

# How Does E-book Bag Promote Learning? Video Analysis Based on Classroom Recordings

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*Abstract: With the popularity of mobile learning and the rapid development of internet, e-book bag has received increasing attention. However, recent studies rarely analyze the functional characteristics of E-book bag and its influence on teachers' instructing and students' learning from the perspective of classroom teaching application. In this regard, this study selected 20 sections of live e-book bag teaching video recorded in Changchun, China, and analyzed the functionality of e-book bag using Video Analysis on its following four dimensions: situation creation, knowledge construction, collaborative communication, and evaluation feedback. We concluded that e-book bag has three major functions: "resources and toolkits", "teaching interaction", and "teaching evaluation". Meanwhile, it provides support for active interaction between teacher and students, between students, and between students and learning contents as well. Therefore, the use of e-book bag satisfies students' individualized learning, supports the communication and cooperation between teacher and students, and helps students to construct knowledge in depth.*

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## Literature Review and Questions

**T**HE e-book bag is a sub-model of intelligent teaching. It refers to a new teaching mode that utilizes information equipment, which can play an active role in guiding students for a series of learning behaviors. In recent years, studies have shown (Cho, et al., 2017) that educators look forward to triggering “teaching transform” by adding “digital technology elements” and adopting this transform to promote the development and enhancement of students’ intelligent and advanced thinking skills. E-book bag, as an efficient and operative way of learning, has meaning in existence. The rise of e-book bag model not only narrows the basic differences between schools and teachers, but also reflects the principle of equal teaching deeply.

As far as existing research is concerned, current literature tends to interpret e-book bag as a carrier device or learning environment from the perspective of “tool view” or “environmental view” (Zhao & Zhu, 2009). The E-book bag mobile terminal can directly support teacher and students through the user information management system, and use the personal account to bind the relevant data in the e-book bag, such as: school records, e-books, micro-courses, and other resources and tools. In addition, in order to effectively update and share resources and tools, the e-book bag also has the function of resource management; teacher can prepare various resources and tools according to teaching contents and needs before lesson. When teaching, students can upload and download resources and tools quickly and easily.

As early as 2000, e-book bag began to be used in Singapore. Due to its limited functions and high promotion costs, it did not receive adequate feedback (Tang, et al., 2014). Currently, e-book bag has been becoming a multi-functional electronic device with information storage, recording contents and reading materials, promoting intelligent education, and has gradually been becoming an irreversible trend of the times and development needs. South Korea, the USA, Japan, European countries etc. have taken measures to reduce its cost, and promoted the use of e-books within their countries. At the same time, in China, e-book bag has also received increasing attention and has been given new vitality. Since 2008, along with the implementation of the projects introduced by Intel in the “One-to-One” Digital Learning Application Research Project, the leading company products in the field of e-book bag technology in China are Hanwang and Youxuepai. Hanwang’s products mainly use its ink screen technology, which is better at protecting children’s vision, and meanwhile Youxuepai’s electronic screen technology facilitates the playback of courseware and audiovisuals.

In terms of application, scholars have done a more detailed theoretical analysis of e-book bag and its functionalities. Based on the existing research results, the function of e-book bag can be summarized into four categories: i) to support multimedia functionality, i.e. the text, audio, picture, video, etc. can be shared by the information device between the teacher terminal and the student terminal; ii) the learning management functionality, students can use e-book bag to manage and classify learning information independently; iii) the teaching management functionality. Teacher can dynamically

share the learning situation and learning characteristics of the students through the terminal, and take it as a classroom management assistance; iv) to support the interaction between teachers and students, to build a platform for exchanging and communicating between parents, students and parents, at anytime and anywhere (Martel, et al., 2006).

There are two distinct perspectives on the role of e-book bag in teaching exist. Some considered that e-book bag has a positive effect on learning. After active discussion regarding the role of e-book bag in teaching, it showed that, e-book bag not only enhances students' learning output at the cognitive and non-cognitive levels, effectively promote the development of students' cognitive level, but also improve students' learning attitudes, mobilize students' enthusiasm and promote students' personalized learning (Zhang, 2011). Meanwhile, through the visualization of the teaching contents, e-book bag creates a relaxed classroom atmosphere, improves student's participation in the class, and it is a good platform to promote the interaction between teacher and students while facilitating teacher to master the learning situation (Guan & Zhu, 2018).

However, others questioned the specific functionalities of e-book bag, and presented that disadvantages existed for its application in teaching, pointed out the potential negative effects in terms of health, internet addiction and cost (Zhu & Yu, 2011). First, the e-book bag cannot effectively integrate with the classroom, not only does not play its functionality ideally, but also may affect the child's writing ability and vision, and even cause the child to rely too much on the network and addiction (Liu, 2013). Second, in the case that e-book bag has not been popularized and lack of its resource library, the use of e-book bag cannot meet the needs of students well, and it has considerable costs, further increasing the pressure on the families to invest in education (Hu & Zhang, 2012).

In sum, most previous studies paid more attention to the results of the concept, but not that many practical researches focused on specific application of e-book bag in the intelligent teaching. From the perspective of methods, they belonged to academic analysis, but there are few evidence-based studies. From the research process, currently available studies could not clearly answer what happened in the process of using e-book bag, and could not reasonably and scientifically tell the impact of e-book bag on teachers' instructing and students' learning.

Therefore, this study focuses on the following issues:

1. How is e-book bag applied in teaching practice?
2. What role does e-book bag play in the teaching process?
3. How to make it work better according to the characteristics of e-book bag?

As thus we selected 20 videos that use e-book bag teaching according to above questions. Under the perspective of classroom video, we meticulously observed the real scene of the smart teaching classroom using e-book bag, used video analysis to explore how e-book bag affects teachers' instructing and students' learning in practice.

## **Research Design and Data Sources**

## **Samples**

Accordingly, we collected the teaching video cases from 20 elementary and middle schools in which e-book bag was applied in Changchun, China (**Table 1**). These schools included but not limited to: Changchun City Elementary School Affiliated to Changchun Normal University, Changchun City First Experimental Elementary School, Changchun City Lvyuan Elementary School, etc. The schools selected in this study have introduced e-book bag technology and applied it to their practical teaching. In addition, there are differences in the practical application of e-book bag in different disciplines, for example, for more perceptual liberal arts subjects such as Chinese that focuses more on the audible functionality of e-book bag, but for more rational science subjects such as Mathematics that focuses more on the visualization of charts. So the teaching cases selected in this study included both liberal arts and science. Therefore, the data were more scientific and comprehensive.

All the video data used in our study were recorded in class received permission from both parents and teachers. The ownership of the video was attributed to the schools where the videos were recorded. In the course of the research, we also obtained authorization from the schools indicating that the videos could be used for research and publication.

## **Research Method**

In this study, we used video analysis to analyze selected teaching video examples. The video analysis method was to get the most direct and detail data of the teaching and learning process through reviewing the class teaching videos, and then deeply analyzed its specific influence on the teaching and learning between teacher and students. In China, video analysis has become an indispensable part of modern education. Yong (2015) proposed that analyzing teaching videos was extremely beneficial to teachers' reflection and promoted teachers' professional learning in the future. Hong (2017) showed that video analysis was different from other teaching methods, and it made the science curriculum more visual and provided students with a perceptual understanding. Wang (2018) showed that video analysis should be analyzed from four aspects: teaching content, audio-visual presentation, guiding interaction and rhythm. However, most traditional video analyses were not that in-depth in contents, in overall, it was not that easy to observe the specific facts and phenomena in detail. In addition, the sample size was small, and the traditional video analyses have certain errors in the experimental results (Guo, et al., 2019).

Most video analysis methods generally analyzed classroom teaching videos from four aspects: teaching contents, audiovisual presentation, guiding interaction, and rhythm. However, few focuses on these four aspects to help students create scenarios, construct knowledge, communicate and evaluate feedback. Under the scenario creation mode, teacher can flexibly use language or modern teaching tools to create a familiar situation that is easy to be understood, and thus stimulate students' imagination, thinking and emotions, and promote their interests and creativity. Former Soviet educator

**Table 1. Twenty Class Teaching Videos in Elementary and Middle School in Changchun, China.**

	<b>Grade</b>	<b>Subject</b>	<b>Contents</b>	<b>Teaching Methods</b>	<b>Video#</b>
Elementary School	3rd	English	Unit Text: Family	Teacher Explanation, Audio Reading	01
	4th	Math	Average Value	Explaining Interaction, Drawing, Animation	02
	4th	Chinese	Text "Viewing the Tide"	Teacher Explanation, Courseware Display	03
	4th	English	Unit Text: Time	Teacher Explanation, Audio Reading	04
	5th	English	Oral Audiovisual Practice	Q&A Between Teacher and Students, Group Interaction	05
	5th	Chinese	Text "Poplar Tree"	Explain Interaction, Courseware Display	06
	5th	Math	Polygon Area Calculation	Explain Interaction, Video Presentation	07
	6th	English	Unit Test Explanation	Answering Questions, Audio Analysis	08
	6th	Chinese	Appreciation Of Poetry	Teacher Explanation, Courseware Display	09
	6th	Math	Position and Direction	Course Explanation, Courseware, Drawing	10
Middle School	7th	Math	Quadrilateral Review	Answering Questions, Courseware Display	11
	7th	Geography	Chinese Terrain	Teacher Explanation, Animation, Picture	12
	7th	History	The Dynasty Replacement of Xia, Shang and Zhou	Explain Interaction, Video Playback	13
	8th	English	English Grammar - Past Continuous Tense	Answering Questions, Courseware Display	14
	8th	Physics	Particles and The Universe	Teacher Explanation, Animation, Picture	15
	8th	Politics	Rights and Obligations	Teacher Explanation, Courseware Display	16
	9th	Chemistry	Burning Condition	Teacher Explanation, Experimental Interaction	17
	9th	Geography	Global Climate Type and Distribution	Teacher Explanation, Video, Animation	18
	9th	Chinese	Reading Comprehension	Answering Questions, Courseware Display	19
9th	Math	Binary One Function	Teacher Explanation, Animation Display	20	

Note: All videos were 45 minutes long.

Markalenko said: "Teachers should take the initiative to establish an external environment that evokes the necessary mental state, perceptions, emotions, motivations, and motivates their actions in the learning process" (ITL Research, 2010). For knowledge construction, it emphasizes the initiative of learners, after a series of receiving, reflecting, and questioning, it can organize the knowledge they have learned and absorbed them into their own knowledge reserve (Chang & Sheu, 2002). For collaborative com-

munication, it is cooperation through learning experience and information and resource exchange (Zheng & Zhang, 2012). For evaluation feedback, it refers to the feedback of learning results to teachers, so that teaching and learning can be regulated timely (Guo, et al., 2013).

The above-mentioned four dimensions relate to the interaction between students and learning contents, between students and students, and between students and teachers. They are the mainframes that support the overall teaching activities. We used video analysis method to analyze the videos recording the use of e-book bag from these four dimensions: scenario creation, knowledge construction, collaborative communication, and evaluation feedback. So as to get to know how the e-book bag influence teachers' instructing and students' learning, and how it promotes the development of students' abilities.

In the processing video data, we recorded the behavioral activities of teachers and students in the classroom in each video, and then organize the video data according to corresponding dimensions to obtain preliminary analysis results. In order to ensure the robustness of the analysis results, six months after the initial analysis, we conducted a second analysis of the video materials, compare the similarities and differences between the two analysis results, and drew consistent conclusions. Finally, the video materials were further inspected and extracted until there were no new findings and conclusions to ensure the validity and saturation of the data.

## **The Teaching Activity Coding and Application**

We herein carefully reviewed the videos selected from 20 lessons, recorded the student's learning activities in the teaching practice regarding the use of e-book bag, divided from the two aspects of learning behavior and cognitive activities, and then followed the dimensions according to the role played by each behavior. **Table 2** is based on the key teaching behaviors involved in the coding development of classroom teaching behaviors on using e-book bag from the four dimensions mentioned above. Referring to the coding system listed in **Table 2**, the teaching activities between teachers and students in each dimension were described in detail, especially the learning activities of students. We thus came to the application and role of e-book bag in teaching practice, and summarize its functional characteristics.

## **Results**

### **The Use of E-Book Bag in Teaching Practice in Four Dimensions**

Through the selection of 20 cases, we analyzed the application of e-book bag in teaching practice in four dimensions. Two classic cases were selected for general representative discussion. In case #1 (Video 02) in the picture below, the school was conducting an e-book-bag-based experiential learning based on the "average score" of the fifth grade Mathematics. This case effectively used the interactive teaching technology

**Table 2. “E-books Support Smart Classroom Learning Behavior” Code.**

<b>Dimensional Structure Model</b>	<b>Behavioral Participation</b>	<b>Cognitive Participation (Discovery, Conception, Induction, Choice, Evaluation)</b>
Situation Creation	<ol style="list-style-type: none"> <li>1. Watch the content of the presentation</li> <li>2. Explain the scene information in the courseware resources</li> <li>3. Watch the video or listen to the audio to understand the situation</li> <li>4. Practice or experiment in the classroom</li> <li>5. Use terminal multimedia to participate in classroom questioning, test, answer and alter screen presentation</li> </ol>	<ol style="list-style-type: none"> <li>1. Understand the content of different presentations (text, video, animation, audio, etc.)</li> <li>2. Recall information related to the information obtained</li> <li>3. Associate with external environment or data</li> </ol>
Knowledge Construction	<ol style="list-style-type: none"> <li>1. Comment with public editing tools</li> <li>2. Optimize own results based on the results of others</li> <li>3. View related information resources such as study cases (use resource information such as study cases, e-books, etc.)</li> <li>4. Choose the appropriate learning resources and tools</li> <li>5. Search for relevant information resources with search tools</li> <li>6. Extract important information from resources (using public editing tools, notebooks, etc.)</li> <li>7. Integrate information and make learning works (using characterization tools such as mind maps)</li> <li>8. Use the subject inquiry tool to operate and summarize the problem solving process (using discipline tools such as virtual experiments)</li> <li>9. Students acquire and analyze information or data by doing experiments and searching.</li> </ol>	<ol style="list-style-type: none"> <li>1. Interpret, reflect, and correct their own results</li> <li>2. Modify, refine, and integrate information resources</li> <li>3. Create new information</li> <li>4. Analyze, reflect, and absorb the results of others</li> </ol>
Collaborative Communication	<ol style="list-style-type: none"> <li>1. Respond to questions raised by teachers, etc.</li> <li>2. Initiate a hand-lifting speech, etc., ask the teacher</li> <li>3. Ask the teacher through an online communication tool</li> <li>4. When altering screen, use annotations to explain with teachers, share and exchange learning results.</li> <li>5. Alter screen demo to share your learning outcomes</li> <li>6. 6. Communicate issues, share resources, and discuss results with communication tools</li> </ol>	<ol style="list-style-type: none"> <li>1. Raising conflicts with cognition</li> <li>2. Explain and illustrate</li> <li>3. the constructed knowledge to others</li> </ol>
Evaluation Feedback	<ol style="list-style-type: none"> <li>1. Teacher initiates evaluation invitation, student evaluation</li> <li>2. Evaluate the results and performance of others with features such as 'Like'</li> <li>3. Negotiate solutions with voting, communication, etc.</li> <li>4. Propose information that is inconsistent with cognitive structure</li> <li>5. Use online tests to test learning outcomes</li> <li>6. Real-time monitoring of learning progress</li> </ol>	<ol style="list-style-type: none"> <li>1. Analyze, reflect, and evaluate the performance of others</li> <li>2. Analyze and evaluate learning resources and tools</li> <li>3. Organize, classify, analyze, synthesize, and evaluate data or information</li> <li>4. Analyze, reflect, and summarize problem solutions</li> <li>5. Analyze and reflect on learning outcomes</li> <li>6. Rethink the problem provided by the teacher</li> <li>7. Reflect on the performance of their owns or others</li> </ol>

through the application of multimedia. It created a more suitable environment for students to provide support for their learning, thus promoting the school's internal special discipline construction and resources sharing between teachers and students, and it helped improve the efficiency of students' learning at school. From this, the most direct application of e-book bag in teaching is experiential learning.

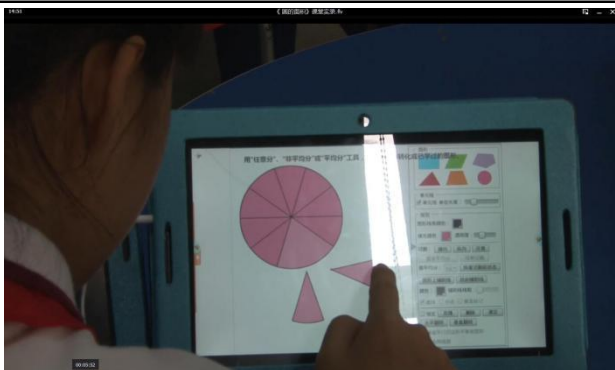
Through the analysis of Video case #2 (**Snap Pictures 1 and 2**), under the guidance of the situation and teachers, students used the combination of information and technology to carry out a series of teaching interactions such as questions, exams, answers, and screen presentations. Combining all the video cases, we found that teacher visualized the questions by the e-book bag, drew the attention of students in the class, and clearly demonstrated the process of teachers' questions. Through the problem of immediate visualization and the encouragement of teachers, they brainstormed immediately, responded to teacher's problems actively, and answered teacher's questions according to the prior-reading materials in the e-book bag. The teacher altered the screen and interpreted vividly the concept of "equal division" through various charts. These interactions, without exception, enhanced the connection between teachers and students, so that students could improve their learning efficiency in terms of cognitive attitude, participation, and motivation, etc. From the video, we also felt intuitively that students were influenced by subjective initiative and individual thinking. They were attracted by novel e-book bag, fully mobilized visual and auditory senses, concentrated on listening to the teacher and constantly "storage-consolidation-practice" knowledge in their minds. These series of behaviors showed that with the full use of e-book bag, teachers could successfully stimulate students' imagination, thinking and emotions, and improve their interests and create a good learning atmosphere.

Under the knowledge construction dimension (**Figure 1**), the e-book bag supported students' self learning, gave students the opportunity and right to arrange their own learning activities and realize knowledge management. For example, in Video 03 (24'32''-30'47''), Video 07 (28'45''-34'37''), Video 11 (24'22''-36'47''), the teacher shared the specific classroom learning materials to the class through the e-book terminal, and students prepared and digested by themselves and asked questions, discussed and solved questions in group, and finally submitted the group discussion to the e-book bag. The teacher evaluated and shared the process and results in the class. It showed that the use of e-book bag in teaching stimulated greatly the autonomy of students' learning, promoted students to learn independently and collaboratively, and provided them with channels for individualized learning habits. This method allowed them to develop their own thinking while learning relevant knowledge, and achieved the development of both aspects, so that they could learn happily, actively and collaboratively, and finally they could be more suitable to the society. Therefore, the promotion of teaching technology, the improvement of teaching level and the construction of teaching environment through e-book bag can help teachers to impart knowledge better, as thus achieving the purpose of strengthening teaching quality. As the concept of intelligent education is deepened and applied to practice, the e-book bag can mainly support three modes: teachers' teaching, students' self-cooperation and intelligent star teaching. E-book bag

**Snap Picture 1. Students are Investing in E-Book Bag Learning. (Video 02, 8'45''–11'50'')**



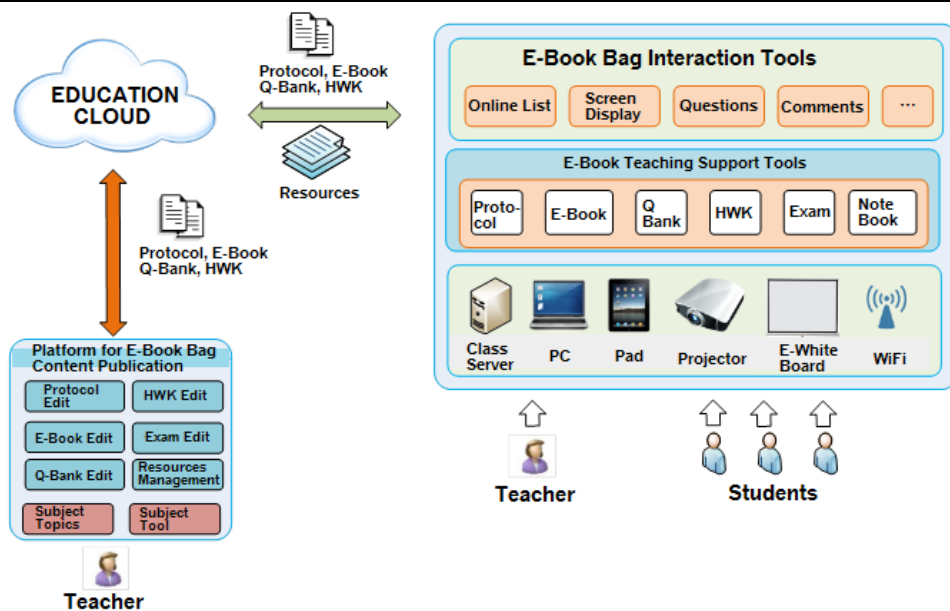
**Snap Picture 2. Real Shots of Students Using E-Book Bag for Learning. (Video 02, 15'23''–17'46'')**



can also effectively help teachers to carry out related activities to improve the quality of teaching and materialize specific teaching methods and provide students with better quality learning resources and high-tech teaching platform. The learning efficiency in class has been improved by e-book bag. Based on this, the helpfulness and function of the e-book bag for knowledge construction is obvious and effective for both teachers and students.

In order to do as much as possible, it is necessary to scientifically arrange planned teaching and personalized learning activities. In Video 13 (8'22''-15'17''), the History teacher used the teaching method of playing related video materials to guide students to understand the dynasty replacement of the dynasties of Xia, Shang, and Zhou by watching the video as a relatively easy way to obtain information. This can help the seventh grade students establish the concept of dynasty in the history learning. From this, the use of technology and information to promote the improvement of teach-

Figure 1. Experiential Learning Activity Model Supported by E-Books.



Note: Q-Bank, Question Bank; HWK, Homework.

ing quality, teachers can be better able to take measures against the status quo, improve teaching, and design corresponding session in class according to the actual needs of students, i.e., finding the optimal solution for class teaching. Through promoting the development of personalized education using scientific arrangement of the teaching and personalized learning activities, more students have the opportunity to conduct personalized learning. In addition, this method can also promote students' learning outside of the classroom.

Case #2 (Video 18) was collected on-site in the second phase of the National Information Technology and Teaching Integration Showcase and Training Event.

In the collaborative communication dimension, e-book bag provided a benign development platform for the exchange of learning between teacher and students, and between students and students. From the recorded Video 18 (17'25''-19'46'') (**Snap Picture 3**), it could be visually found that students could achieve the interactive teaching in class through the e-book bag, the teacher used the online listing function to display and view students' online situation, check students' hand-raising situation, the submitted questions, and altered screen presentation. The teacher could share pictures for everyone. Students could use the editing tools on the tablet to comment on the pictures, express their opinions, and send the pictures they have back to the teacher. The teacher could select excellent works from the review pictures sent by the students to explain. For the selected pictures, the students can like, save, or enlarge the view; the

**Snap Picture 3. Live Recording. (Video 18, 7'25''–16'56'')**

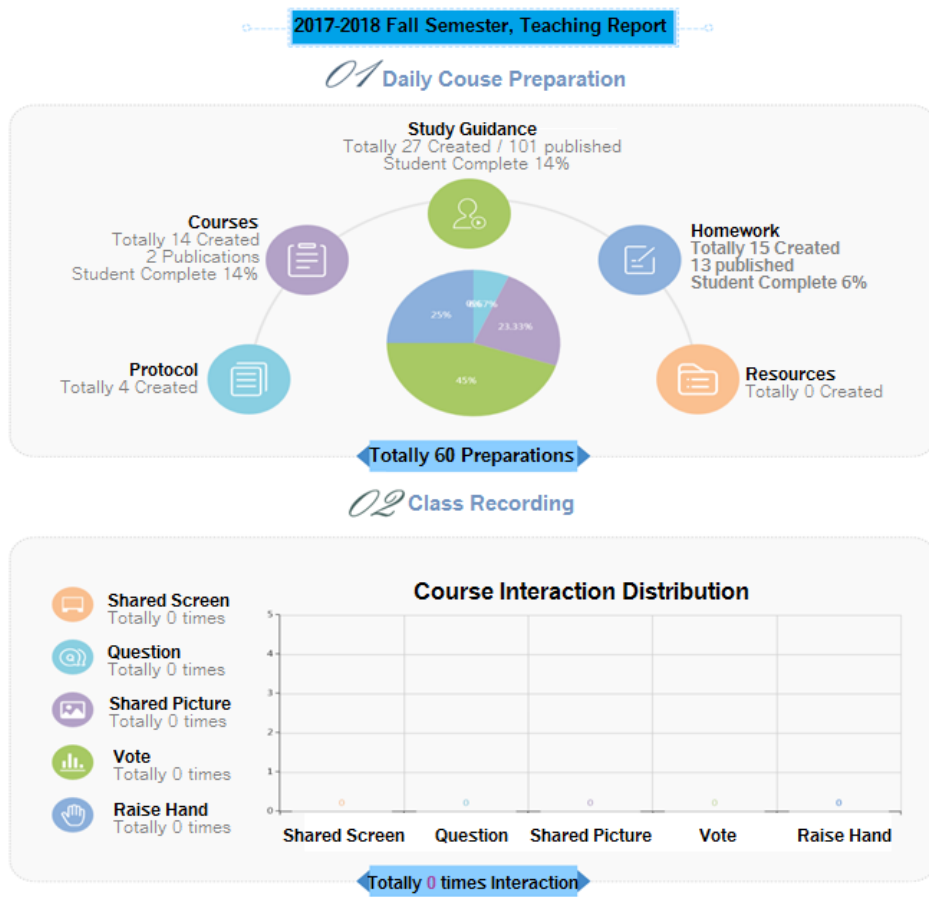


teacher can let the author student of the picture explain the pictures on the tablet side, the big screen will synchronize the presentation process. It can change the teaching normality in the past, re-establish the interaction between teachers and students, and ensure the effectiveness of classroom teaching. Through the use of e-book bag for teaching, teachers can better provide convenient mobile services, help simultaneous presentation of teaching resources, including instructions, courseware, and homework.

In the evaluation feedback dimension, through Video 04 (37'38''-43'21''), Video 08 (46'56''-49'51''), Video 13 (25'32''- 38'27'') and Video 19 (22'32''-45'27''), etc., it was known that the e-book bag supports both teachers and students to view, publish and share instructions, courseware, and assignments on the mobile side. Teachers could review assignments on the mobile side, added personalized comments to each student; viewed the textbooks, teaching reports and progress, and teaching situation, including daily preparations and interactions in the class. Students can participate in the theme activities, upload works, and exchange discussion, assignment details and reports on the mobile side. In the actual recording, we can intuitively get connection between teachers and students through e-book bag. The following picture showed the statistical distribution of the e-book bag in classroom interaction (**Figure 2**). It can be seen from this chart that teachers can guide students to summarize the achievements, reflection and suggestions of the theme activities, and publish the results on the platform. Students can test their learning results through the teaching process.

Through the analysis of the selected teaching recorded video, we could find that the e-book bag fully utilizes scenario creation, knowledge construction, collaborative communication and evaluation feedback and other functions in the specific classroom practice and learning as well as in the collaborative application of the theme activity.

**Figure 2. E-Book Bag Classroom Interaction Distribution Statistics.**



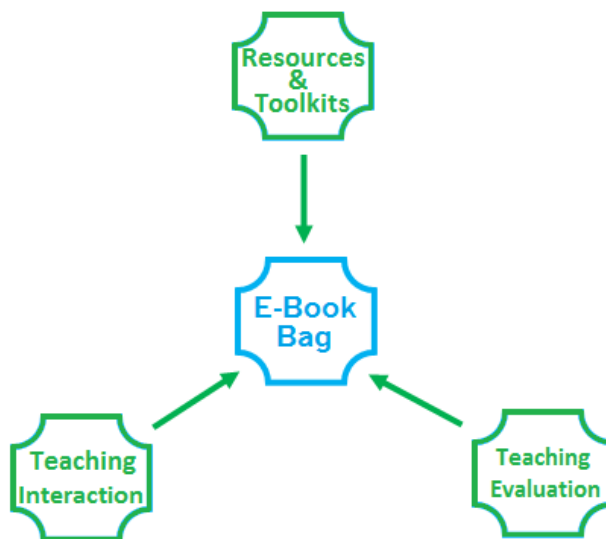
## The Role of E-Books in the Teaching Process

Based on the records and analyses of the application of e-book bag in classroom practice and their respective role in the above four dimensions, the role of e-book bag in the teaching process can be summarized as following three categories in **Figure 3**: “resources and toolkits”, “teaching interactions”, and “teaching evaluation”.

### *The Role as the “Resources and Toolkits”*

Resources and tools were different forms of learning after processing, and were the main environmental conditions for teachers and students to complete knowledge construction. Whether at teacher’s terminal or at student’s terminal, resources and tools

**Figure 3. Three Functions of E-Book Bag.**



included resources such as study cases, e-books, and micro-courses as well as related teaching tools and subject tools based on learning objectives, individuals, contents, styles, and scenarios. In addition, in order to effectively update and share resources and tools, resource management function was also set up to upload and download resources and tools conveniently and quickly. Students could choose and download independently the various resources and tools that teachers prepared for them before lesson. The study case was used to support the student's self-directed learning, allow students to complete a preliminary understanding of knowledge. E-book bag was media-based and can not only present knowledge contents, but also enable students to interact with learning contents. For example, the micro-courses, was short and succinct, which could help students to learn key points of knowledge in a targeted manner. Therefore, paperless work is convenient for students to answer, but also convenient for teacher to manage and check.

### ***The Role in Teaching Interaction***

Specifically, interaction refers to online and in-class communication between teacher and students, students and students. With regard to online communication, the teacher terminal and the student terminal allow communication anywhere and anytime. The intelligent classroom supported by the e-book bag advocated the teaching philosophy of "teacher-leads, student-centered", so the teacher terminal and the student terminal have different functional modules. Classroom interaction was dominated by the function of the teacher's terminal. It included: screen demo, raise hand list, listen carefully, ask questions, screen broadcast, share pictures, collect pictures, send and receive files, vote, monitor, screen pen, lock, group management and other functionalities.

### ***Supporting Role of Teaching Evaluation***

Evaluation helped to promote teachers' reflection on teaching and students' reflection on learning. It mainly included functions such as testing, analysis of the situation, evaluation of the classroom, and soliciting opinions. Among them, the analysis of the situation and the solicitation of opinions are unique to teacher's terminal. The test and the evaluation are common to both terminals of teacher and students. Among them, the test is a way for students to conduct self-evaluation. From the test results, the teacher could extract information about students' learning situation and propose corresponding improvement. The analysis of the learning situation was to analyze students' participation and achievements in the class, and helped teachers to assess students' learning situation. The classroom evaluation was initiated by the teacher's terminal, and the teacher and students conduct self-evaluation of their performance, respectively. The solicitation of opinions was initiated by the teacher terminal, and the students used the "like" functionality to vote on the learning outcomes of other students.

These three functions of the e-book bag greatly supported the role and effect of the teaching scenario creation, student knowledge construction, the collaborative communication, and evaluation feedback of teachers and students.

### **The Role of E-Book Bag in Interactive Teaching**

We could clearly receive the results of the observation of 20 smart classroom teaching records from the aspects of scenario creation, knowledge construction, collaborative communication and evaluation feedback. It was also found that students learning under the premise of applying e-book bag, they achieved a good effect of interactive teaching and their learning often had higher learning efficiency. It could be seen from the code of **Table 2**, "The behavior of e-book bag supports intelligent classroom learning that in the smart classroom", and the interactions between students and teachers, students and learning contents occurred under the support of e-book bag, its characteristics are:

First, the interactive and evaluation functionalities of the e-book bag were used in the interaction between students and teachers. With the support of the e-book bag environment, teachers guided students to think independently, ask questions, share results, and learn to reflect. Throughout this process, students are required to use the technical environment for communication and reflection.

Second, the interactive, evaluation, resources and tools functionalities of the e-book bag were used in the interaction between students. With the support of the e-book bag, students and their peers identified the subject of inquiry, and negotiated solutions and used resources and tools to express their opinion. It was worth mentioning that when students encountered problems, they could use the communication tools to consult with their peers (either in the same group or in different groups). Although there was less online communication in the class, building and utilizing a learning network was one of the skills that students must have. Meanwhile, when evaluating the perfor-

mance or learning outcomes of peers, they used the evaluation function in the e-book bag to vote for the students or learning outcomes that they thought were the best, and optimized their learning outcomes by reflecting on others' learning outcomes. Throughout the process, students were required to use the technical environment for communication, collaboration, and reflection.

Third, the resources and tools and evaluation functionalities of the e-book bag were used in the interaction between students and learning contents. The learning contents were mainly presented in the form of digital information resources. Students needed to select appropriate learning resources and tools according to their learning needs, and completed the self-construction through interacting with digital information resources and tools; for instance, we used the study case to obtain the knowledge information of the new course or used the virtual experiment tool to summarize the knowledge information of the experimental process, and finally integrated the obtained information together to complete the learning task. We also created relevant information, and completed the process of constructing information from the preset information through the process of acquiring, modifying, refining, and integrating. At the same time, students used evaluation function (online and other ways) to reflect on their learning outcomes. Throughout this process, students were required to use the e-book bag environment for self-construction and reflection.

Fourth, e-book bag had multifaceted roles in promoting smart learning. As far as the intelligent classroom teaching and learning under the support of e-book bag was concerned, the behavior of "learning" and the behavior of "teaching" were manifested in the form of "behavior pairs" in which symbiosis coexisted; in other words, the intelligent classroom teaching activities are composed of multiple "behavior pairs" in a certain logical order.

## **Discussion**

Gu (2018) and Zhong (2011) showed that e-book bag had a positive effect on learning and could promote students' learning. From our observation and analyses of the specific learning behavior in the recorded videos of the application of the e-book bag, we drew the same conclusions as Gu and Zhong did. On the one hand, the e-book bag can fully mobilize students' enthusiasm for learning, and promote students' independent and individualized learning. On the other hand, the use of e-book bag is also conducive to strengthening communication between teachers and students and forming a benign interaction. Given the e-book bag has the function of "resources and toolkits", it will effectively create real-life task situations, activate students' cognitive experience, and embody abstract concepts with interactive resources such as synchronous experiments and rich media e-textbooks. Although doubts exist regarding the specific functionalities of e-book bag and even negative effects there, we considered that as long as the students are correctly and actively guided to use e-book bag, its beneficial effects will be much greater than the possible negative ones. Therefore, we believe that the support

role of e-book bag for intelligent learning is mainly reflected in the following three aspects: learning mode, interpersonal interaction and cognitive process.

## **Meet Students' Individualized Learning**

Individualization, as its name implies, is uniqueness, while individualization in learning means that students can do self-selection according to their unique learning needs. Chabert et al. (2006) found that the rich resources and tools in the e-book bag could customize the learning plan suitable for them according to the different learning styles, knowledge levels and the specific learning situation. In our study, we observed that students could use e-book bag to select different forms of resources according to their learning style, such as text, pictures, micro-courses, etc., and also could select different levels of learning tasks according to their cognition level, like basic, promotion, or expansion task. Moreover, Gao (2011) and Qian (2012) also pointed out that the application of e-book bag to teaching had mobilized the enthusiasm of students, promoted the individualized learning, broke through the limitations of time and space, extended in-class learning to after-school, helped to develop self learning plans, completed self-learning contents, and expanded knowledge. In the process of self-selection, students' individualized learning was realized, which avoided the situation that students' learning situation was seriously differentiated and the teaching methods could not meet their learning needs.

## **Support Teaching Interaction and Cooperation**

Interaction and cooperation are the characteristics of the e-book bag environment. It provides a platform for students to communicate, enhances interpersonal dialogue and interaction, and promotes knowledge for exchange and sharing. Liu (2013) pointed out that various resources and tools could satisfy the multi-dimensional interaction between students and teachers, between students and learning contents, and help to complete cooperative learning in the process of interaction. The media-containing characteristic, openness, and relevance of resources make them be three-dimensional, which not only presents learning contents, but also supports interactive activities such as student annotation and experiment. In our study, we observed that both students and teachers created "brainstorm" through interaction with available resources, and completed "collision of ideas" with the classroom interaction (voting, sharing pictures, etc.). After class, when students encountered problems during the self-studying process, they sought help from teachers and classmates through online communication tools to solve problems. Using the e-book bag environment, teachers and students also carried out inquiry activities in a planned and targeted manner to jointly solve the real problems. The teacher-guided students' subjective learning atmosphere was strong, and the participation of teachers and students in the classroom and the interaction between them outline the basic situation that shows a two-way classroom and "dual subjects".

## **Support and Promote Knowledge Construction**

Knowledge construction is the interactive result of cognitive experience and environment. The rich resources of e-book bag create real-life task situations and activate students' cognition. With the help of synchronous experiments, media-enriched electronic textbooks and other interactive resources, the abstract concept can be embodied to form a chain of knowledge convergence and adaptation. In the learning process, students use the public editing tools to mark and record resources any time, make notes, and refine key knowledge points. After learning, students use the cognitive tools such as mind maps to sort out what they learned, summarize the learning results, and share them with teachers and other students through the online communication tool or classroom interaction function, by which they test their own views that differ from peers, and then make correction, absorb the essence of others, and promote knowledge sharing.

A difference exists between e-book bag-supported intelligent teaching and traditional teaching. This difference is majorly from the teaching methods. As Donovan (2007) indicated that intelligent teaching was more vital between teachers and students, and between students, and enabled knowledge to be transferred and communicated better. In comparison, traditional teaching oftentimes uses a boring and indulgent "instillation learning" method, from which teachers unilaterally output knowledge, and then students are lack of vitality. E-book bag focuses on the use of digital and internet resources. The pictures and videos of the e-book bag are more likely to attract students' attention, which contributes to students' learning, and to teacher's instructing, and receives instantaneous feedback from the students.

According to the Constructivism Learning Theory (Chen, 2019), the application of e-book bag in the teaching practice at elementary and middle schools had greatly enhanced students' participation in learning, and the construction of knowledge constitutes a process of participation of teachers and students. The construction of knowledge requires participation of both teachers and students, so students are no longer passive recipients, but independent active learners. E-book bag provides powerful support for the transformation of the knowledge view and the teaching relationship, and is conducive to transferring teaching mode from teacher-centered to student-centered. When the students' willingness to explore is mobilized, learning itself may become an incentive factor, making students' learning more based on intrinsic motivation rather than external pressure. From the Self-Determination Theory (Jeno, et al., 2019), internal motivation often leads to better output performance, so this is one of the reasons why the use of e-book bag can promote student learning.

## **Research Deficiency and Research Enlightenment**

Our study was based on the 20 teaching practice videos of e-book bag use in Changchun, China. Through video analysis, we recorded and analyzed the actual application of e-book bag in real teaching process, and drew above-mentioned conclusions regard-

ing e-book bag's beneficial effect on students' learning. However, the limitations need to be acknowledged.

Although we selected 20 videos as the sample size, and they were from 20 elementary and middle schools in Changchun, China, the geographical coverage of the samples was a limitation. Therefore, the results may not represent the overall situation of the e-book bag application in domestic classroom teaching.

For each selected video, it only had 45 minutes of recording, which just was a fragment of one regular class teaching. In addition, given teacher's supervision and guidance in the class, the use of e-book bag would be more proactive. As the function of e-book bag has been doubted and questioned (Hu & Zhang, 2012; Liu, 2013; Zhu & Yu, 2011), they pointed out the negative impact of e-book bag on students' learning, including health, internet addiction, and cost. Although these negative effects are subtle and unconscious, and need to be observed for a longer period of time. Therefore, just in a 45-min long teaching video, we were unable to conduct research and discuss the drawbacks of e-book bag far deeper.

In sum, the application research of e-book bag based on classroom recordings fully utilized the advantages of e-book bag, built up a supportive environment for intelligent teaching, and integrated information technology with all aspects of education and teaching, as thus had education information tool become an essential way for teachers' instructing, students' learning, and teaching management. E-book bag helps to support teachers' intelligence being materialized and distributed, exercises their instructing level, and improves their teaching quality. For students, e-book bag helps them to carry out independent and individualized collaboration to get extensive learning, and enhances their innovative ability in acquiring knowledge and training skills, so that they can learn in an easy, happy, and active way with high quality and efficiency. Therefore, e-book bag has a far-reaching and long-lasting effect on students' autonomy, innovation, and quality learning, and can be promoted nationwide experimentally. However, it needs to be kept in mind that e-book bag, as an electronic product, will inevitably produce some negative impact on students. So in order to reduce the potential negative impact, teachers and schools are responsible for actively guiding students to use e-book bag in a right way at right time. In the future, studies on the function of e-book bag should focus more on its potential drawbacks, and use larger sample size to obtain a more complete and representative understanding. ■

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