Educational Research and Reviews

Full Length Research Paper

Effect of streaming on students' achievement in vocational training of pharmaceutical technology

Christopher Man Kit Leung and Ho Leung Au*

Hong Kong Institution of Vocational Education, Hong Kong.

We present the findings of a study carried out to determine the effect of streaming on students' preferences and their academic results in pharmaceutical technology. In the study we analyzed achievement scores on examination results in the two semesters of the academic year 2005/2006 of a sample of 85 students in the first year of a Higher Diploma in Pharmaceutical Technology in the Department of Applied Science of the Hong Kong Institution of Vocational Education. Raw data were analyzed statistically and the hypotheses tested. Generally, the results indicated that streaming based on academic results and students' preference impaired overall students' achievements, after the streaming exercise, for the students who were streamed to the less popular division.

Key words: Streaming, academic achievement, pharmaceutical technology, negative effects, students' preference.

INTRODUCTION

Many of the studies on streaming exercises were carried out in primary or secondary levels.- Students were usually grouped by their ability although they were maintained in the same curriculum with similar intended learning outcomes (Van de Gaer et al., 2006). Implied in these 'banding' procedures is the notion that all students grouped in a class are of similar ability, and are thus able to benefit from any particular approach of teaching tailored to their ability level (Forgasz, 2010). In class room management, streaming using ability grouping is normally adopted for its efficiency and fairness. If the two streams in a programme have significant differences in their programme objectives, in designing the system for allocation of students to these streams, ethical concerns may incur. Streaming based on ability grouping is therefore both an administrative efficiency consideration and an ethical issue. Indeed there are many studies pointing out that some students at lowest streams may be adversely affected by the streaming process (Boaler et al., 2000; Vanderhart, 2006).

In tertiary education settings, students are more engaged in specialized studies - they are approaching the exit of their mainstream education and are preparing to work. Students are therefore taught an entirely different curriculum depending on their ability group and preference on different career choices. Streaming exercise in this case added an additional dimension of complexity – in addition to ethical and efficiency implications; it is also a career issue.

The current study focuses on the Higher Diploma in Pharmaceutical Technology, which offered two streams of study-Western medicine and Chinese medicines. This course was a merging of the two previous courses, namely, Higher Diploma in Pharmaceutical Technology (which focused on Western medicine) and Higher Diploma in Pharmaceutical Technology in Chinese Medicines (which focused on Chinese medicine). The merging of the two courses was based on the following rationale in a

*Corresponding author. E-mail: hlau@vtc.edu.hk. Tel: 852-25958242.

Abbreviations: SMA, Semester Module Average; **HKCEE,** Hong Kong Certification of Education Examination.

particular time frame of 2005:

1. There was an increasing number of pharmaceutical firms manufacturing and marketing both Western and Chinese medicine (CM) products.
2. As modernization of CM industry progresses, the manufacturing process for Chinese and Western medicines was becoming more similar.
3. Consumers were taking both Western and Chinese medicine products and hence there was a need for dispensers, whether they specialize in either Western or Chinese medicines or have the basic knowledge of both types of medicine.
4. Potential job market for the graduates was expanding into areas of drug regulatory, registration and licensing involving both Western and Chinese medicines.
5. There was initiative to support the trend of synergistic integration of the Chinese and Western medicine for a more cost effective health care system.

The merged course provided training in the application of pharmaceutical sciences in both Western and Chinese medicines. The emphasis was to lay a firm foundation of knowledge in science and supporting subjects (Discipline Common Modules), upon which students build the basics of pharmaceutical sciences (Course Core Modules) and in-depth specialized training in Western medicine or the Chinese medicines field.

Graduates were expected to possess good technical, communicative and management knowledge and skills to enable them to be immediately ready for joining the workforce and to continue their education after graduation if they prefer to.

Many studies that focus on ability grouping where students are taught different curricula found positive effect for high-stream students and negative effects for low-stream students (Kerckhoff, 1986; Callaghan, 2005). Explanation to this effect, particularly the negative effects for low-stream students, includes the hypothesis that teachers assigned for teaching students in lower status streams share a lower 'study culture', are less experienced, less enthusiastic and they often need to spend more time maintaining disciplines (Boaler, 1997; Ireson and Hallam, 1999; Stevens and Vermeersch, 2010). These negative effects induced by teachers' differential behavior however were not the cause of the negative effects found in the present study because both groups of students are having their lectures together and are taught by the same teachers in both semesters.

There could be the argument that the impairing effects observed in this study were not derived by the streaming exercise. Rather it would be a natural selection in which more able students would show intrinsic interest in their school subjects and with that intrinsic motivation, usually to achieve their objectives of understanding the subject better (Watkins, 1983; Van and Schenk, 1984). However, in this study, the differences of the students' intrinsic motivation and interests between the two streams were found to be insignificant. Although further studies are needed to identify the mechanism involved in such results, there are strong indications that streaming itself, as a selection process into streams with unequal popularity, may have adverse effects on the academic potential of those students who entered into the less popular stream.

Streaming mechanism

The 3-year Higher Diploma programme consisted of two semesters per academic year and there were six semesters in total. The streaming (that is allocation of students among different streams) took place in semester one. In other words, students were allocated to different streams before the commencement of semester 2. Since the actual differences of teaching between the two streams started in semester 3 of year 2, the students from the two streams continued to have common subjects in semester 2 of year one after the streaming exercise.

In order to make proper scheduling arrangement, the streaming mechanism took place before semester two based on the academic result of semester one. In other words, even the students of the Higher Diploma were asked to take the same first year common subjects, they were basically pre-determined on which streams they would be specialized in the beginning of semester two of year one.

The streaming mechanism consisted of two assessment components – (1) The order preference of the students which were collected though a survey conducted in semester one. (2) The result of the students' overall semester module average (SMA) of semester one. Students with the highest SMA in semester one were the first to be allocated to the stream based on their order of preference. Roughly 50% of the planned places were allocated to each stream. In the case where the places in first choice of the stream were all taken up, students were then admitted to their next choice according to their order of preference.

METHOD OF STUDY

The baseline academic attainment of the students at the point of admission to the Higher Diploma was calculated on the results of their best six subjects in the Hong Kong Certification of Education Examination (HKCEE). The HKCEE was a public examination for students who had completed a full-time five-year secondary school course. With the introduction of the Hong Kong Diploma of Secondary Education Examination, the HKCEE is discontinued from 2012. The results of all other subjects of the HKCEE were indicated by six grades (A, B, C, D, E and F), of which grade A was the highest and grade F was the lowers. Results below grade F were designated as unclassified. The result of the best six subjects was quantified by using the conversion formula (A=5, B=4, C=3, D=2, E=1) in which the alphabets represent the subject grades. The total

Table 1. Stream preference as collected from the students in their 1st semester.

1st choice preference of the streams – survey from semester one	Students' number	Allocated stream in semester two	
		Western medicine	Chinese medicine
Western medicine	76	45	31
Chinese medicines	7	0	7
No stream preference	3*	0	3

*One of the students from this group withdrew from the school in semester 2. In general, most students (> 88%) opted for western medicine as their first choice. Only around 8% of the students took Chinese Medicines as their preferred stream. The result indicated that most of the students regarded Chinese Medicines stream as second choice.

score of the best six subjects were commonly adopted in the Hong Kong education system to assess the overall academic performance in the public examination.

The total scores of the student's best six subjects in the HKCEE examination are then compared between the two streams. Data are expressed as means ± standard error and analysed by Student's unpaired t-test. The upper limit for statistical significance was set at P<0.05.

The academic results of the students from semester 1 and semester 2 of the first year of the 3-year programme were first obtained from the academic record in terms of the semester module average (SMA) - the average of the all the modules in the semester. The percentage change of individual student's SMA in the second semester was then computed based on the following formula:

$$\frac{(\text{SMA of Semester 2} - \text{SMA of Semester 1})}{(\text{SMA of Semester 1})} \times 100\%$$

The percentage changes of the student's SMA were then compared between the two streams. Data are expressed as means ± standard error and analysed by Student's paired t-test. The upper limit for statistical significance was set at P<0.05.

As the academic variations of individual students were minimized by paired t-test, and the fact that all the students were taking identical subjects in both semester 1 and semester 2, statistical significance would most likely reflect either (a) the effects from the streaming exercise, or (b) the adaptability of the students who could adapt faster to the teaching methods of the school - and hence achieved better academic result which enabled them to enter the stream of their choice.

The possible effects of (b) – contribution to the academic result based on adaptability were further assessed by Pearson correlation: The Pearson correlation coefficient square (R-square) between the percentage change of the student's SMA and the student's SMA in semester 1 was computed to estimate the contribution to the percentage change in SMA related to academic capability and adaptability of the student.

RESULTS

The students were asked for their preferences between the two streams in semester one. They were informed that roughly an equal number of the places will be allocated to each stream. Table 1 shows the preference selection of the students.

One of the students from this group withdrew from the school in semester 2.

In general, most students (> 88%) opted for western

medicine as their first choice. Only around 8% of the students took Chinese Medicines as their preferred stream. The result indicated that most of the students regarded Chinese Medicines stream as second choice.

There was no statistical difference when the total scores of the best six subjects of their HKCEE results were compared between the two streams (Table 2). The result suggested there was no significant difference of the academic attainment between the two groups at the point of their admission into the Higher Diploma.

After the stream allocation which took place before the commencement of semester two, the students continued to study together as one group in semester 2. There is no major change in the class behavior among the students in the second semester as observed by their teachers. Tracker analysis on academic performance of individual students is presented in table 3.

Table 3 suggested that there were significant changes of performance (SMA attainment) between the two streams in semester two by comparing to the two groups of students' individual academic baselines in semester one. It could be possible that the significant findings were derived from the natural selection of internal adaptability – more adaptable students were selected to the stream of their choice, instead of the external streaming effects. This possibility was then estimated by Pearson correlation (R-square value).

As the learning environment in secondary schools in Hong Kong is quite different from that in tertiary education, students may need to be more independent in the learning environment. Students who better adapt to the learning environment at tertiary education may be reflected from their academic performance (the SMA obtained).

The correlation between the percentage change of students' SMA and their SMA in semester 1 is computed by the R-square value as shown in Table 4. There was no observable difference between the percentage change (a proxy measurement of adaptability) with their SMA results in semester one.

The low R-square values in both groups indicating that the correlation between the percentage change in SMA and the SMA in semester 1 is weak. If a student adapt

Table 2. Total score of best six subjects in HKCEE with respect to their streams.

	No of students	Total score of best six subjects in their HKCEE (means ± standard error)
Western medicine stream	45	13.22 ± 0.33
Chinese medicine stream	40	12.53 ± 0.31

Table 3. Percentage change of students' SMA between semesters 2 and 1 with respect to their streams.

	No of students	Percentage change of SMA (%) (means ± standard error)
Western medicine stream	45	-13.29 ± 1.62
Chinese medicine stream	40	-27.8 ± 3.63*

* $P < 0.001$ when compared with the corresponding values of the students from the Western Medicine Stream who studied the same subjects in both semesters 1 and 2.

Table 4. R-square value between percentage change of students' SMA and the student's SMA in semester 1 with respect to their streams.

	No of students	R-square
Western medicine stream	45	0.010
Chinese medicine stream	40	0.153

better to the learning environment in semester 1, it is expected that his/her academic performance should be improved (measured by the SMA change) in semester 2.

DISCUSSION

The present study revealed the difference of academic achievement of two groups of students – those who entered into the favourable stream and those who entered into the less favourable stream. It may be hypothesized that the difference was due to the possibility that those students who entered the favourable stream were having their academic potential enhanced. However, the difference contributing to the academic potential difference in streaming process should be small as indicated by the weak correlation between the percentage change in SMA and SMA in semester 1. It is believed that the students who entered into the less favorable stream were experiencing the negative effect of streaming on their academic potential which caused the difference in their academic achievements in semester 2.

Feedback from teaching staff suggested that those students who were allocated to the Chinese Medicine Stream (most people preferred the Western Medicine Stream) tended to give up. It was possible that most people when applying for the Higher Diploma in their initial entry point in year one preferred to study Western Medicine and many of them were then forced to study Chinese Medicines after Semester One.

The SMA of semester 2 on average was lower than SMA of semester 1 for both streams probably due to more advanced, and hence difficult subjects in semester two. Alternatively, since the streaming allocation was based on the SMA of semester 1, the students tended to work harder in semester one. The drop of SMA of semester 2 in those students allocated to Chinese Medicine Stream was on average further down than those in the Western Medicine Stream ($P<0.05$).

It is believed that this is caused by the adverse effects of streaming especially when Chinese Medicine Stream was labelled as a weaker stream. This issue is sensitive because the drop in performance is related to the process, and is not related to the initial ability of the students (the students in two streams have similar EAIs).

In conclusion, there is a statistically significant effect in reducing the performance of the students who entered into the less popular stream in semester two of the programme. It may be attributable to many factors such as "learned helplessness" and "labeling effects" (Worthy, 2010), which might also be the contributing factors of the adverse reaction. There is the possible argument that without deliberately doing so, teachers' approaches in handling student-learning interactions may be favouring those students in the popular stream. This argument however is deemed not acceptable as the students were grouped for identical modules in the semester two of the Higher Diploma.

A number of implications can be inferred from these findings. Although streaming by academic results is a transparent, and perhaps an efficient process, for allocation of limited quota to a class, it would induce an adverse labeling effect for those who entered the less popular stream. In this study, the adverse labeling effect might consequently affect the potential achievement of the students.

REFERENCES

Boaler J (1997). Setting, social class and survival of the quickest. Br. Educ. Res. J. 23(5):575-595.

Boaler J, William D, Brown M (2000). Students' experiences of ability grouping – disaffection, polarization and the construction of failure. Br. Educ. Res. J. 26(5):631-648.

Callaghan RM (2005). Tracking and high school English 1, Am. Educ. Res. J. 42(2):305-328.

Forgasz H (2010). Streaming for Mathematics in Years 7-10 in Voctoria: An Issue of Equity?, Math. Educ. Res. J. 29(1):57-90.

Ireson J, Hallam S (1999). Raising standards: is ability grouping the answer?, Oxford Rev. Educ. 25(3):343-358.

Kerckhoff AC (1986). Effect of ability grouping in British secondary schools. Am. Sociol. Rev. 51(6):842-858.

Stevens PAJ, Vermeersch H (2010). Streaming in Flemish secondary schools: exploring teachers' perceptions of and adaptations to students in different streams. Oxford Rev. Educ. 36(3):267-284.

Van de Gaer E, Pustjes H, Van Damme J, De Munter A (2006). Tracking and the effects of school-related attitudes on the language achievement of boys and girls. Br. J. Sociol. Educ. 27(3):293-309.

Van Rossum EJ, Schenk SM (1984). The relationship between learning, conceptions, study strategy and learning outcome. Br. J. Educ. Psychol. 54:73-83.

Vanderhart PG (2006). Why do some schools group by ability?, Am. J. Econ. Sociol. 65(2):435-462.

Watkins D (1983). Depth of processing and the quality of learning outcomes. Instr. Sci. 12:49-58.

Worthy J (2010). Only the Names Have Been Changed: Ability Grouping Revisited, Urban Rev. 42:271-295.