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Can "Smart Homework" Achieve the Goal of Chinese "Double Reduction" Policy to Reduce Burden and Improve Quality?—The Positive and Negative Effects of "Smart Homework" on Students

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Abstract: The application of information technology provides technical support for achieving the requirements of reducing burden and improving quality in the Chinese "Double Reduction" Policy. Based on the analysis of the mechanism and path of "Smart Homework" (an educational tool that applies artificial intelligence technology) to reduce the burden and improve the quality of Chinese Jiangxi Province by using the literature, this paper investigates 78 counties and cities of this province and finds that this tool can reduce the burden of primary and secondary school students' homework, improve the completion of homework, reduce the willingness to participate in after-school tutoring, and improve the self-efficacy and learning investment, so as to achieve the goal of the Chinese "Double Reduction" Policy, but at the same time, the lack of convenience in using intelligent products has caused psychological anxiety for a small number of students. The psychological mechanism of reducing burden and improving quality is in line with the principle revealed by the Yerkes–Dodson law; that is, as learning anxiety decreases, the impact of psychological stress on learning efficiency increases. The appropriate psychological stress enhanced the impact of psychological pressure on learning efficacy and engagement, and improved learning efficiency. The article believes that, first, based on the principle of a three-layer structure of homework burden, the use of "Smart Homework" achieves the reduction of homework burden from three aspects: surface layer, inner layer, and core layer. Second, "Smart Homework" reduces the willingness to participate in extracurricular tutoring and, to some extent, reduces the burden of extracurricular tutoring. Third, "Smart Homework" can help students better complete homework and improve learning efficiency.

Keywords: Smart Homework; "Double Reduction" Policy; learning anxiety; learning self-efficacy; learning engagement

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1. Introduction

In order to solve the problem of heavy homework and off-campus training burden on primary and secondary school students, in July 2021, the Central Committee of the Communist Party of China and the State Council issued the "Opinions on Further Reducing the Homework and Off-Campus Training Burden of Students in Compulsory Education" (referred to as the "Double Reduction" Policy), which requires "improving the quality of homework design" and "improving the quality of classroom teaching" [1,2]. Homework, as an important means of consolidating classroom learning and verifying classroom teaching effectiveness, plays an important role in the teaching process. However, traditional homework methods have many drawbacks, making it difficult to accurately understand

students' learning needs and provide targeted guidance [3]. Moreover, the strategy of "doing endless exercises" has become the main means for many schools to enhance students' competitiveness, and the workload and difficulty of homework are constantly increasing [4]. Relying solely on traditional homework methods is difficult to meet the requirements of the "Double Reduction" Policy of reducing workload and improving quality.

In recent years, a new form of homework tool called "Smart Homework" has emerged in China. Jiangxi Province launched a pilot project for the "Smart Operation" project in Nanchang City in 2018, and introduced policies in 2021 to promote it throughout the province [5]. Jiangxi's "Smart Homework" is a network platform organized and developed by the Jiangxi Provincial Department of Education, which uses optical scanning identification, dot matrix code, structured knowledge graph, cloud question bank, artificial intelligence engine, big data analysis, and other technologies, and can run on smartphones, computers, PC computers, and TV sets with set-top boxes [6]. The process of "Smart Homework" is as follows: (1) Students use homework books with dot matrix codes to complete paper homework, teachers use smart pens to grade homework, and homework information is uploaded to the online platform through the smart pen. (2) A set of incorrect questions is generated for each student in the background, and relevant micro course resources and consolidation exercises are pushed to the students. (3) Students can log in to the platform through PC web pages, TV set-top boxes, WeChat mini programs, and other means to view the set of incorrect questions, watch micro lesson videos, and consolidate practice questions. In addition, teachers, schools, and education authorities can view the usage of "Smart Homework", relevant statistical data, and quality monitoring reports through the platform [7]. In September 2021, the Ministry of Education promoted Jiangxi's "Smart Homework" as a typical case of schools implementing the "Double Reduction" Policy [8].

There are two types of electronic products related to smart homework. One is traditional responsive online homework systems, which rely on the Internet to provide students with online exercises, provide answers to each question, and allow multiple attempts. A study found that traditional responsive online homework systems can improve academic performance more than paper homework because online learning systems provide students with more timely feedback and prompts [9], allowing learners to try multiple times, retaining their information for repeated viewing and learning [10], and providing teachers with timely and organized information about student homework. Another product is an adaptive online homework system. Adaptive learning refers to a learning method that dynamically adjusts the objectives or types of curriculum content according to individual cognition and ability. It uses technology and teacher intervention to provide personalized support and improve learners' performance [11]. It is generally believed that all students can benefit from adaptive learning [12]. In the past two decades, adaptive learning has attracted the attention of computer science, artificial intelligence, and other technologies. Many scholars creatively applied advanced algorithms in artificial intelligence, and made a series of research achievements in this field [13]. An adaptive online homework system is an information system that applies adaptive learning to students' homework. It can dynamically present learning content and resources according to the personality characteristics of learners, and build learning paths suitable for their characteristics for students [14]. Research has compared the differences between traditional responsive online homework systems and adaptive responsive online homework systems, and it is generally believed that using adaptive responsive systems has better results than traditional responsive systems [15,16].

Overall, there is currently relatively little empirical research on smart homework or online homework systems, and there is a lack of research on the impact of the use of smart products on compulsory education students. This article intends to explore the mechanisms and approaches of reducing and improving the quality of "Smart Homework" through literature review. Based on the analysis of the survey questionnaire on "Smart Homework"

in Jiangxi Province, the effectiveness of reducing and improving the quality of "Smart Homework" will be verified, and suggestions will be made on how to better use it.

2. Literature Review

According to literature published by authoritative media and academic journals, "Smart Homework" applies technologies such as the Internet, artificial intelligence, and big data to the design and management of homework, achieving a layered, flexible, and personalized homework approach [17]. By reducing homework time, improving learning efficiency, reducing learning pressure and anxiety, and providing timely and effective homework feedback to students, it achieves the effect of reducing workload and improving quality. However, there is also literature indicating that the use of information technology, including artificial intelligence products, can have a certain degree of negative impact on students.

2.1. A Mechanism for Reducing Workload and Improving Quality through "Smart Homework"

First, "Smart Homework" provides precise and personalized homework services. Under the traditional homework mode, it is difficult for students and teachers to accurately grasp their learning situation. They often use an increase in the number of questions to enhance learning effectiveness, inevitably resulting in mechanical, ineffective, and simple repetition drawbacks. "Smart Homework" accurately identifies the weak points in students' knowledge learning through a set of incorrect questions. By promoting relevant micro course resources and drawing inferences, it strengthens students' learning shortcomings, provides more accurate and personalized learning services for students, and overcomes the drawbacks of traditional homework [6].

Second, "Smart Homework" provides strong support for teachers' teaching. Under traditional homework methods, homework grading is usually done manually by teachers, occupying a lot of valuable time for teachers. "Smart Homework" utilizes artificial intelligence technology to achieve intelligent homework grading, freeing teachers from heavy and mechanical work, and provides teachers with a study situation analysis report to provide them with a more accurate and comprehensive grasp of students' learning. Teachers can allocate more time to analyzing learning situations, designing homework, conducting teaching research, developing more targeted and efficient teaching design plans, and providing more targeted guidance to students [6].

Third, "Smart Homework" provides students with timely and effective homework feedback. A study found that timely checking and correcting students' homework by teachers can improve academic performance [18], indicating that timely and effective feedback has a positive significance in improving learning efficiency. Smart Homework pushes micro course resources and draws inferences based on student error problem sets, leveraging the fast and accurate advantages of information technology to provide timely and effective homework feedback for students, enabling them to timely understand and grasp their learning situation, and improving learning efficiency.

2.2. The Path to Reducing Burden and Improving Quality through "Smart Homework"

Some scholars believe that homework burden has a three-layer structure, with the surface layer being homework time and difficulty; the inner layer being negative emotions, such as psychological burden and anxiety caused by time consumption and homework difficulty; and the core layer being the allocation of educational resources and personal educational interests [4]. "Smart Homework" has made significant breakthroughs in all three aspects, mainly manifested in:

First, "Smart Homework" achieves better learning outcomes with less homework volume and time.

Under the traditional homework mode, to improve learning efficiency, it is usually achieved by increasing the amount and duration of homework. Research in the academic community has shown that increasing the amount of homework and extending homework

time may not necessarily achieve the goal of improving learning outcomes. Li Bo et al. (2022) found that the relationship between homework time and learning efficiency is an "inverted U-shaped" curve relationship, with an optimal homework time for learning efficiency. When homework time is longer or shorter than this optimal time, learning efficiency will decrease. The best homework time for junior high school students is 0.96 h per day, but in reality, the average homework time for seventh- and ninth-grade junior high school students in China exceeds 2 h per day, much higher than 0.96 [19]. There is reason to believe that compared with traditional homework models, "Smart Homework" reduces the amount of homework and homework time, making homework time closer to the optimal homework time on the "inverted U-shaped" curve of homework time and academic performance. With less homework amount and homework time, better learning outcomes are achieved, and the burden of homework is reduced from the surface.

Second, "Smart Homework" reduces students' learning pressure and anxiety, improves learning efficiency, and reduces their willingness to participate in extracurricular tutoring.

Compared with traditional homework, Jiangxi's "Smart Homework" can help students identify weak links in their learning, provide targeted learning resources, avoid ineffective "brushing", reduce time consumption, and reduce homework pressure [17,20]. There is a high correlation between stress and anxiety. If "Smart Homework" can alleviate homework pressure, then learning anxiety will also be reduced, achieving a reduction in homework burden from the inside. The above literature also supports that "Smart Homework" can improve learning outcomes. According to the Yerkes–Dodson law, the relationship between the intensity of learning anxiety and work efficiency is an "inverted U-shaped curve". The level of learning anxiety that achieves optimal work efficiency is called the optimal arousal level, and learning anxiety that is higher or lower than the optimal arousal level can reduce work efficiency [21]. "Smart Homework" reduces students' learning burden and improves learning efficiency, which is consistent with the law revealed by the Yerkes–Dodson law; that is, learning anxiety is reduced while learning effectiveness is enhanced, and the level of learning anxiety is approached from above the optimal arousal level to the optimal arousal level. Learning effect is highly correlated with learning self-efficacy [22] and learning investment [23], so "Smart Homework" may enhance learning efficiency and increase learning investment. In addition, research has shown that learning pressure can affect parents' family education anxiety, which in turn affects students' willingness to participate in subject-based extracurricular tutoring [24]. Therefore, the decrease in learning pressure may reduce students' willingness to participate in extracurricular tutoring.

Third, "Smart Homework" has achieved high-quality resource sharing, playing a positive role in the rational allocation of educational resources and safeguarding the personal educational interests of ordinary students. The Jiangxi Electronic Education Museum uses the micro course collection system to collect high-quality micro courses from primary and secondary school teachers throughout the province, and pushes micro course videos to students based on their incorrect question sets. Micro lesson videos can be watched repeatedly without time constraints, and can better assist students in reviewing unfamiliar knowledge points compared with classroom teacher explanations. For students who use "Smart Homework", micro lesson videos allow them to have access to excellent teachers before leaving home or school, and learn knowledge through their lectures and knowledge explanations. "Smart Homework" has, to some extent, achieved the sharing of high-quality resources, allowing for a more reasonable allocation of high-quality educational resources, better safeguarding the personal educational interests of ordinary students, and achieving a reduction in homework burden at the core level.

2.3. The Negative Impact of the Use of Intelligent Products on Students

Academic research has shown that the use of information technology, including artificial intelligence products, has a certain degree of negative impact on students.

Shatri (2020) summarized relevant academic research and concluded that while the positives far outweigh the negatives, the downside of technology still exists. These negative

effects include spreading false information, promoting lazy behavior in learning, and potentially causing possible denials of human attributes. On the one hand, the student broke up with telematics, after a determined emotional capacity, such as socializing with people there, omitting the whole social experience from their lifestyle. On the other hand, the information technology revolution is telecommunications threats to create an expanding gap between the computer literate and the technologically depraved or technological [25].

The use of intelligent products by students also has negative impacts. Lepp's (2014) study on college students found that high-frequency mobile phone users often have higher anxiety and lower life satisfaction compared with their peers who use their phones less frequently [26]. Singh (2018) summarized relevant academic research and found that the use of smartphones is positively correlated with anxiety levels, and more use of smartphones can lead to higher levels of anxiety; when they have to leave their phones for a period of time, they will feel anxious because they have formed a dependence on their phones [27].

Considering that "Smart Homework" in Jiangxi Province mainly targets students in compulsory education, the devices used include smartphones, tablets, televisions, desktop computers, and other devices. Therefore, the use of "Smart Homework" by these students in their homework may have a certain degree of negative impact.

Based on the above analysis, this study proposes the following assumptions:

Hypothesis 1: *"Smart Homework" can reduce students' homework burden, manifested in allowing them to complete homework in a shorter time and have a lower sense of learning anxiety.*

Hypothesis 2: *"Smart Homework" can reduce the burden of off-campus training for students, manifested in reducing their willingness to participate in off-campus tutoring.*

Hypothesis 3: *"Smart Homework" can help students better complete homework and improve learning efficiency, which is reflected in that students who use "Smart Homework" have a stronger sense of self-efficacy and higher learning commitment.*

Hypothesis 4: *The use of "Smart Homework" may have a certain degree of negative impact.*

3. Data and Variables

3.1. Data

In November 2021, researchers conducted a questionnaire survey on the basic situation of "Smart Homework" implementation in Jiangxi Province. The sample covered 78 counties (cities, districts) in 11 regions of Jiangxi Province, including Fuzhou, Ganzhou, Jian, Jingdezhen, Jiujiang, Nanchang, Pingxiang, Shangrao, Xinyu, Yichun, and Yingtan. A total of 28,808 valid questionnaires were collected from students, of which 18,379 (63.8%) used the "Smart Homework" platform and 10,429 (36.2%) did not use it. A total of 3562 valid questionnaires were collected from teachers, of which 3348 (94%) used the "Smart Homework" platform and 214 (6%) did not use it. This study mainly focuses on student questionnaire data, with teacher questionnaire data as an auxiliary tool to verify the analysis results of student questionnaire data.

3.2. Variables

3.2.1. Main Variables

The main variables include homework completion, learning anxiety, learning self-efficacy, learning engagement, whether to use "Smart Homework", willingness to participate in after-school training, and whether feeling anxious about "Smart Homework". One question was set for homework completion, learning engagement, willingness to participate in after-school training, and whether to use "Smart Homework". The variables of learning anxiety and learning self-efficacy were measured with a scale. The Learning Anxiety Scale is adapted from Anthony's (2000) Learning Anxiety Scale [28], with a 6-item

set. In this measurement, the scale's α = 0.891, and the KMO and Bartley spherical test value = 0.883. The learning self-efficacy scale adopts the learning self-efficacy scale [29] of Liang Yusong (2000), which has 12 items. In this measurement, α = 0.944, and the KMO and Bartley spherical test value = 0.952.

3.2.2. Control Variables

The control variables used in this study mainly include family economic conditions, physical health status, self-education expectations, grades, and genders. Generally speaking, parents from families with better economic conditions will provide more financial and emotional support for their children's education, which will have an impact on their sense of learning efficacy, academic engagement, and academic performance [30]. Self-educational expectations refer to students' own vision of their future educational achievements, which plays a positive role in stimulating learning potential, increasing learning engagement, and improving academic performance [31,32].

The basic characteristics of variables are shown in Table 1.

Table 1. Basic characteristics of main variables (N = 28,808).

Variable	Variable Description	Mean	Std.
Grades	1–12, respectively, represent grades 1–12	5.63	1.77
Genders	1 represents male and 2 represents female	1.47	0.50
Family economic status	1–5, respectively, represent very difficult, relatively difficult, average, relatively wealthy, and very wealthy	2.86	0.48
Physical health status	1–5, respectively, indicate very bad, not very good, average, quite good, and very good	4.19	0.84
Learning engagement	1–5 indicate a gradual increase in investment	3.44	0.82
Learning self-efficacy	1–5 indicate a gradual increase in sense of efficacy	3.52	0.80
Learning anxiety	1–5 represent the increase in pressure intensity from small to large	1.94	0.86
Completion of homework	1–4, respectively, indicate no writing at all on campus, a few completed on campus, most completed on campus, and all completed on campus	1.97	0.64
Self-expectation of education	1 = don't study now, 2 = graduated from junior high school, 3 = vocational/technical school, 4 = vocational high school, 5 = ordinary high school, 6 = junior college, 7 = undergraduate degree, 8 = master's degree, 9 = doctoral degree, 10 = it doesn't matter	7.40	1.39
Whether to use "Smart Homework"	1 = used, 0 = not used	0.64	0.481
Willingness to participate in extracurricular tutoring	1–5 indicate willingness from small to large	2.56	1.066
Whether feeling anxious about "Smart Homework"	1 = yes, 2 = no	1.91	0.286

4. Data Analysis Results

4.1. Analysis of the Effect of Reducing Burden and Improving Quality in "Smart Homework"

4.1.1. Basic Information on the Use of "Smart Homework"

Descriptive statistical analysis was conducted on the samples using "Smart Homework", and the results are shown in Tables 2–5. Among the disciplines used, Chinese (83.6%), mathematics (87.8%), and English (78.1%) have the highest proportion. Among the platform uses, error analysis (88.4%), watching micro videos (77.5%), and submitting assignments (77.2%) accounted for the highest proportion. After using the platform, it is generally felt that the workload has decreased (71.2%), the interest in learning has increased (72.5%), the academic performance has improved (68.4%), the academic pressure has decreased (72.8%), and the platform is generally satisfactory (73.7%). In terms of the time of using the "Smart Homework" platform, the vast majority of students' usage time is controlled within 1 h (the sum of the selected ratios of 30 min and 31–60 min exceeds 90%).

Table 2. Basic statistics on the use of "Smart Homework" in different disciplines (N = 18,379).

Disciplines	Middle School	Primary School	Total
Chinese	71.6%	88.1%	83.6%
Math	82.2%	89.9%	87.8%
English	80.2%	77.3%	78.1%
Morality and the Rule of law	32.4%	3.7%	11.5%
Physics	40.8%	--	--
Chemistry	23.2%	--	--
Biology	37.3%	--	--
History	35.2%	--	--
Geography	31.3%	--	--

Table 3. Statistics on the "Smart Homework" platform usage (N = 18,379).

Works Submitting	Error Analysis	Watch Micro Lesson Videos	Check the Question of Drawing Inferences from One Instance	Learning Situation Report	View Answer Record
77.2%	88.4%	77.5%	57.7%	40.5%	50.3%

Table 4. The proportion of average daily platform usage time.

No Homework	Within 30 min	31–60 min	61 to 90 min	91 min or More
3.6%	62.9%	27.4%	4.6%	1.5%

Table 5. Statistics on the perfection of "Smart Homework" effect (N = 18,379).

Items	Options and Perception		
Does the school set up homework stratification	Set (42%)	Not set (58%)	
Perceived changes in workload	Alleviated (71.2%)	Unchanged (24.5%)	Aggravated (4.3%)
Perceived changes in learning interests	Improved (72.5%)	Unchanged (26.1%)	Reduced (1.4%)
Perceived changes in academic performance	Improved (68.4%)	Unchanged (29.7%)	Reduced (1.9%)
Changes in perceived learning pressure	Alleviated (72.8%)	Unchanged (23.6%)	Aggravated (3.6%)
Satisfaction with the platform	Satisfied (73.7%)	At large (24.5%)	Not satisfied (1.8%)

4.1.2. Effects of the Use of "Smart Homework" on Homework Completion, Learning Anxiety, Willingness to Participate in After-School Training, Learning Self-Efficacy, and Learning Engagement

Multivariate regression analysis was conducted with homework completion, learning anxiety, participation in after-school tutoring, self-efficacy, and learning engagement as dependent variables. The results are shown in Table 6. The data show that the use of "Smart Homework" has a significant impact on homework completion ($p < 0.001$) and learning anxiety ($p < 0.001$) in regression, indicating that the use of "Smart Homework" allows more students to complete homework at school, with less homework time and lower learning anxiety. This result is consistent with the results of the descriptive statistical analysis in Table 4; thus, hypothesis 1 holds. The impact of "Smart Homework" on students' willingness to participate in extracurricular tutoring is also significant ($p < 0.001$). After using "Smart Homework", students' willingness to participate in extracurricular tutoring decreases; thus, hypothesis 2 is valid. The use of "Smart Homework" also has a significant impact on learning self-efficacy ($p < 0.001$) and learning engagement ($p < 0.001$). Students who use "Smart Homework" have a stronger sense of learning self-efficacy and higher learning engagement than those who do not. This result is consistent with the results of the descriptive statistical analysis in Table 6; thus, hypothesis 3 holds.

Table 6. Multiple regression analysis results of homework completion and learning anxiety (N = 28808).

Independent Variable	Dependent Variable				
	CSH	**LA**	**WPET**	**LES**	**LE**
Grade	−0.03 ***(−12.49)	0.03 ***(13.37)	0.01(1.88)	−0.02 ***(−10.43)	0.03 ***(12.52)
Sex	−0.01(−0.72)	0.01(1.37)	0.05 ***(4.23)	0.01(1.88)	0.08 ***(9.53)
FES	0.01(1.42)	−0.09 ***(−9.58)	0.06 ***(4.86)	0.01(1.35)	0.08 ***(9.01)
PHS	0.03 ***(5.84)	−0.09 ***(−17.13)	−0.01(−0.80)	0.06 ***(13.02)	0.06 ***(11.85)
LE	0.04 ***(5.24)	0.05 ***(5.17)	−0.17 ***(−12.98)	0.03 ***(3.86)	0.14 ***(16.50)
LSE	0.04 ***(7.8)	−0.18 ***(−28.72)	−0.11 ***(−12.39)	0.29 ***(54.36)	-
LA	0.12 ***(21.98)	−0.31 ***(−48.68)	−0.02 *(−2.56)	-	0.33 ***(54.36)
CH	-	−0.11 ***(−15.84)	−0.04 ***(−4.11)	0.14 ***(21.97)	0.05 ***(7.80)
SEE	−0.08 ***(−15.84)	-	0.19 ***(22.53)	−0.25 ***(−48.68)	−0.16 ***(−28.72)
WUSH	−0.01 **(−2.56)	−0.04 ***(−11.41)	−0.004(−0.88)	0.08 ***(28.43)	0.05 ***(15.56)
WPET	−0.01 ***(−4.11)	0.09 ***(22.53)	-	−0.01**(−2.56)	−0.05 ***(−12.39)
Constant	−2.31 ***(−52.25)	4.15 ***(76.78)	2.44 ***(31.82)	2.5 ***(53.50)	1.62 ***(31.45)
R^2	0.081	0.273	0.06	0.339	0.271

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, LE = learning engagement, CSH = completion status of homework, FES = family economic status, PHS = physical health status, LE = learning engagement, LSE = learning self-efficacy, LA = learning anxiety, CH = completion of homework, SEE = self-expectation of education, whether to use "Smart Homework", WPET = willingness to participate in extracurricular tutoring. The value of T is in parentheses.

4.2. Analysis of the Psychological Mechanism of Reducing Burden and Improving Quality in "Smart Homework"

According to the Yerkes–Dodson law, there is an "inverted U-shaped" relationship between learning anxiety and learning outcomes, where moderate levels of anxiety can achieve optimal learning outcomes, while high or low levels of anxiety can reduce learning outcomes [33]. To test whether there is an "inverted U-shaped" relationship between learning anxiety and learning effectiveness, the researchers added a variable named learning anxiety square (obtained by the square calculation of learning anxiety) to the regression analysis in Table 5, and included this variable in the regression equation for analysis. The results showed that when learning self-efficacy and learning involvement were taken as dependent variables, the coefficient and significance of grade and other variables did not change significantly, and the regression coefficient of the learning anxiety square was significant ($p < 0.001$). In both cases, the coefficient signs were opposite to learning anxiety. This indicates the existence of an "inverted U-shaped" relationship between learning anxiety and learning outcomes.

Academic research shows that there is a high correlation among learning anxiety, learning self-efficacy, and learning engagement. Learning anxiety can have an indirect impact on learning outcomes through perceived learning efficacy and engagement, and perceived learning efficacy can also have an indirect impact on learning outcomes through engagement [34–36]. If the use of "Smart Homework" can reduce learning anxiety and improve learning self-efficacy and learning engagement, then the influence of learning anxiety of the group using "Smart Homework" on learning self-efficacy and learning engagement should be stronger than that of the group not using it. In addition, if the use of "Smart Homework" can simultaneously enhance learning self-efficacy and learning engagement, then the impact of the former on the latter should not be different in the use and nonuse of "Smart Homework". For this reason, the researchers built a theoretical model, as shown in Figure 1, taking learning engagement as a dependent variable, learning anxiety as an independent variable, learning self-efficacy as a mediating variable, and "intelligent work" as a regulating variable.

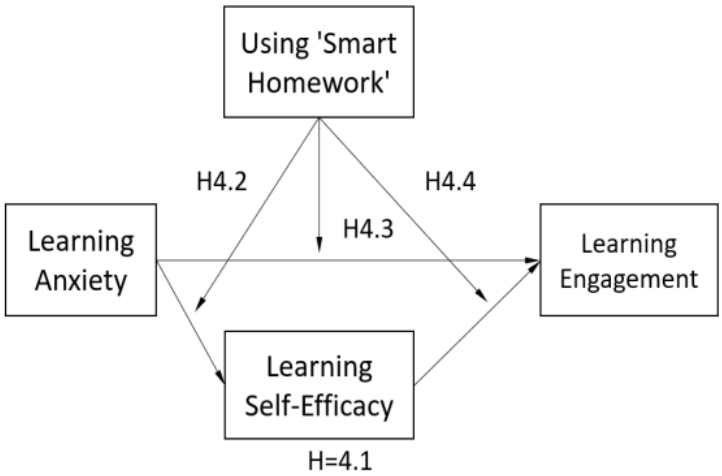

Figure 1. Theoretical model of hypothesis 3.

The theoretical model is in line with Hayes's No. 59 model [37]. The researchers tested the model using the porosity plug-in of SPSS. The results show that the direct effects of learning anxiety → learning self-efficacy ($p < 0.001$), learning anxiety → learning engagement ($p < 0.001$), learning self-efficacy → learning engagement ($p < 0.001$) are significant. Effect = −0.1429, BootSe = 0.0054, BootLLCI = −0.1533, BootULCI = −0.1324, [BootLLCI, BootULCI] interval does not contain 0, and learning self-efficacy has a significant mesomeric effect between learning anxiety and learning engagement. Whether or not to use "Smart Homework" has a significant moderating effect between learning anxiety and learning self-efficacy ($p < 0.001$), whether or not to use "Smart Homework" has a significant moderating effect between learning anxiety and learning engagement ($p < 0.001$), and whether or not to use "Smart Homework" has no significant moderating effect between learning self-efficacy and learning engagement ($p > 0.05$). Compared with students who did not use "Smart Homework", the impact of learning anxiety on learning efficacy and engagement is more significant among students who use "Smart Homework". This indicates that the use of "Smart Homework" indeed reduces academic pressure on primary and secondary school students, improves their learning effectiveness, and plays a role in reducing the burden and improving quality.

4.3. The Negative Impact of Using "Smart Homework"

The data shown in Table 7 are a statistical table of anxiety levels when using "Smart Homework". Among all 18379 people who filled out the questionnaire, 1650 felt anxious when using "Smart Homework", accounting for 8.98%. Among the various causes of anxiety, "inconvenient platform operation" (52.79%), "intelligent homework" (32.68%), "wrong homework" (34.64%), too much homework (28.36%), too small screen (25.15%), hierarchical work that makes you feel inferior (18.67%), and too simple work (11.3%) were ranked from high to low. The combined proportion of "inconvenient platform operation" and "screen too small" directly related to the platform reached 77.94%, indicating that the use of "Smart Homework" does have a negative impact on some students, and the inconvenient operation of the platform itself and the small display screen are the main reasons. To further understand the relationship between students' anxiety and the use of "Smart Homework", researchers conducted a correlation analysis between the two data items "whether they feel anxious when using "Smart Homework" and "average daily time spent using the platform", and found a correlation coefficient of −0.025 ($p < 0.001$) between the two. This indicates that the longer you use the platform, the more likely you are to experience anxiety. Therefore, hypothesis 4 is validated.

Table 7. Statistics on feeling anxiety using "Smart Homework".

	Yes	No	N
Do you feel anxious using "Smart Homework"	1650(8.98%)	16729(91.02%)	18379
Too much homework	468(28.36%)	1182(71.64%)	1650
Layered homework makes oneself feel inferior	308(18.67%)	1342(81.33%)	1650
The platform operation is not convenient	871(52.79%)	779(47.21%)	1650
Parents can see homework mistakes	522(31.64%)	1128(68.36%)	1650
Screen is too small	415(25.15%)	1235(74.85%)	1650
Brothers and sisters at home should use "Smart Homework"	538(32.6%)	1112(67.4%)	1650
The homework is too simple	187(11.3%)	1463(88.7%)	1650

Note: The data in the table represent the number of people, and the corresponding percentages are in parentheses.

5. Conclusions

First, the use of "Smart Homework" reduces the workload of homework from three aspects: surface layer, inner layer, and core layer. On the one hand, "Smart Homework" utilizes adaptive technology to achieve precise services for students' learning, reducing the workload compared with "question sea tactics" and avoiding mechanical, ineffective, and simple repetitive homework. Allowing students to complete homework in a timely manner within the school reduces homework time, indicating that "Smart Homework" can help solve the problem of excessive time on the surface of homework burden. On the other hand, students who use "Smart Homework" perceive a lighter learning burden and anxiety, which better stimulates the individual's potential and brings their "arousal level" of motivation to or near the optimal state. First, teachers have more time to understand the learning situation, optimize teaching and homework design, guide students' learning, and provide more targeted learning assistance to students. Compared with students' aimless exploration, it reduces the difficulty of their learning and alleviates the psychological anxiety caused by ineffective exploration. Second, students consolidate weak points in knowledge learning by repeatedly watching excellent teachers' explanations of knowledge points in micro lesson videos. For students who use "Smart Homework", it, to some extent, reduces the difficulty of completing homework and alleviates homework anxiety. According to the three-layer structure principle of homework burden, "Smart Homework" reduces homework burden from three aspects: outer layer, inner layer, and core layer, namely, reducing homework time and workload; reducing the sense of boredom, failure, and anxiety caused by the difficulty and duration of homework; and through micro course videos, sharing high-quality resource, which has been achieved, which, to some extent, ensures the educational interests of ordinary students. This conclusion confirms the existing literature's view on "Smart Homework" in Jiangxi, such as a report by *China Education Daily* titled "Homework is smarter and students do not cry out", which suggests that "Smart Homework" in Jiangxi effectively reduces students' homework burden [38].

Second, "Smart Homework" reduces the willingness to participate in extracurricular tutoring and, to some extent, reduces the burden of extracurricular tutoring. The results of data analysis show that students who use "Smart Homework" are less willing to participate in extracurricular tutoring than students who do not use "Smart Homework". This conclusion is consistent with academic research on the influencing factors of participating in extracurricular tutoring. Research has shown that excessive educational anxiety can increase students' willingness to participate in extracurricular tutoring, thereby affecting their behavior of participating in extracurricular tutoring [39]. Off-campus tutoring is usually "exam-oriented", and teaching activities are carried out in a synchronous or slightly advanced manner with the school, using "question sea tactics" for high-intensity training [24]. Excessive educational anxiety can easily lead to a utilitarian mindset of only investing in "subject-oriented" tutoring. Additionally, "Smart Homework" improves learning efficiency by accurately positioning learning needs and providing high-quality and targeted micro course resource services, so that students do not need to participate in extracurricular tutor-

ing. While reducing learning pressure, it increases learning interest and reduces learning anxiety, thereby reducing students' willingness to participate in extracurricular tutoring and reducing the burden of extracurricular tutoring.

Third, "Smart Homework" can help students better complete homework and improve learning efficiency. "Smart Homework" uses high-quality micro lesson resources to help students learn, enhances learning input, improves learning efficiency, and enables students to have a stronger sense of self-efficacy in learning, using process-based learning information to assist teachers in analyzing learning situations, optimizing homework design, and improving teaching efficiency. This conclusion is also consistent with the views of the existing literature. Shi Yinuo (2021) believes that Jiangxi's "Smart Homework" has achieved "targeted homework", utilizing learning behavior data to support personalized teaching [20]. The collection of incorrect questions and micro lesson videos for "Smart Homework" has played an important role in it. Among all the functions of "Smart Homework", "error analysis" and "watching micro lesson videos" are the two most commonly used. This indicates that "Smart Homework" is mainly manifested in enhancing the mastery of weak knowledge points and improving the degree of fine processing of knowledge in helping students improve their learning effectiveness. This is consistent with the findings in the academic community that adaptive learning systems help students change the process of knowledge refinement and enhance their learning engagement [14]. The problem set and micro lesson videos help learners overcome setbacks, form successful experiences in the process of correcting errors and mastering knowledge points, enhance learning efficiency, and further affect learning engagement, thereby achieving the effect of improving high learning efficiency.

Fourth, "Smart Homework" has a certain degree of negative impact on students, which can cause a small number of students' psychological anxiety. The longer they use it every day, the easier it is to form anxiety. This is mainly due to the lack of convenience in the operation of the "Smart Homework" platform or the small display screen. This conclusion shares similarities and differences with existing research findings. The similarity is that both the conclusions of this study and existing studies suggest that the use of smart products has a negative impact, and the longer is the time spent using smart products, the more likely it is to cause psychological anxiety [26,27].

The difference is that this study found that students with psychological anxiety only account for a small proportion of the surveyed student population, and the proportion is not high. This may be because existing research mainly investigates the use of smartphones by college students, while this study mainly focuses on students in compulsory education. The vast majority of students at this stage do not have their own smart products. The operation of the "Smart Homework" platform is completed through their parents' smartphones, tablets, desktop computers, televisions, and other devices, and the vast majority of students use the platform within 1 h per day. The use of electronic products is not as prone to students developing a dependency mentality as smartphones, so the psychological anxiety caused only appears in a small group of students.

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