The higher the score, the higher the level of academic achievement.

Procedures and Statistical Analyses

The study protocol was approved by the Ethics Committee of the Nanjing Forestry University prior to the commencement of the study and followed the Declaration of Helsinki for research involving human subjects. Permission from school leaders, students and their parents was obtained prior to conducting the questionnaire. An online questionnaire survey was conducted during class time in the school’s computer room. Before completing the questionnaire, all participants were informed of the anonymity and the fact that it would not interfere with or influence their academic achievement.

Data analyses were performed using SPSS 28 and the PROCESS 3.3 macro for SPSS. First, we conducted descriptive statistics analysis and Pearson correlation analysis to gain a preliminary overview of study variables. Second, we used PROCESS to run the mediation and moderated mediation analyses in Model 7. Direct and indirect effects were estimated using Preacher and Hayes’ bias-corrected non-parametric bootstrapping techniques with 5000 bootstrap samples.^{35,36} The existence of mediation and moderated mediation effects was further evaluated using 95% bias-corrected CIs, as suggested by prior research.³⁷ These effects were considered statistically significant if the confidence intervals did not contain zero.

Results

Common Method Bias Test

Procedural control and statistical testing were applied to verify and reduce the problem of common method bias. Procedural control included informing the subjects of the anonymity and confidentiality of the questionnaire, arranging the items of the same dimension in disorder, and the setting of reverse items in the questionnaire. In addition, Harman’s single-factor test was applied to test the common method bias—that is, unrotated exploratory factor analysis was performed on all measurement items. The results suggested that the first common variance factor was 21.98%, which is less than the critical standard of 40%.

Preliminary Analyses

Table 1 shows the mean (M) (for continuous variables), standard deviation (SD), and inter-correlation for all measures in the present study. The results revealed significant and positive correlations between the four variables, namely Internet use, future orientation, academic achievement, and urban-rural areas, with correlation coefficients ranging from 0.16 to 0.23.

Table 2 presents the rural-urban differences in independent, dependent, and mediating variables obtained using an independent-sample *t*-test. The frequency of Internet use among rural adolescents was lower than that of urban adolescents ($t = -6.83, p < 0.001$). The level of future orientation ($t = -7.42, p < 0.001$) and academic achievement ($t = -6.02, p < 0.001$) among rural adolescents were also lower than those among urban adolescents.

Table 1 Summary of Means (M), Standard Deviations (SD), and Inter-Correlations

	M	SD	1	2	3	4	5	6
1. Gender	—	—	1					
2. Grade	—	—	−0.02	1				
3. Internet use	2.56	0.68	0.05	0.07*	1			
4. Future orientation	3.43	0.61	0.02	−0.08**	0.16**	1		
5. Academic achievement	0.00	1.00	0.06*	0.00	0.16**	0.23**	1	
6. Urban-rural areas	—	—	−0.05*	0.11**	0.18**	0.20**	0.16**	1

Note: Gender and urban-rural areas were dummy variables, male/rural =0, female /urban =1; * $p < 0.05$; ** $p < 0.01$.

Table 2 Description and Comparison of Key Variables on Rural and Urban Adolescents

Variable	Areas	M	SD	t
Internet use	Rural	2.44	0.69	−6.83***
	Urban	2.69	0.63	
Future orientation	Rural	3.31	0.56	−7.42***
	Urban	3.56	0.63	
Academic achievement	Rural	−0.16	1.22	−6.02***
	Urban	0.17	0.66	

Note: *** $p < 0.001$.

Internet Use and Academic Achievement: A Moderated Mediating Effect

Model 7 in SPSS macro program Process V3.3 developed by Hayes was used for data processing to examine the mediating effect of future orientation and the moderation effect of urban-rural areas in the relation between Internet use and academic achievement.³⁸ Except for the variables gender, grade, and urban-rural areas, all variables were standardized, and grade and gender were input as control variables. The results indicated that, as shown in Table 3, Internet use significantly positively predicted academic achievement ($B = 0.14$, 95% CI [0.08, 0.19]). When the mediating variable was included, the predictive effect of Internet use on academic achievement declined but was still significant ($B = 0.10$,

Table 3 A Moderated Mediation Model

Regression Model		Goodness-of-Fit Index			Regression Coefficient				
DV	IV	R	R ²	F	B	t	p	LLCI	ULCI
Academic achievement	Grade	0.15	0.02	9.01***	−0.01	−0.09	0.93	−0.07	0.07
	Gender				0.06	1.17	0.24	−0.04	0.17
	Internet use				0.14	5.01	0.00	0.08	0.19
Future orientation	Grade	0.27	0.07	19.48***	−0.15	−4.11	0.00	−0.22	−0.08
	Gender				0.05	0.86	0.39	−0.06	0.16
	Internet use				0.22	5.76	0.00	0.14	0.29
	Urban-rural areas				0.37	6.63	0.00	0.26	0.48
	Internet use × Urban-rural areas				−0.18	−3.24	0.00	−0.29	−0.07
Academic achievement	Grade	0.25	0.06	20.39***	0.02	0.58	0.56	−0.05	0.09
	Gender				0.06	1.09	0.28	−0.05	0.16
	Internet use				0.10	3.85	0.00	0.05	0.16
	Future orientation				0.20	7.31	0.00	0.15	0.25

Note: *** $p < 0.001$.

Abbreviations: DV, Dependent Variable; IV, Independent Variables; LLCI, Lower Limit Confidence Interval; ULCI, Upper Limit Confidence Interval.

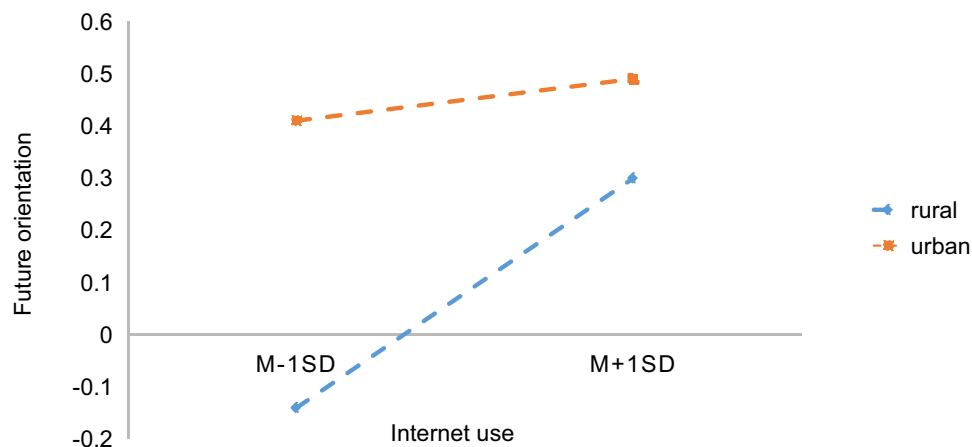


Figure 2 The Moderating Role of Urban and Rural areas in the Relation between Internet Use and Future Orientation.

Abbreviations: M, Means; SD, Standard Deviations.

95% CI [0.05, 0.16]). Meanwhile, Internet use significantly positively predicted future orientation ($B = 0.22$, 95% CI [0.14, 0.29]), and future orientation positively predicted academic achievement ($B = 0.20$, 95% CI [0.15, 0.25]). The interaction between urban-rural areas and Internet use had a significant predictive effect on future orientation ($B = -0.18$, 95% CI [-0.29, -0.07]).

The simple slope was used to further investigate the moderating effect of urban-rural areas (Figure 2). The results suggested that the predictive effect of Internet use on future orientation was not significant among urban adolescents ($B_{simple} = 0.04$, 95% CI [-0.04, 0.12]), but was significant among rural adolescents ($B_{simple} = 0.22$, 95% CI [0.14, 0.29]). In urban adolescents, the mediating effect of future orientation was 0.01 (95% CI [-0.01, 0.03]), and its 95% Bootstrap confidence interval contained 0, which was not significant. In rural adolescents, the mediating effect of future orientation was 0.04 (95% CI [0.03, 0.06]), and its 95% Bootstrap confidence interval did not contain 0, which was significant.

Discussion

Internet Use and Academic Achievement

This study found that Internet use positively predicts the academic achievement of adolescents, which is consistent with previous findings. Previous studies have suggested that the advantages of the information resources available on the Internet provide convenience for students to complete learning tasks, and a large number of online video tutorials can help adolescents form vicarious experiences to improve learning efficacy.³⁹ Moreover, adolescents can communicate with teachers and classmates through the Internet when they have questions about their studies,⁹ which is helpful to improve academic achievement. Some studies have also shown that frequent browsing of news and participation in discussions on public issues online helps adolescents acquire knowledge, understand concepts, and form opinions, which are important cognitive abilities in academic activities.⁴⁰ Thus, Internet use appears to promote adolescents' academic achievement.

The Mediating Effect of Future Orientation

The results of the present study also indicated that future orientation mediates the relation between Internet use and academic achievement—that is, Internet use promotes the development of future orientation, which then further promotes academic achievement. Previous studies mainly focused on the impact of environmental systems such as family and school on future orientation,^{16,19,41,42} but have ignored the possible impact of the online environment on future orientation.

The Internet breaks the limitations of space and time and provides information channels for adolescents to gain access more diversified career models, character stories, and lifestyles. Bandura pointed out that powerful and charismatic figures in electronic media easily become target role models for children.²² Chen, Li, and Huang also found that

providing students from poor families with a model of striving for goals can significantly improve their personal goal level.⁴³ These studies suggest that the abundant information resources on the Internet, especially information related to role models, may provide opportunities and materials for the development of adolescents' future orientation.

The online environment also provides the conditions for adolescents to rid themselves of the shackles of the physical world and express or explore themselves freely.⁴⁴ Adolescents can experience different images of themselves through role-playing in online games.⁴⁵ These self-exploration experiments may also help adolescents establish goals and therefore improve their future orientation. Future orientation has always been an important predictor of adolescent academic achievement,^{24,46} and it plays a mediating role in the relation between Internet use and academic achievement.

The Moderating Effect of Urban and Rural Areas

The results also indicate that the moderating effect of urban-rural areas in the relation between Internet use and future orientation is significant, which appears in the fact that the contribution of Internet use to future orientation is significant only among rural adolescents. According to the ecological techno-microsystem theory, the effectiveness of electronic media is moderated by individual characteristics and the family environment.^{12,32} Numerous empirical studies have affirmed the moderating role of individual characteristics and reported electronic media to be more helpful for introverted individuals, individuals who are not well socialized (eg, who experience social anxiety) or individuals with poor reading skills.^{9,47,48} In contrast, there are few study findings on the impact of electronic media that is moderated by family and other environments.⁴⁹ The findings of the present study, however, reveal the compensatory effects of Internet use on the development of rural adolescents.

The results of independent-sample *t*-test revealed that the development level of future orientation of rural adolescents was significantly lower than that of urban adolescents, which was consistent with the findings of previous studies.^{50,51} Due to the slow pace of economic development and the relatively closed information environment in rural areas of China, adolescents have few sources of information and role models with which to set up their future goals. According to Wang and Ma, adolescents in low social classes of China are faced with the dilemma of having low life goals.⁵⁰ Morimitsu has reported that adolescents in lower social class may be subject to career ceilings in regard to setting their goals for the future, given the lack of diverse, high-level career role models in their living environment.⁵¹ In such a context, the wealth of information resources and the diversity of role models to which they are exposed to the Internet compensate for the development of future orientation among adolescents in the rural area.

A few researchers have found that providing laptop computers to rural children was an effective way to improve educational outcomes and narrow the education gaps between urban and rural areas.⁵² However, there were few discussions as to why Internet use enhances the educational outcomes of rural adolescents. The present study results suggest that Internet use enhances rural adolescents' level of future orientation, which in turn positively contributes to academic achievement.

Limitations of the Study

This study has the following limitations. First, the study collected survey data through the method of a self-report, which may lead to common method bias. Although the analysis results suggested that this did not form a serious problem, future studies should endeavor to collect data from various sources, such as parents and teachers, to gain a deeper, more accurate understanding of the relations among variables.

Second, this study did not distinguish specific online activities when exploring the impact of Internet use on future orientation. Previous studies have shown that inappropriate Internet use (eg, overindulgence in online entertainment activities) is negatively correlated with adolescents' academic achievement.⁵³ As a result, the positive relation between Internet use and academic achievement found in this study may be attributed to stringent school and family control and supervision of adolescents' Internet use in primary and secondary school. Future studies need to distinguish the relation between different online activities and academic achievement.

Finally, this study had a cross-sectional design and cannot make causal inferences about the relation between these variables; hence, experimental studies could be conducted in the future to examine the relations between these variables.

Conclusions

This study found that Internet use not only contributes directly to adolescents' academic achievement but also promotes the development of adolescents' future orientation, which in turn can improve their academic achievement. Moreover, the effect of Internet use on future orientation was moderated by urban and rural areas. The effect of Internet use in promoting future orientation was only significant among rural adolescents. Based on the findings of this study, parents and teachers should encourage adolescents, particularly those in rural areas, to actively use Internet information resources to construct future goals and improve academic achievement.

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Disclosure

The authors report no conflicts of interest in this work.

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