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# ДИДАКТИЧЕСКИЕ АСПЕКТЫ ИНФОРМАТИЗАЦИИ ОБРАЗОВАНИЯ

# DIDUCTIC ASPECTS OF EDUCATION INFORMATIZATION

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## Research on the differences of students' learning styles and knowledge integration in SPOC learning: a case study of course "Basic Portuguese"

**Jing Hu[1], Silva Maria do Carmo Vieira[2]✉**

[1]*Nankai University,*
*94 Weijin Rd, Nankai District, Tianjin, 300071, People's Republic of China*
[2]*NOVA University Lisbon,*
*26C Avenida de Berna, Lisbon, 1069-061, Portuguese Republic*
✉ carmo.vs@fcsh.unl.pt

**Abstract.** *Problem and goal.* With the advent of the information age, Internet-based online learning has also become one of the learning methods chosen by many learners. They can use these online learning platforms to complete knowledge construction while learning offline. *Methodology.* Most studies of learning behaviors focus on the discovery of the best learning model and disregard the possible impact of different learning behaviors on knowledge construction. Therefore, based on the Felder – Silverman learning style model, this article uses the Solomon learning style scale to improve the design of the questionnaire and collect four-dimensional differential learning behaviors data. In order to further understand the influence of learning styles on the effectiveness of online learning, we also use online learning data on the Small Private Online Course platform and general cognitive intelligence knowledge integration theory to clarify the relation between learning modes and individuals' differences. *Results.* This study observes and analyzes the learning behavior data of 46 students of Nankai University in the SPOC learning platform, also analyzes the differences in learning styles and knowledge construction of students in the SPOC environment. Compared with the traditional "Basic Portuguese" teaching method, the blended teaching model based on the Chaoxing Learning platform has unparalleled advantages. Interactions inside and outside the classroom, improving student participation and promoting teaching diagnosis. *Conclusion.* Through a comprehensive analysis of questionnaire data and online data, we found that some learning styles have different effects on the effectiveness of online learning, ignoring the individual differences of learners will still cause problems in knowledge construction.

**Keywords:** SPOC, learning style, knowledge integration, differentiation

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# Исследование различий стилей обучения студентов и интеграции знаний в процессе обучения в среде SPOC на примере курса «Основы португальского языка»

**Ц. Ху[1], С.М. до Кармо Виейра[2]✉**

[1]*Нанькайский университет,*
*Китайская Народная Республика, 300071, Тяньцзинь, Нанькай, Weijin Rd, д. 94*
[2]*Новый университет Лиссабона,*
*Португальская Республика, 1069-061, Лиссабон, Avenida de Berna, д. 26C*
✉ carmo.vs@fcsh.unl.pt

**Аннотация.** *Проблема и цель.* С наступлением информационной эры многие учащиеся все чаще обращаются к онлайн-обучению и используют специализированные платформы для завершения построения знаний, занимаясь в автономном режиме. *Методология.* Большинство исследований обучающего поведения фокусируются на поиске наилучшей модели обучения и игнорируют возможное влияние различных форм обучения на построение знаний. Поэтому, основываясь на модели стилей обучения Фелдера – Сильвермана, в данной работе для улучшения опросника и сбора данных о поведении учащихся при четырехмерном дифференциальном обучении применялась шкала стилей обучения Соломона. Для лучшего понимания влияния стилей обучения на эффективность онлайн-обучения использовались данные об обучении на платформе небольших частных онлайн-курсов и общая теория интеграции знаний когнитивного интеллекта для выяснения связи между режимами обучения и индивидуальными различиями. *Результаты.* Проанализированы данные об учебном поведении 46 студентов Нанькайского университета, занимающихся на платформе SPOC, выявлены различия в стилях обучения и построении знаний студентов в среде SPOC. По сравнению с традиционным методом обучения на курсе «Основы португальского языка» смешанная модель обучения с использованием платформы Chaoxing имеет беспрецедентные преимущества. Взаимодействие внутри и вне класса положительно сказывается на вовлеченности студентов и содействует педагогической диагностике. *Заключение.* Установлено, что некоторые стили обучения по-разному влияют на эффективность онлайн-обучения, а игнорирование индивидуальных различий учащихся негативно отражается на построении знаний.

**Ключевые слова:** SPOC, стиль обучения, интеграция знаний, дифференциация

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**Problem statement.** In recent years, the rapid development of "Internet+" and educational informatization has brought many opportunities for the reform of education and teaching models. One of the most significant changes is that learners use the Internet for online learning, which breaks through the restrictions of traditional classroom teaching and learners can learn at anytime, anywhere and at will. Based on the advantages of online learning, many online tutoring systems have been widely used, such as Microlecture, Massive Open Online Courses (MOOC), Blackboard, Moodle, etc. Compared with traditional classrooms, these platforms are more open and autonomous.

However, unlike Moodle and Blackboard, the MOOC platform has almost abandoned all adaptability, hoping to meet individual differences in a minimalist way. To solve these issues, Fox (2013) proposed the concept of Small Private Online Course (SPOC) used only in school teaching [1]. The SPOC model advocates blended online and offline courses, combining teacher-student interaction in traditional classrooms and ubiquitous learning methods in the virtual space, which can effectively make up for the shortcomings of online teaching, break the limitations of time and space in learning.

The extension of learning provides an operable mode for the deep integration of modern information technology and classroom teaching [2]. Most researchers believe that SPOC, as an assisted learning platform, can improve learning results. Teachers can analyze learners' mastery from small-scale learning groups and provide effective guidance to learners in order to achieve personalized teaching goals. A recent study by Zhang et al. (2015) showed that compared with traditional classrooms, students learn more efficiently and have a more stable learning status in the SPOC platform of blended teaching [3].

SPOC blended teaching has gained increasing attention in the field of foreign language teaching. Wang et al. (2016) used SPOC for college English teaching and constructed the SPOC flipped classroom, which provides effective resources and space-time environment for learners [4]. Zhang and Tao (2017) applied SPOC to the teaching of translation courses for English majors. They discussed teaching resources, teaching environment, autonomous learning and teaching innovation.

They found that SPOC could play an important role in teaching translation courses [5]. Jiang (2018) used SPOC in flipped classroom teaching mode in college English teaching practice, combined with a case study of a collage in Chongqing, conducted an in-depth study on the operating mechanism of large-scale teaching of college English flipped classroom based on SOPC and analyzed critically the advantages and disadvantages of this teaching mode [6]. Liu et al. (2019) carried out empirical research on the differences in knowledge integration of learners in SPOC learning and revealed the impact of SPOC learning on learners' knowledge construction. The study found that "SPOC platforms do not have universal applicability if they only provide audiovisual media resources that meet the minimum needs of learners" [7. P. 36].

However, the researches about SPOC are mainly focused on college English teaching and few studies have applied it to the teaching of non-common languages. We use "foreign language" as a classification term to search on two plat-

forms – Chinese University MOOC and Xuetang Online[1] and found that until January 30, 2019, China University MOOC has a total of 115 foreign language online courses; in addition to English, Japanese accounts for 5 and Spanish for 4, 3 courses in German, 2 courses in French, 1 course in Russian and no Portuguese course. Xuetang Online shows a total of 85 courses, of which 5 are Japanese, 2 are Spanish, 1 is French and only 1 is Portuguese. It can be seen that the online open courses for foreign language majors are basically English courses and the resources for Portuguese major are very scarce.

Therefore, we begun to explore the blended teaching of Portuguese based on Chaoxing Learning platform[2] from January of 2019. The course "Basic Portuguese" plays a pivotal role in Portuguese major and its teaching effect directly affects the achievement of the educational objectives.

*Flipped class of "Basic Portuguese" based on SPOC.* Applying the SPOC blended teaching model to the "Basic Portuguese" course requires two stages, namely the preparatory stage and the practical application stage. In the preliminary preparation stage, we completed four tasks: analyzing the educational objects, determining the teaching objectives, integrating teaching resources and building online courses. Our video resources of the curriculum were shot and produced in Chaoxing Company. In the actual application stage, we split the course into three stages according to SPOC teaching model: pre-class, during-class and after-class.

Before class, students need to log in to the Chaoxing Learning platform, complete the pre-class preview by analyzing the objectives, watching online resources (including lesson plan, PPT, teaching videos, etc.), thinking and discussing leading questions. We can intuitively understand the difficulties encountered by students in the preview through the data on the SPOC platform and the students' discussions, and then prepare targeted classroom teaching content.

During class, the basic steps are as follows: 1) we refer to the results of online self-study of our students, first explain the problems in the preview and introduce the course content; 2) broadcast audiovisual materials related to the theme of the self-study content in the classroom and issue inquiry tasks on the learning platform, students need to understand the content of materials and complete online inquiry tasks through "watching" and "listening"; 3) we can show students the completion of the inquiry tasks on the class through computer or mobile terminal and explain the important and difficult points of the lesson; 4) guide students to think and practice around the theme of the lesson, refer to audiovisual materials and randomly select students to complete the scene; 5) in the case of limited time, the remaining students will send the tasks that they have not shown in class to the Superstar Learning discussion platform. The use of Chaoxing Learning platform in classroom teaching allows teachers and students to get immediate feedback, which is of positive significance for the correction of teaching behaviors.

[1] Chinese University MOOC and Xuetang Online are the largest and most resourceful online platforms of China.

[2] Chaoxing Learning platform. Available from: http://i.mooc.chaoxing.com/space/index?t=1582365941726 (accessed: 02.02.2020).

After class, we can arrange group tasks for students based on the learning goals of the lesson, or design a scenario based on ability goals, or conduct group discussions on a topic. The teacher can use extracurricular time to evaluate students online and use the Superstar Learning's chat function to selectively provide personalized guidance, or explain general problems in the class group, which is conducive to all students to study together and also encourage students to participate in mutual evaluation.

In order to meet the basic needs of learners, most of SPOCs use audiovisual media as the main form of learning resources and its exercises are used as the main knowledge integration test specification. This has led to the knowledge integration model of recollection, consolidation, advancement and application of predecessor knowledge, driven by exercises in SPOC, which are achieved by using online learning platforms. According to a constructivist perspective, knowledge has led to learning behaviors during the construction process [8]. Therefore, in an online learning environment, learners who study according to their different motives, such as their hobbies and needs, will inevitably have different learning behaviors during the learning process. The learning behaviors recorded by the network can fully reflect the differences in knowledge integration of different learners.

Based on the general cognitive and intellectual integration theory proposed by Hannon and Daneman (2014), a mathematical model of learners' knowledge construction mode is established [9]. Knowledge construction in general cognitive and intellectual integration theory consists of four abilities:

1) to awaken predecessor knowledge – whether the learner can awaken the necessary predecessor knowledge from memory;

2) to make inferences based on the information provided by the text – whether the learner could infer the relevant predecessor knowledge needed in the face of current information (such as tests);

3) to access the predecessor knowledge – whether the learner can accurately find the predecessor knowledge to solve the current problem;

4) to integrate the predecessor knowledge and information – whether learners can solve current problems by integrating predecessor knowledge.

The differences in the above four abilities can be reflected to a mathematical model established by the amount, frequency and duration of the accessed predecessor knowledge [10]. According to Zhao et al., by monitoring the relevant learning behavior data generated during the learning process and using the bias of learner's learning style as a clustering index, it can be seen the differences in the knowledge integration mode of the learners and the differences in the implementation effect of the SPOC platform on different types of learners.

*The study of learning styles.* The online learning system is called the Adaptive Educational Hypermedia (AEH) system or the Adaptive Learning Hypermedia (ALH) system. In these systems, in order to provide learners with more accurate and effective personalized services, Learning Style (LS) is integrated into user models by many ALH systems in an attempt to provide learners with a differentiated learning process that suits individual needs.

American scholar, Herbert Thelen proposed the theory of LS in 1954, but there is still no unified definition. Although scholars' definitions of LS are not

uniform, the basic cognition is consistent: LS is unique, stable and personalized. Researchers have proposed various models based on different learning style definitions [11]. The most representative ones are Kolb Learning Style Model (1984), Honey and Mumford Learning Style Model (1986), Dunn Learning Style Model (1982), Felder – Silverman Learning Style Model (FSLM) (1988) and others.

Although LS has received a lot of attention, it still has many unresolved issues, such as controversy over its effectiveness, reliability and practicality [12]. Professor Coffield of Institute of Education (IOE) of University of London published a report in 2004 questioning the effectiveness of learning styles in basic education, especially classroom teaching [13]. The report surveyed 71 learning style models and pointed out that the use of learning style theory in teaching activities must be done with caution, as many measurement instruments have serious loopholes after intensive and rigorous testing. A similar challenge argues that the use of LS in ALH systems is equally risky [14]. For example, Brown (2009) states that using learning styles as models doesn't guarantee that learners will learn from them or benefit from the way they like. Conversely, learners can benefit if they develop skills that they don't like to overcome the potential weaknesses of their learning styles [15].

Despite many controversies, learning styles have a significant effect on improving learners' learning experiences. Akbulut pointed out in his research on the user model of learning styles [14], although the integration of learners' learning styles in the ALH system is still controversial in terms of whether it can promote learning effects, compliance with learners' learning style tendencies can indeed improve learners' learning experiences. In addition, the positive impact of LS is also reflected in the cognitive experience that can enrich learner's various experiences related to satisfaction, positive attitude and positive emotions [16]. For example, Liegle et al. (2006) showed in their research that providing learners with navigational needs that meet their learning style preferences could significantly improve their total learning. The preference value of LS is not only reflected in the ALH system, but also evidence shows that in ordinary teaching activities, if teachers can reasonably use the LS principle when facing adult learners, it can make their learning process more comfortable and improve their learning ability [17].

Through a comparative analysis of existing learning style models and their applications, we believe that FSLM describes the LS in the most detailed way and that the uniqueness and completeness of the internal structural design is conducive to clustering the learning group, and thus achieving the construction of adaptive learning system at the level of group. FSLM is most widely used in the research field of adaptive network learning, which means that carrying out research based on FSLM can enhance the application and reference value of research conclusions. In view of this, this study selects FSLM as the basis for the division of learning groups.

In the FSLM, there are two different types of learners in four dimensions [18]:

1) there are active and reflective learners in the information-processing dimension. Active learners tend to gain knowledge by actively doing things, discussing or applying or explaining to others, and enjoy teamwork. Pensive learners often learn through in-depth thinking, preferring to study alone or together with a fixed learning partner;

2) there are sensing and intuitive learners in the perception dimension. The former is used to learning facts, while the latter prefers theoretical knowledge. Sensing learners are patient with details, good at memorizing facts, but avoiding complex things. Intuitive learners are better at mastering new concepts and prefer complex things. Compared to sensing learners, they have a better understanding of abstract concepts, but they are more careless;

3) the information input dimension is divided into visual and verbal learners. Visual learners are good at remembering what they see, such as videos, pictures and so on. Verbal learners are good at remembering what they hear or read;

4) the content understanding dimension is divided into sequential and global learners. Sequential learners prefer to study step by step and understand the content in a certain logical order. Global learners prefer to think comprehensively and their thinking is more divergent and jumping. When performing a test, sequential learners tend to answer questions from the back to the front; in contrast, global learners first browse through the questions and then select questions to answer.

Alshammari et al. (2015) [18] mentioned in their research on adaptive online learning that traditional online learning systems are designed for general learners without considering individual needs. The adaptive online learning system squares up factors such as learning style and knowledge level to provide more personalized teaching. Its user model is built on Felder – Silverman learning style bias. Based on this, a general adaptive framework is proposed. An experiment with 60 participants on the online learning platform produced positive results. The experimental results show that if the teaching materials and learning information perception match the learners' learning style, it will have a positive effect on the learning results and learners' satisfaction. The research results show that the media presentation form of the online learning platform will have a significant impact on the learning model of the learners.

In summary, FSLM can be used as an effective index to study individualized differences in online learning mode. The learning style bias of learners in different dimensions can be used as the basis for learners' clustering. Learners' groups divided according to learning styles have significant individual differences in the sensitivity of different forms of learning resources and learning behaviors [19]. This article follows the method of dividing learners' groups by using learning styles as an index to study the role of resources in SPOC to assist different learners in building and integrating knowledge.

**Method of research.** This article uses the SPOC of "Basic Portuguese" as an example to explain the possible impact of different learning styles and learning behaviors on knowledge construction. Based on this purpose, the following three questions are raised:

1) the relationship between learning modes and individual differences;

2) using learning style bias as an index, whether there are differences in the types of cognitive behaviors of different types of learners;

3) whether the non-differential learning services provided by the SPOC curriculum is able to assist learners in knowledge integration and whether the simultaneous online and offline indiscriminate services will bring different knowledge construction effects to learners with individual differences.

*Subjects and data sources.* The subjects in our research are 46 students in Collage of Foreign Languages of Nankai University (average age – 18.5, 41 girls, 5 boys). They are students of the same starting point and have no basic knowledge of Portuguese.

The data sources come from the results of the questionnaire and backstage data of the course. The questionnaire was distributed on January of 2020, a total of 46 questionnaires were issued and 46 were retrieved, the activity coefficient was 100%.

The backstage data was collected from September of 2019 to January of 2020. The data obtained from the platform includes: username, nickname, amount of videos, amount of documents, amount of video views, frequency of video views, time of video views, daily learning numbers, posts, responses, comments, unit assignments and test scores. The data analyzed after collection mainly includes SPOC scores (S), the amount of video views (Vm), the frequency of video views (Vf) and the time of video views (Vt).

*Data analysis instruments.* There are two approaches to learning style measurement. The first is to analyze learners' learning styles explicitly through correlation scales. Each learning style model has a matching learning style scale; among them, the Solomon Learning Style Scale is more representative. Felder and Solomon proposed the Solomon Learning Style Scale in 1977, using FSLM to infer the learning style of learners explicitly [8]. The second is an implicit method, by analyzing online learning behavior data and using relevant algorithms to analyze learners' learning styles. Compared to the explicit method, the implicit method doesn't require the learner to spend a lot of time answering the questionnaire and it can reflect the LS of learners objectively and truly. However, it has the disadvantage of "cold start", which means the learning style cannot be obtained due to lack of data at the beginning.

In our research, we first apply the Solomon Learning Style Scale to explicitly calculate students' learning styles, then use implicit methods to collect students' various learning behavior data online and use related algorithm analysis to obtain their online learning styles. We adopt Epidata to establish the database and SPSS19.0 for data analysis.

**Results and discussion.** The learning method of the "Basic Portuguese" course is "online learning + offline learning". About offline learning style, Table 1 shows the responses of 46 students to Solomon Learning Style Scale (44 questions). According to the statistical results, it can be found that on some questions, the respondents have basically the same choices (bold, the percentage of options is 0–10% or 90–100%), which indicates that these questions haven't played their due role in distinguishing learning styles. At the same time, on other questions, the respondents' choices are very different (underlined, the percentage of options is 40–60%), indicating that learning styles are well distinguished.

In view of the above analysis, the impact of each question can be given a corresponding weight in the statistical process. For example, for questions with a small impact (questions 3 and 12), we can reduce their weight to 0.5; for questions with a larger impact (questions 8, 14, 16, 20, 24, 30, 32, 33, 37, 40, 42, 44), increase their weight to 1.5. Table 2 shows the results of the scale analysis of a certain stu-

dent after revision. It can be seen that the revised learning style of the student changed from 5a, 1a, 7a, and 3b to 6a, 1.5a, 6.5a, and 5b. In the case where the learning style discrimination threshold is unchanged, the student's analysis results become active, sensing, visual and global.

*Table 1*

**Summary of the answers to questionnaire for 46 students**

| No. of question | No. of student | | Percentage | | No. of question | No. of student | | Percentage | | No. of question | No. of student | | Percentage | | No. of question | No. of student | | Percentage | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | a | b | | a | b | a | b | | a | b | a | b | | a | b | a | b |
| 1 | 33 | 13 | 73 | 27 | 12 | 45 | 1 | **97** | **3** | 23 | 33 | 13 | 73 | 27 | 34 | 8 | 38 | 17 | 83 |
| 2 | 32 | 14 | 70 | 30 | 13 | 35 | 11 | 77 | 23 | 24 | 23 | 23 | 50 | 50 | 35 | 34 | 12 | 73 | 27 |
| 3 | 41 | 5 | **90** | **10** | 14 | 23 | 23 | 50 | 50 | 25 | 31 | 15 | 67 | 33 | 36 | 29 | 17 | 63 | 37 |
| 4 | 15 | 31 | 33 | 67 | 15 | 31 | 15 | 67 | 33 | 26 | 15 | 31 | 33 | 67 | 37 | 23 | 24 | 50 | 50 |
| 5 | 11 | 35 | 23 | 67 | 16 | 28 | 18 | 60 | 40 | 27 | 31 | 15 | 67 | 33 | 38 | 31 | 15 | 67 | 33 |
| 6 | 34 | 12 | 73 | 27 | 17 | 17 | 29 | 37 | 63 | 28 | 14 | 31 | 30 | 70 | 39 | 34 | 12 | 73 | 27 |
| 7 | 34 | 12 | 73 | 27 | 18 | 31 | 15 | 67 | 33 | 29 | 31 | 14 | 70 | 30 | 40 | 28 | 18 | 60 | 40 |
| 8 | 22 | 24 | 47 | 53 | 19 | 14 | 32 | 30 | 70 | 30 | 28 | 18 | 60 | 40 | 41 | 9 | 37 | 20 | 80 |
| 9 | 15 | 31 | 33 | 67 | 20 | 18 | 28 | 40 | 60 | 31 | 31 | 15 | 67 | 33 | 42 | 23 | 23 | 50 | 50 |
| 10 | 38 | 8 | 83 | 17 | 21 | 17 | 29 | 37 | 63 | 32 | 22 | 24 | 47 | 53 | 43 | 31 | 15 | 67 | 33 |
| 11 | 37 | 9 | 80 | 20 | 22 | 14 | 32 | 30 | 70 | 33 | 26 | 20 | 57 | 43 | 44 | 24 | 22 | 53 | 47 |

*Table 2*

**Results of revised Felder – Silverman questionnaire**

| Username | Revised Felder – Silverman Scale | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Active | Reflective | | Sensing | Intuitive | | Visual | Verbal | | Sequential | Global |
| | No. of question | a | b | No. of question | a | b | No. of question | a | b | No. of question | a | b |
| | 1 | 1 | 0 | 2 | 1 | 0 | 3 | 1(0.5) | 0 | 4 | 1 | 0 |
| | 5 | 1 | 0 | 6 | 1 | 0 | 7 | 1 | 0 | 8 | 0 | 1(1.5) |
| | 9 | 0 | 1 | 10 | 1 | 0 | 11 | 1 | 0 | 12 | 1(1.5) | 0 |
| | 13 | 1 | 0 | 14 | 1(1.5) | 0 | 15 | 0 | 1 | 16 | 1(0.5) | 0 |
| | 17 | 0 | 1 | 18 | 0 | 1 | 19 | 1 | 0 | 20 | 0 | 1(1.5) |
| | 21 | 1 | 0 | 22 | 0 | 1 | 23 | 1 | 0 | 24 | 0 | 1(1.5) |
| | 25 | 1 | 0 | 26 | 0 | 1 | 27 | 1 | 0 | 28 | 0 | 1 |
| | 29 | 1 | 0 | 30 | 1(1.5) | 0 | 31 | 1 | 0 | 32 | 0 | 1(1.5) |
| | 33 | 1(1.5) | 0 | 34 | 0 | 1 | 35 | 1 | 0 | 36 | 0 | 1 |
| | 37 | 1(1.5) | 0 | 38 | 1 | 0 | 39 | 0 | 1 | 40 | 1 | 0 |
| | 41 | 0 | 1 | 42 | 0 | 1 | 43 | 1 | 0 | 44 | 0 | 1(1.5) |
| | Total | 8(9) | 3 | Total | 6(7) | 5 | Total | 9(8.5) | 2 | Total | 4(4.5) | 7(9.5) |
| | (larger number – smaller number) + letter of the larger number | | | | | | | | | | | |
| | | 5a(6a) | | | 1a(1.5a) | | | 7a(6.5a) | | | 3b(5b) | |

After completion of offline learning, we guide students to use the SPOC platform for online learning. Homework, exercises and other tasks should be completed on SPOC, as shown in Figure 1. However, the submission of SPOC exercises is performed in a flexible manner, as long as the students submit to the platform within the corresponding deadline, we will give the corresponding results after reviewing. Therefore, there are no fixed requirements for the quantity and quality of these exercises. It is determined and completed by students according to their needs. It is one of the ways to consolidate and transfer knowledge.


**Figure 1.** Submissions of exercises and homework on SPOC

The media teaching resources on this SPOC inherit the main characteristic of teaching resources used in face-to-face teaching, which is taking audiovisual media as the main manifestation of precursor knowledge, as we can see in Figure 2. Learners' exercises in SPOC usually lag behind classroom teaching content, so when they complete, they will go through a process of review, access, use and ultimately problem solving of precursor knowledge. The more the exercises in SPOC cover the needs of the precursor knowledge, the greater the integration requirements are.

The online data collection is distributed at two time points in the entire learning process (one semester), which are mid-term and end-term. Each time of the collection mainly includes the SPOC score (S) of each learner, the amount of predecessor video views (Vm), the frequency of predecessor video views (Vf) and the time of predecessor video views (Vt). The reason why these 4 sets of data are collected is because from them we can see that learners with different learning

modes and learning styles bring forward biases of review, access and use of predecessor knowledge in the SPOC learning environment and cause differences in knowledge construction.

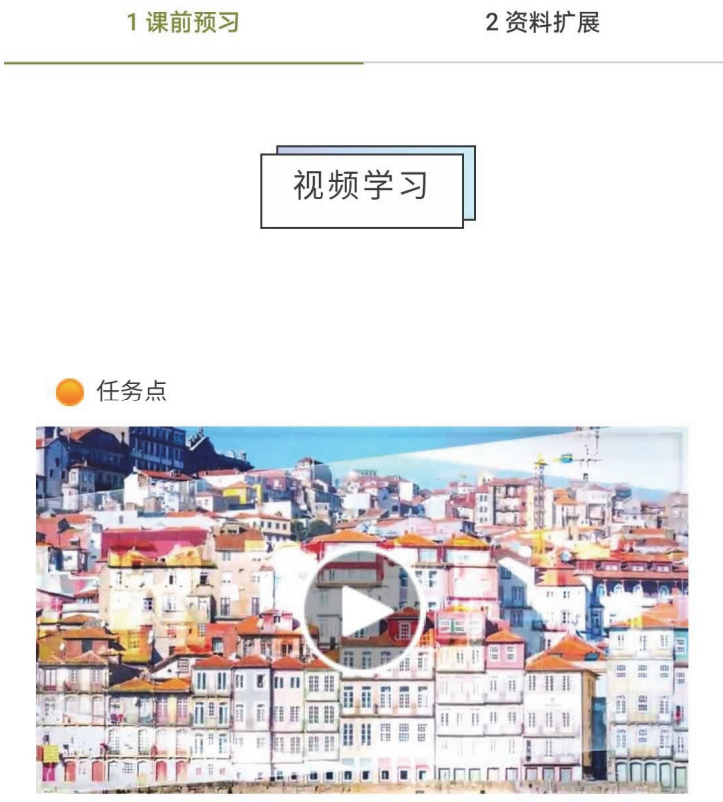


**Figure 2.** Video learning resources

We subdivided 40 subjects who were sensitive to audiovisual media from 46 students, divided them according to the Felder – Silverman learning style dimension, which was used as an index to calculate the average of the data in every moment and every dimension, and performed student's t test on each data in the dimension. Table 3 and Table 4 record the statistical analysis results of the data collected at two key moments on the learning timeline. ACT stands for active learners, REF stands for reflective learners, SEN stands for sensing learners, INT stands for intuitive learners, SEQ stands for sequential learners and GLO stands for global learners.

Judging from the completion of the two-stage exercises on SPOC and the data of reviews of predecessor knowledge, the significant difference appears in the sensing/intuitive learning styles. Sensing learners have significantly fewer amount of exercises completed in SPOC than intuitive learners, their amount, frequency and average duration of videos views are also less than intuitive learners. However, from the data at end-term, this significant difference has become a subsignificant difference (<0.1) in terms of submission of SPOC exercises by deadline. It shows that sensing learners are inferior with respect to preferences and results in completing reviews of predecessor knowledge and solving current prob-

lems through the SPOC system. Combined with the final exam scores and there is no significant difference in the final exam scores of sensing/intuitive learners, it can be seen that the sensing learners supplemented offline (with paper, books and other traditional media) the missing predecessor knowledge from the online learning process.

*Table 3*

**Statistical analysis results of the data collected at mid-term**

| Dimension of LS / Parameter | | Felder – Silverman learning style dimension | | | | | |
|---|---|---|---|---|---|---|---|
| | | ACT/REF | | SEN/INT | | SEQ/GLO | |
| | | ACT | REF | SEN | INT | SEQ | GLO |
| S 得分 | M | 69.6 | 68.84 | 61.38 | 70.08 | 64.46 | 70.11 |
| | P | 0.8326 | | 0.0538 | | 0.1175 | |
| Vm 总数 | M | 45.03 | 47.64 | 34.33 | 48.94 | 43.43 | 46.37 |
| | P | 0.6360 | | 0.0372* | | 0.6164 | |
| Vf 频率 | M | 1.60 | 1.72 | 1.63 | 1.67 | 1.62 | 1.77 |
| | P | 0.4757 | | 0.9043 | | 0.5055 | |
| Vt 时长 | M | 267528.6 | 281809.3 | 255812.5 | 305523.3 | 281166.1 | 284952.7 |
| | P | 0.6813 | | 0.2770 | | 0.9211 | |

*Table 4*

**Statistical analysis results of the data collected at end-term**

| Dimension of LS / Parameter | | Felder – Silverman learning style dimension | | | | | |
|---|---|---|---|---|---|---|---|
| | | ACT/REF | | SEN/INT | | SEQ/GLO | |
| | | ACT | REF | SEN | INT | SEQ | GLO |
| S | M | 85.30 | 85.38 | 80.11 | 85.32 | 81.32 | 85.82 |
| | P | 0.9729 | | 0.0809 | | 0.0653 | |
| Vm | M | 82.74 | 81.55 | 61.09 | 85.83 | 76.93 | 86.11 |
| | P | 0.8965 | | 0.0376* | | 0.3845 | |
| Vf | M | 1.92 | 1.88 | 1.59 | 1.89 | 1.72 | 1.97 |
| | P | 0.7778 | | 0.2110 | | 0.1203 | |
| Vt | M | 372287.36 | 370733.39 | 295937.54 | 393099.31 | 36277.98 | 267162.04 |
| | P | 0.9645 | | 0.0299* | | 0.9093 | |

The common feature of sensing learners and intuitive learners in the knowledge construction mode is the parameter Vt, which has no influence on their behavior mode and can be ignored. Sensing learners' integration of predecessor knowledge under practice in SPOC depends on their own predecessor knowledge accumulation and the number of predecessor video views. In terms of intuitive learners, their integration depends on the amount of predecessor video views and the frequency of each predecessor video views.

According to the different abilities of predecessor knowledge integration in general intelligence, learners' use of predecessor knowledge can be divided into three goals: review, consolidation and transfer. The assist provided by SPOC platform for sensing learners is limited to the surface review stage. For example, if both sensing and intuitive learners' access ten predecessor knowledge videos at the same time, each video is accessed once, sensing learners can obtain more efficient knowledge-building effects under the predecessor knowledge review mode.

However, with the increase in the frequency of video access, when learners cannot achieve the goal of consolidating and transferring knowledge from the review mode, they will switch to the continuous learning mode and achieve higher-level knowledge integration goals by increasing the frequency of access to predecessor knowledge. At this time, the knowledge-building effect of sensing learners will not change and the language-building effect of intuitive learners will increase linearly. This shows that the assist provided by SOPC for sensing learners can only be limited to the initial stage of general intellectual knowledge construction, it cannot serve them in a higher-level knowledge construction.

**Conclusion.** This study observes and analyzes the learning behavior data of 46 students of Nankai University in the SPOC learning platform, also analyzes the differences in learning styles and knowledge construction of students in the SPOC environment. We believe that compared with the traditional "Basic Portuguese" teaching method, the blended teaching model based on the Chaoxing Learning platform has unparalleled advantages. Interactions inside and outside the classroom, improving student participation and promoting teaching diagnosis and improvement all have positive effects. In the "Internet+" era, the use of information technology has provided a guarantee for mixed teaching. For example, the data analysis of the SPOC curriculum before class provides a sufficient basis for the teaching activities in class; the application of mobile devices to implement the process assessment records, interactive discussion and other functions can effectively improve teaching efficiency.

On the other hand, the results of this study prove that even if teachers guide and participate actively in SPOC online interactions in the classroom, ignoring the individual differences of learners will still cause problems in knowledge construction. The audiovisual media that is commonly used in classroom teaching is not a panacea as main form of learning resources in online learning systems, learners who are sensitive to the expression of learning resources don't show significant differences in knowledge construction without subdivision. However, with the further subdivision of these learners' groups, sensing learners are significantly different from the intuitive learners in the modes, efficiency and effects of review, access and use of predecessor knowledge. If the teacher is unable to guide and intervene well, the learning effect, especially the knowledge construction may become unstable.

Therefore, we recommend for SPOC of foreign languages that:

1) add text-based teaching resources to the course. For learners who are unable to complete effective online integration based on the predecessor knowledge expressed in video media, providing text-based teaching resources is a necessary means to improve the efficiency of SPOC;

2) add optional SPOC tasks that require higher predecessor knowledge integration skills on the timeline. If the learning time has passed the midline and there are still significant delays in SPOC scores for the learners, they are required to try to complete these tasks;

3) provide more abundant learning resources based on students' different learning styles to meet individual learning requirements. While reviewing various teaching resources, some resources should be modified or supplemented, and fi-

nally integrated into a set of multi-module and three-dimensional online resources that is more practical and close to the curriculum ability goals.

For conclusion, learning style and online behavior analysis are hot research topics, it requires more researchers to explore for a long time to solve the problems in teaching, so as to promote the improvement of teaching quality and the development of educational informatization.

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**Bio notes:**
*Jing Hu*, PhD in Educational Sciences, lecturer, Head of the Department of Portuguese of Nankai University, researcher of the Interdisciplinary Center for Social Sciences (CICS.NOVA). E-mail: hujingzinha@hotmail.com

*Silva Maria do Carmo Vieira*, retired assistant professor of the Faculty of Social and Human Sciences of the Nova University of Lisbon, researcher of the Interdisciplinary Center for Social Sciences (CICS.NOVA). E-mail: carmo.vs@fcsh.unl.pt

**Сведения об авторах:**
*Ху Цзин*, кандидат педагогических наук, преподаватель, заведующий кафедрой португальского языка Нанькайского университета, научный сотрудник Междисциплинарного центра социальных наук (CICS.NOVA). E-mail: hujingzinha@hotmail.com

*Карму Виейра Сильва Мария ду*, отставной доцент факультета социальных и гуманитарных наук Нового университета Лиссабона, научный сотрудник Междисциплинарного центра социальных наук (CICS.NOVA). E-mail: carmo.vs@fcsh.unl.pt