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Why Asset-Based Approach to Teaching Is More Effective than the Usual Deficit-Based Approach, and Why The New Approach Is Not Easy to Implement: A Simple Geometric Explanation

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Why Asset-Based Approach to Teaching Is More Effective than the Usual Deficit-Based Approach, and Why The New Approach Is Not Easy to Implement: A Simple Geometric Explanation

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Abstract

Traditional approach to teaching is based on uncovering *deficiencies* in student's knowledge and working on these deficiencies. Lately, it has been shown that a more efficient approach to education is instead when we start with the student's strengths (*assets*), and use these strengths to teach the students; however, this asset-based approach is not easy to implement. In this paper, we provide a simple geometric explanation of why the asset-based approach to teaching is more efficient and why it is not easy to implement.

1 Formulation of the Problem

Traditional deficit-based approach to teaching. Traditional approach to teaching is based on uncovering deficiencies in students' knowledge. Based on the results of pre-test or a midterm exam, the instructors learns about the topics that the students have not yet fully mastered, and concentrate on these topics.

For example, a graduate computational science program usually attracts both computer science students who want to work on applications of computing, and science and engineering students, who would like to improve their computational skills so that they will be able to solve important problems from science and engineering.

In the usual deficit-based approach, when we teach a computer science course to all these students, we take into account that students from science and engineering background are less knowledgeable in computer-related topics, so we spend extra time explaining these topics to non-computer science students.

Asset-based approach. Teaching can be made more efficient if we take into account that, while students from engineering and science may lack some programming skills, they usually have a much better understanding of the corresponding physical situations and problems. This understanding often helps them get a good idea of what all the intermediate computational results should be – and thus, catch possible mistakes at an early stage.

In general, this asset-based approach – looking for (and using) advantages that individual students have – is known to be very helpful in education; see, e.g., [1, 2].

Asset-based approach sounds reasonable, but it is not easy to implement. At first glance, the asset-based approach sounds reasonable, but it is not yet as widely spread as it should be. The main reason for this slow spread is that, as experience shows, this approach is not easy to implement.

Natural questions. Why is asset-based approach useful? Why is it not easy to implement?

What we do in this paper. In this paper, we provide a simple geometric answer to both questions.

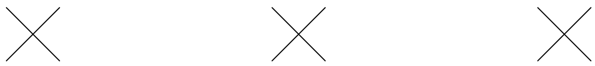
2 A Simple Geometric Model of Teaching Explains the Efficiency of Asset-Based Approach

The goal of teaching. For each of the classes, we want a student to be knowledgeable and skillful in all the topics studied in this class.

Let us describe this goal in visual (geometric) terms. For each topic, we can describe the student's current level of knowledge and skills by an appropriate grade. To visually represent the student's knowledge in a topic, it is therefore natural to take a point that corresponds to this particular grade on a vertical straight line: the better the grade, the higher the point.

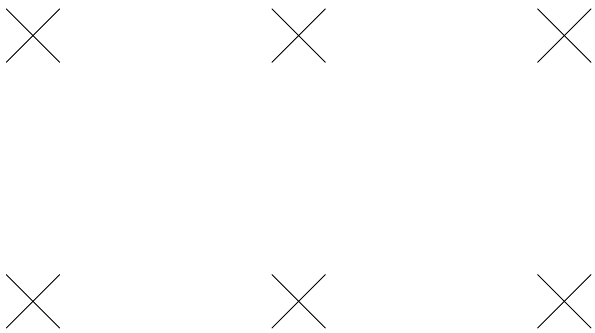
To represent the student's knowledge in all the topics, it is reasonable to consider several parallel vertical lines corresponding to different topics – so that similar topics will be represented by nearby lines, while lines corresponding to very different topics and subjects should be distant from each other.

In these terms, how can we represent the desired state of the student's knowledge. Our main objective is to make sure that every student has excellent knowledge and skills in all the subjects and all the topics. In this ideal state, points describing the student's knowledge in different topics are all on the same (highest) level:

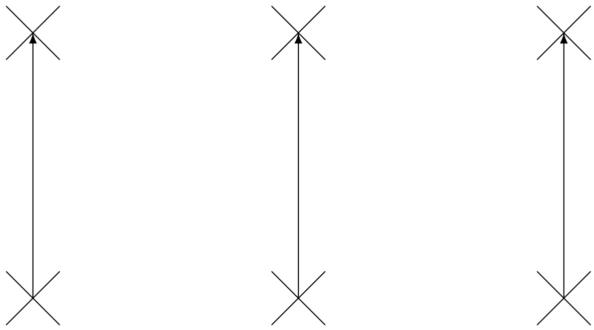


Ideal situation. In the ideal situation, a student is moving steadily, and has the same original level of knowledge in all the subjects. In this case, the student's original levels of knowledge are also described by points on the same level – but, of course, this original level is lower that what we want at the end of the class.

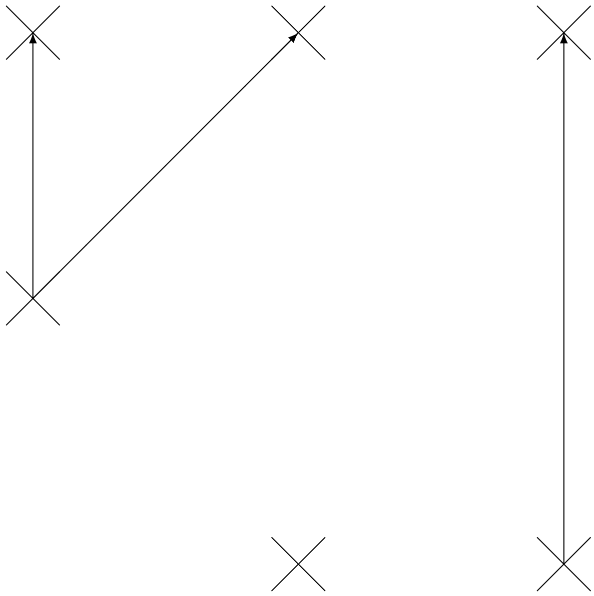
The goal of teaching is to move the student's knowledge from the lower points (corresponding to original level of knowledge) to the higher point which corresponding to the desired level of knowledge



To reach each point of the desired state as fast as possible, it is reasonable to start with a point from the original state which is the closest to the desired point. In the ideal case, when all points describing the original state are on the same horizontal level, and all the points describing the desired state are on the same horizontal level, for each desired-state point, the closest starting-state point is the one on the same vertical line, i.e., the one corresponding to the same topic. Thus, in this case, the traditional deficit-based approach makes perfect sense: for each topic, we find out the students's deficiencies and work on them.



Real-life non-ideal cases. In real life, a student rarely has the same level of knowledge in all the topics. As a result, if for some topic, the current level is too low (i.e., is a deficiency), the closest point to the desired level of this topic is *not* the current state of this topic, but rather the current state of some nearby topic – in which the student's knowledge is much higher (i.e., which is an asset):

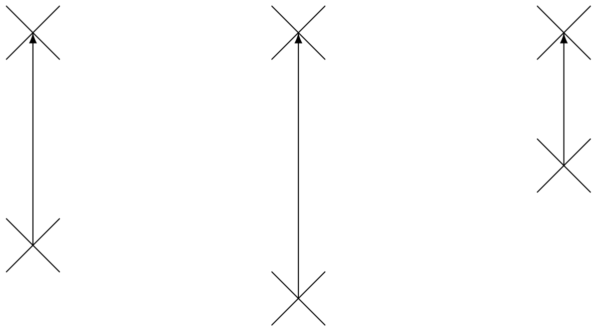


This is exactly the idea behind asset-based approach to teaching! Thus, our simple geometric model indeed provides an explanation of why the asset-based approach to teaching is efficient.

3 Why Asset-Based Approach Is Not Easy to Implement

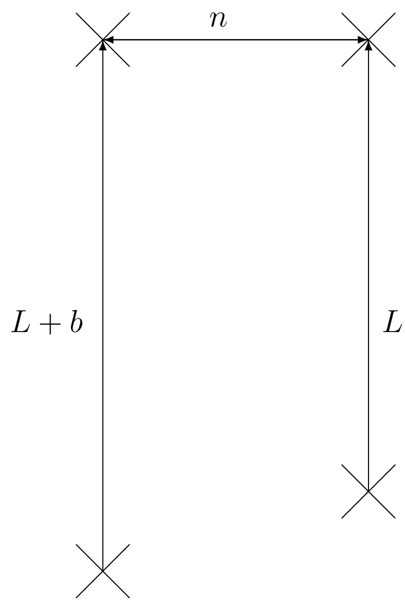
Short-term vs. long-term approaches to teaching. Day-by-day teaching is mostly concentrated on short-term goals: mostly, when we teach, we think of the topic that we teach this week, and we want to make sure that this particular topic is well understood. Of course, we also think long-term, in terms of how this topic is related to other subjects where this material will be needed, but such long-term considerations usually take less of our time than day-by-day short-term teaching.

Our emphasis on short-term teaching leads to an overemphasis on deficiency-based teaching. In geometric terms, an emphasis on short-term effects means that we mostly consider objective points which are close to the points that describe the current state of the student's knowledge. In this case, the closest point to each desired topic is indeed the point describing the student's knowledge of the same topic:



From the long-term viewpoint, however, asset-based approach is better. If instead of thinking short-term and concentrating on this week's goals, we think of the general goal of the class (or even the general goal of the whole program), then the distance from the current state to the desired state increases. How will this affect teaching?

Let us consider a real-life case when the student's knowledge in one topic is b points lower than in the neighboring topic – of distance n from the first one. We want the student to eventually reach the same level on both topics. If we denote the distance between the current and desired levels for the second topic by L, then for the first topic, the distance is $L + b$:



In this case, the traditional deficiency-based approach means that to get to the desired state of knowledge of the first topic, we start with the current (deficient) level of knowledge in this topic. The distance needed for this transition is $L+b$. In contrast, the asset-based approach means that we start with the topic in which the student originally has an advantage, i.e., with the second topic. The corresponding distance is $\sqrt{L^2+n^2}$.

The asset-based approach is more efficient if $\sqrt{L^2+n^2} < L+b$, i.e., equivalently, when $L^2+n^2 < L^2+2L\cdot b+b^2$, which, in its turn, is equivalent to $2L\cdot b > n^2-b^2$. For sufficiently large L, this inequality is always true. Thus, if we consider a sufficiently long-term approach, we should use the asset-based approach.

This explains why asset-based approach is often difficult to implement. As we have shown, for the asset-based approach to be efficient, we need to consider long-term teaching objectives.

However, long-term approach is more difficult to implement: instead of simply selecting parameters characterizing one week's teaching, we need to take into account teaching for all this long period of time. This explains why asset-based approach is not easy to implement.

Acknowledgments

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