



Introduction of Studio Physics Teaching in Panama



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Abstract

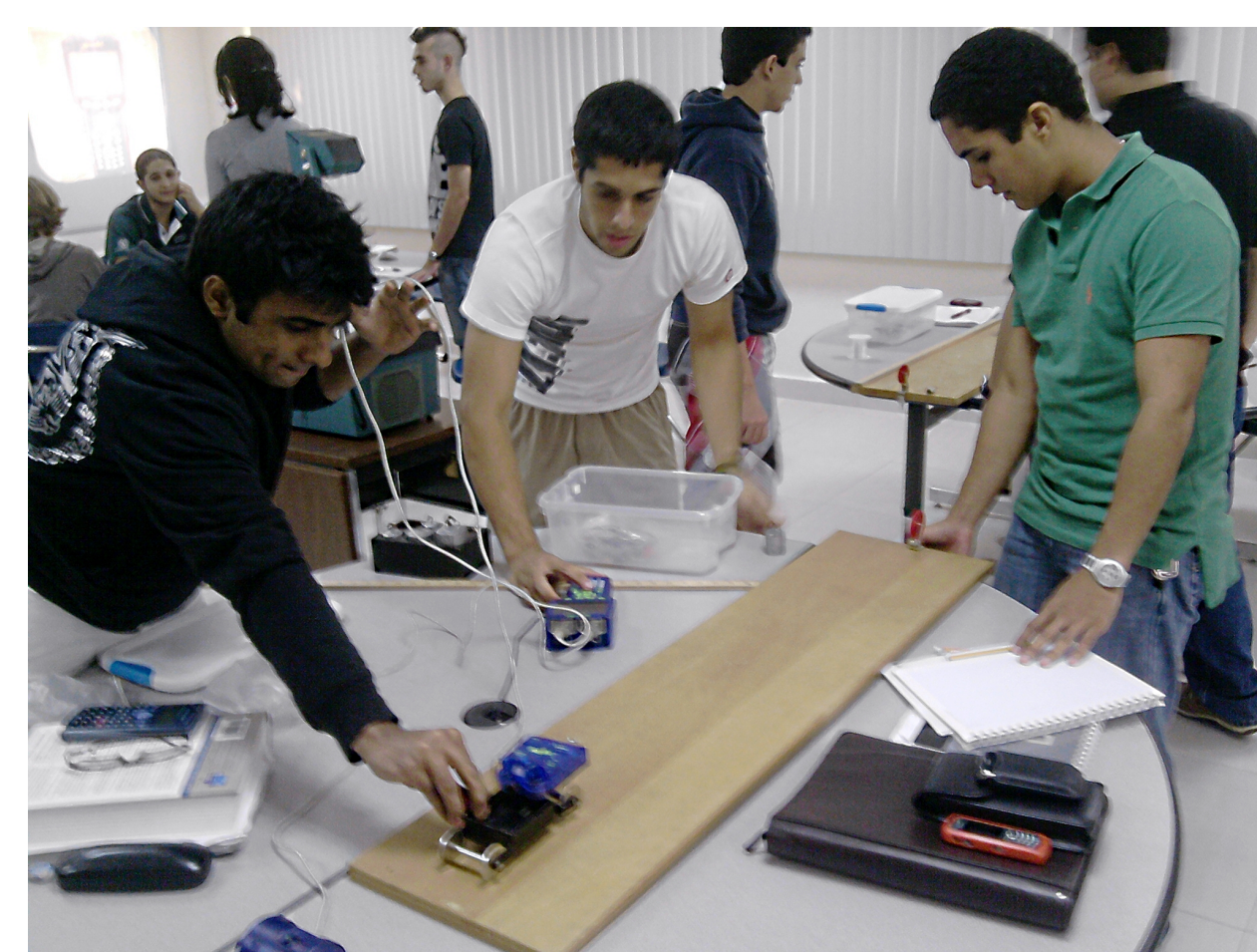
Physics Studio teaching was recently introduced at an international and multicultural academic program of a U.S. university in Panama. The results of introducing and implementing studio-style teaching on the conceptual understanding of calculus-based introductory physics have been measured by comparing the newtonian conceptual framework before and during studio implementation. The research was carried over the last five years in different semesters. The measurement tool used was the Force Concept Inventory. The initial learning stage of the incoming diverse students has been found to be at a significantly lower level than the generally reported in the U.S. The normalized gain in conceptual understanding was significantly larger than in the former traditional system, and has become consistent in the last semesters. Multicultural aspects that may affect the entry level and performance enhancement are discussed.

INTRODUCTION

- Most of Physics Education Research has focused on conceptual understanding in introductory physics courses, at college and schools [1].
- PER work has resulted in different curricular and learning space developments; one popular adoption has been Studio Physics [2,3], a system which integrates lecture, experiments and recitation in the same class using PER-based textbooks [5-6] vs more traditional texts [7].
- One widely used tool to evaluate the effectiveness of such changes and to measure conceptual understanding gains in students has been the Force Concept Inventory (FCI) [4]. Many studies have compared Traditional teaching with new approaches of Studio Teaching using the FCI [9-12].
- This work reports the first study using FCI in Panama to evaluate the change from Traditional to Studio teaching in a Newtonian Mechanics course.

The Environment

- FSU-Panama has a two-year introductory core for science and engineering students with two courses of calculus-based general physics and one course on modern physics.
- A major concern has been the state of conceptual understanding and misconceptions students bring to the first course of introductory physics; this concern increases due to the high diversity on the student's high-school science education.
- FSU-Panama student population is very diverse: most are local Panamanians, largely from private schools; others from Colombia, Venezuela, Peru, Ecuador and a small portion from Central America and the Caribbean. About two to three out of twenty introductory physics students come from the U.S.



Studio Teaching class (mechanics with real-time sensors) at FSU Panama

STUDIO vs. TRADITIONAL PHYSICS TEACHING in PANAMA - RESULTS

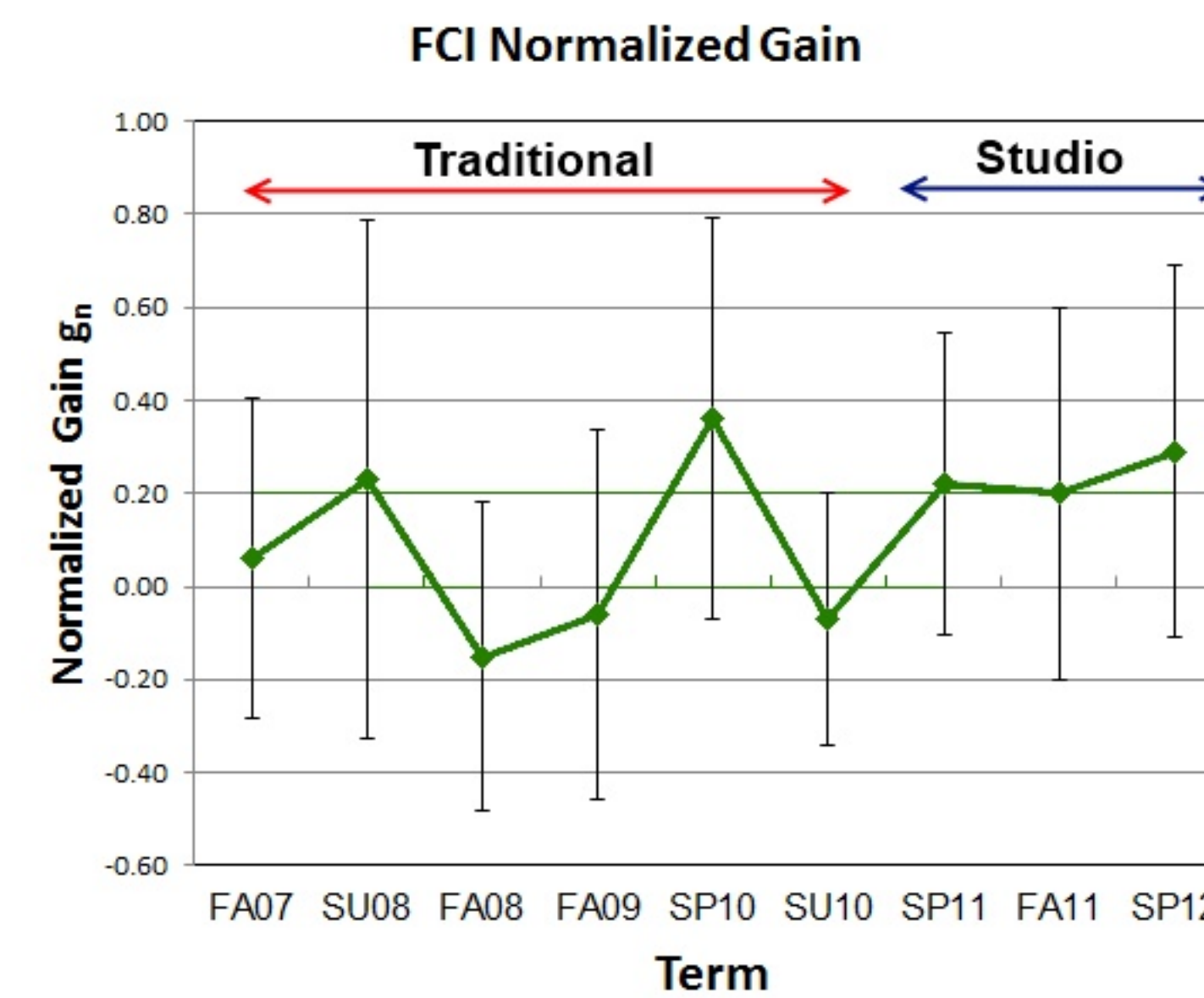
TRADITIONAL TEACHING : 2005-2010

- Introductory calculus-based General Physics courses were taught in a lecture-laboratory-recitation scheme until mid 2010.
- FCI tests were administered first day of class (pre-test) and the last week of class (post-test) for Fall 2007, Summer 2008, Fall 2008, Fall 2009, Spring 2010 and Summer 2010 terms.
- Normalized gains for conceptual learning in Traditional and Studio teaching were determined using the Hake's relation [8]

$$g_n = \frac{\%Post-test - \%Pre-test}{100 - \%Pre-test}$$

STUDIO TEACHING: 2010 to Date

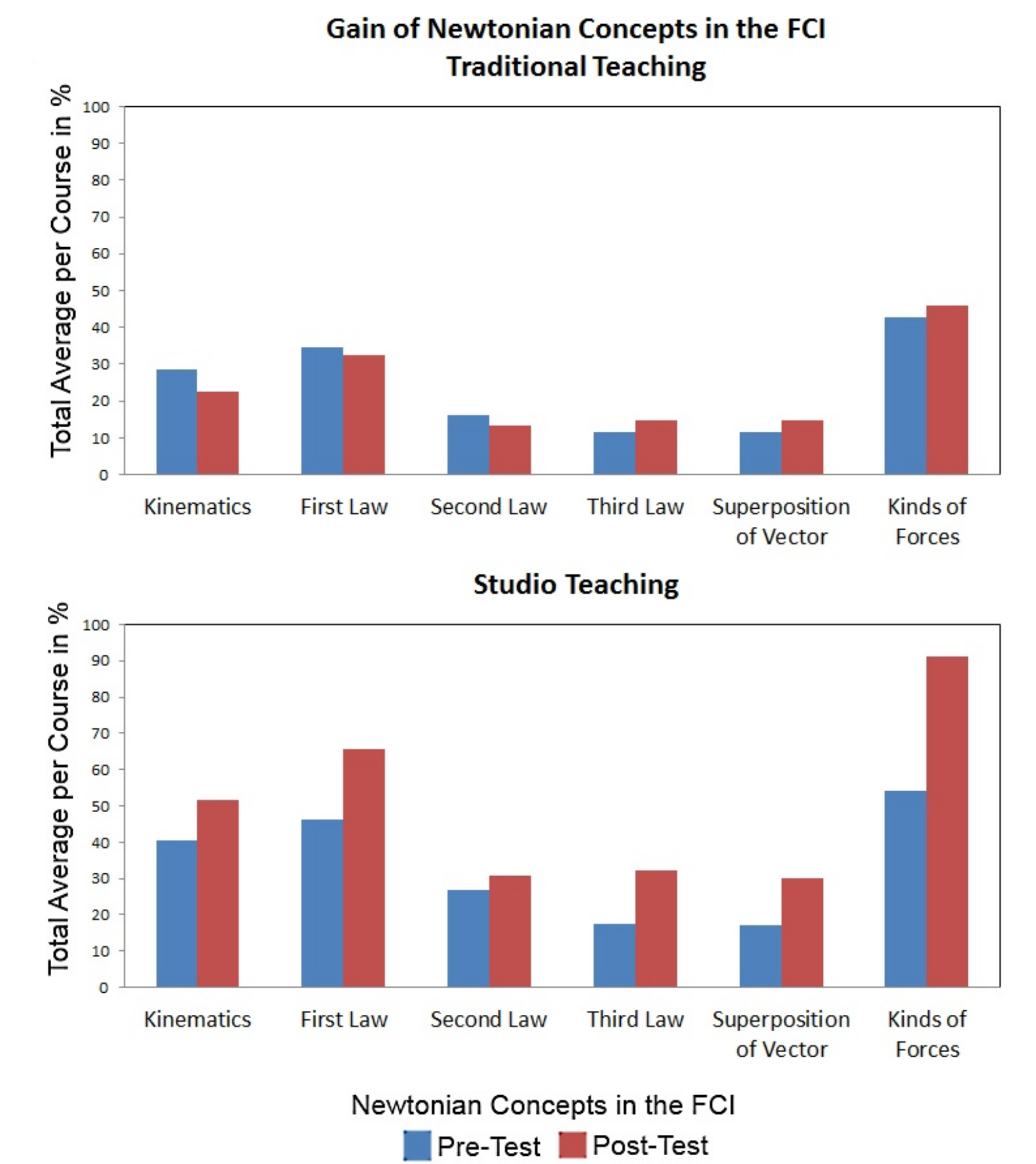
- Gradual implementation of Studio teaching started in Summer 2010 with interspersed mini lectures, group experimental activities and cooperative problem solving, peer instruction.
- Normalized Conceptual gains were measured using FCI pre-tests and post-test in Spring 2011, Fall 2011 and Spring 2012.



FCI Normalized Gain, for Traditional teaching (FA07-SU10) and Studio teaching (SP11-SP12). Classes were small: 15 to 25 students each. Spring 2010 was an exceptionally good and active group.

NEWTONIAN CONCEPTUAL GAIN

- FCI test allows to analyze changes in the students on mastery of key Newtonian concepts: Kinematics, First Law, Second Law, Third Law, Superposition of vectors and Kinds of forces. The FCI items can be grouped in relations with these concepts and specific gains in understanding these concepts can be analyzed in more detail.
- Gains in Newtonian concepts were substantially better in Studio teaching with respect to former Traditional system.



Gain of Newtonian Concepts based in the Force Concept Inventory, Traditional teaching (2007-2010) vs. Studio Teaching (2010-2012).

CONCLUSIONS

- Conceptual gains in Traditional teaching were low (1 exception).
- Students seem to gain a more consistent conceptual understanding with Studio teaching than with Traditional teaching.
- Cultural differences based on the way physics, and science in general, is taught in different countries of Latin America where most of the students come from, as compared to U.S. education, could also affect the way the students learn and overcome newtonian misconceptions and gain better conceptual understanding of fundamental physics.

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