The influence of undergraduate research on learning outcomes

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**Background**

- Research has grown from activity conducted by walled-in elite specialists to something which engages many more people within universities and beyond, including undergraduates.
- A growing body of research has explored undergraduates’ participation in research. Empirical studies affirmed that research participation is a ‘high impact practice’ (HIP).
- Not enough research has verified the causal effect of undergraduate research on students’ development, as traditional model estimation could be biased.

**Method**

- **Data:** CCSS 2016-2018
  - 49 four-year universities and colleges; Sample size: 257,529
- **Variables**
  - Research activities: Professional competition; Research with teachers; Journal contribution
  - Learning outcomes: Self-perceiving learning outcomes (SLPO); Grade-Point Average (GPA)
  - Education contexts: Institution type; Major area; Grade level
  - Other covariates: Individual characteristics; Family background; Research environment
- **Propensity score matching (PSM) and linear regression**
  $$P(Y_1|X) = Pr[T = 1|X = x]$$
  $$P(Y_0|X) = 1 - Pr[T = 1|X = x]$$
  $$Y_1$$ refers to the individual who participated in undergraduate research, while $$Y_0$$ refers to who did not.
  $$\text{Outcomes} = \beta_0 + \beta_1 \text{Research} + \beta_2 \text{Individual} + \beta_3 \text{Family} + \beta_4 \text{Institution} + \varepsilon_i$$
  Additionally, this research uses linear regression method with the samples and weights from PSM results to furtherly reduce the bias.

**Undergraduate research participation rates under different educational contexts**

**Linear regression results based on PSM samples and weights**

<table>
<thead>
<tr>
<th>Context</th>
<th>Activity</th>
<th>SLPO</th>
<th>GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities</td>
<td>Pcompetition</td>
<td>0.109***</td>
<td>0.088***</td>
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<tr>
<td>Research</td>
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<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Journalon</td>
<td>0.169***</td>
<td>0.000</td>
<td></td>
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<tr>
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<td>0.092***</td>
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<td>0.018***</td>
<td></td>
</tr>
<tr>
<td>Journalon</td>
<td>0.201***</td>
<td>0.062***</td>
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</tr>
</tbody>
</table>

**Conclusions**

- Chinese undergraduates obtain high motivation towards research activities but the participation rates among different activities are still far from satisfaction.
- After reducing probable self-selection bias, undergraduate research still has significant effect on improving students’ learning outcomes.
- The paradox between perceptive and external outcomes reveals that future undergraduate research needs to focus more on the process of stimulation, guidance and collaboration, rather than the orientation about premature engagement in publication.

**Research Questions**

- What are the differences of undergraduate research participation under different educational contexts?
- What research activities play relatively significant roles under different educational contexts?

**Limitations & Reflections**

- This research uses three representative research activities as independent variables. However, each variable exists inner qualitative differences (e.g.: The quality of academic journals is different).
- The results may be affected by the limitation of research sample.