Impacts on English International Testing Goal Achievement
~Student Inclusivity, Learning Curves, and Diminishing Returns~

学生中心教育、学習曲線および学習収穫逓減
～国際英語検定の結果への影響～

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Abstract

This paper seeks to explain the reasons behind the phenomenon represented in the hypothesis that *students who initially score highly in IELTS find it more difficult to increase their score by the same proportion as those who don't score as highly* (Lynch, 2015a), in the situation of language education. It presents the Law of Diminishing Returns and the Learning Curve, along with a case study from a Japanese university to show that this hypothesis is a natural phenomenon, meaning that students who perform highly in any test (or in any task), when compared to those who do not perform as well (with both groups coming from the same base ability or performance) will find it difficult to maintain additional increases in performance that are greater than the group who are playing "catch up". Overall, the findings of this paper provide reasons behind the hypothesis and produce a simple theory which states that as the ability of a class increases, goals in terms of an increase in standardised test scores should be reduced accordingly. In other words, while the above hypothesis includes the word IELTS, the phenomenon is not limited to just the IELTS examination. This allows us to generalise the hypothesis to *students who initially score highly find it more difficult to increase their score by the same proportion as those who don't score as highly*. The above findings were under the conditions that students had completed the first phase of a language education learning curve (i.e., basic language education), which can be expected to be true in the case of all university students as they have completed at least six years of compulsory secondary level education.

1.0 Introduction

Lynch (2015a, b) reported that a class of students who were self-selected for a challenging class will, all else being equal, score more highly in the IELTS international English language test than those students who had been selected purely on the basis of their results in a placement test. In that research, the former class is labelled as Class B, and the latter as Class A. However, it was noticed that, after Class B scored significantly higher than Class A, the slope of their improvement in the

English language was not as steep as that of Class A. This paper seeks to explain the reasons behind this phenomenon which is represented in the hypothesis that *students who initially score highly in IELTS find it more difficult to increase their score by the same proportion as those who don't score as highly*. Indeed, this paper looks at the issue from a more general point of view, seeking to explain the matter using models from education in general, as well as from the field of economics. In particular, the learning curve, the law of diminishing returns, and a case study of university lecturers' intuition-based setting of goals (using the TOEIC) are used to argue the existence of a curved learning effect in English education, with this effect then used to explain the observed IELTS and other testing results.

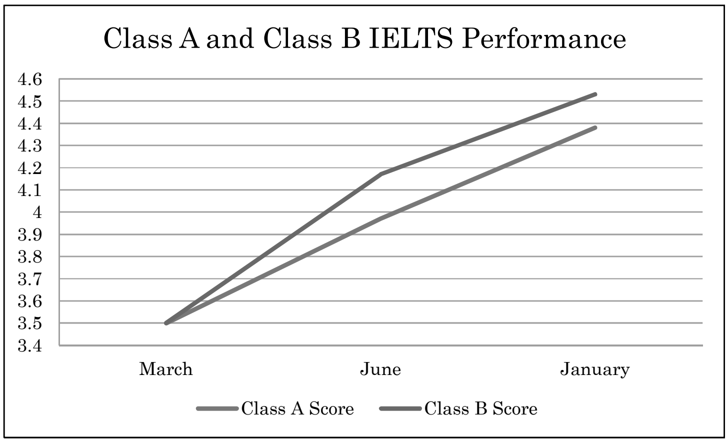
2.0 Observed Data, Return Expectation Laws and Hypotheses, and a Case Study

2.1 Results Observed from IELTS Results in a University

It has been shown that, when students self-select to be placed in a high-stakes class which includes international testing, those students initially perform better than students who were teacher selected, when other conditions are the same. However, this better performance is not maintained linearly (Lynch, 2015a). Table 1 and Graph 1 show this phenomenon, showing Class B (the self-selecting class) scoring higher than Class A (the placement test selected class) from a similar ability start-point. Subsequently, the slope of Class B's improvement becomes flatter, but Class A's improvement slope does not significantly change.

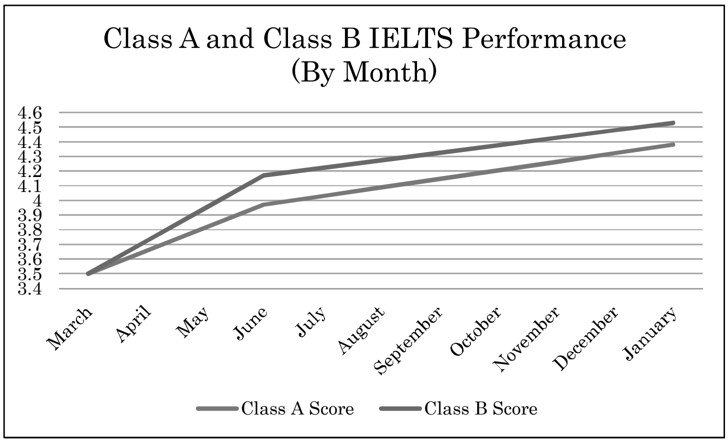
	Class A			Class B		
Date	Mar-13	Jun-13	Jan-14	Mar-14	Jun-14	Jan-15
Overall Score	3.5	3.97	4.38	3.5	4.17	4.53

Table 1: Class A and Class B IELTS Test Scores



Graph 1: Class A and Class B IELTS Test Performance

On visual inspection, the performance of Class A (the lower line) looks more consistent (i.e. straighter) than the performance of Class B. However, the perceptive researcher will notice that the gaps shown between testing times are not equal and, therefore, Class A's English language improvement slope may not be so consistent after all. Graph 2 shows the same data, with data points calculated for each month (consistent data time gaps).

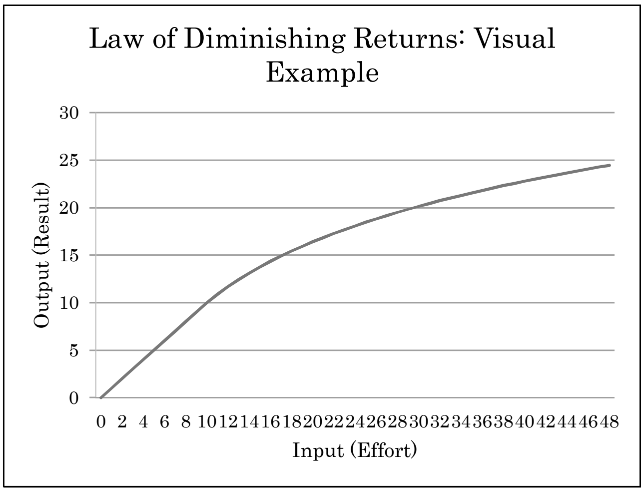


Graph 2: Class A and Class B IELTS Test Performance (By Month)

The data plotted in Graph 2 suggests that both Class A and Class B show what is known in economics as "diminishing returns", which is a situation where the same effort (class and personal study) produces a lower return (IELTS test score), and that the returns for Class B diminish more rapidly than those for Class A. Reasons for this are discussed below.

2.2 The Law of Diminishing Returns

There is a generality of economic theory which might be called a law (Shephard and Färe, 1974) called the Law of Diminishing Returns. Using an analogy, they explain it as a proposition that asserts that "as equal quantities of capital and labor are applied successively to a given plot of land, the output resulting from these applications will increase monotonically at first up to a certain point, after which further applications will result in steadily decreasing product increments tending to zero." An example of the law of diminishing returns is simulated in Graph 3.



Graph 3: The Law of Diminishing Returns (Visual Example)

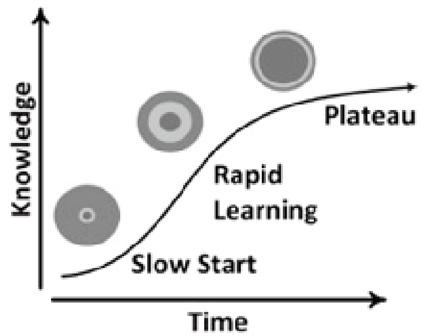
Notice that, in the example given in Graph 3, an input of one unit of effort yields an output of one unit of result, for the first ten units of input. In other words, there is a straight line relationship for the first ten units. Then, from input units 11 onwards, the resultant output decreases in perpetuity. Note that the above ignores the phenomenon of “negative returns” that would be expected to eventually occur in Shephard and Färe’s (1974) analogy.

For reference, the calculation used to produce the example in Graph 3 was [Output = Input] for the first ten units of input, and [Output = Previous Output + (Previous Input/Current Input)] for subsequent input. This calculation guarantees a positive but decreasing output after ten units, although never quite going to zero. One reason for this is that the Law of Diminishing Returns in this paper is based on an educational context, which is expected to produce *something* (even as a side-effect of what is being taught, or as learners will mature over time).

2.3 Learning Curve

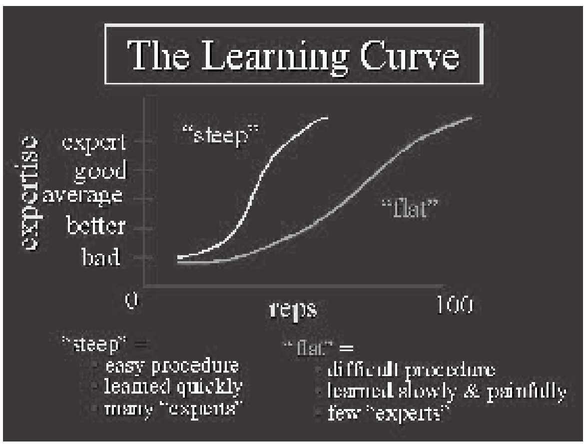
Learning Curve is a concept that describes "how new skills or knowledge can be quickly acquired initially, but subsequent learning becomes much slower" (Investopedia, 2015). The concept has wide applications such as in education, in industry (e.g., when considering staff training), and in finance (e.g., when considering resource investment). Research into the application of the concept is long established with, for example, the most relevant five papers using the keyword "Learning Curve" cited in Google Scholar dating from 1979, 1974, 1981, 1992, and 1964, respectively (Google Scholar, 2015). However, none of these papers deal with learning curve in education, not to mention in language education while, on the other hand, research into learning curve in the business and science world is well developed.

There are many examples of the learning curve. Graph 4, below, shows a traditional sigmoid learning curve (Teamsquatchinusa, 2014). Note that, as with the depiction of the Law of Diminishing Returns, above, the “plateau” is not depicted as a true plateau, with its slope being (slightly) greater than zero.



Graph 4: Traditional Sigmoid Learning Curve

It has been shown that the slope of the learning curve can be adjusted, depending on the teaching procedure, the method of learning, and the availability of experts in the topic field (Bokertov, 2015). Graph 5 shows two learning curves, one relatively steep and one relatively flat. The word "reps" in the graph refers to the word "repetitions", although this does not necessarily mean students have to repeat their learning in the same way as before; they could, for example, use learned grammar gained from reading in a different environment such as in writing, speaking or even listening.



Graph 5: Steep and Flat Sigmoidal Learning Curves (Bokertov, 2015)

2.4 Data from a Case Study on "Fair Expectations in Setting English Goals"

The following is a case study from a Japanese university. The university was looking for a way of setting goals to: 1. motivate their students to become more aware of, and to put more effort into their English learning, 2. introduce an element of accountability into the English programme, and 3. serve as a teacher and curriculum guide. It was decided that, instead of setting overall class goals, each student would have their own personal goal based on their current ability. This was deemed necessary due to the wide range of student English ability in each class, despite most students being placed according to their pre-entry TOEIC scores. Another advantage of goal setting would be that the university could announce to students a "minimum acceptable level", an "ideally expected level", as well as an "individual student personal goal". The TOEIC test was chosen as a suitable goal for the students for reasons including the following:

1. The students' TOEIC score before entering university was known, due to them having taken the pre-entry placement test (which was a TOEIC test).
2. Japanese companies are familiar with the TOEIC test. Therefore, being able to write a TOEIC result when applying for a job would be beneficial to the students.
3. Many of the teachers were familiar with the TOEIC contents.
4. The TOEIC is relatively inexpensive (when compared to international tests such as the IELTS).
5. There is a wide selection of material available for teaching TOEIC. Books which include short lessons are available, ensuring that TOEIC teaching would not take more than 1/4 of class time. (Note: It was decided that teachers would teach TOEIC for 20 minutes out of a 90 minute class).

One issue that had to be solved was the question of how to set the aforementioned <u>minimum acceptable level, ideally expected level</u>, and <u>individual student personal goals</u>. TOEIC is a multiple choice examination, with students being required to choose one answer from four choices in most questions, and to choose one answer from three choices in one short section. Therefore, random answering should, on average, result in a score of over 1/4 of the maximum score.

The maximum score in the TOEIC (reading and writing test) is 990 points so any student should be expected to score at least approximately 250 points at a sitting (if guessing randomly with average luck). Unfortunately, however, it was noticed that a not insignificant number of students had scored much lower than that in their pre-entry TOEIC tests. This could have been for a number of reasons, such as not understanding how to do the test, apathy (including falling asleep), poor test time management (i.e., not being able to select an answer to all answers in time), or, for a few cases, bad luck.

The teachers considered the above, and deemed that a <u>minimum acceptable goal score should be 250 points</u>.

The ideally expected level of all students was set at 600 points for first year students after one year. This was based on the teachers' experiences and opinions that any serious Japanese university student should be expected to achieve 600 points in TOEIC. Such a score was also regarded as a suitable intermediate step toward achieving the goals set by a range of multinational corporations, or companies that export their products internationally. A guide to the TOEIC (Trew, 2007) gives the results of a survey of such companies showing the ranges required for the following:

1. Airline flight attendant (600-700)
2. Promotion to section chief (600-730)
3. Assignment to overseas offices (650-750), and
4. Executive managers (800+)

However, it was also recognised that having all students achieve 600 points was an ideal situation that was different than reality, hence the need to create a personal goals system. The personal goals for students were set based on the score each individual student got on the pre-entry placement test. The teachers intuitively (based on their experience) knew that, for example, it would not be a huge feat for a student with a score of 300 points to increase their score by, say, 50 points. However, a student with 900 points would require an enormous effort to achieve a similar increase.

The following logic was used to work out the students' personal goals:

1. Students who had a pre-entry TOEIC score at or over the ideally expected level (of 600 points) would be required only to increase their score by 10 points. (One reason was that it was assumed that such a student would have other goals, such as IELTS. Another reason was to make a relatively fair system, so a high level student would not be "punished" for initially scoring well, whether due to high skill or good luck).

   Example 1: Student A's pre-entry TOEIC score was 660 points.
   => Student A's goal TOEIC score was 660 + 10 = 670 points.

2. Students scoring less than 600 points in the pre-entry TOEIC test were required to increase their score by 20% of the difference between their score and the ideally expected score, or to get a score of 250, whichever was the highest.

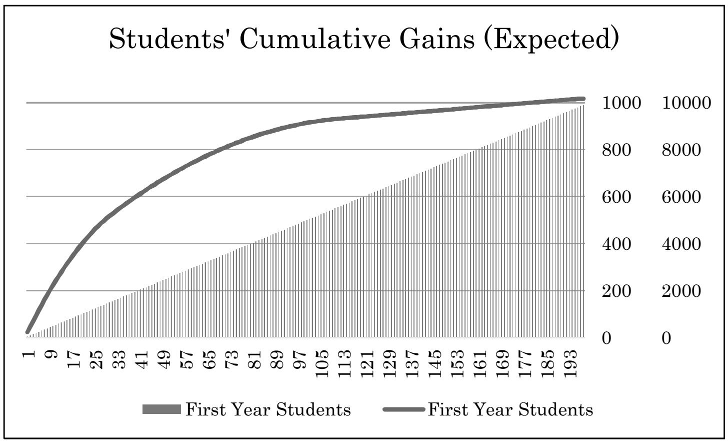
   Example 2: Student B's pre-entry TOEIC score was 400 points.
   => Student A's goal TOEIC score was 400 + (600-400)*20% = 440 points.

   Example 3: Student C's pre-entry TOEIC score was 100 points.

=> Student A's goal TOEIC score was 100 + (600-100)*20% = 200 points.
However, this score was less than 250 points, so the goal was set at 250 points.

It was agreed that the above system was as fair as possible to all the students, while establishing one standard for the entire cohort of students. It achieved a balance between achieving a minimum standard at university, setting an ideal goal, supporting and encouraging higher level students to continue to improve (and not slip back), encouraging other students by not being so draconian as to dissuade students from studying (as an achievable goal was set for each student), and holding students responsible for their study results. The standard was given teeth by assigning 20% of the students' class evaluation score (i.e., their class credit) to achievement of their personal goals (and also giving partial credit for partial goal achievement).

The implementation of the above was not directly research driven, being rather intuition, expectation and experience driven. When the above system was graphed (using cumulative gains per each additional input), the graph shown in Graph 6 was revealed.



Graph 6: One-Year TOEIC Achievement Goals in a Japanese University

It can be seen that the graph resembles more the Law of Diminishing Returns model than the Learning Curve model. Note that the curved line is the cumulative output, including the previous output. In other words, it simulates the situation of an imaginary student who takes the TOEIC continuously and improves their score by the smallest (consistent) unit each time, which is then used as the next input (next beginning score). In the TOEIC, the test score goes up in increments of five points. As the minimum score (higher than zero) is five points, and the maximum score is 990 points, the number of increments (used as input, on the x-axis) is therefore 199. The first y-axis (max axis value shown 1000) is also an input indicator, and merely shows what score each increment on the x-axis refers to (i.e. x-axis value multiplied by five). The output is the curved line, which has a maximum of over 10,000 (to be precise, it is 10,165). This is graphed while taking into account the previous scores gained, as it is cumulative output. The scores gained are the improvement in a student's ability (from the student's current level to the student's personal goal level). Therefore, a student who started at five points (with a personal goal of 250 points) would have to gain (or output) +245 points. The next student, beginning at 10 points (with same personal goal of 250 points) would have to gain +240 points. These are added together to become 485 points for a total system output, and so on (resulting in a depiction of cumulative increase). Note that the above graph is not to be used as a reference for calculating students' goal scores, as it shows cumulative data. The calculation presented earlier should, instead, be used.

3.0 Discussion

3.1 The Law of Diminishing Returns vs The Learning Curve

It can be seen from the data above that the system put in place in the case study was similar to a Diminishing Returns Model. However, that does not necessarily mean that the Learning Curve Model is not valid in education. In fact, comparison of the Diminishing Returns Model and the sigmoidal Learning Curve Model show that they are similar when the first third of the Learning Curve Model is disregarded. It can be taken for granted that this first third, with its low slope, has been completed by all students by the time they get to university. In English language education, things students learn in this initial section would include writing the alphabet, saying simple sentences such as greetings, and being able to understand simple utterances, which is, for some, the "learned slowly and painfully" section (Bokertov, 2015). Students cover at least this section in their year of two of compulsory language education at secondary level, and then go on to learn more advanced material. The result is that, basically, students at university level are expected to be in the second or third segment (of three) of the learning curve, which means that *both* the Law of Diminishing Returns and The Learning Curve are valid at university level.

3.2 Meaning for Language Education at Tertiary Level

The above discussion of the two models, together with findings from the case study, show that the Law of Diminishing Returns (and the second and third segments of the Learning Curve) are important depictions of how learning works in university, in a language program. This, in turn, means that all student and class goals should not be absolute (such as only setting a target of X points in a test for all students in class Y) but, instead, need to include student personal goals. Furthermore, it also becomes clear that language ability goals for a series of classes should not be set in terms of language tests. In other words, goals (in terms of increases in language ability as shown on standardised testing) should be set at less than previous goals (with *previous* referring to either classes students have taken *and/or* classes where the average ability of students is lower than the current class).

To illustrate the above, let's take a series of classes:

The classes can be labelled as： Class 1, Class 2, Class 3, Class 4, ... , ...
The respective goals for each class are: Goal 1, Goal 2, Goal 3, Goal 4, …, ...
The language ability of the students in the classes would follow the following pattern:
Class 1 < Class 2 < Class 3 < Class 4 < ... < ...

On the other hand, the goal of each class (in terms of an expected increase in points on standardised testing, when the same test is taken in all classes) would obey the following pattern:
Goal 1 > Goal 2 > Goal 3 > Goal 4 > ... > ...

Of course, by extension, the personal goals of each student would, when comparing classes, also reveal the same pattern.

4.0 Conclusion

This research used Law of Diminishing Returns and the Learning Curve, along with a case study from a Japanese university to show that the general hypothesis "*students who initially score highly find it more difficult to increase their score by the same proportion as those who don't score as highly*" is a natural phenomenon, meaning that students who perform highly in any test (or in any task), compared to those who do not perform as well, with both groups coming from the same base ability or performance, will find it difficult to maintain additional increases in performance that are greater than the group who are playing "catch up". A simple theory was produced which states that as the ability of a class increases, goals in terms of an increase in standardised test scores should be reduced accordingly. The hypothesis in Lynch (2015a) limited itself to the IELTS examination, but this paper has allowed us to generalise the hypothesis to include all standardised tests and tasks.

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