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HOW TO IMPROVE EDUCATION SKILLS

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EXECUTIVE SUMMARY

The connection between education, skills, for both individuals and the society at large has been investigated through a large body of literature in the past fifty years. However, differences of private returns to skills were found by subgroup (e.g., sex, age, language, or urban/rural area) across studies but were not systematic and were reckoned to likely come from differing methodologies or samples. At the macroeconomic level, empirical evidence consistently showed that the quality of what students learned in school and national growth were greatly and significantly connected. Originally a social equity instrument and a fundamental human right to all citizens, education is also now seen as the foundation for sustainable and inclusive growth. Using schooling gains as a traditional proxy for human capital, empirical research has long examined the effects of increases in quantity of education on long-term economic growth and individual earnings across countries.

Technical and vocational skills taught at the upper secondary and tertiary levels also prove to yield higher returns, although from a sociopolitical standpoint, offering TVE instruction earlier in the schooling cycle might be pushed forward where it is thought to (and was also proved to) lead to higher retention and completion.

EDUCATIONAL OBJECTIVES

There are three taxonomies. Which of the three to use for a given measurable student outcome depends upon the original goal to which the measurable student outcome is connected. There are knowledge-based goals, skills-based goals, and affective goals (affective: values, attitudes, and interests); accordingly, there is a taxonomy for each. Within each taxonomy, levels of expertise are listed in order of increasing complexity. Measurable student outcomes that require the higher levels of expertise will require more sophisticated classroom assessment techniques.

The course goal in Figure 2--"student understands proper dental hygiene"--is an example of a knowledge-based goal. It is knowledge-based because it requires that the student learn certain facts and concepts. An example of a skills-based goal for this course might be "student flosses

teeth properly." This is a skills-based goal because it requires that the student learn how to do something. Finally, an affective goal for this course might be "student cares about proper oral hygiene." This is an affective goal because it requires that the student's values, attitudes, or interests be affected by the course.

Table 1: Educational Objectives for Knowledge-Based Goals

LEVEL OF EXPERTISE	DESCRIPTION OF LEVEL	EXAMPLE OF MEASURABLE STUDENT OUTCOME
1. KNOWLEDGE	Recall, or recognition of terms, ideas, procedure, theories, etc.	When is the first day of Spring?
2. COMPREHENSION	Translate, interpret, extrapolate, but not see full implications or transfer to other situations, closer to literal translation.	What does the summer solstice represent?
3. APPLICATION	Apply abstractions, general principles, or methods to specific concrete situations.	What would Earth's seasons be like if its orbit was perfectly circular?
4. ANALYSIS	Separation of a complex idea into its constituent parts and an understanding of organization and relationship between the parts. Includes realizing the distinction between hypothesis and fact as well as between relevant and extraneous variables.	Why are seasons reversed in the southern hemisphere?
5. SYNTHESIS	Creative, mental construction of ideas and concepts from multiple sources to form complex ideas into a new, integrated, and meaningful pattern subject to given constraints.	If the longest day of the year is in June, why is the northern hemisphere hottest in August?
6. EVALUATION	To make a judgment of ideas or methods using external evidence or self-selected criteria substantiated by observations or informed rationalizations.	What would be the important variables for predicting seasons on a newly discovered planet?

Table 2: Educational Objectives for Skills-Based Goals

LEVEL OF EXPERTISE	DESCRIPTION OF LEVEL	EXAMPLE OF MEASURABLE STUDENT OUTCOME
PERCEPTION	Uses sensory cues to guide actions	Some of the colored samples you see will need dilution before you take their spectra. Using only observation, how will you decide which solutions might need to be diluted?

Table 2: Educational Objectives for Skills-Based Goals

LEVEL OF EXPERTISE	DESCRIPTION OF LEVEL	EXAMPLE OF MEASURABLE STUDENT OUTCOME
SET	Demonstrates a readiness to take action to perform the task or objective	Describe how you would go about taking the absorbance spectra of a sample of pigments?
GUIDED RESPONSE	Knows steps required to complete the task or objective	Determine the density of a group of sample metals with regular and irregular shapes.
MECHANISM	Performs task or objective in a somewhat confident, proficient, and habitual manner	Using the procedure described below, determine the quantity of copper in your unknown ore. Report its mean value and standard deviation.
COMPLEX OVERT RESPONSE	Performs task or objective in a confident, proficient, and habitual manner	Use titration to determine the Ka for an unknown weak acid.
ADAPTATION	Performs task or objective as above, but can also modify actions to account for new or problematic situations	You are performing titrations on a series of unknown acids and find a variety of problems with the resulting curves, e.g., only 3.0 ml of base is required for one acid while 75.0 ml is required in another. What can you do to get valid data for all the unknown acids?
ORGANIZATION	Creates new tasks or objectives incorporating learned ones	Recall your plating and etching experiences with an aluminum substrate. Choose a different metal substrate and design a process to plate, mask, and etch so that a pattern of 4 different metals is created.

Table 3: Educational Objectives for Affective Goals

LEVEL OF EXPERTISE	DESCRIPTION OF LEVEL	EXAMPLE OF MEASURABLE STUDENT OUTCOME
RECEIVING	Demonstrates a willingness to participate in the activity	When I'm in class I am attentive to the instructor, take notes, etc. I do not read the newspaper instead.
RESPONDING	Shows interest in the objects, phenomena, or activity by	I complete my homework and participate in class discussions.

Table 3: Educational Objectives for Affective Goals

LEVEL OF EXPERTISE	DESCRIPTION OF LEVEL	EXAMPLE OF MEASURABLE STUDENT OUTCOME
	seeking it out or pursuing it for pleasure	
VALUING	Internalizes an appreciation for (values) the objectives, phenomena, or activity	I seek out information in popular media related to my class.
ORGANIZATION	Begins to compare different values, and resolves conflicts between them to form an internally consistent system of values	Some of the ideas I've learned in my class differ from my previous beliefs. How do I resolve this?
CHARACTERIZATION BY A VALUE OR VALUE COMPLEX	Adopts a long-term value system that is "pervasive, consistent, and predictable"	I've decided to take my family on a vacation to visit some of the places I learned about in my class.

To determine the level of expertise required for each measurable student outcome, first decide which of these three broad categories (knowledge-based, skills-based, and affective) the corresponding course goal belongs to. Then, using the appropriate descriptions of the various levels of expertise. Determine which description most closely matches that measurable student outcome. As can be seen from the examples given in the three Tables, there are different ways of representing measurable student outcomes, e.g., as statements about students (Figure 2), as questions to be asked of students (Tables 1 and 2), or as statements from the student's perspective (Table 3). You may find additional ways of representing measurable student outcomes; those listed in Figure 2 and in Tables 1-3 are just examples.

Above mentioned way is a convenient way to describe the degree to which we want our students to understand and use concepts, to demonstrate particular skills, and to have their values, attitudes, and interests affected. It is critical that we determine the levels of student expertise that we are expecting our students to achieve because this will determine which classroom assessment techniques are most appropriate for the course. Though the most common form of classroom assessment used in introductory college courses--multiple choice tests--might be quite adequate for assessing knowledge and comprehension (levels 1 and 2, Table 1), this type of assessment often falls short when we want to assess our students knowledge at the higher levels of synthesis and evaluation (levels 5 and 6).4

Multiple-choice tests also rarely provide information about achievement of skills-based goals. Similarly, traditional course evaluations, a technique commonly used for affective

assessment, do not generally provide useful information about changes in student values, attitudes, and interests.

Thus, commonly used assessment techniques, while perhaps providing a means for assigning grades, often do not provide us (or our students) with useful feedback for determining whether students are attaining our course goals. Usually, this is due to a combination of not having formalized goals to begin with, not having translated those goals into outcomes that are measurable, and not using assessment techniques capable of measuring expected student outcomes given the levels of expertise required to achieve them. Using the CIA model of course development, we can ensure that our curriculum, instructional methods, and classroom assessment techniques are properly aligned with course goals.

SKILLS FOR INDIVIDUALS ECONOMIC OUTCOMES OF EDUCATION

Education Skills Have Strong Economic Benefits for Individuals. The human capital theory articulates that when individuals invest in furthering their education, they make themselves subsequently more productive in the labor Market, which leads in turn to receiving higher earnings. This comes with two assumptions. First, that earnings actually do fully reflect individual productivity; and second, that productivity gains acquired through more education will necessarily result in higher earnings for the worker. Some studies have challenged this hypothesis, including the credentials theory according to which education is only a manifest signal (but not automatically factual) of potentially higher productivity in the world of work. Education gains have traditionally been measured quantitatively through the number of school years completed.

RELATIONSHIP BETWEEN INDIVIDUALS' EDUCATION SKILLS, AND ECONOMIC GROWTH AT THE NATIONAL LEVEL

Conceptual Links between the Returns to Education Skills at the Micro and the Macro Levels.

Given the robust and reiterated evidence that skills and education attainment do enhance individual earnings for individuals at the microeconomic level, a wealth of studies have also investigated if and how achievement and education at large also affect the socioeconomic growth and development of countries at the macroeconomic level. How is exactly shaped this micro-macro linkage from a conceptual point of view?

Adequate skills would allow individuals to be more productive overall. Increasing one's productivity would benefit businesses in the formal sector and also self-employed trades in the informal sector—making these more dynamic, productive, and profit-generating. In turn, these more productive businesses would participate in the aggregate to their nation's ability to generate wealth through an increase in outputs. In other words, it would be the accumulation of human capital, qualitatively through skills gains, quantitatively through more years in school, as a factor of production augmented with an element of technological change that would drive economic growth. The differences in human capital levels would consequently drive differences in *output* levels across countries. This assumption is based on the neoclassical growth model, also known as the exogenous growth model, which assumes diminishing returns. Moreover, a lack of an adequate pool of skills would hinder enterprises from hiring the staff they really need, possibly causing losses of productivity during these periods of shortage, which they might resolve by appointing individuals with mismatched skills or lower skills, which in itself is detrimental to maximizing profits. On the other hand, the skilled worker might find himself or herself in high demand and could negotiate this as an advantage on the labor market, to the detriment of the

market (e.g., higher turnover, poaching, wage increase unrelated to actual productivity)

RELATIONSHIP BETWEEN EDUCATION SKILLS, AND NATIONAL GROWTH

The standard econometric method to estimate the effect of education on national growth is to estimate cross-country growth regressions, where countries' average annual growth in per capita gross domestic product (looked at over several decades) is expressed as a function of measures of education, along with other relevant variables. Over the years, despite evidence of the impact of education and the economic growth researchers have had difficulty finding consistent or statistically significant effects of quantity of education in cross-country national growth regressions at the aggregate level.

SKILLS ASSOCIATED WITH ECONOMIC BENEFITS AT THE MICRO AND MACRO LEVELS

Cognitive and Non-cognitive Skills

Is there a difference in returns depending on the types of skills that individuals acquired? There is indeed substantial evidence across international comparative research studies, that at both the individual and the country levels, differences in cognitive skills in particular have had different effects. In other words, the labor market tends to reward certain cognitive skills over others, although it was also showed that tests results were correlated. There are many different kinds of cognitive skills, and it is likely that some have larger effects on incomes than others. If the skills with the largest impacts could be identified, it may be that schools should focus on those skills and de-emphasize others."

Although national growth across countries and even was found positively and significantly associated with individual skills in mathematics, science, and reading altogether, models robustness varied slightly, often to the detriment of science, when the effect of mathematics and science-related skills were examined separately.

DEBATES AROUND THE ECONOMIC BENEFITS ASSOCIATED WITH TECHNICAL AND VOCATIONAL SKILLS

A common assumption is that acquiring technical or vocational skills while in school would help graduates find work more easily and become more productive and trainable once a part of the labor force, thus increasing their earnings prospects. Demand for technical/vocational skills has been strong in the recent years, and access to such instruction has been supported. However, the traditional perception that low achievers tend overall to be channeled into technical and vocational education, and its associated negative reputation of being an educational dead end, have the propensity to tarnish its potential.

INTERMEDIATE SKILLS AND PRODUCTIVITY

'Intermediate' here refers to technicians, craft workers and other employee's with qualifications and skills below university graduate level but who are above the low-skilled category. As with high-skilled workers, the principal mechanisms by which intermediate skilled workers can contribute to productivity center on innovation and efficiency. For example, incremental innovations in products, services, processes and modes of work organization rely heavily on workers in direct production, marketing, finance and human resources departments who have developed new ideas through learning-by-doing in the course of their work (Toner,

2010).Intermediate-level skills also make key contributions to absorptive capacity at firm level. Even if high-skilled employees such as professional engineers and scientists contributed is proportionately to firms' ability to identify and acquire useful external knowledge, the successful application of this knowledge will depend in many ways on intermediate-skilled employees as well as on high-skilled employees. For example, there are many key support roles for technicians in product design and development areas and for craft-skilled workers in improving production processes.

SUMMARY AND ASSESSMENT

Investment in skills development—in conjunction with many other kinds of investment (In machinery, equipment, innovation and other assets)—has an important part to play in fostering productivity growth. Hence in this report we compare the UK with three high productivity industrialized countries—the US, France and Germany—in terms of the mix of high-level and intermediate skills that is produced and the different ways that general and vocational education and training is provided in each country.

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