

# **Learning Science through STEM Based Instructional Material: Its Effectiveness in Improving Students' Conceptual Understanding and Its Effect towards Engineering Design Behaviors and Teamwork Skills**

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## **ABSTRACT**

This study examined the effectiveness of science instructional material in improving students' conceptual understanding of science and its effect towards students' engineering design behaviors and teamwork skills. Sample of this study consist of two classes of 8<sup>th</sup> grader at a junior secondary school in Bandung, Indonesia. A quasi experimental through pretest and posttest design were conducted as method of research where experiment group utilized STEM-based instructional material and control group utilized non STEM-based instructional material. A set of pretest and posttest were given to assess the development of students' conceptual understanding, Informed Design Learning and Teaching Matrix was used to characterize observable patterns of student engineering design behaviors within engineering design process and students' teamwork skills were observed by using CATME-likert scale. The result of independent sample t-test showed that there were significance differences of students' posttest score and average N-gain score between control group ( $\langle g \rangle_{ave}=0.44$ ) and experiment group ( $\langle g \rangle_{ave}=0.72$ ) with sig = 0.001 ( $p < 0.05$ ). The result of students' engineering design behavior observation revealed that in the first phase both of experimental group and control group were categorized either as beginning designer or emerged designer, but in the second phase students who learnt science through STEM based instructional material performed better engineering design behaviors. Students' teamwork skills of control group were categorized as medium level, meanwhile experiment group were categorized as high level. In summary, STEM based instructional material has better effect in promoting students' conceptual understanding of science, engineering design behavior and teamwork skills rather than non-STEM based instructional material due to the differences of content presentations of integrated science and engineering design activities.

**Keywords:** STEM based instructional material, Conceptual understanding, Engineering design behaviors, Teamwork skills

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# **Belajar IPA melalui Bahan Ajar IPA berbasis STEM: Efektivitas dalam Meningkatkan Pemahaman Konsep dan Efeknya terhadap Perilaku *Engineering Design* dan Kemampuan Bekerja Sama pada Siswa**

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## **ABSTRAK**

Penelitian ini bertujuan untuk mengkaji efektivitas bahan ajar IPA berbasis Sains, Teknologi, Engineering dan Matematika (STEM) dalam meningkatkan pemahaman konsep IPA dan efeknya terhadap perilaku *engineering design* dan kemampuan bekerja sama pada siswa. Sampel penelitian ini terdiri dari dua kelas siswa SMP kelas 8 di Bandung, Indonesia. Metode penelitian yang digunakan adalah *quasi experiment* dengan desain *pretest* dan *posttest* dimana kelompok eksperimen menggunakan bahan ajar berbasis STEM dan kelompok control menggunakan bahan ajar yang tidak berbasis STEM. *pretest* dan *posttest* diberikan pada siswa untuk menilai perkembangan pemahaman konsep IPA, *Informed Design Learning and Teaching Matrix* digunakan untuk menggolongkan pola perilaku *engineering design* yang diamati pada siswa dalam proses *engineering design*, kemampuan bekerja sama pada siswa diamati menggunakan instrumen skala *likert CATME*. Hasil dari *independent sample t-test* menunjukkan bahwa ada perbedaan yang signifikan pada skor *posttest* dan rata-rata N-gain antara kelompok kontrol ( $\langle g \rangle_{ave}=0.44$ ) dan kelompok eksperimen ( $\langle g \rangle_{ave}=0.72$ ) dengan nilai  $\text{sig} = 0.001$  ( $p < 0.05$ ). Hasil pengamatan perilaku *engineering design* mengungkap bahwa pada fase pertama proses *engineering design*, baik kelompok eksperimen maupun kelompok kontrol dikategorikan sebagai *beginning designer* atau *emerged designer*, akan tetapi pada fase kedua terdapat perbedaan yaitu siswa yang belajar IPA melalui bahan ajar berbasis STEM menunjukkan perilaku *engineering design* yang lebih baik. Kemampuan bekerja sama pada siswa di kelas kontrol memiliki kategori medium, sementara kelas eksperimen memiliki kategori tinggi. Dapat disimpulkan bahwa bahan ajar berbasis STEM memiliki pengaruh yang lebih baik dalam menumbuhkan pemahaman konsep IPA, perilaku *engineering design* dan kemampuan bekerja sama pada siswa yang disebabkan karena adanya perbedaan penyajian konten IPA terpadu dan aktivitas *engineering design* dalam bahan ajar berbasis STEM.

**Kata kunci:** Bahan ajar berbasis STEM, Pemahaman konsep, Perilaku *engineering design*, Kemampuan bekerja sama

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