An Empirical Study on Hypothesis Testing in Integrative Education for Visually Impaired Students

Zhang Juxiao, Chen Kunyu

School of Mathematics and Information Science, Nanjing Normal University of Special Education, Nanjing, 210038, Jiangsu, China

Keywords: Micro class; Flip Classroom; Higher Education; Integrative Education; Hypothesis Testing

Abstract: As more and more disabled people enter higher education in China, we need to explore new ways of integrated education. Firstly, this paper analyses the dilemma of the integrated education of visual impairment. Secondly, it chooses the knowledge points of basic computer courses to establish micro-courses and implement them. Finally, through the hypothesis test method, the empirical relationship between the learning effect of visually impaired students and the flipped classroom teaching mode is made. Empirical research shows that the use of micro-curriculum classroom teaching methods can effectively improve the learning effect of visually impaired students, and enhance the robustness of visually impaired students to knowledge points.

1. Introduction

1.1 Research Status of Micro-Course

Since 2011, some domestic scholars have introduced micro-classes [1], micro-classes, flipped classes, Mu-classes and other papers as research content show blowout growth. Whether elementary and secondary education or higher education, whether vocational education or adult education, there are a lot of research papers on micro-class and flipped classroom [2]. This paper synthesizes the research viewpoints of domestic and foreign scholars (Noora Hamdan, 2013; Zhang Jinlei, 2013), mainly including theoretical research, research summary, resource construction, learning mechanism research and teaching practice research, etc. [3]. The origin, characteristics, advantages and reflection of micro-class and flip-flop classroom [4] [11]. Theoretical research on teaching patterns and design has cognitive load theory [5]. Gamification learning concept [3] and project-based learning [6]. The construction of learning resources [7] learning resource application model [8]. Micro-course attributes, characteristics, production principles, key production strategies, etc. [9]. Based on the "micro-course", the role of the teacher in the flip classroom [10]. There are many teaching practices that are combined with subject knowledge, such as the application of flipping classrooms in college English, modern educational technology courses, and computer courses [17][18].

Micro-study research not only requires more theoretical research and deeper thinking, but also needs to be validated through empirical research on flipping classrooms based on “micro-courses“. Not only innovative research such as teaching mode and reconstruction of teaching structure is needed, but also the improvement of students' interest and the guarantee of teaching quality. Not only do we need more applications of micro-class flip classes in different disciplines, but we also need systems to guarantee the construction of learning resources system and the transformation of teachers' and students' roles and the enhancement of their abilities [12] - [14].

1.2 Difficulties of Integrative Education in Higher Education

The integration education of visually impaired students in higher education has been in an unprecedented dilemma of "integration but incompatibility".

(1) The support service system is not perfect. The total number of visually impaired students is small, there are many professional categories, and the support system is difficult to construct. For

  DOI: 10.25236/etmhs.2019.084

example, the Braille version of the textbook is lacking and cannot be equipped in a short time. The learning materials provided to visually impaired students are extremely limited, making it difficult to learn.

(2) There is a big difference between the learning needs and learning goals of the same grade students. Visually impaired students and sound college students have significant differences in metacognitive strategies and cognitive abilities. Teachers cannot reduce teaching content or reduce teaching difficulty for visually impaired students, and teaching progress cannot be slowed down. It makes the visually impaired students only sitting in the corner of the classroom and learning by themselves. This is a mixed education and not a fusion education.

(3) The teacher lacks the concept and method of integrated education. Generally, teachers do not have the concept and method of integrating education. Teachers who understand integrated education can not complete the task of professional courses. It is difficult to provide necessary one-on-one counseling and guidance.

(4) Visually impaired students lack a strong learning partner. Visually impaired students have lower learning efficiency than ordinary students due to physiological defects. Integrative education brings about the decentralization of specialties for visually impaired students. Sometimes only one visually impaired student in a specialty can not improve the quality of learning and learning effect without learning peers when previewing, reviewing and internalizing knowledge after class.

(5) The teaching evaluation mechanism of visually impaired students is not perfect. It is unrealistic and unreasonable to completely copy the evaluation mechanism of ordinary students to evaluate the teaching of visually impaired students. Establishing an independent evaluation mechanism, because of the small overall base and only one person in some majors, is difficult to have a reasonable measurement standard, and can not play the role of inspection, supervision and incentive.

2. Application of Microcourse in Computer Basic Course of University with Visual Impairment

The development of information technology not only changes the education of ordinary students, but also changes the education mode of visually impaired students. For visually impaired students, information technology not only breaks through the limitations of region and time and space, but also brings them technical means such as text, text-to-speech conversion and speech recognition, which makes up for the disadvantage of visually impaired students in traditional integrated education [15]. In addition, the visually impaired students' hearing and memory, post-study learning time and intensity, make the visually impaired students more suiTable to use the "micro-course" to learn, can adapt to the "micro-class" flip classroom teaching methods.

In this paper, in order to solve the learning dilemma of the visually impaired students in the computer basic course, the teaching method of using the micro-course to flip the classroom is adopted, and the implementation is carried out in different classes of different professions to verify its effectiveness and limitations.

3. Experimental demonstration

3.1 Experimental process

The application of micro-classes in the teaching of integrated education for visually impaired students is characterized by: it is conducive to cultivating the ability of self-learning and self-exploring of visually impaired students, and promoting the improvement of innovative thinking and cooperative ability [16].

3.1.1 Experimental object

2016 level 5 low vision and 4 full blind; 2017 level 3 full blind 2 low vision; 2018 level 1 full blind 2 low vision. There is no correlation between visually impaired individuals, and the learning ability and level are normally distributed.

3.1.2 Establish two sets of test questions

The two sets of questions have the same level of difficulty but no identical questions. Each set of questions consists of 10 questions (10 points), 5 questions (10 points) and 1 question (20 points). Group roll step:

(1) The knowledge points of the micro-teaching teaching, a total of 30 multiple-choice questions and 15 fill-in-the-blank questions.

(2) Choose 40 students of different majors in the same grade, and the final score of the computer is between 80-85 points.

(3) Forty students completed the test and counted the scoring rate of each question.

(4) Two sets of test papers consisting of 10 multiple-choice questions and 5 filling-in questions with the same or similar score were selected.

(5) Each set adds 1 question operation, the operation steps are basically the same, the material is different.

3.1.3 Test results of visually impaired students

A multi-year multi-group block test was conducted in May, September and October of 2018, respectively, and five groups of visually impaired students were tested. The 2016 level of visually impaired students only tested the A volume, the 2017 and 2018 visually impaired students tested A/B two volumes. The A volume is tested after the traditional teaching method, and the B-volume micro-course teaching method is tested. The score data is shown in Table 1.

Table 1 Visually impaired group test score data

Grade	Level 2016									Level 2017					Level 2018		
Student number	1	2	3	4	5	6	7	8	9	1	2	3	4	5	1	2	3
A volume score	12	17	2	13	3	10	11	12	30	34	32	39	27	26	19	14	17
B volume score	--	--	--	--	--	--	--	--	--	29	30	27	22	17	36	31	29

In the course of the test, two students of Grade 2016 filled in the results randomly and handed in the paper (removing samples). After pretreatment, the mean and variance are calculated, as shown in Table 2.

Table 2 Preprocessing Three Rounds and Five Groups of Teaching Evaluation Data

Data analysis items	May 2018		September 2018	October 2018	
	Level 2016	Level 2017	Level 2018	Level 2017	Level 2018
Data serial number	First group	Second group	Third group	Fourth group	Fifth group
Examination questions adopted	A sets	A sets	A sets	A sets	B sets
Teaching method	Tradition	Micro lesson	Tradition	Micro lesson	Micro lesson
Sample size (n)	7	5	3	5	3
Sample mean $(\overline{X})$	15	30.2	16.667	21.4	32
Sample variance (S^2)	292/6	230.8/4	12.667/2	153.2/4	26/2

The F test and T test of hypothesis test were used to analyze the above data.

$F = \frac{S_1^2}{S_2^2}$ was chosen as the test statistic. When H_0 was established, $F \sim F(n_1 - 1, n_2 - 1)$. For a given saliency level α ($\alpha = 0.01$ in this paper), the critical values $F_{1-\alpha/2}(n_1 - 1, n_2 - 1)$ and $F_{\alpha/2}(n_1 - 1, n_2 - 1)$ are obtained by looking up the quantile Table of F distribution, and the

rejection domain is $W = \left\{\left\{F < \left(F_{\alpha/2}(n_1 - 1, n_2 - 1)\right)^{-1}\right\} \cup \left(F > F_{\alpha/2}(n_1 - 1, n_2 - 1)\right)\right\}$.

3.2 Effectiveness analysis of teaching methods:

3.2.1 Data analysis of the first and second groups

Characteristics: The same test questions, the same test time, different grades, different teaching methods.

To test the hypothesis:

$$H_0: \sigma_1^2 = \sigma_2^2; H_1: \sigma_1^2 \neq \sigma_2^2 \tag{1}$$

$F = \frac{S_1^2}{S_2^2}$ was selected as the test statistic. See Table 2, $n_1 = 7$, $n_2 = 5$, $S_1^2 = 292/6$, $S_2^2 = 230.8/4$

$$F = \frac{S_1^2}{S_2^2} = \frac{292/6}{230.8/4} = 0.843 \tag{2}$$

Looking up the quantile Table of F distribution, we can get that:

$$F_{\alpha/2}(n_1 - 1, n_2 - 1) = F_{0.005}(6,4) = 21.97 \tag{3}$$

$$F_{1-\alpha/2}(n_1 - 1, n_2 - 1) = \frac{1}{F_{\alpha/2}(n_1-1,n_2-1)} = \frac{1}{F_{0.005}(6,4)} = \frac{1}{21.97} = 0.0455 \tag{4}$$

If the rejection domain is $(0,0.0455) \cup (21.97, +\infty)$ and the statistic F is not in the rejection domain, H_0 should be accepted, that is to say, the variance of the two populations is the same under the horizontal $\alpha = 0.01$.

Based on the above calculation, it can be concluded that the variance between the two groups is equal, and whether the results need to be improved significantly, then the hypothesis test is carried out:

$$H_0: \mu_1 \leq \mu_2; H_1: \mu_1 \geq \mu_2 \tag{5}$$

Because the variance is equal and unknown at that time, the selected test statistics are as follows:

$$T = \frac{\bar{X} - \bar{Y}}{\sqrt{\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}} \cdot \sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \tag{6}$$

$\bar{x} = 15, \bar{y} = 30.2$ is known from Table 2.

$$t = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}} \cdot \sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = \frac{15-30.2}{\sqrt{\frac{292+230.8}{10}} \cdot \sqrt{\frac{1}{7}+\frac{1}{5}}} = -3.59 \tag{7}$$

Given $\alpha = 0.01$, $t_\alpha(n_1 + n_2 - 2) = t_{0.01}(10) = 2.76$ is obtained by looking up the distribution Table, so the rejection domain is $\{T > 2.78\}$, and the value of statistic T is $|T| = 3.59 > 2.76$, so H_0 is rejected. That is to say, the integration of micro-class teaching and flip-class teaching can significantly improve students' performance.

3.2.2 The second and third groups of data analysis

Characteristics: The same test questions, different test time, different grades, different teaching methods.

As shown in Table 2, $n_2 = 5$, $n_3 = 3$, $S_2^2 = 230.8/4$, $S_3^2 = 12.667/2$.

Calculations are available, $F = 9.11$. The rejection domain is $(0,0.005) \cup (199.2, +\infty)$, and the statistic F is not in the rejection domain. Therefore, H_0 should be accepted, that is to say, the variance of two populations is the same under horizontal $\alpha = 0.01$.

From Table 2, $\bar{x} = 30.2$, $\bar{y} = 16.667$. For a given $\alpha = 0.01$, the t distribution Table is $t_\alpha(n_2 +$

$n_3 - 2) = t_{0.01}(6) = 3.14$, so the rejection domain is $\{T > 3.14\}$, and the value of the statistic T is $|T| = 2.91 < 3.14$, so H_0 is accepted. That is, the third set of data is not significantly better than the second set of data.

3.2.3 Third and fifth sets of data analysis

Characteristics: Different questions, different testing time, the same students, different teaching methods.

As shown in Table 2,$n_3 = 3,\ n_5 = 3,\ S_3^2 = 12.667/2,\ S_5^2 = 26/2$.

$F = 0.487$, the rejection domain is $(0,0.005) \cup (199, +\infty)$, the statistic F is not in the rejection domain, so H_0 should be accepted, that is to say, the variance of two populations is the same under horizontal $\alpha = 0.01$.

As shown in Table 2 $\bar{x} = 16.667, \bar{y} = 32$, for a given $\alpha = 0.01$, the $t_\alpha(n_3 + n_5 - 2) = t_{0.01}(4) = 3.75$ is obtained by looking up the t distribution Table, so the rejection domain is $\{T > 3.75\}$, and the value $|T| = 6.04 > 2.76$ of the statistic T, so H_0 is rejected. That is to say, the integration of micro-class teaching and flip-over classroom education has significantly improved students' performance.

3.2.4 The first and third groups of data analysis

Characteristics: The same test questions, different test time, different grades, the same teaching methods.

As shown in Table 2, $n_1 = 7,\ n_3 = 3,\ S_1^2 = 292/6,\ S_3^2 = 12.667/2$.

The calculation is available, $F = 7.684$, then the rejection domain is $(0,0.005) \cup (199.3, +\infty)$, and the statistic F is not in the rejection domain, so H_0 should be accepted, that is, the variance of the two populations is considered to be the same under horizontal $\alpha = 0.01$.

From Table 2, $\bar{x} = 15, \bar{y} = 16.667$ is known. For a given $\alpha = 0.01$, the t distribution Table is $t_\alpha(n_1 + n_3 - 2) = t_{0.01}(8) = 2.90$, so the rejection domain is $\{T > 2.90\}$, and the value of the statistics T is $|T| = 0.391 < 2.90$, so H_0 is accepted, that is, the third group of data is not significantly better than the first group of data.

3.2.5 Fourth and Five Groups of Data Analysis

Characteristics: The same test questions, the same test time, different students, the same teaching methods.

As shown in Table 2, $n_4 = 5,\ n_5 = 3,\ S_4^2 = 153.2/4,\ S_5^2 = 26/2$.

The rejection domain is $(0,0.005) \cup (199, +\infty)$ for $F = 2.946$, and the statistic F is not in the rejection domain. Therefore, H_0 should be accepted, that is to say, the variance of two populations is the same under horizontal $\alpha = 0.01$.

From Table 2, $\bar{x} = 21.4, \bar{y} = 32$ is known. For a given $\alpha = 0.01$, the t distribution Table is $t_\alpha(n_4 + n_5 - 2) = t_{0.01}(6) = 3.14$, so the rejection domain is $\{T > 3.14\}$, and the value of the statistics T is $|T| = 2.656 > 2.76$, so the H_0 is rejected. That is to say, the data of the fifth group is significantly better than the data of the fourth group. The main reason is that the 2017 level has a forgetting phenomenon for knowledge point learning.

It can be seen from the above comparison data that the two sets of knowledge points are consistent in difficulty but have no identical test questions, which can better reflect the learning effect of students. The use of micro-curriculous classroom teaching methods can effectively improve the learning effect of visually impaired students. Enhance the robustness of visually impaired students to knowledge points; slow down the memory attenuation rate of knowledge points.

3.3 Analysis of limitations of teaching methods

Traditional teaching methods can not satisfy the teaching of computer basic courses for visually impaired students at all. It is imperative to explore new teaching methods by means of information technology. Fusion education based on "micro-lesson" in flipped classroom is a new teaching

method, which has the following shortcomings:

(1) There is a blind area in the micro-lesson. Some knowledge points can not or are not suiTable for making micro lessons.

(2) The first curriculum development has a huge workload, especially the design and production of micro-courses. It is suggested that the production of micro-courses in integrated education should be combined with the development of school-based online courses.

(3) There are obstacles in information transmission between visually impaired students and teachers. Online course (such as MOOC) teachers and students can interact online and offline, but most of the interaction between visually impaired students and teachers is offline, and the role of visually impaired students' partners is obvious.

4. Conclusion

In recent years, more and more disabled students have entered colleges and universities. The obstacles and challenges facing the development of higher integration education for the disabled have gradually emerged. It is urgent to establish a support and guarantee system for higher integration education for the disabled, which is suiTable for our national conditions. How to carry out integrated education for visually impaired students, how to learn for students and how to teach for teachers are worth studying and exploring. The main purpose of this paper is also to explore the quality improvement of integrated education, and hope to find visually impaired students suiTable for integrated education rather than mixed education methods. Introducing “micro-courses“ into the classroom and using the teaching method of flipping classrooms to conduct integrated education, empirically studied the effectiveness and limitations of this teaching method, and hoped that more teachers and scholars would participate. Therefore, a new teaching and learning framework can be established to make it suiTable for the integration education of visually impaired college students.

Acknowledgement

Key Education Reform Project of Nanjing Special Education Teachers College “Precision and Stratified Teaching Improves the Quality of Computer Basic Teaching in Universities“; Research on the Application of `Input Method for Multi-touch Gesture Recognition'(CLM2017-06) in the Chinese Paralympic Association Sign Language Braille Project in 2017; Research on Braille Machine Translation Method (No. 17KJD520006).

References

[1] Dorsett, Pat. Flipped Classroom Experiences: Student Preferences and Flip Strategy in a Higher Education Context.[J]. Higher Education, 2017, 73:1-18.

[2] Long T, Logan J, Waugh M. Students’ Perceptions of the Value of Using Videos as a Pre-class Learning Experience in the Flipped Classroom [J]. TechTrends, 2016, 60(3):245-252.

[3] Brooks A W. Information literacy and the flipped classroom: Examining the impact of a one-shot flipped class on student learning and perceptions [J]. Communications in Information Literacy, 2014, 8(2):225-235.

[4] miR-141 Is a Key Regulator of Renal Cell Carcinoma Proliferation and Metastasis by Controlling EphA2 Expression [J]. Clinical Cancer Research, 2014, 20(10):2617-2630.

[5] Bidelman G M, Moreno S, Alain C. Tracing the emergence of categorical speech perception in the human auditory system [J]. NeuroImage, 2013, 79:201-212.

[6] Ahn S Y, Chang Y S, Sung D K, et al. Mesenchymal Stem Cells Prevent Hydrocephalus After Severe Intraventricular Hemorrhage [J]. Stroke, 2013, 44(2):497-504.

[7] Gonzalez-Castillo J, Hoy C W, Handwerker D A, et al. Tracking ongoing cognition in

individuals using brief, whole-brain functional connectivity patterns [J]. Proceedings of the National Academy of Sciences, 2015, 112(28):8762-8767.

[8] Venza I, Visalli M, Oteri R, et al. Class I-specific histone deacetylase inhibitor MS-275 overrides TRAIL-resistance in melanoma cells by downregulating c-FLIP[J]. International Immunopharmacology, 2014, 21(2):439-446.

[9] Rodrigue K M, Daugherty A M, Haacke E M, et al. The Role of Hippocampal Iron Concentration and Hippocampal Volume in Age-Related Differences in Memory [J]. Cerebral Cortex, 2013, 23(7):1533-1541.

[10] Kumar D, Karampinos D C, Macleod T D, et al. Quadriceps intramuscular fat fraction rather than muscle size is associated with knee osteoarthritis [J]. Osteoarthritis & Cartilage, 2014, 22(2):226-234.

[11] Bender A R, Daugherty A M, Raz N. Vascular risk moderates associations between hippocampal subfield volumes and memory.[J]. Cognitive Neuroscience Journal of, 2013, 25(11):1851-1862.

[12] D"Auria L, Fenaux M, Aleksandrowicz P, et al. Micrometric segregation of fluorescent membrane lipids: relevance for endogenous lipids and biogenesis in erythrocytes[J]. The Journal of Lipid Research, 2013, 54(4):1066-1076.

[13] D"Antoni L, Kini D, Alur R, et al. How Can Automatic Feedback Help Students Construct Automata?[J]. ACM Transactions on Computer-Human Interaction, 2015, 22(2):1-24.

[14] James A J, Chin C K H, Williams B R. Using the flipped classroom to improve student engagement and to prepare graduates to meet maritime industry requirements: a focus on maritime education[J]. WMU Journal of Maritime Affairs, 2014, 13(2):331-343.

[15] Kurande V, Waagepetersen R, Toft E, et al. Reliability studies of diagnostic methods in Indian traditional Ayurveda medicine: an overview[J]. J Ayurveda Integr Med, 2013, 4(2):67-76.

[16] Wallace M L, Walker J D, Braseby A M, et al. “Now, What Happens During Class? “ Using Team-Based Learning to Optimize the Role of Expertise within the Flipped Classroom [J]. Journal on Excellence in College Teaching, 2014, 25:253-273.

[17] Lax N, Morris J, Kolber B J. A partial flip classroom exercise in a large introductory general biology course increases performance at multiple levels [J]. Journal of Biological Education, 2016:1-15.

[18] Theodoropoulos A, Antoniou A, Lepouras G. Students teach students: Alternative teaching in Greek secondary education [J]. Education and Information Technologies, 2016, 21(2):373-399.