Projecting NAEP Proficient Levels to TIMSS Countries

AIR-NAEP Working Paper 2023-06

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NCES support contracts

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Emmanuel Sikali is the Acting Branch Chief of the Reporting and Dissemination of the Assessment Division. In addition to managing the branch, he is responsible for research and development. In this capacity, Dr. Sikali is the project officer for the EdSurvey subcomponent of ESSIN Task Order 14 and its follow-on contract referenced above.

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Introduction

This paper presents the results of a study that linked scale scores from the 2019 National Assessment of Educational Progress (NAEP) and Trends in Mathematics and Science Study (TIMSS) to compare grade 8 performance in science and mathematics in the United States and TIMSS countries, using the *NAEP Proficient* standard as the measure.

NAEP and TIMSS are national assessments that have two subjects and two grades in common and are designed to produce scores that can be compared through time across cohorts. In this paper, we focus on grade 8 only.

Two previous studies have linked the scores on these two assessments. First, in 2000 a convenience sample of about 1,700 students in the NAEP sample was administered the TIMSS 1999 assessment, which was scored using the established TIMSS 1999 parameters (Johnson et al., 2005; Philips, 2007).[1] The study revealed different results for the two assessments, which was unexpected: while the 1999 NAEP math scores for the linking sample were 0.06 standard deviations (SD) below the U.S. average for NAEP math, the TIMSS math scores were about 0.26 SD below the national average.[2] The study also incorporated linking by moderation and concluded that "the moderation linkage did a decent job of projecting TIMSS scores from NAEP scores in the 12 states that participated in both studies …" (Johnson et al., 2005).

In 2009, NAEP and TIMSS items were offered in braided booklets (Jia et al., 2014) to a sample of grade 8 students. This method used three methods of linking, with the executive summary stating:

> The decision to use statistical moderation was based on the consideration that while all three methods of linking yielded essentially the same predicted TIMSS results, the statistical moderation technique is the simplest method among the three requiring the estimation of the fewest parameters (i.e., the means and standard deviations of the U.S. national public school samples for NAEP and TIMSS). The method also could be applied to the extant national samples of NAEP and TIMSS and did not require additional samples tested with special booklets that included items from both assessments. Selecting this relatively simple and efficient methodology allows NCES to conduct

[1] A previous study used equivalent samples to link NAEP and TIMSS in 1995 and found that grade 4 could not be linked but grade 8 could be.
[2] Authors' calculation from published statistics in Johnson et al. (2005). The TIMSS national standard deviation was published in Mullis et al. (2000). For science, students scored above the NAEP average by 0.07 SD and below the TIMSS average by 0.18 SD.

additional linking studies in the future without the additional resources needed for the braided-booklet samples.

Building upon the findings of Jia et al. (2014), this paper employs the moderation approach to the 2019 NAEP and TIMSS data.

Returning to Johnson's (2005) moderation technique, it uses Taylor series approximation, except in one instance where it uses a method that is not widely accepted where a large difference (as opposed to an infinitesimal one) is applied to estimate a component of the variance. We improve on this methodology by using a Taylor series approximation for every term. While Jia et al. (2014) used a similar approach, their derivation of the estimator follows a different approach from ours, and their report lacks an explanation of intermediate steps. Consequently, it is difficult to compare the methods or verify the Philips method.

Data

In this paper, all NAEP results are from the *2019 Nation's Report Card* (U.S. Department of Education, n.d.), using only the national public (or state public) subsample. The TIMSS 2019 results are based on the TIMSS public-use files (Mullis et al., 2020), using the R package EdSurvey (Bailey et al., 2023). The results were obtained by merging the international files with the U.S. files by school type and filtering for public schools. By using the public school samples, we sidestep any differences between the two surveys in their sampling of private schools.

While NAEP mathematics was designed to generate state-level estimates, NAEP science in 2019 was a national assessment only, so there are no state-level results.

Parameter Estimation

To find the TIMSS score associated with a particular *NAEP Proficient* cut point, we simply map it by equating the means and standard deviations.

$$x_T = \mu_T + \frac{\sigma_T}{\sigma_N}(x_N - \mu_N) \tag{1}$$

where x_T is the *NAEP Proficient* cut point on the TIMSS scale; x_N is the *NAEP Proficient* cut point on the NAEP scale; μ_N is the mean grade 8 2019 scale score of the NAEP public school sample;

σ_T and σ_N are the standard deviations of the TIMSS public and NAEP public[3] 2019 grade 8 scores, respectively; and μ_T is the mean U.S. scale score on TIMSS in grade 8.

Using this methodology, we show the NAEP scores mapped to the TIMSS scale in Table 1.

Table 1. NAEP Proficient cut points for math and science, NAEP performance projected to the TIMSS scale, and the standard error of the projected NAEP performance level on the TIMSS scale

Assessment	NAEP Proficiency Level	NAEP Cut Score (x_N)	Projected NAEP Performance Level on TIMSS Scale (x_T)	Standard Error of Projected NAEP Performance Level on TIMSS Scale
Math	**NAEP Proficient**	299	558	4.91
Science	**NAEP Proficient**	170	568	5.24

Variance estimation of the cut points

Following Johnson et al. (2005), we use the Taylor series approximation to estimate the variance of Equation 1. However, the derivation deviates slightly from that in Johnson et al. because the equation is addressed as a single function instead of breaking it up and then combining the pieces. The Taylor series variance estimate of a function is as described in "Propagation of uncertainty" (2023):

$$\Sigma_{f(z)} = J\,\Sigma_z\,J^T \tag{2}$$

Where $\Sigma_{f(z)}$ is the covariance matrix of the results of a function *f(z)*, *J* is the Jacobian of *f(z)*, and Σ_z is the covariance matrix of the underlying vector *Z*. Here *Z* is a 4-by-1 vector of the estimates of the means and standard deviations of NAEP and TIMSS and

$$Z = \begin{bmatrix} \mu_N \\ \sigma_N \\ \mu_T \\ \sigma_T \end{bmatrix},$$

finally, Equation 1 is *f(z)*.

[3] For the remainder of this report, all references to NAEP and TIMSS results pertain exclusively to the public school subsample. We discontinue using the terms "NAEP public" and "TIMSS public" after this point, in the interest of brevity.

The Jacobian is the vector of the derivatives of x_T with respect to *Z:*

$$J = \begin{bmatrix} \frac{\partial x_T}{\partial \mu_N} \\ \frac{\partial x_T}{\partial \sigma_N} \\ \frac{\partial x_T}{\partial \mu_T} \\ \frac{\partial x_T}{\partial \sigma_T} \end{bmatrix} = \begin{bmatrix} \frac{\sigma_T}{\sigma_N} \\ -\frac{\sigma_T}{\sigma_N^2}(x_N - \mu_N) \\ 1 \\ \frac{1}{\sigma_N}(x_N - \mu_N) \end{bmatrix}.$$

Notice that the Jacobian term in both standard deviations includes a component, $x_N - \mu_N$, that makes the variance dependent on the distance from the mean on the NAEP scale.

The covariance Σ_z matrix is diagonal. Since these estimates are derived from two independent samples, the covariance terms for the first two and final two terms are zero. The covariance terms between the mean and standard deviation (within samples) are also independent. This makes Σ_z diagonal, with elements that are, in order, the variances of μ_N, σ_N, μ_T, and σ_T. These variances are annotated as capital Vs with subscripts indicating which variance they represent. For instance, V_{μ_N} represents the variance of μ_N.

Plugging in Equation 2 for the Jacobian and the diagonal variance matrix, the variance of a cut point (x_T) is

$$\mathrm{Var}(x_T) = \sigma_{X_T}^2 = J^T \Sigma J = V_{\mu_N}\left(\frac{\sigma_T}{\sigma_N}\right)^2 + V_{\sigma_N}\left[\frac{\sigma_T}{\sigma_N^2}(x_N - \mu_N)\right]^2 + V_{\mu_T} + V_{\sigma_T}\left[\frac{1}{\sigma_N}(x_N - \mu_N)\right]^2.$$

See Table 1 for the estimated standard error (square root of the variance) of the cut points.

Estimating the TIMSS country percentage above NAEP Proficient

To estimate the proportion of students above an achievement level cut score, we typically calculate

$$p = \frac{1}{\sum_i^M w_i} \sum_i^M w_i \Pr(\theta \geq x_T),$$

where *p* is the proportion of students above the cut score x_T, θ is the measure of student ability, and there are *M* students, indexed by *i*, each with weight w_i. This probability (*Pr*) is accounted for by integrating across all possible values of the latent ability:

$$p = \frac{1}{\sum_i^M w_i} \sum_i^M w_i \int \mathrm{f}(\theta)[1 \; if \; \theta \geq x_T] d\theta \, .$$

This integration is performed using the *K* plausible values:

$$p = \frac{1}{\sum_i^M w_i} \sum_i^M w_i \sum_{\mathrm{k}}^{\mathrm{K}} [1 \text{ if } \hat{\theta}_{ik} > x_T]$$

Where $\hat{\theta}_{ik}$ is the ith student's kth plausible value.

The variance of *p* is partitioned into two independent components: sampling variance and measurement variance. The sampling variance accounts for the sampling process, while the measurement variance uses the estimate for one plausible value at a time (reversing the order of the sums) and calculates the variance across plausible values.

The discussion so far has excluded uncertainty in x_T. To incorporate that, with θ measured on the TIMSS scale,

$$p = \frac{1}{\sum_i^M w_i} \sum_i^M w_i \int [1 \text{ if } \theta \geq x_T] f(x_T) dx_T \, .$$

Assuming the error in the cut point is normally distributed,

$$p = \frac{1}{\sum_i^N w_i} \sum_i^N w_i \Phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right),$$

Where σ_{x_T} is the variance of the mapped achievement level (from the above equations).

Variance estimation of the proportion above NAEP Proficient

Again using Equation 1, the Jacobian is the first derivative vector.

$$\frac{\partial p}{\partial x_T} = \frac{\partial}{\partial x_T}\left[\frac{1}{\sum_i^N w_i} \sum_i^N w_i \Phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right)\right].$$

Since *w* is not a function of *c,*

$$\frac{\partial p}{\partial x_T} = \frac{1}{\sum_i^N w_i} \sum_i^N w_i \frac{\partial}{\partial x_T} \Phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right).$$

Using the chain rule,

$$\frac{\partial}{\partial x_T} \Phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right) = \phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right) \cdot \frac{\partial}{\partial x_T}\left(\frac{\theta - x_T}{\sigma_{x_T}}\right),$$

$$= \phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right) \cdot \left(\frac{-1}{\sigma_{x_T}}\right).$$

The Jacobian term for θ is very similar. Stacking these up,

$$J = \begin{bmatrix} \frac{\partial p}{\partial \theta} \\ \frac{\partial p}{\partial x_T} \end{bmatrix} = \begin{bmatrix} \frac{1}{\sigma_{x_T}} \cdot \frac{1}{\sum_i^M w_i} \sum_i^M w_i \phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right) \\ -\frac{1}{\sigma_{x_T}} \cdot \frac{1}{\sum_i^M w_i} \sum_i^M w_i \phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right) \end{bmatrix}$$

The matrix Σ is, again, a diagonal matrix because θ is based entirely on the non-U.S. country's TIMSS data, while x_T is based entirely on the U.S. data. Thus, for all countries but the United States, the variance estimator takes the form of the Taylor variance estimator term Σ_z, which is again diagonal. This diagonal pattern results from the fact that the estimation of a country's NAEP proficiency level relies exclusively on the U.S. sample. As a result, the sampling and imputation error are independent across the various terms.

$$V_p = V_{\text{TIMSS}} + V_{\text{linking}}$$

where V_{TIMSS} is the variance of the proportion, calculated using routine TIMSS analytic methods. This result mirrors what would typically be reported for an estimate of the proportion above a cut point in a published study that appropriately addresses both sampling and imputation variance. For example, it matches the result that would be generated by EdSurvey's achievementLevels function (Lee et al., 2022).

Then, defining

$$\xi \equiv \frac{1}{\sum_i^M w_i} \sum_i^M w_i \phi\left(\frac{\theta - x_T}{\sigma_{x_T}}\right) = -\sigma_{x_T} \cdot \frac{\partial p}{\partial x_T},$$

the linking variance is

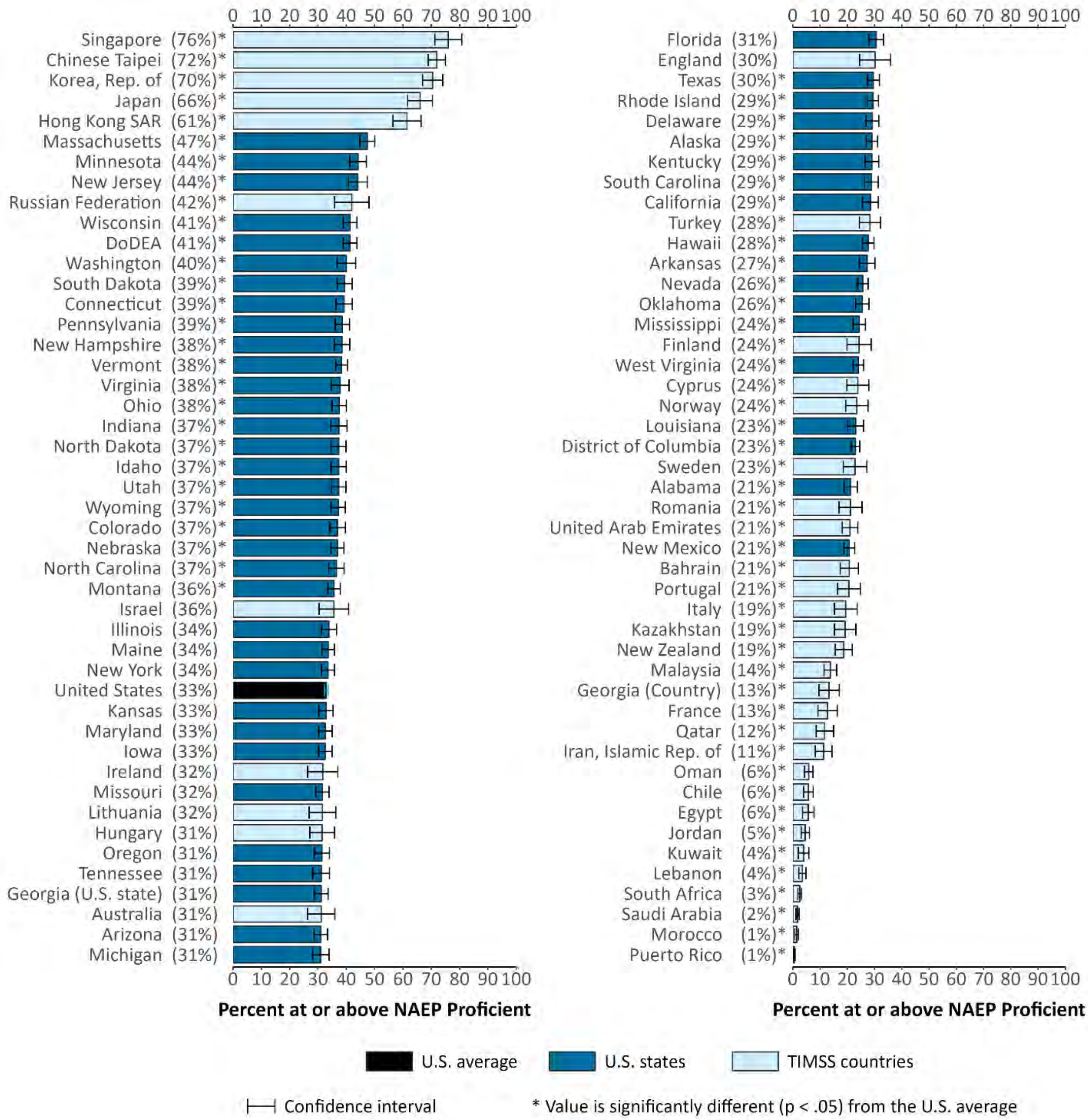
$$V_{\text{linking}} = \left(\frac{\partial p}{\partial x_T}\right)^2 \sigma_{x_T}^2 = \left(-\frac{1}{\sigma_{x_T}} \cdot \xi\right)^2 \sigma_{x_T}^2 = \xi^2 \,.$$

Results

Figure 1 displays the percentage of the U.S. national public sample, each state, and each participating TIMSS country with grade 8 mathematics performance at the 2019 *NAEP Proficient* level. Notably, Singapore stands out with 76% of its students performing at the *NAEP Proficient* level based on its TIMSS mathematics results. The figure also offers a comparative overview of how all states perform in relation to the TIMSS participating countries. A version of this figure that focuses on each state (i.e., shows the significant differences relative to that state) is included in the appendix to this report. For example, Figure A.1 focuses on Alabama.

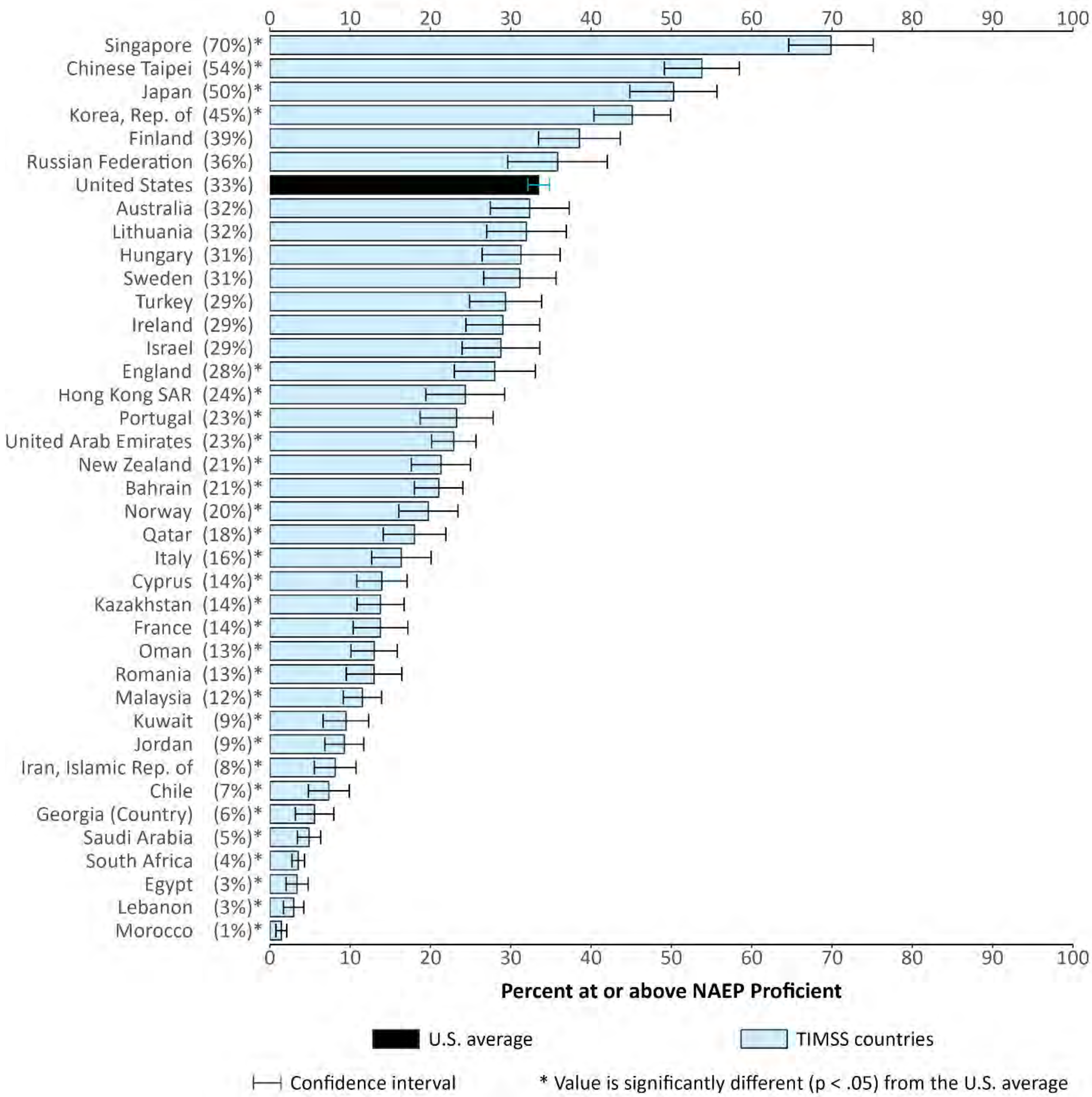
Figure 2 displays the percentage of the U.S. national public sample and each participating TIMSS country with grade 8 science performance at the 2019 *NAEP Proficient* level. Unlike the mathematics assessment, the 2019 NAEP science assessment was not designed to estimate state-level values. In line with the mathematics assessment, Singapore once again had the highest percentage of students (70%) performing at the *NAEP Proficient* level, based on its TIMSS science results.

Figure 1. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries



NOTE: The *NAEP Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. *NAEP Proficient* percentages were measured using TIMSS and statistical moderation.

Figure 2. Percentage of students performing at the NAEP Proficient level in grade 8 science across the U.S. national public school sample and TIMSS countries



NOTE: The *NAEP Proficient* percentage for the U.S. national public sample was measured using NAEP. All non-U.S. *NAEP Proficient* percentages were measured using TIMSS and statistical moderation.

References

Bailey, P., Emad, A., Huo, H., Lee, M., Liao, Y., Lishinsku, A., Nguyen, T., Xie, Q., Yu, J., Zhang, T., Buehler, E., Lee, S., and Webb, B. (2023). *EdSurvey: Analysis of NCES Education Survey and Assessment Data* (R package version 4.0.1). https://CRAN.R-project.org/package=EdSurvey

Jia, Y., Phillips, G., Wise, L.L., Rahman, T., Xu, X., Wiley, C., and Diaz, T.E. (2014). *2011 NAEP-TIMSS Linking Study: Technical Report on the Linking Methodologies and Their Evaluations* (NCES 2014-461). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, DC.

Johnson, E., Cohen, J., Chen, W.H., Jiang, T., and Zhang, Y. (2005). *2000 NAEP−1999 TIMSS Linking Report* (NCES 2005-01). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Lee, M., Zhang, T., Bailey, P., Buehler, E., Fink, T., Huo, H., Lee, S., Liao Y., and Sikali, E. (2022). *Analyzing NCES Data Using EdSurvey: A User's Guide*. American Institutes for Research. https://naep-research.airprojects.org/Portals/0/EdSurvey_A_Users_Guide/_book/index.html

Mullis, I.V.S., Martin, M.O., Foy, P., Kelly, D.L., and Fishbein, B. (2020). *TIMSS 2019 International Results in Mathematics and Science.* Retrieved from Boston College, TIMSS & PIRLS International Study Center website: https://timssandpirls.bc.edu/timss2019/international-results

Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., and Smith, T.A. (2000). *Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*. Boston College. Boston, MA.

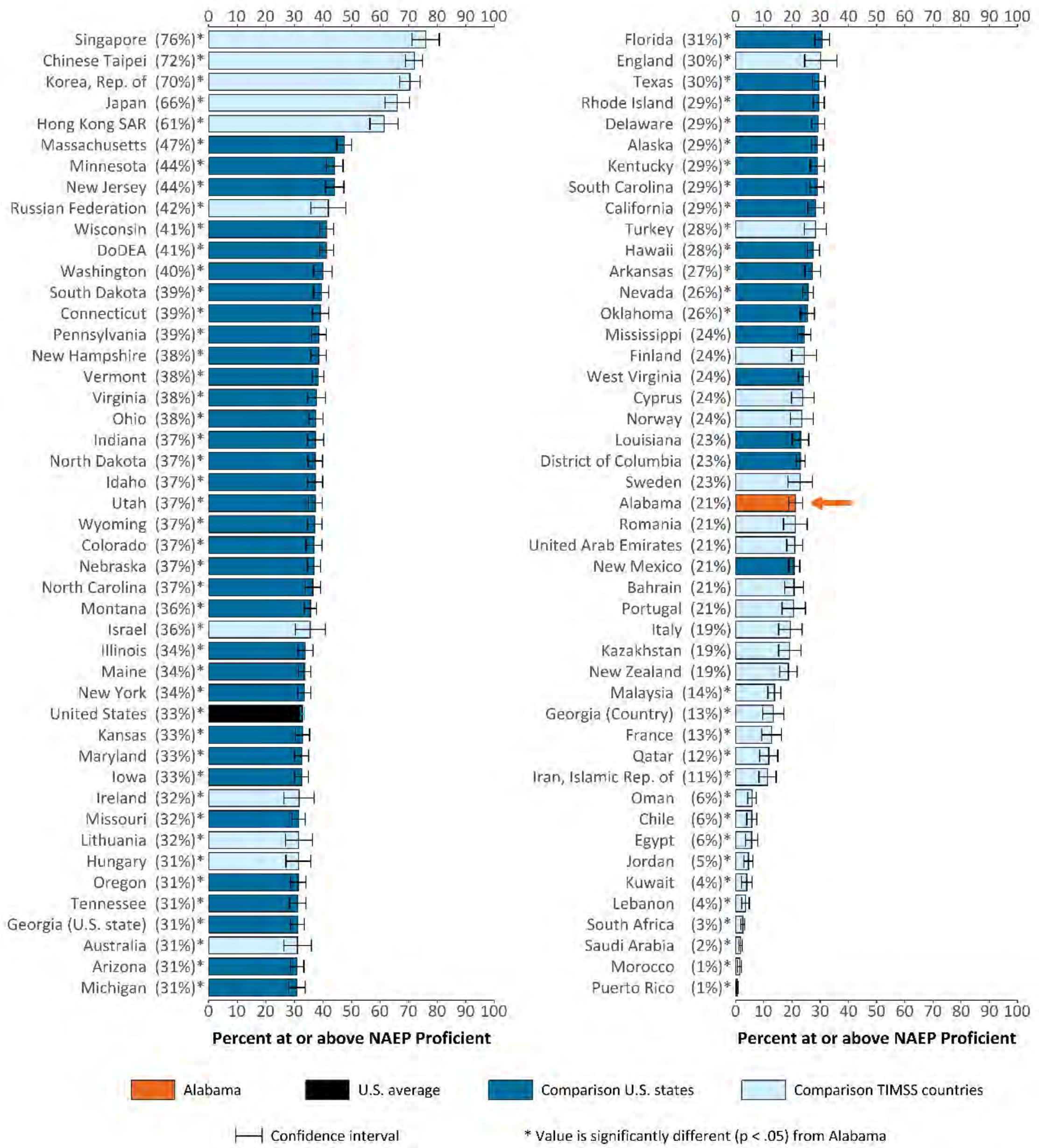
Philips, G. (2007). *Expressing International Educational Achievement in Terms of U.S. Performance Standards: Linking NAEP Achievement Levels to TIMSS*. American Institutes for Research. Washington, DC.

Propagation of uncertainty. (2023, July 20). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Propagation_of_uncertainty&oldid=1164321679

U.S. Department of Education. (n.d.). Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2019 Mathematics Assessment.

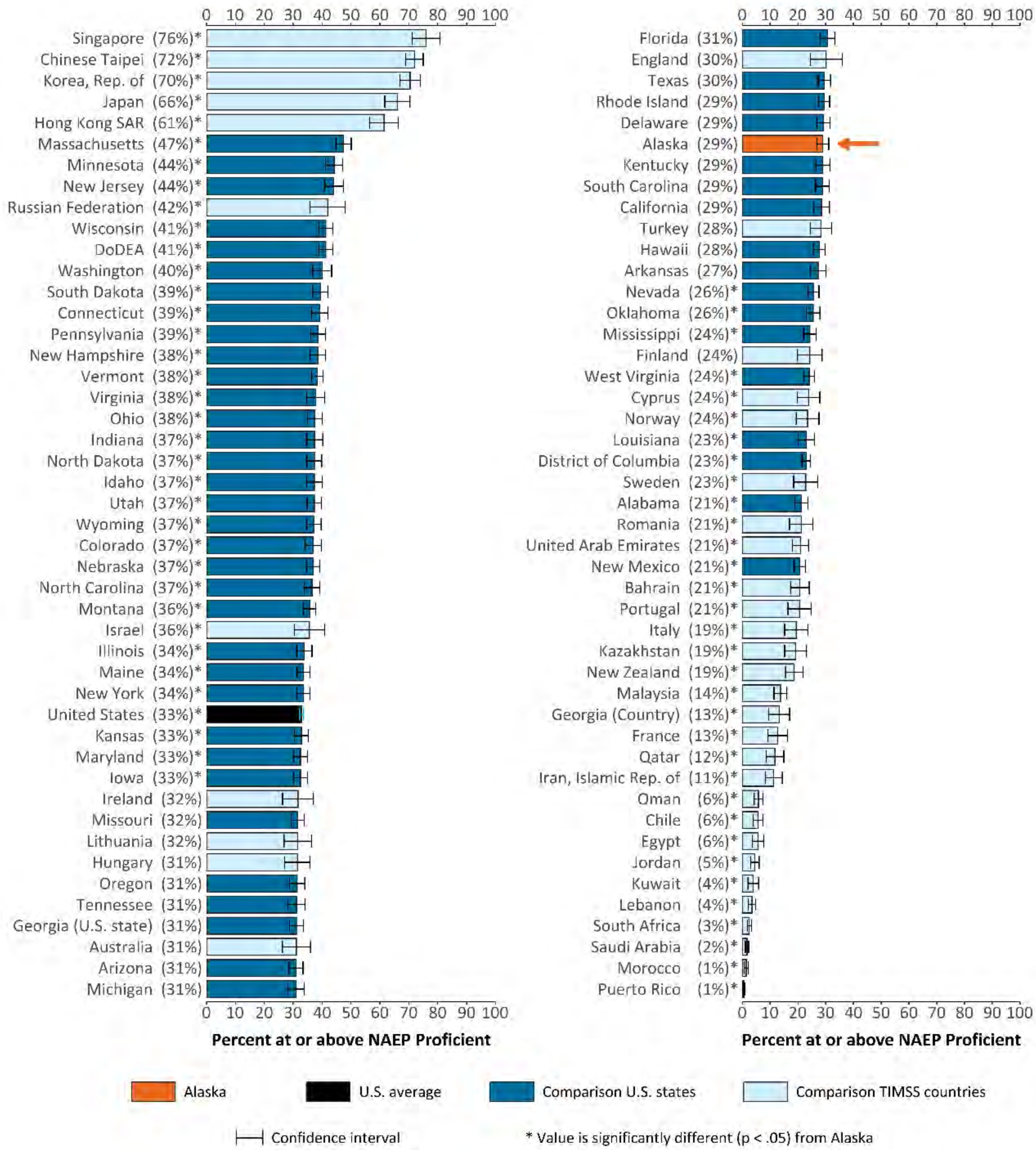
Appendix

Figure A.1. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Alabama



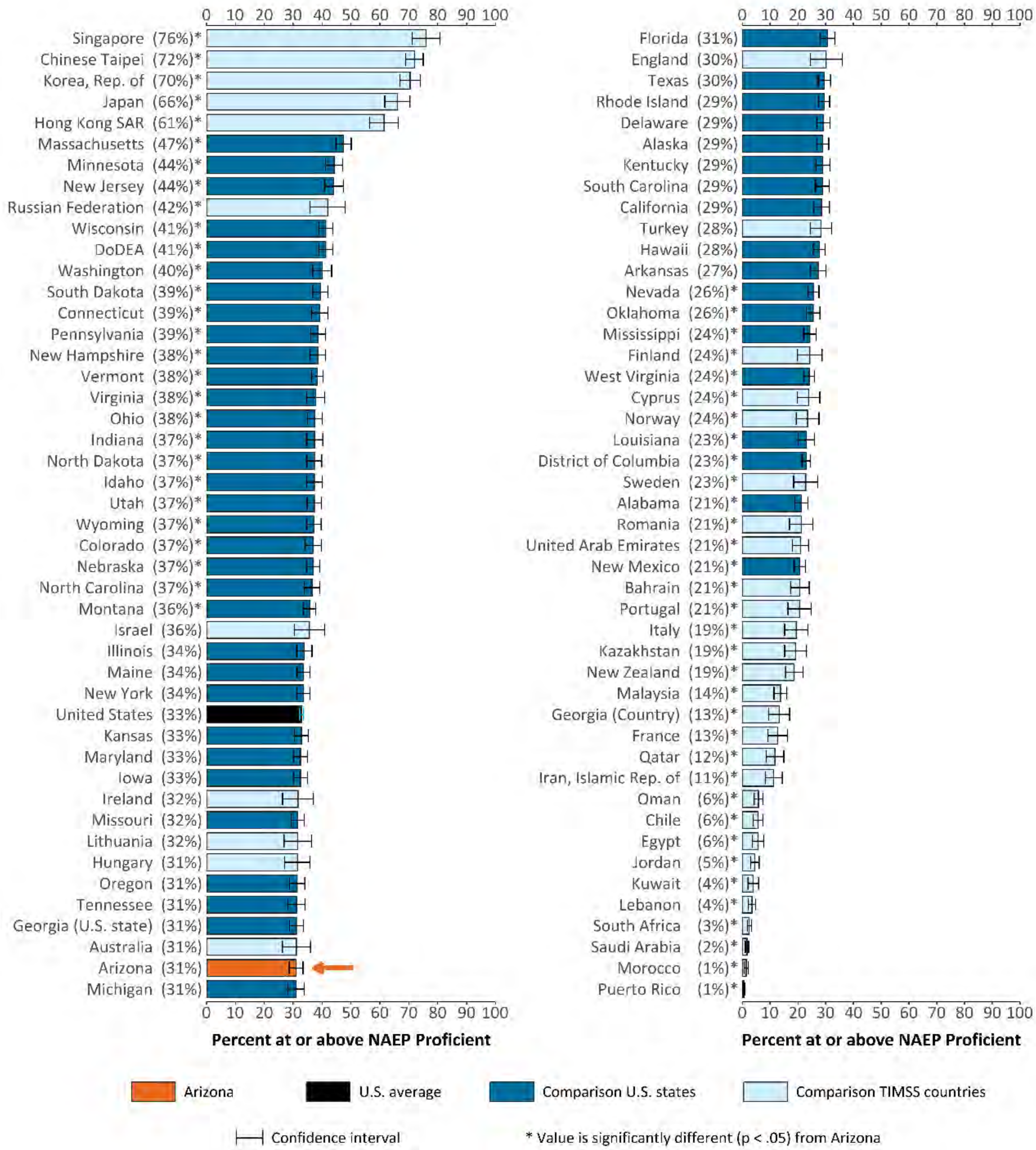
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.2. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Alaska



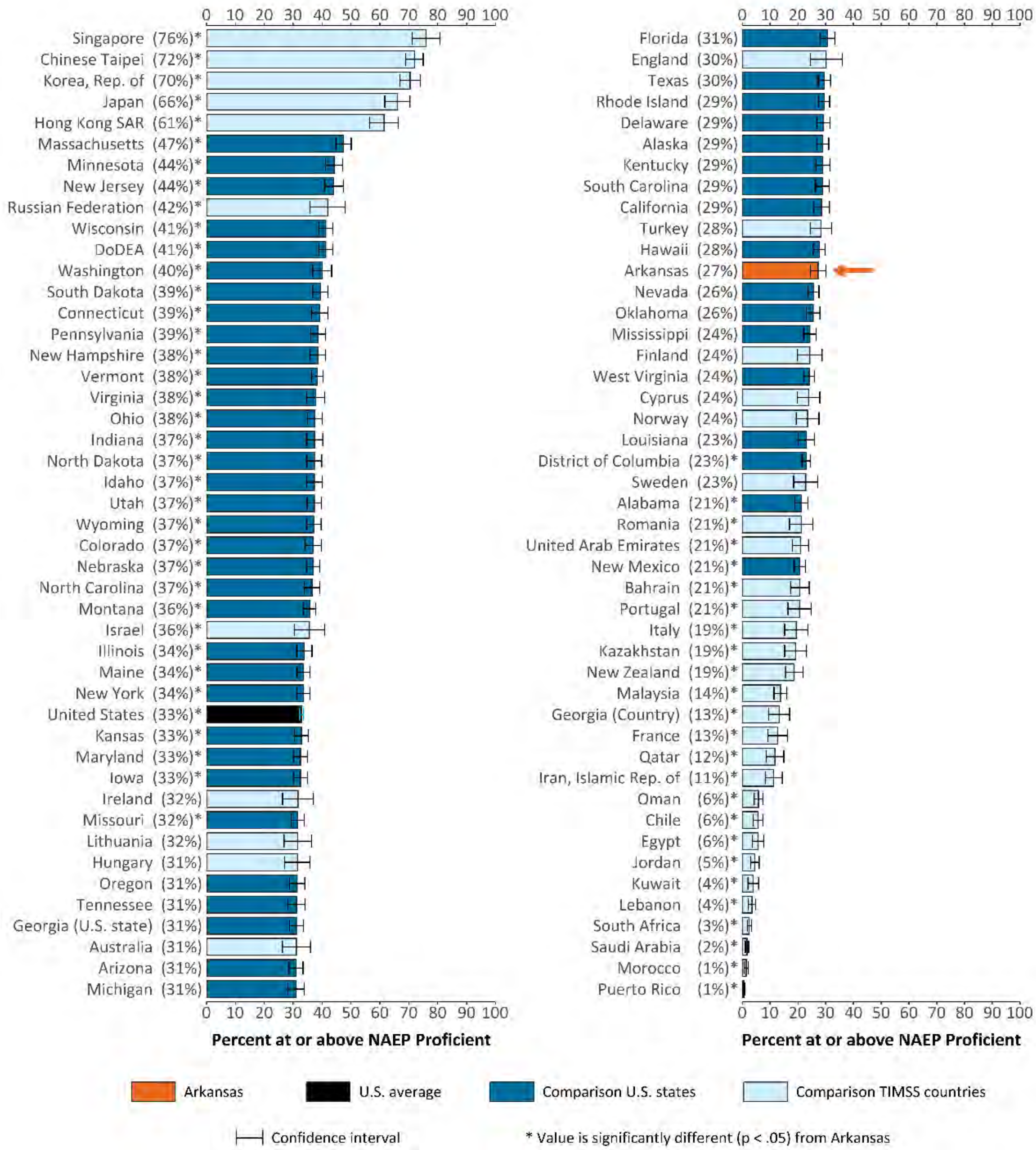
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.3. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Arizona



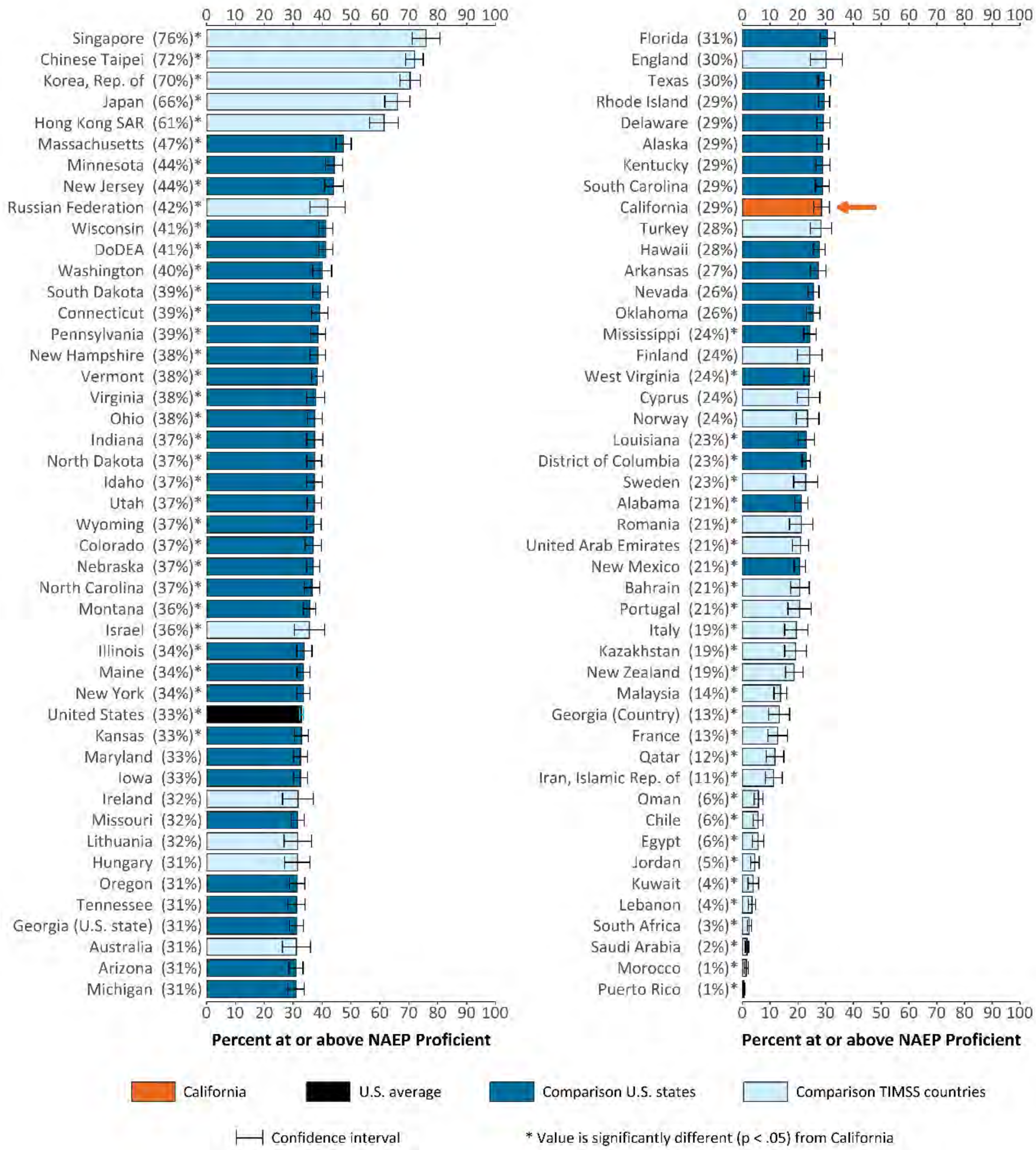
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.4. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Arkansas



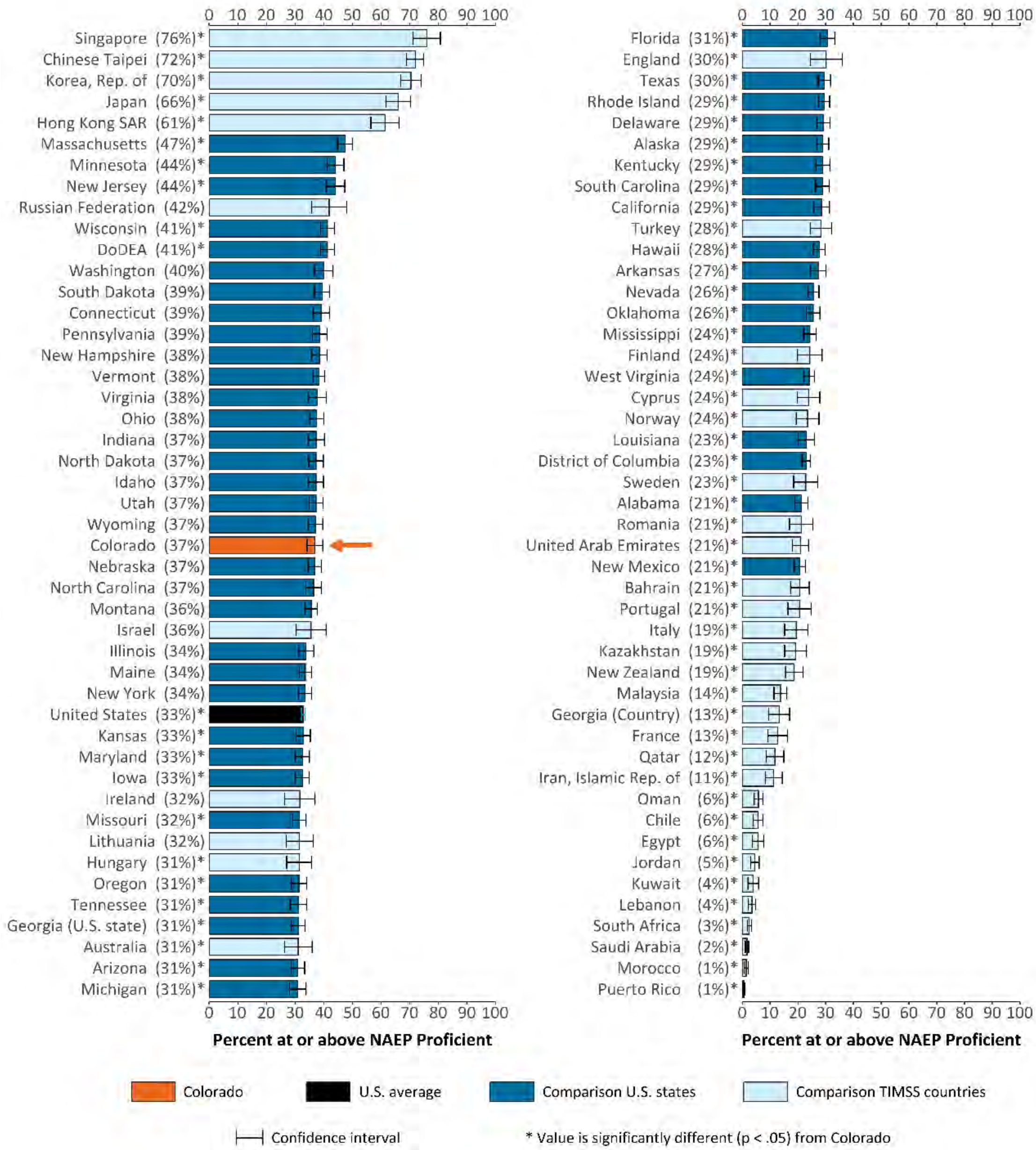
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.5. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to California



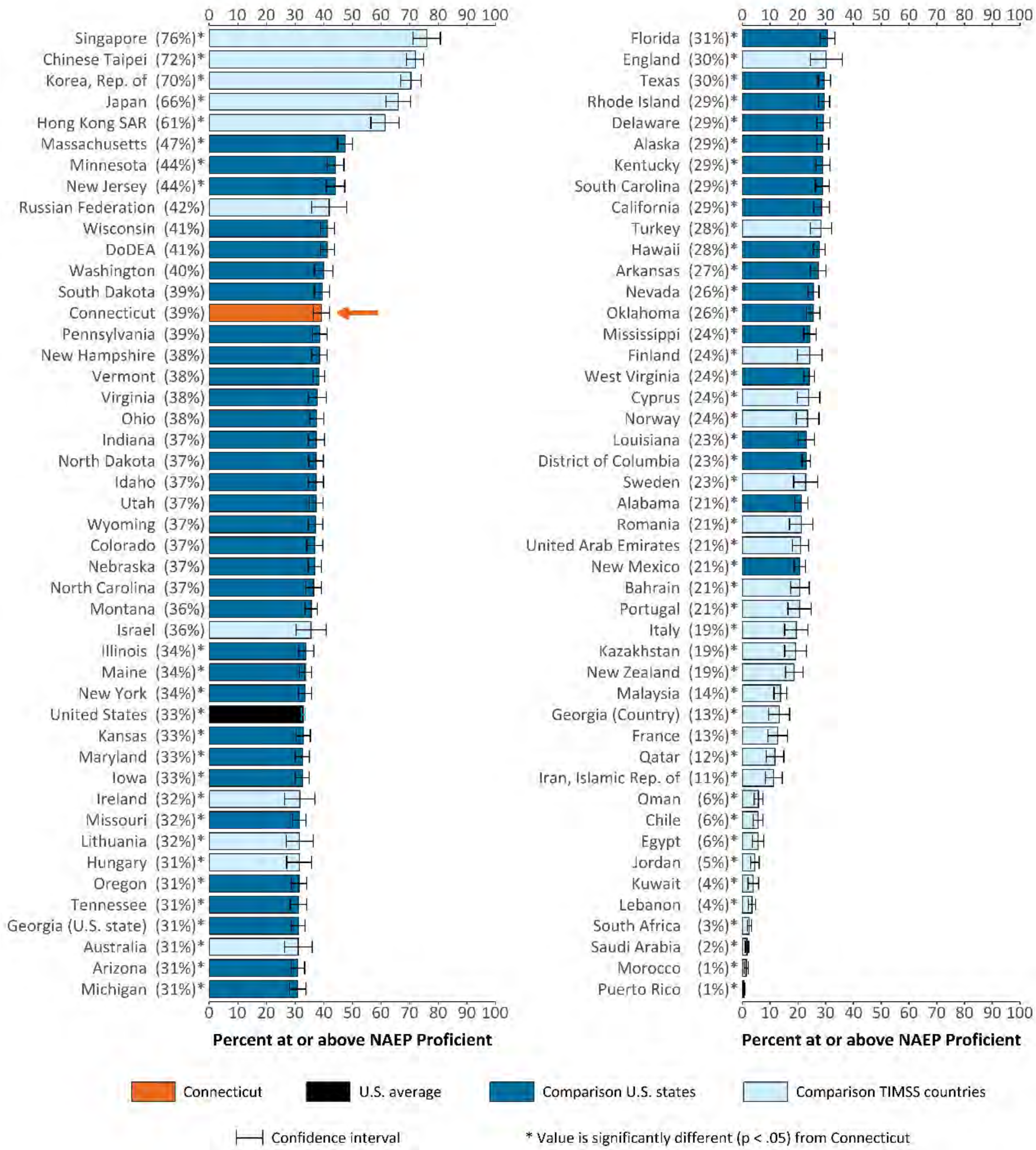
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.6. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Colorado



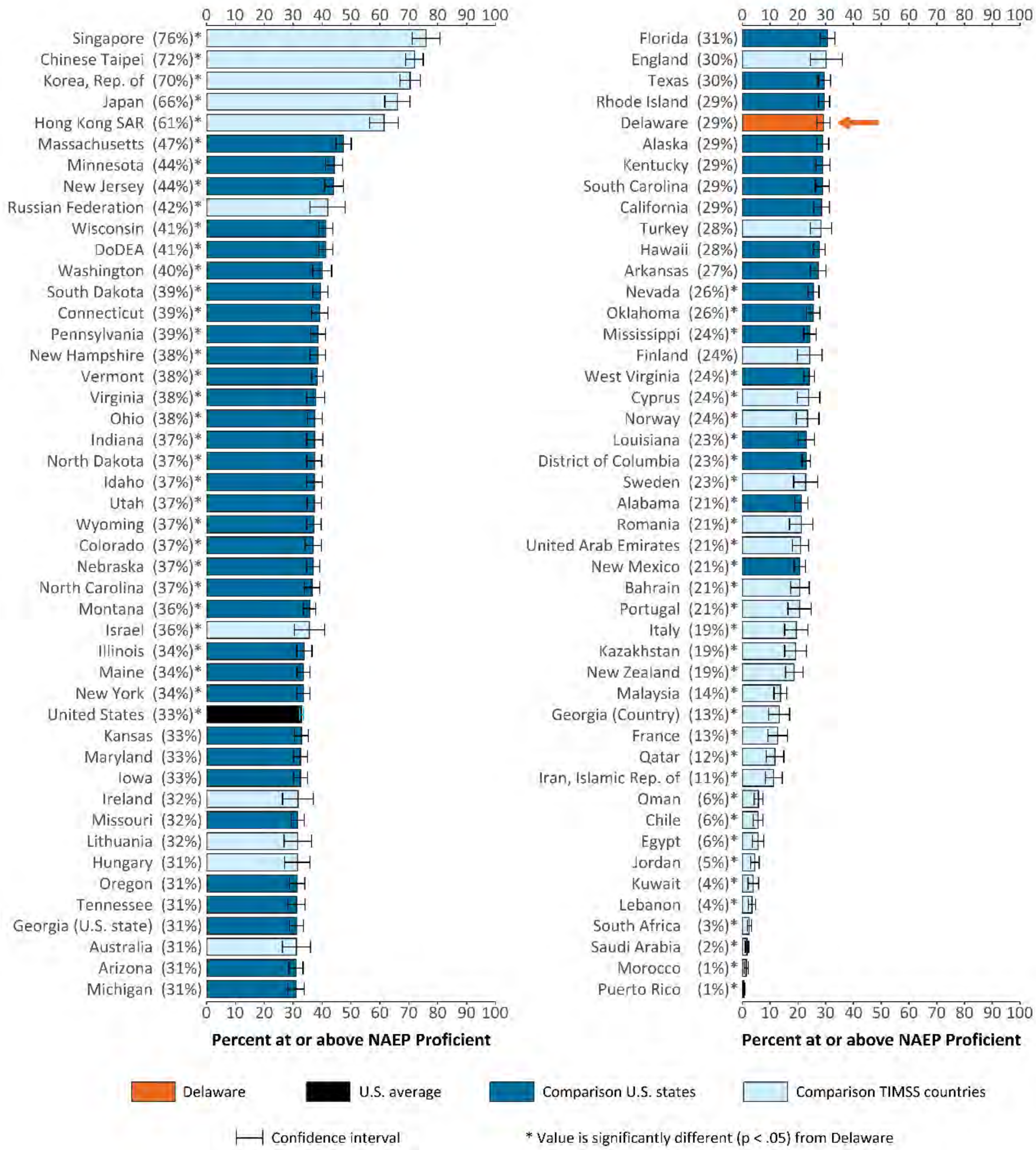
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.7. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Connecticut



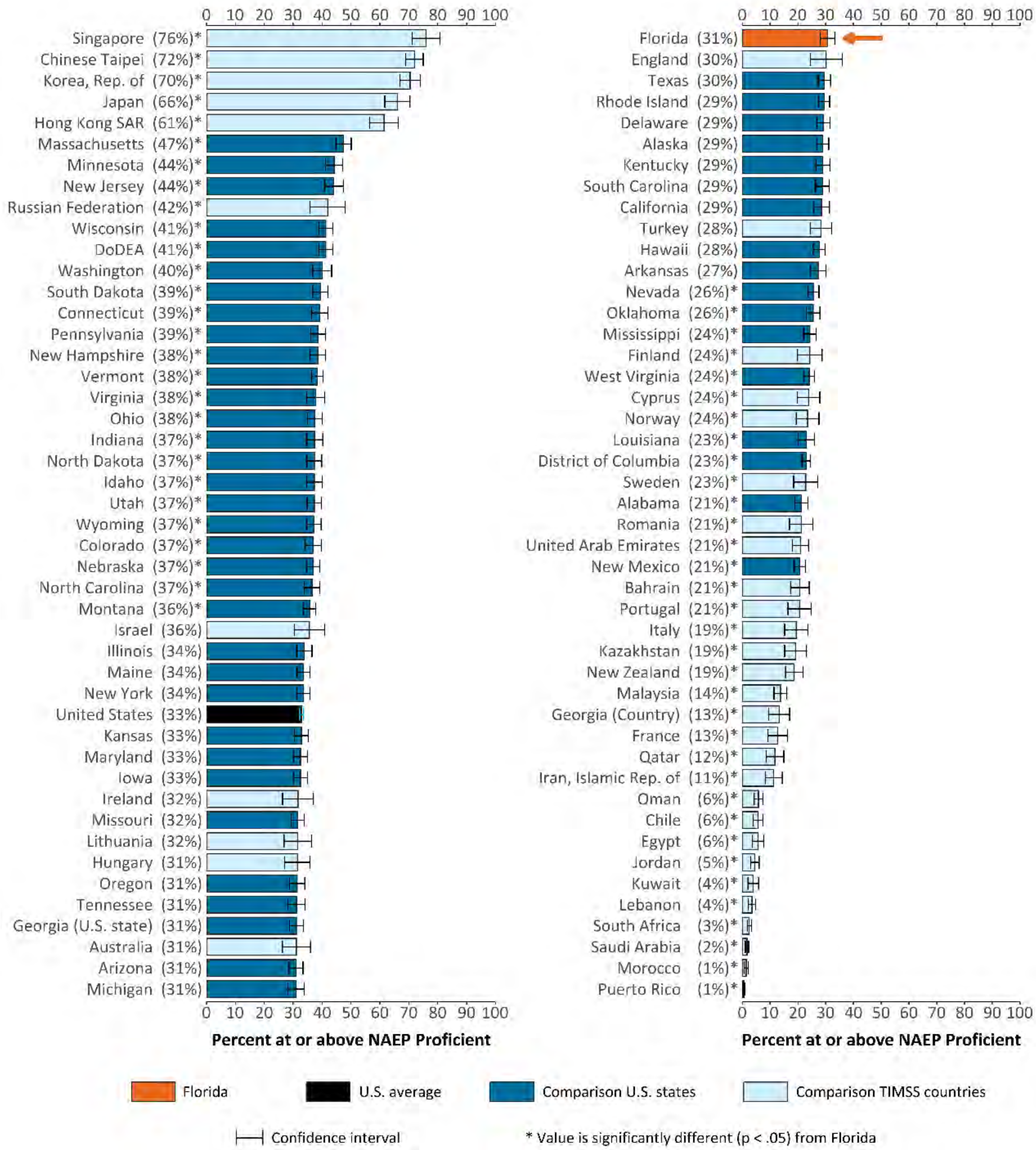
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.8. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Delaware



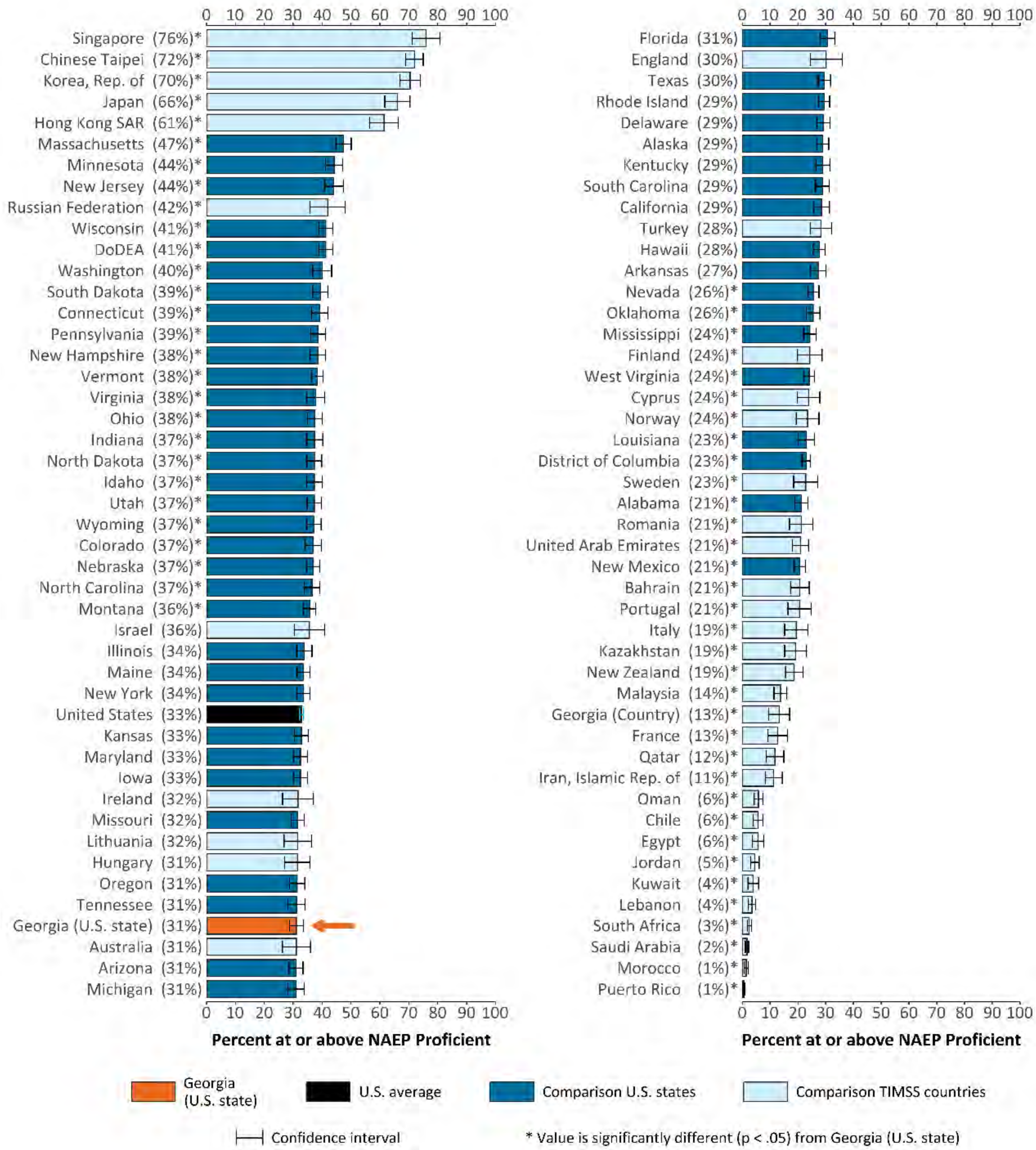
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.9. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Florida



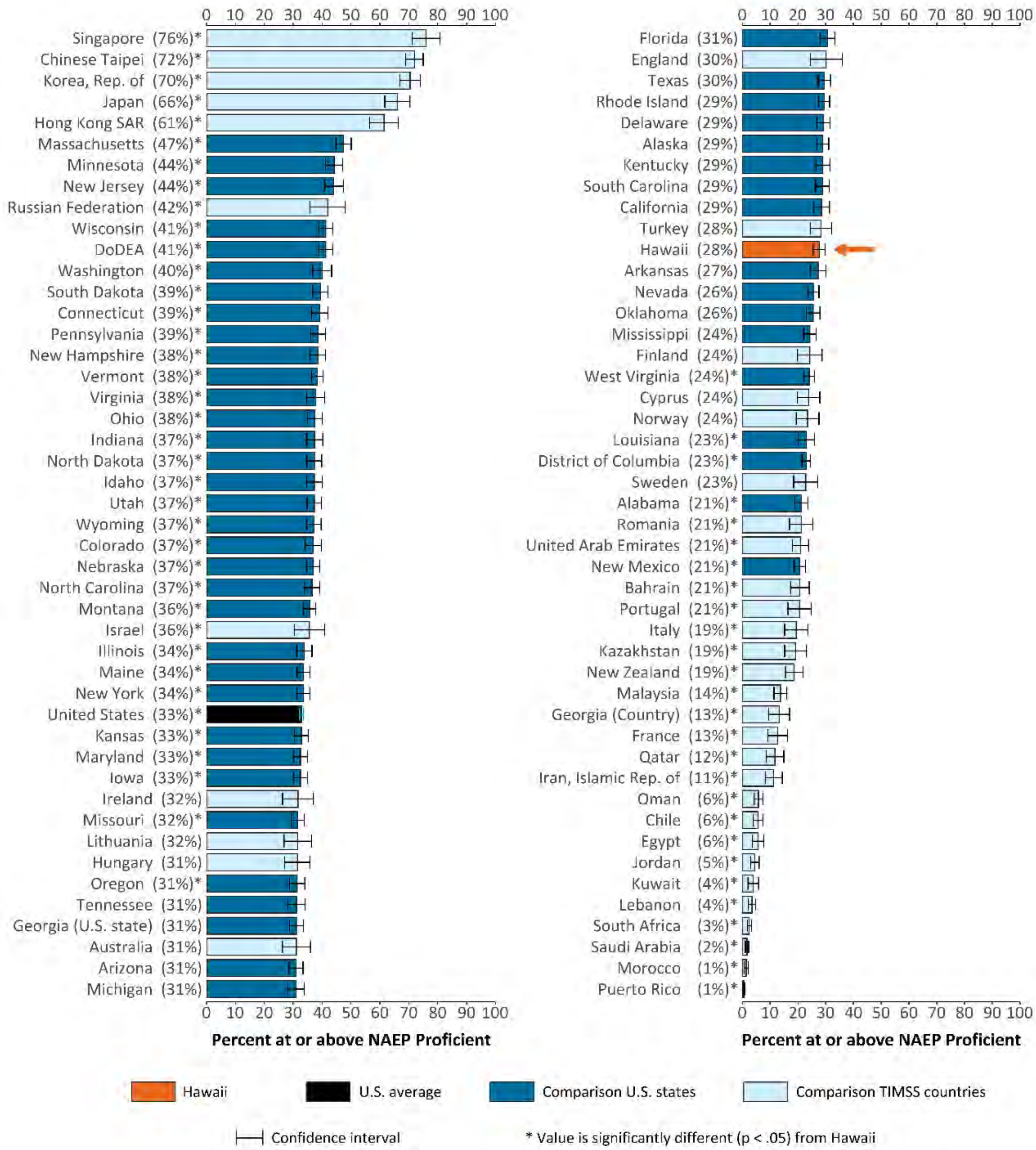
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.10. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Georgia (U.S. state)



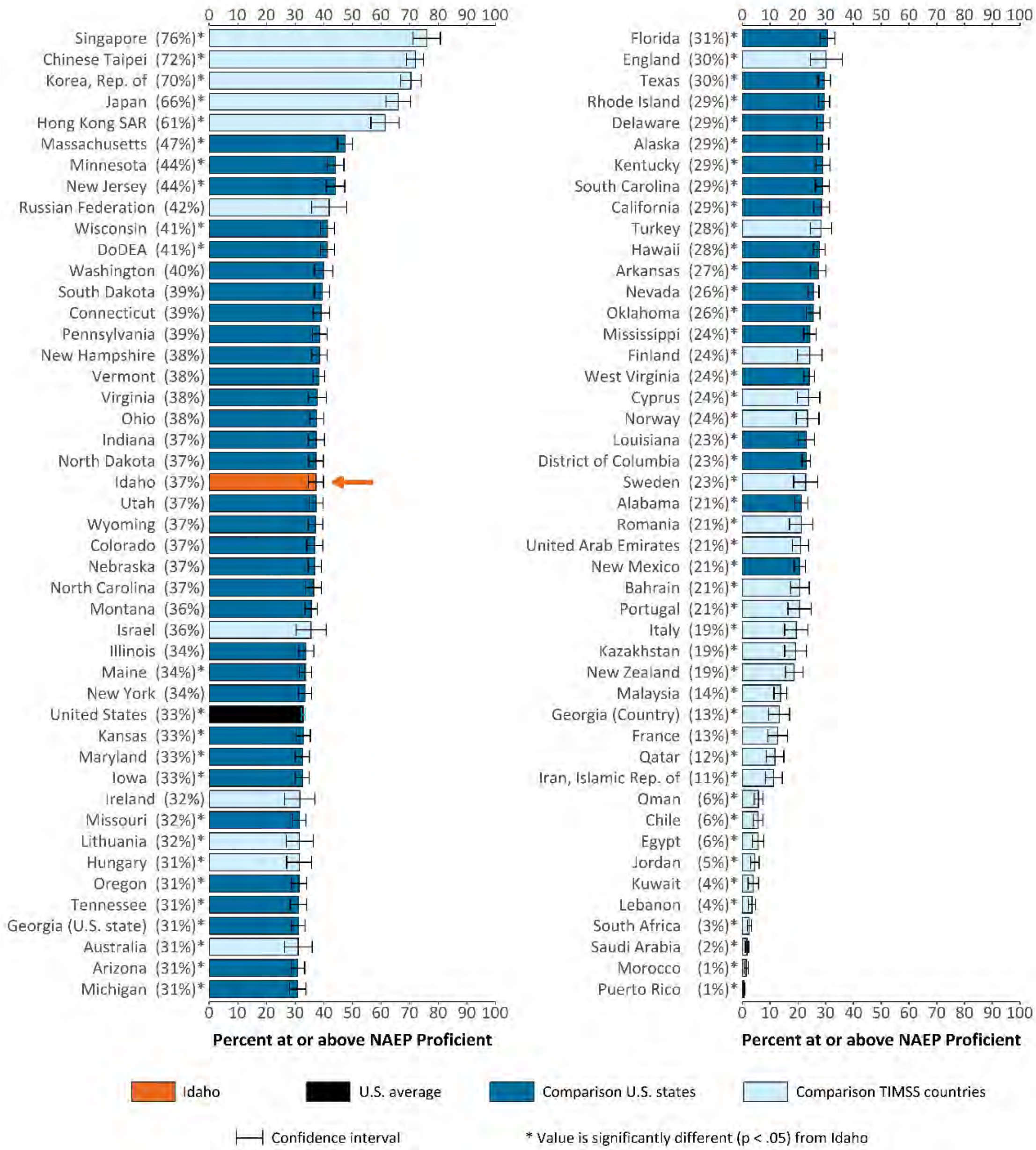
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.11. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Hawaii



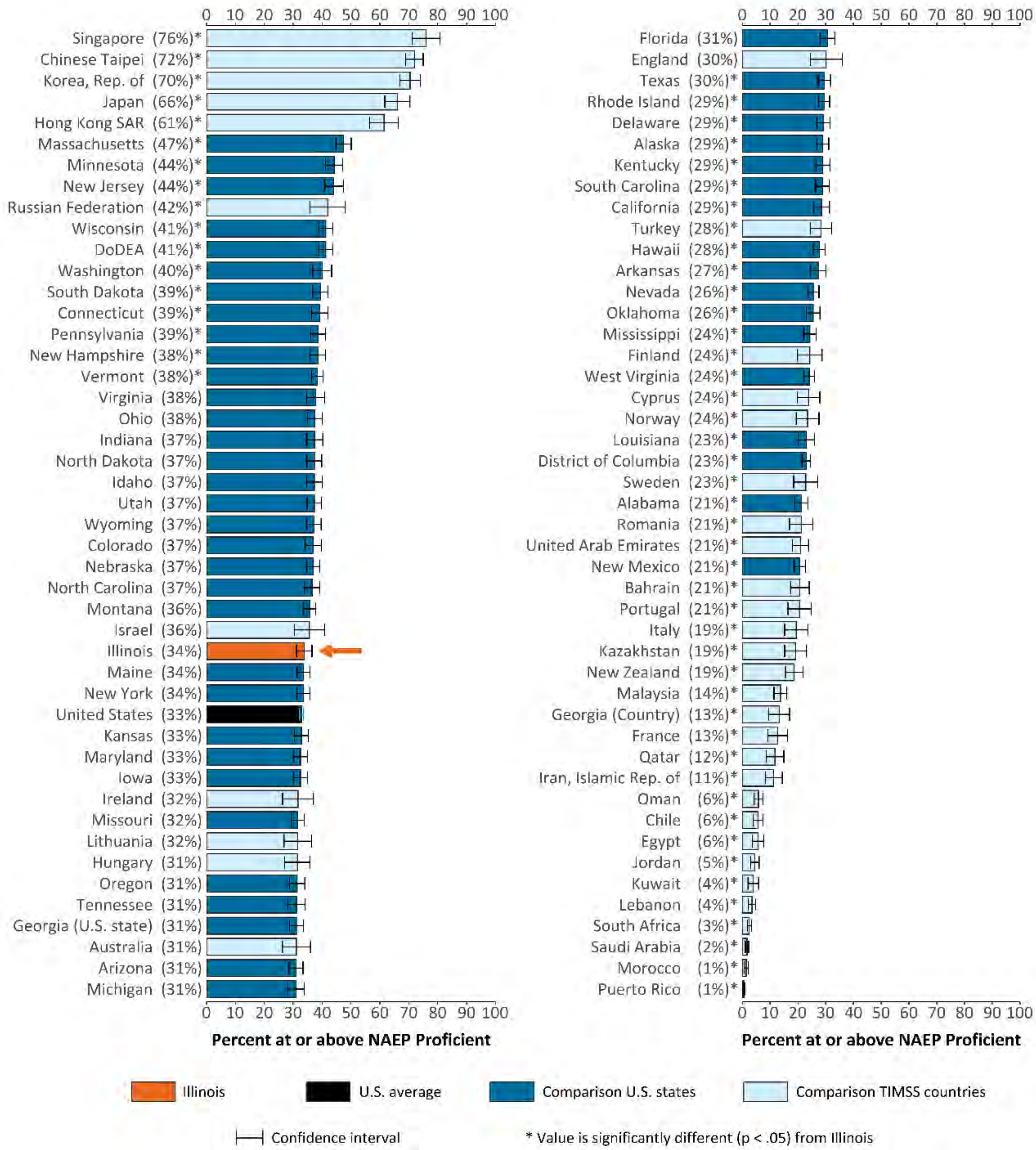
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.12. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Idaho



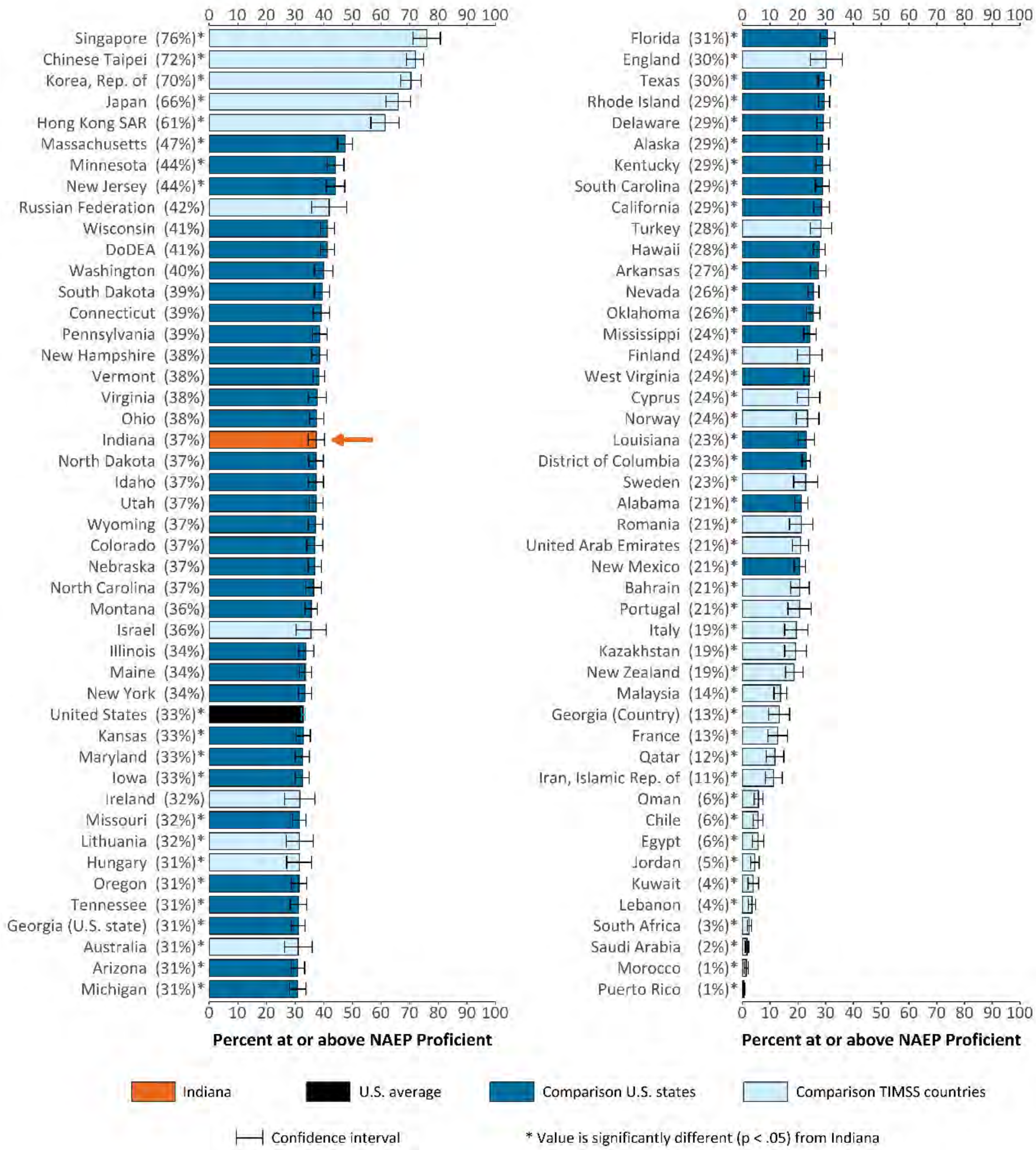
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.13. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Illinois



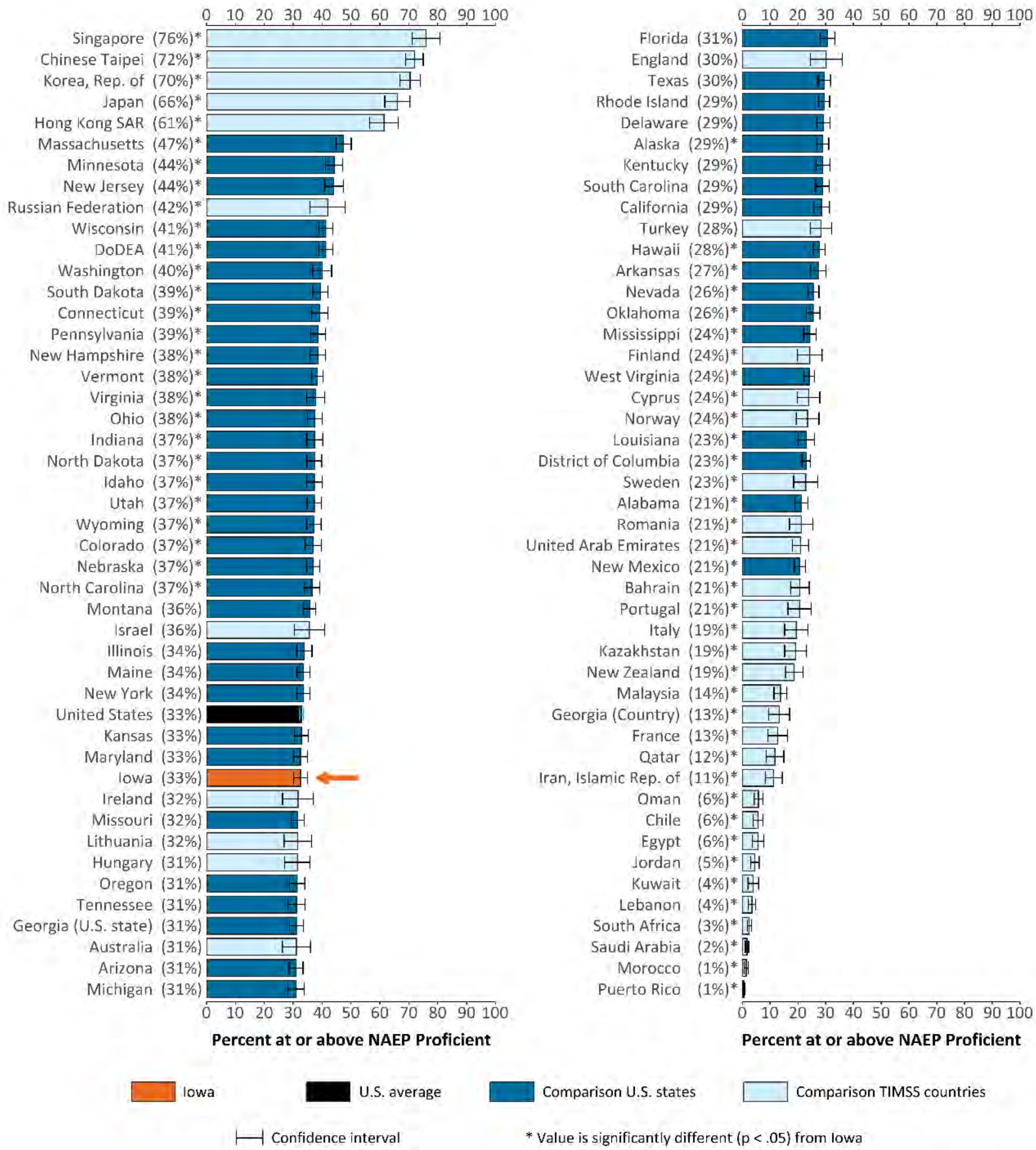
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.14. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Indiana



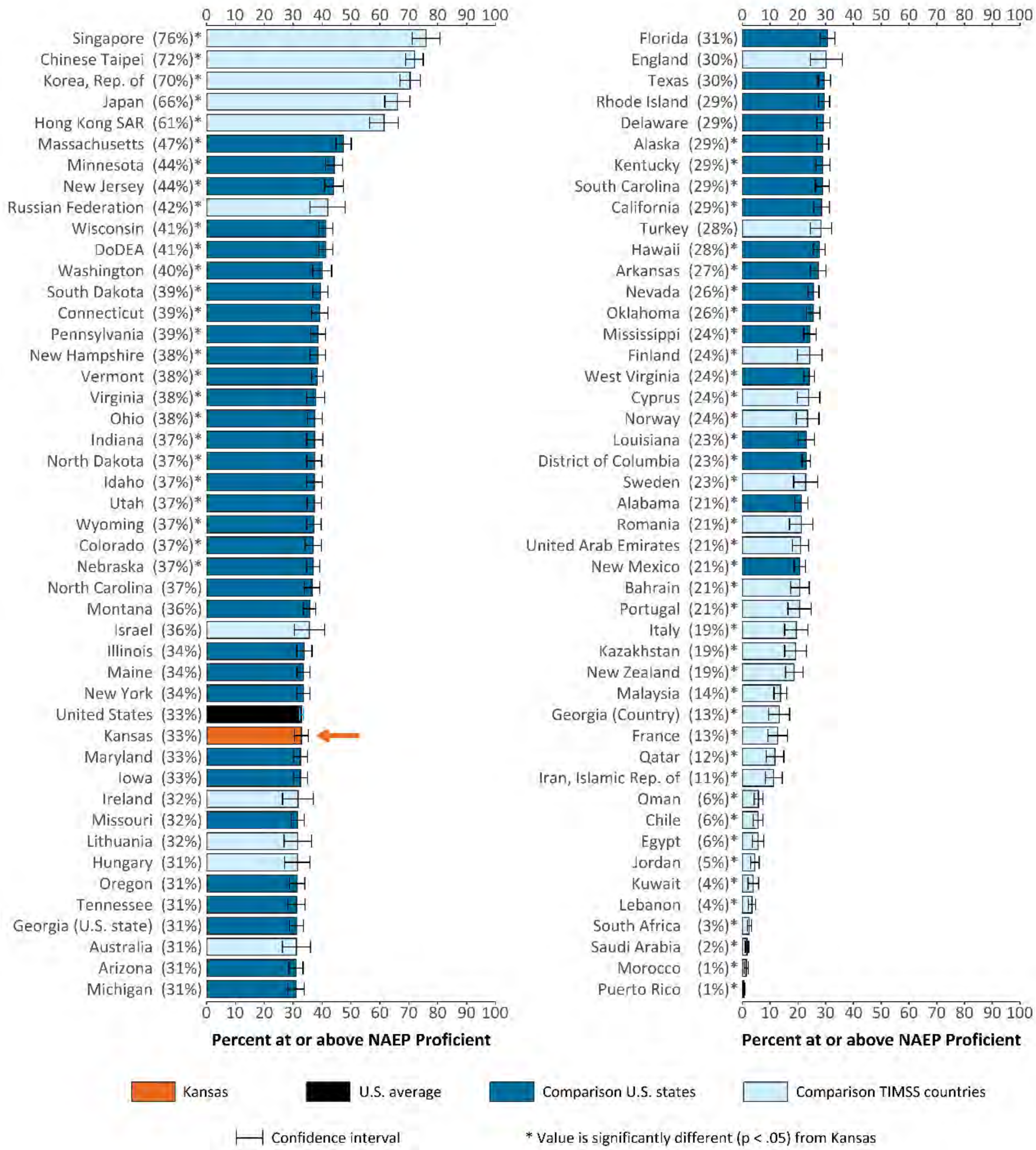
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.15. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Iowa



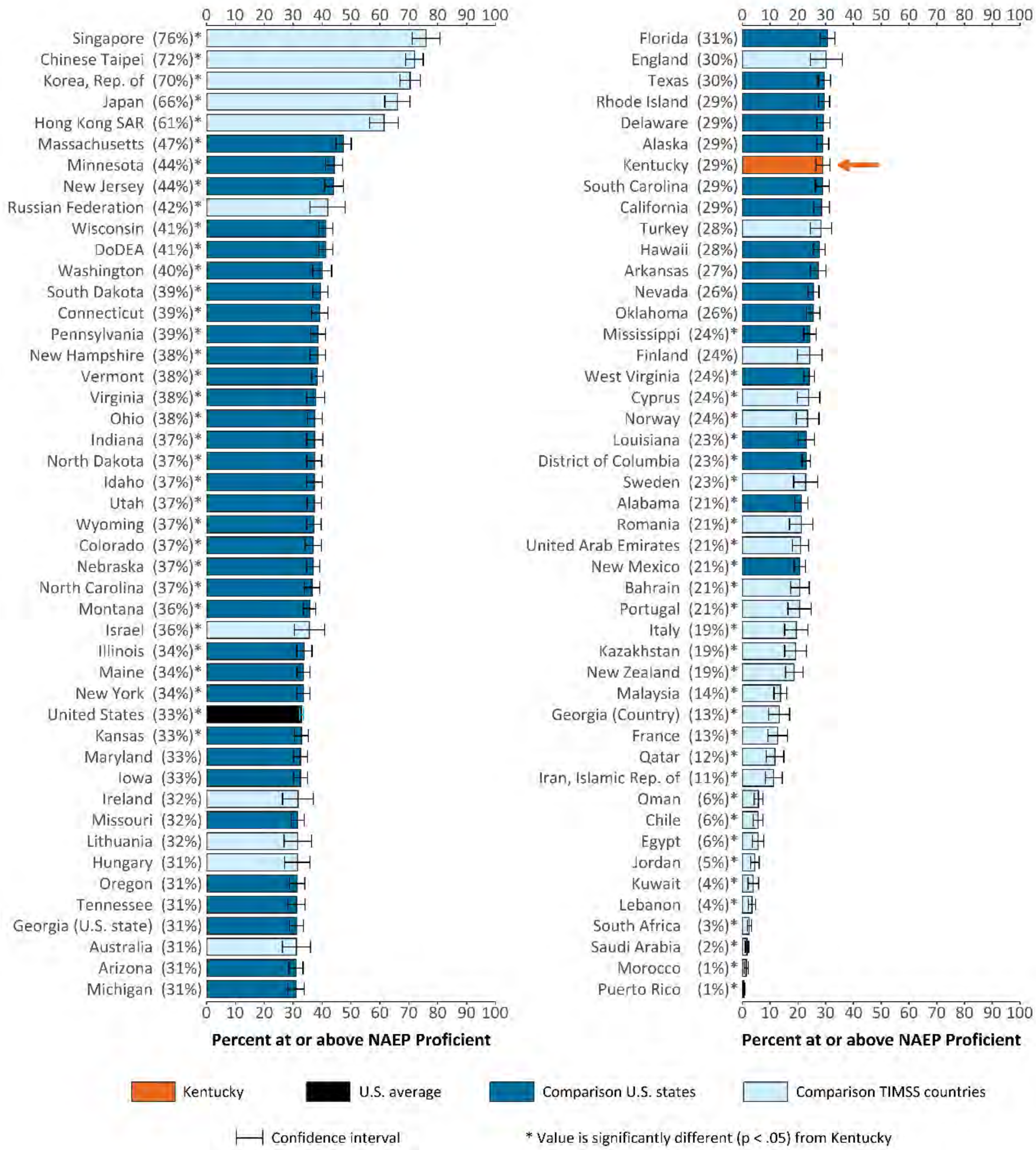
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.16. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Kansas



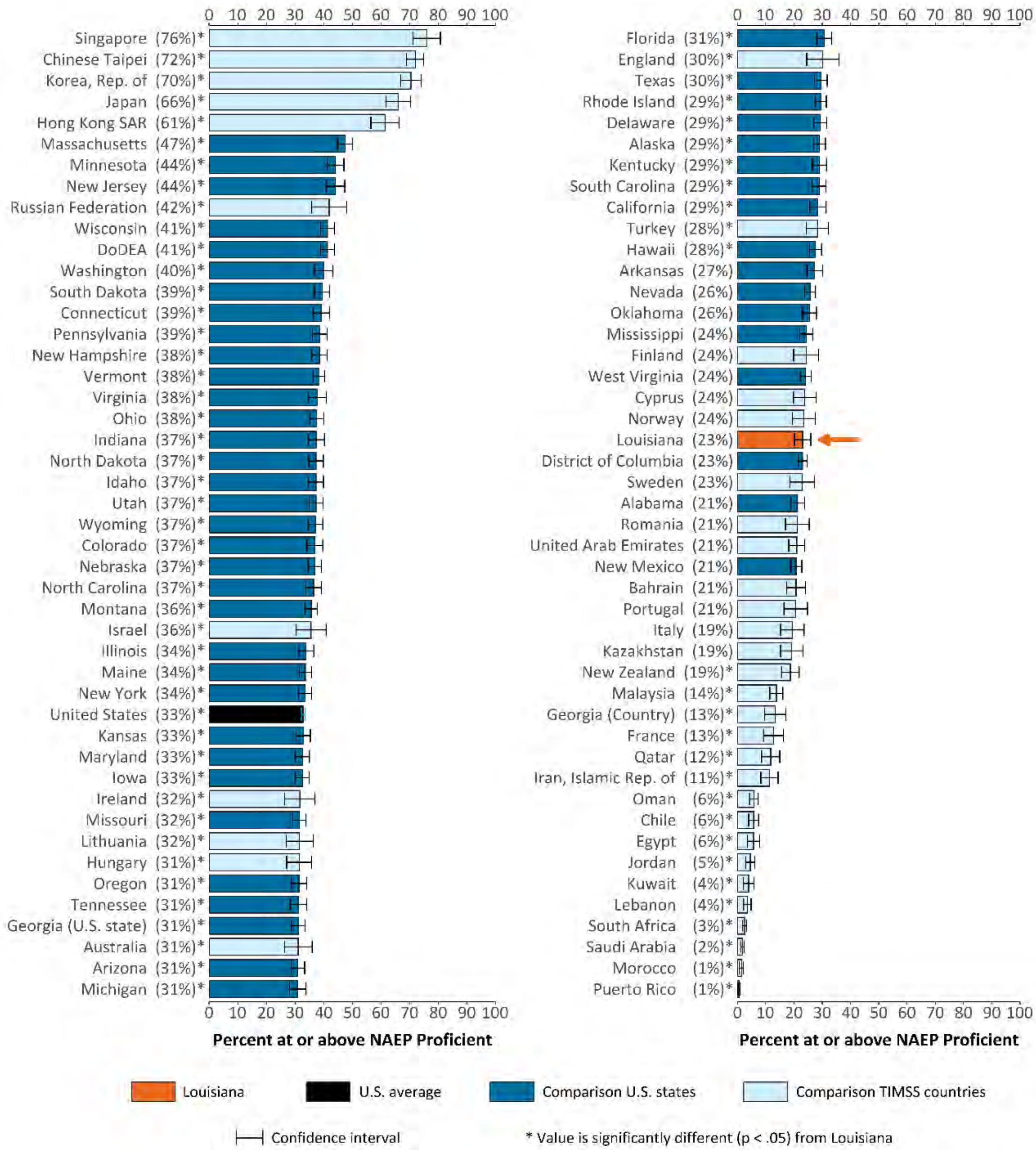
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.17. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Kentucky



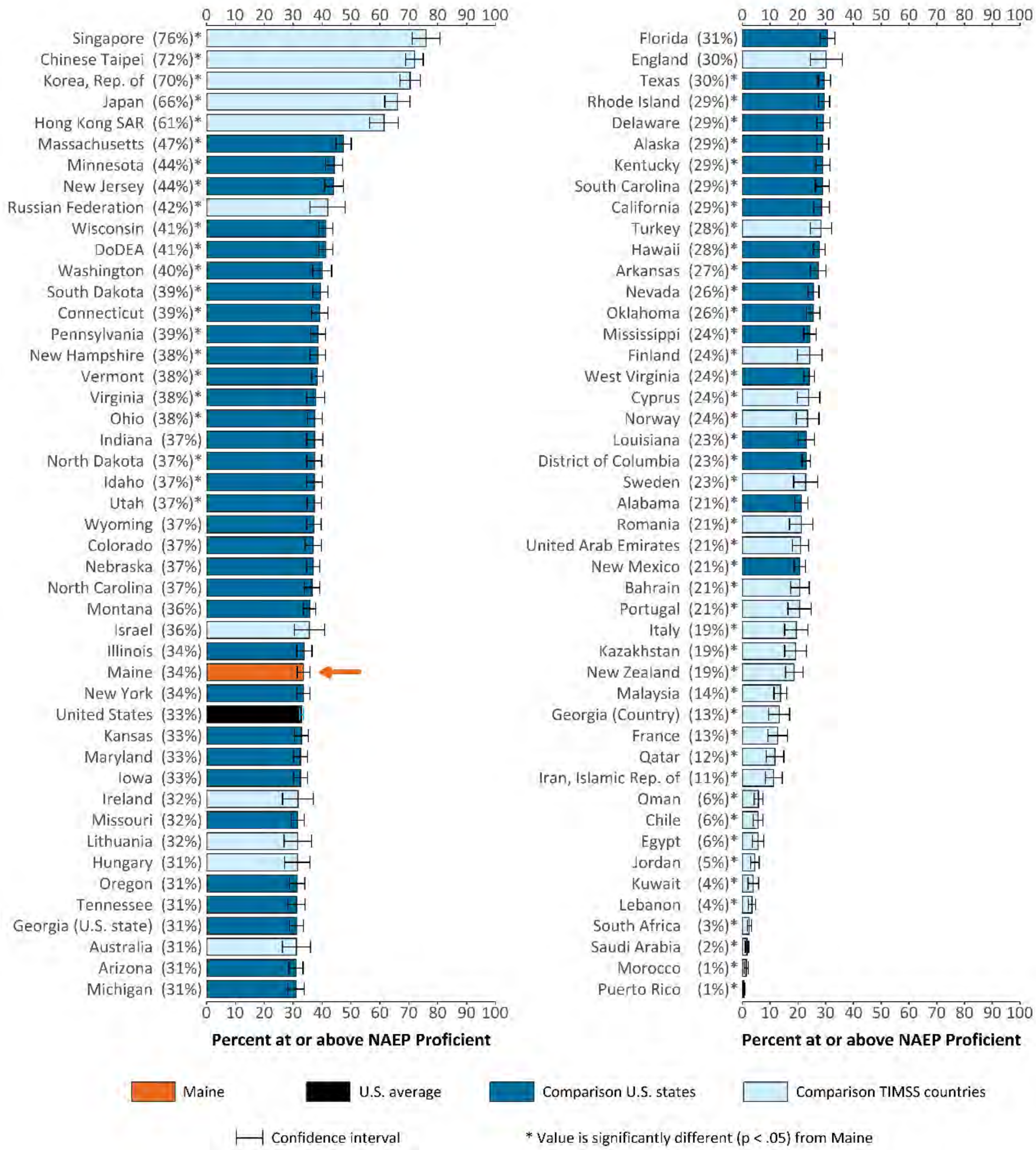
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.18. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Louisiana



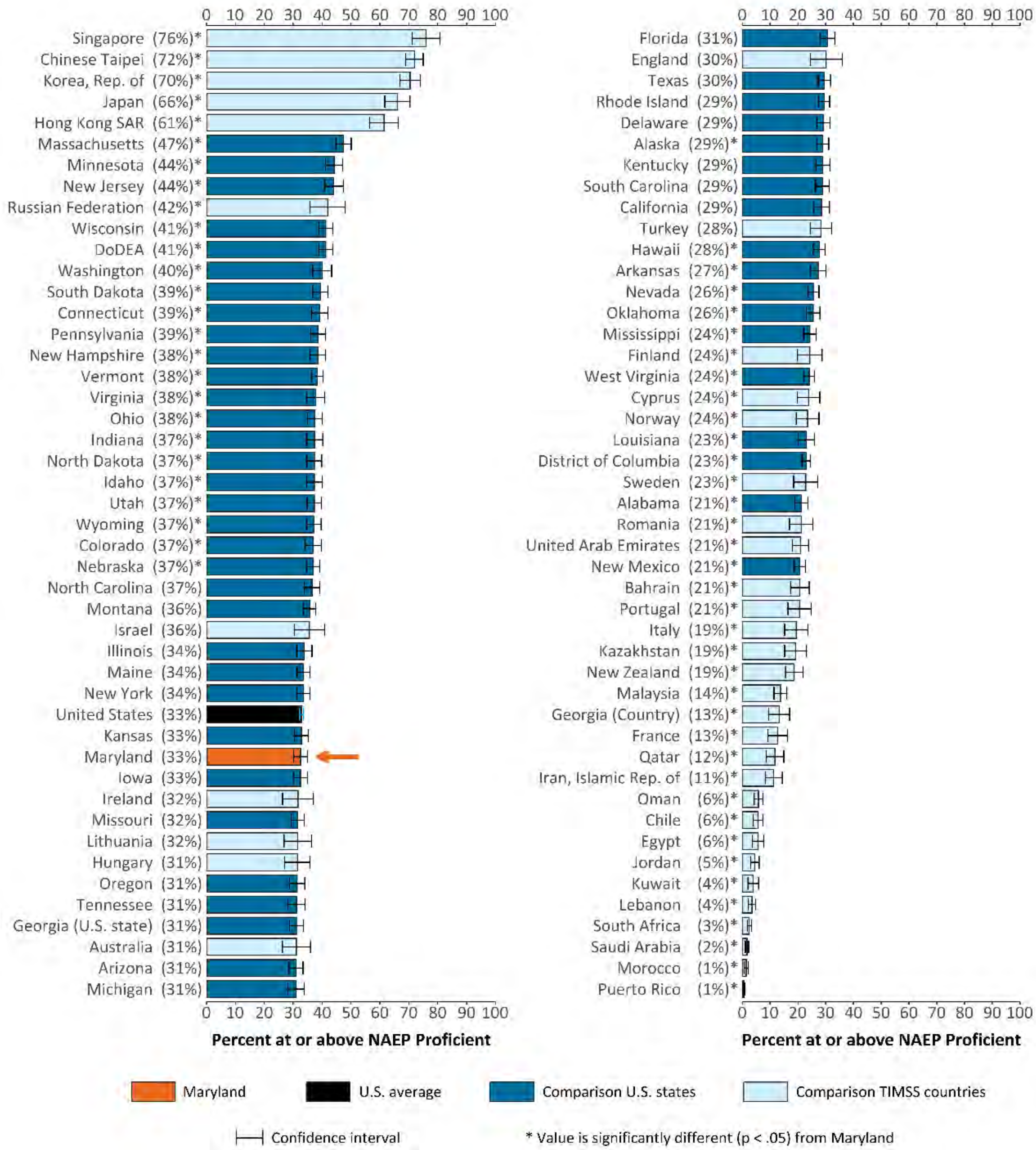
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.19. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Maine



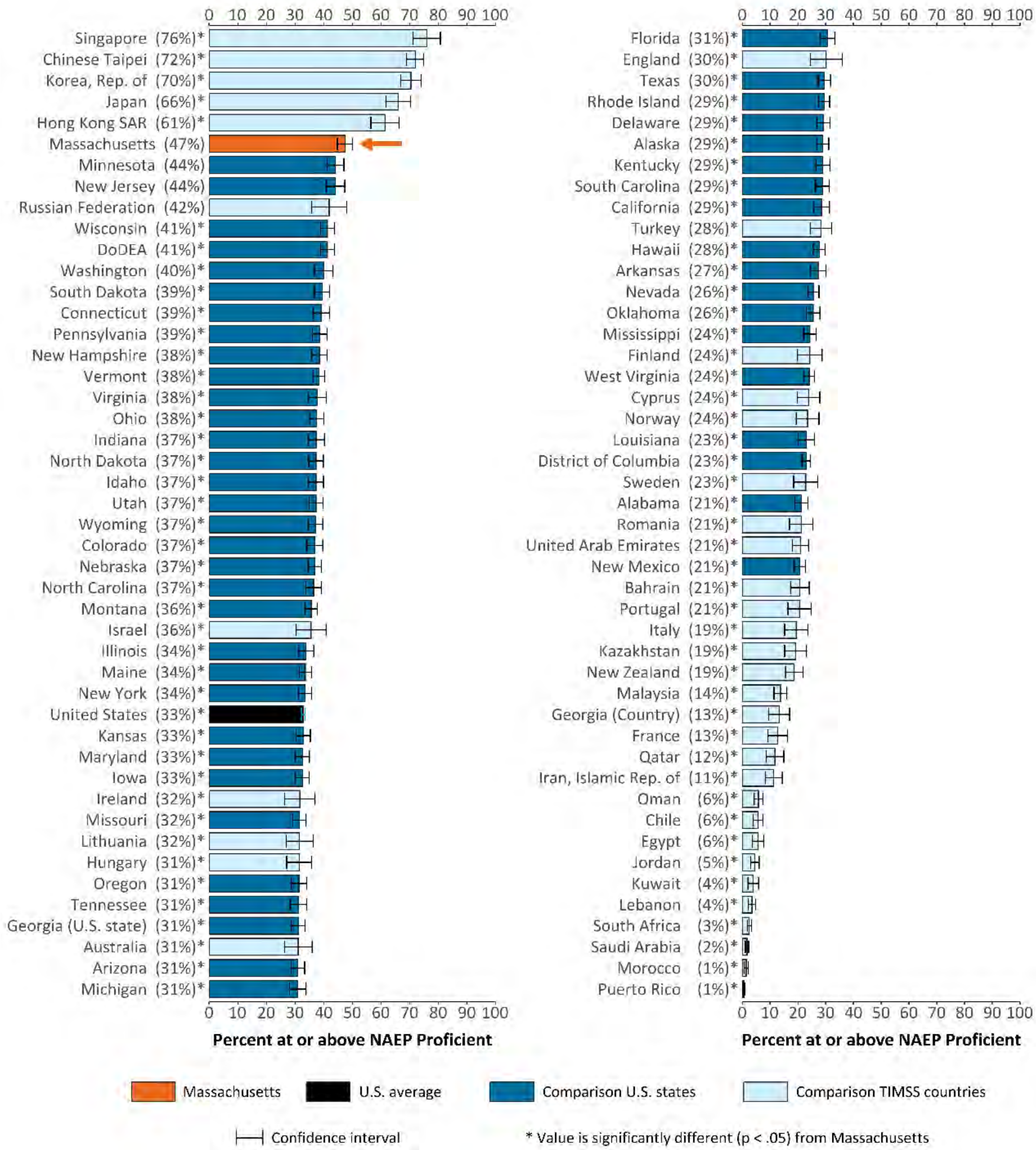
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.20. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Maryland



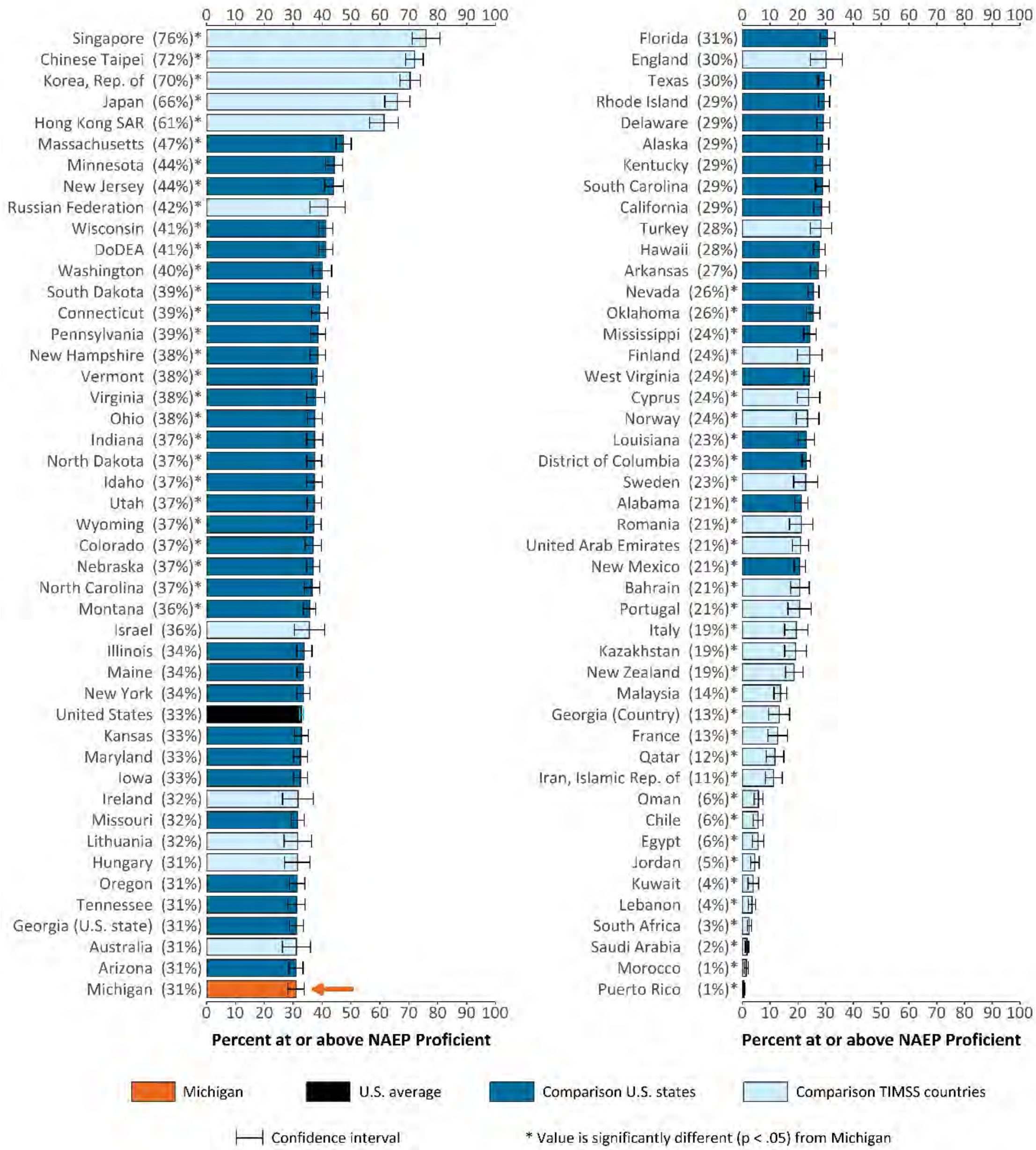
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.21. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Massachusetts



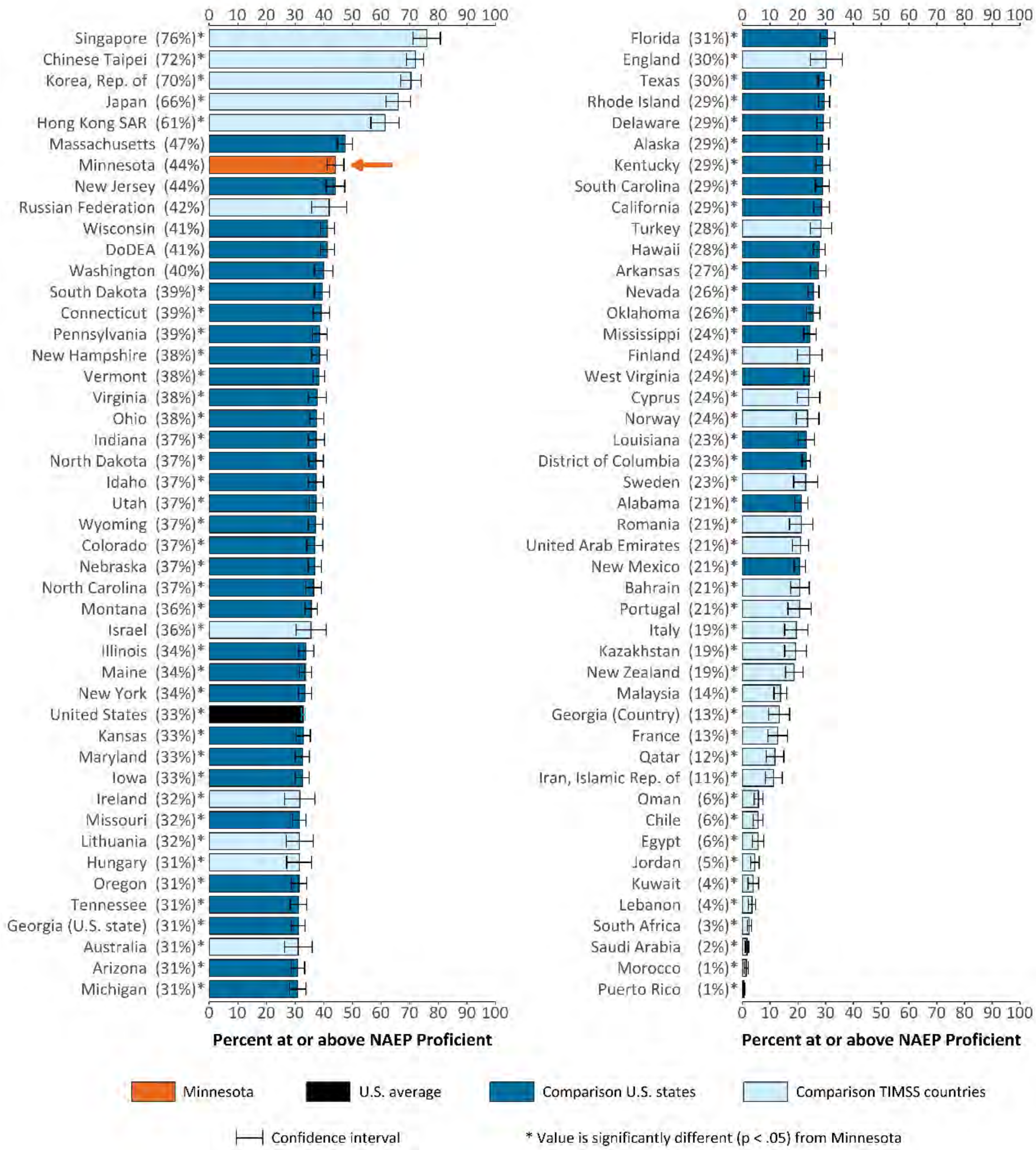
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.22. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Michigan



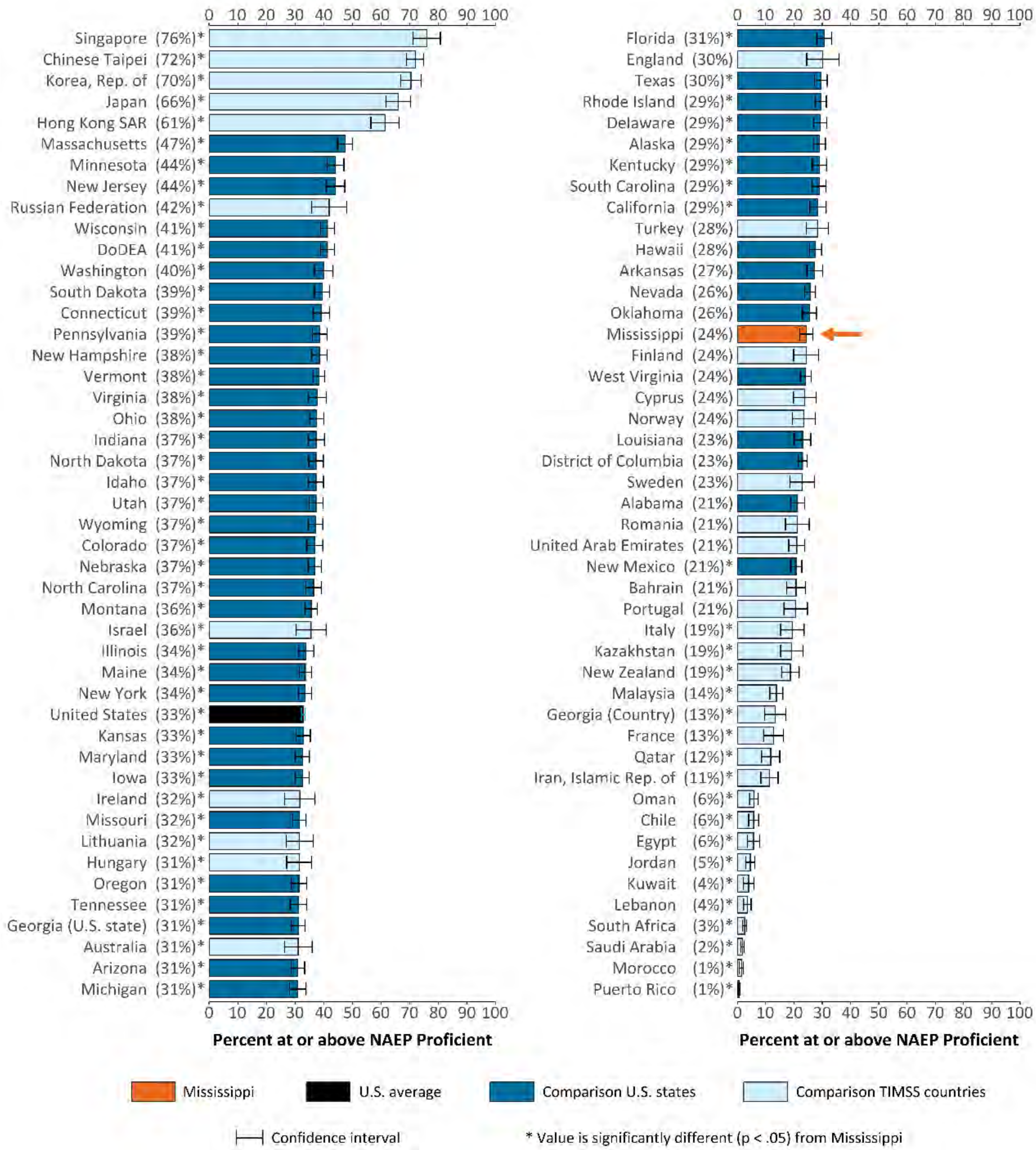
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.23. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Minnesota



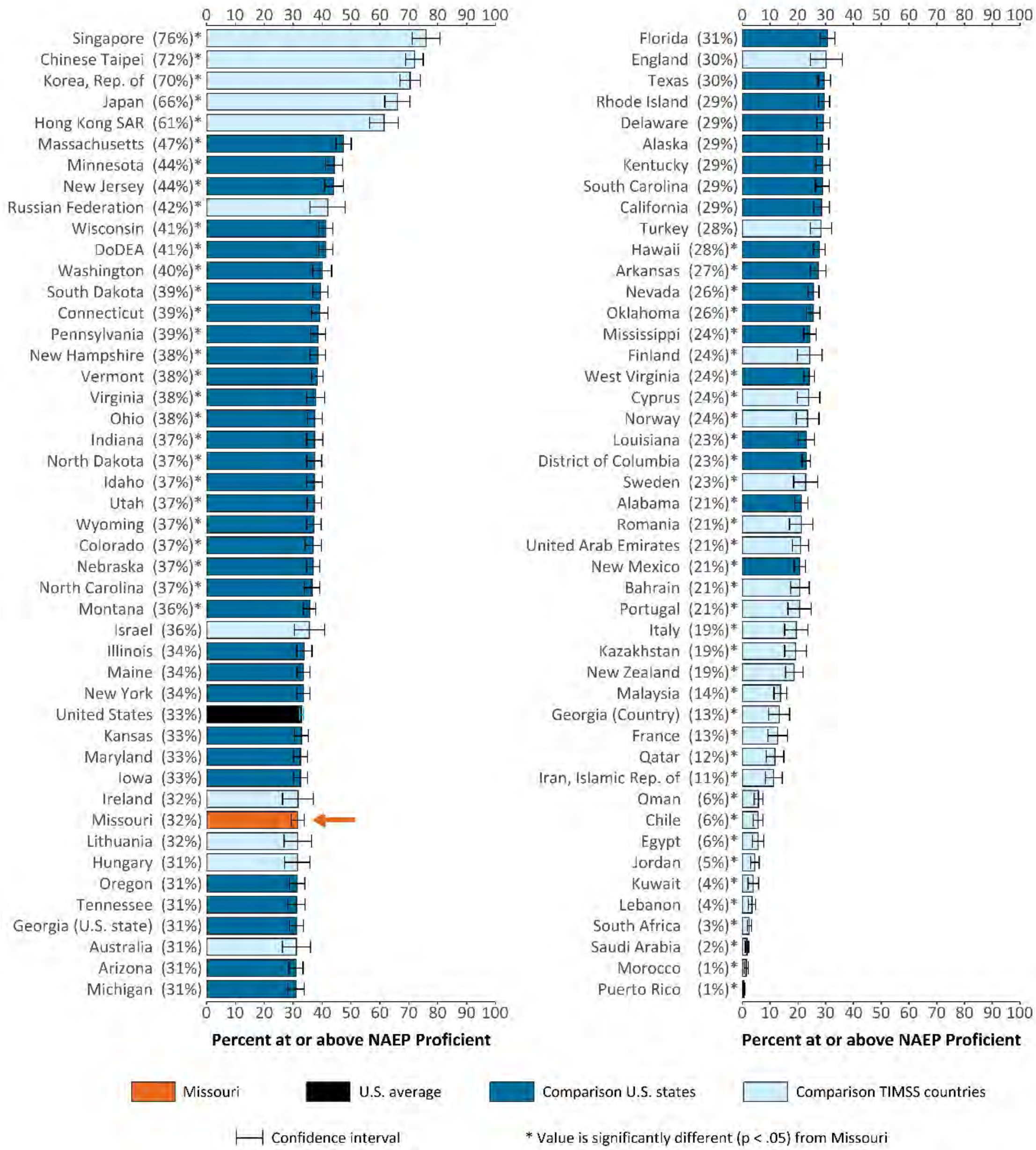
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.24. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Mississippi



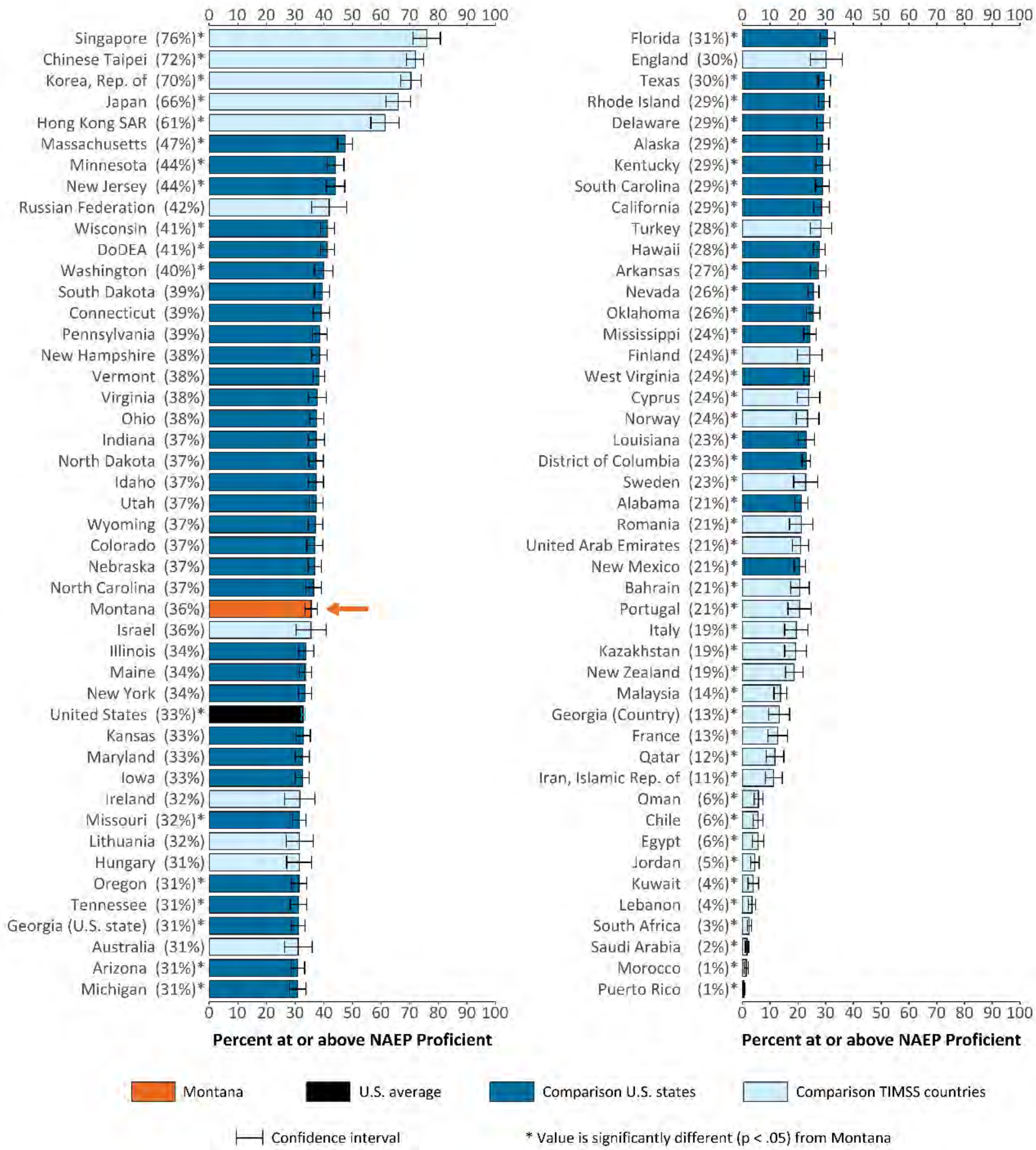
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.25. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Missouri



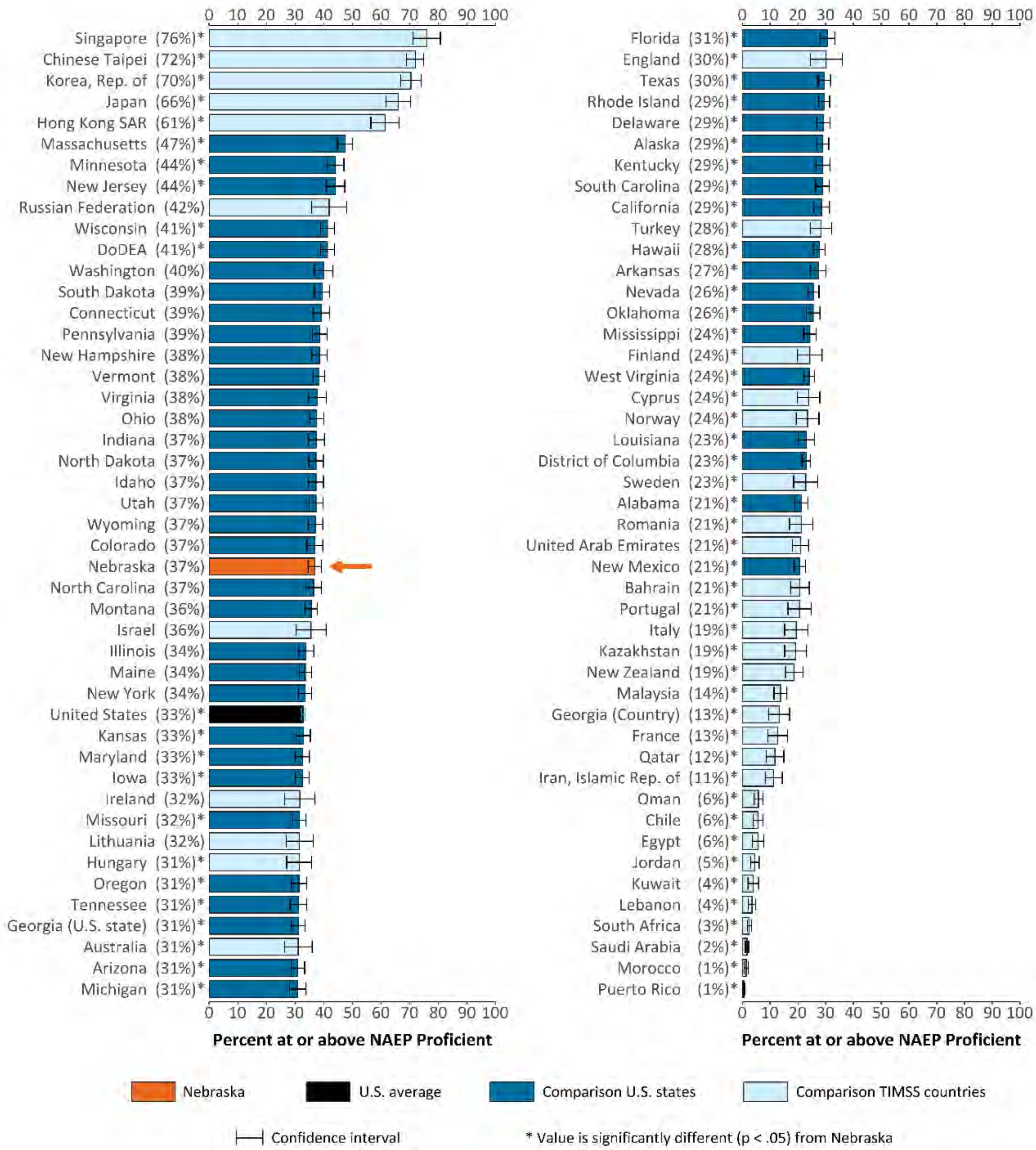
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.26. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Montana



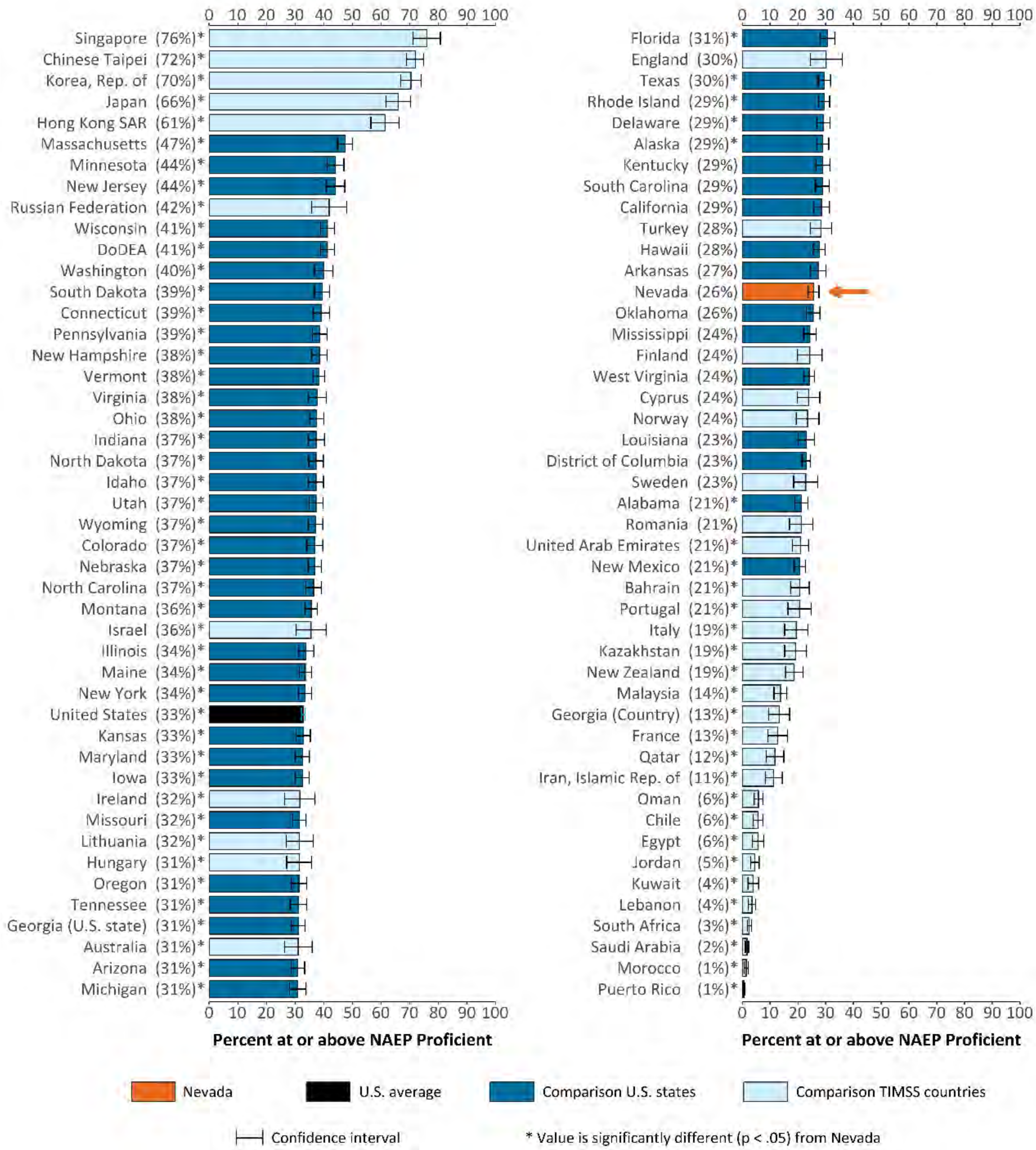
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.27. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Nebraska



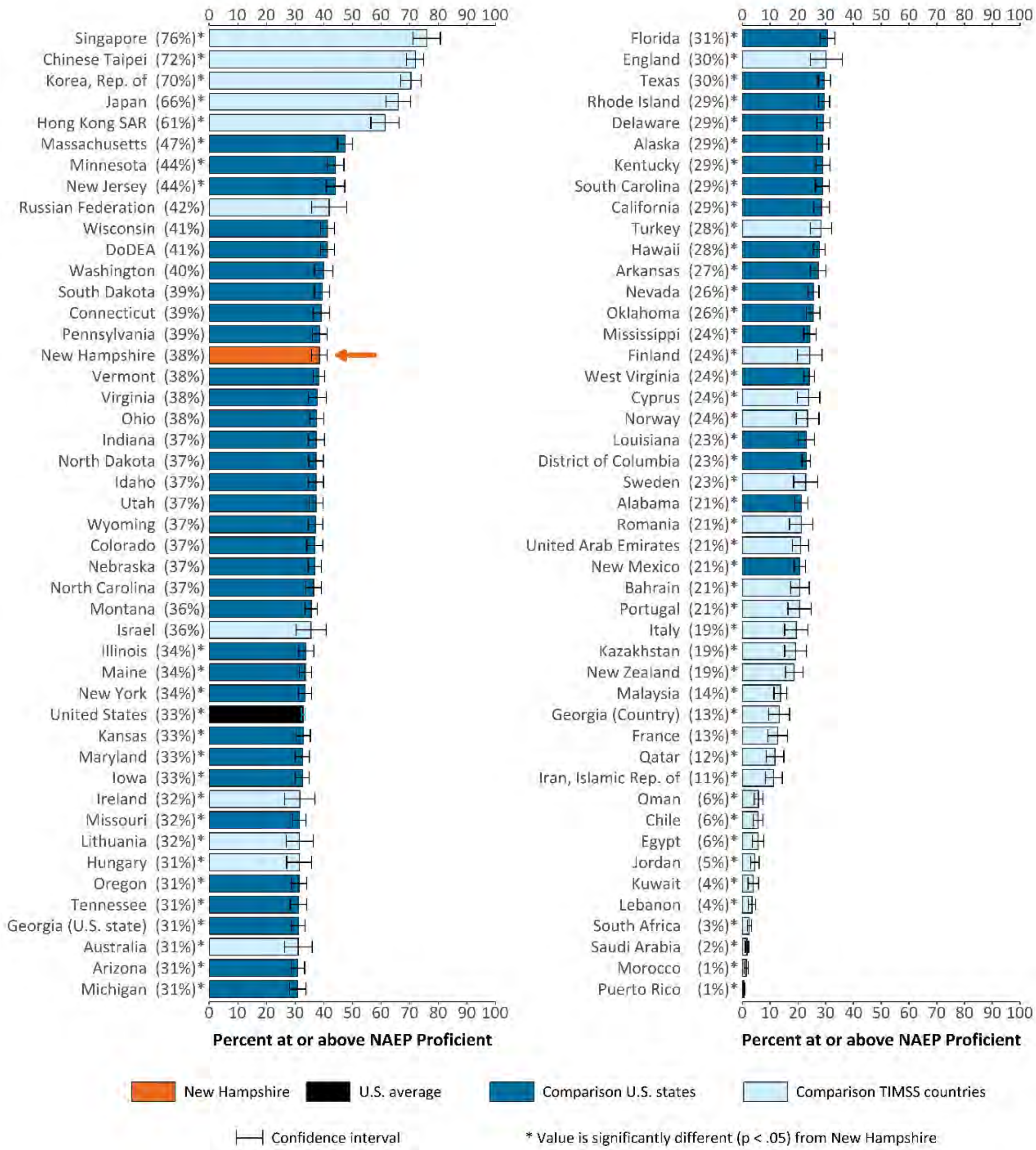
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.28. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Nevada



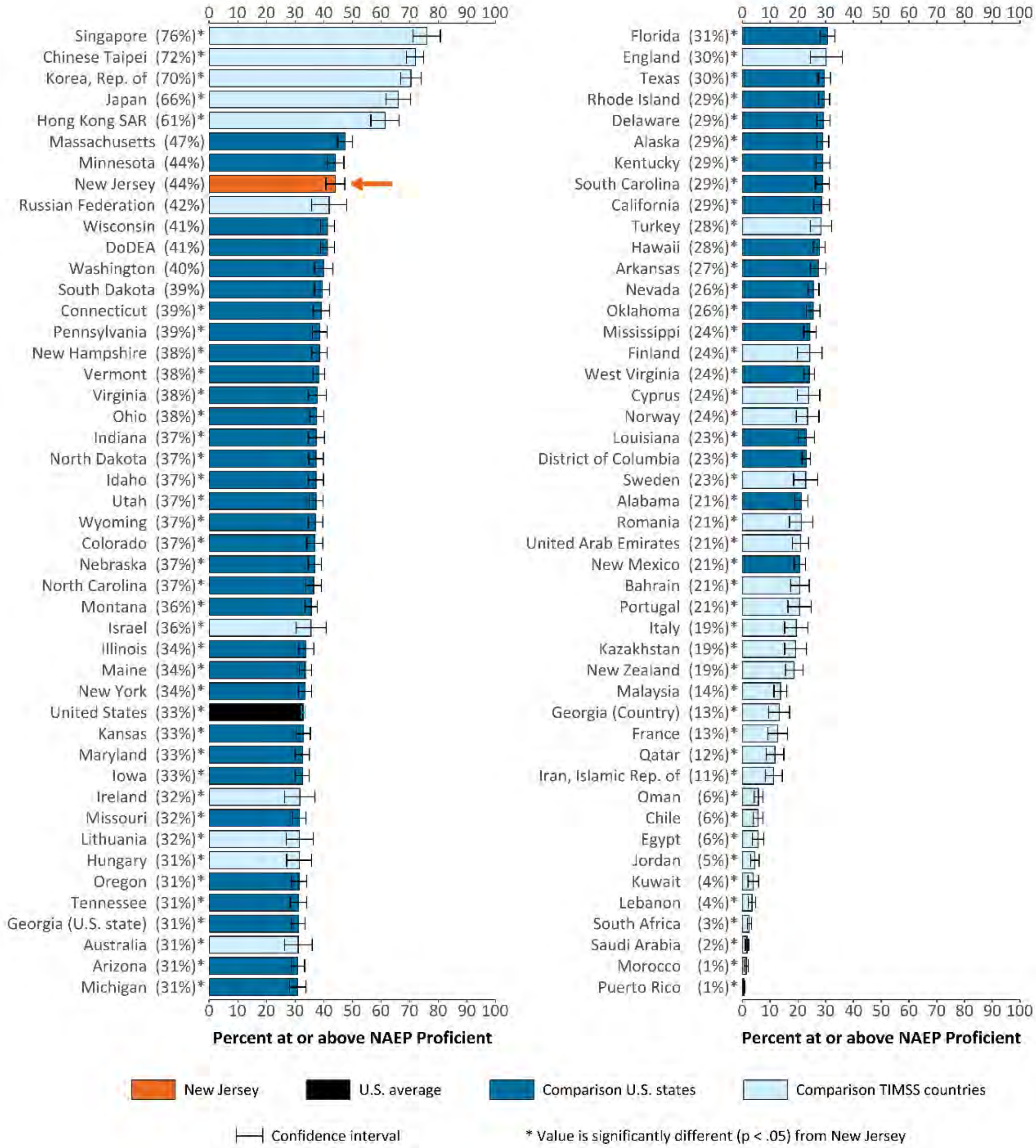
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.29. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to New Hampshire



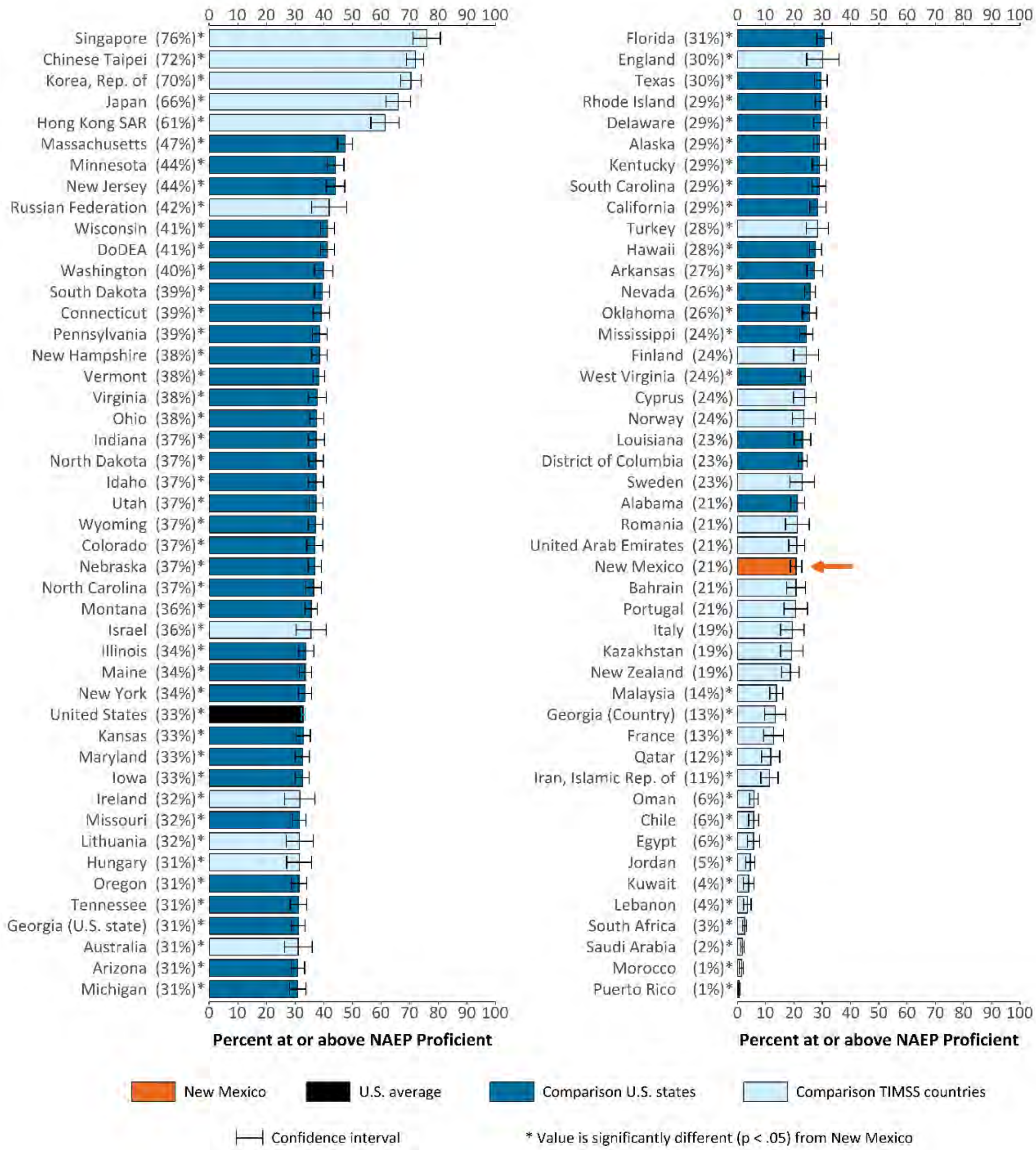
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.30. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to New Jersey



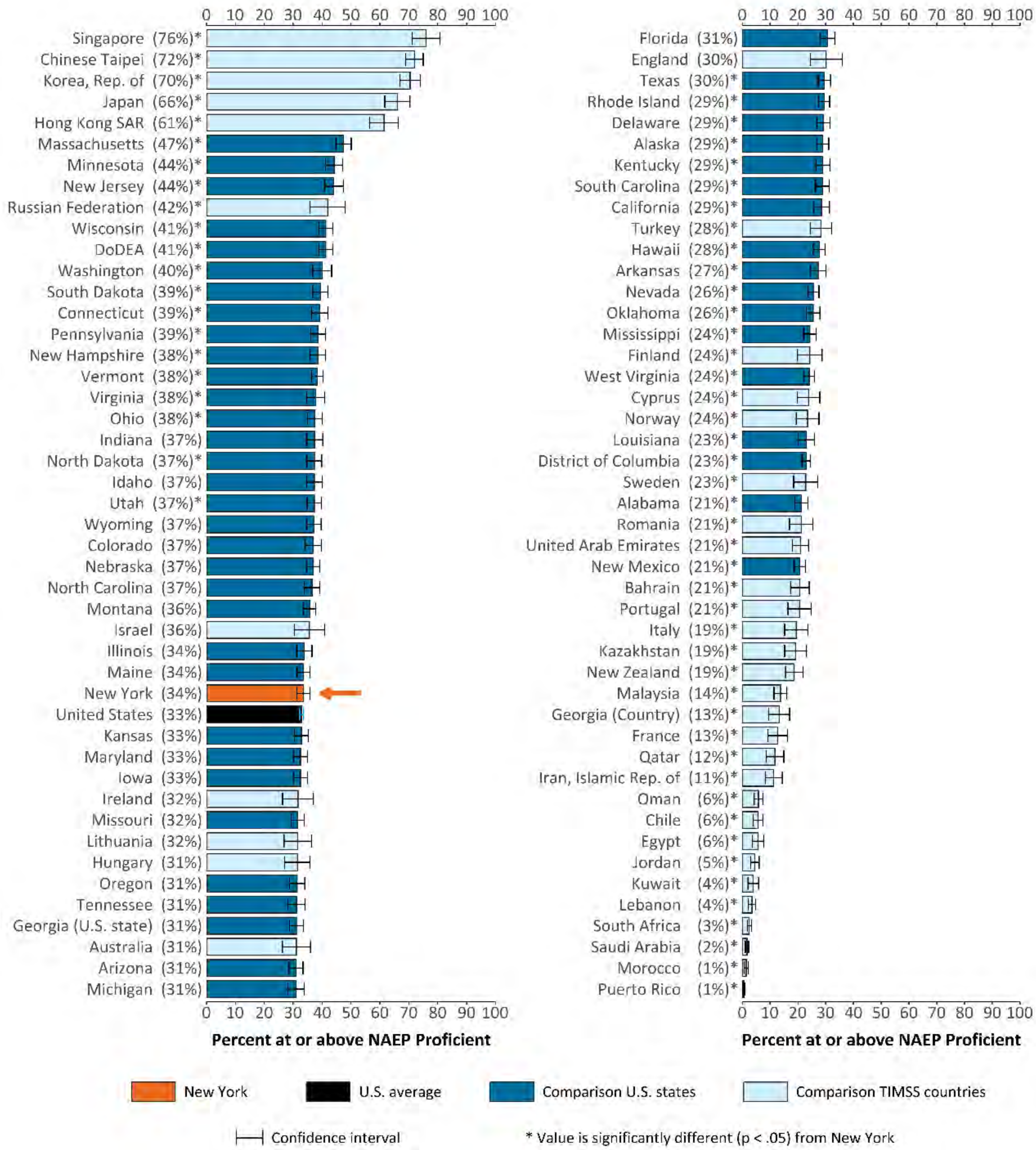
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.31. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to New Mexico



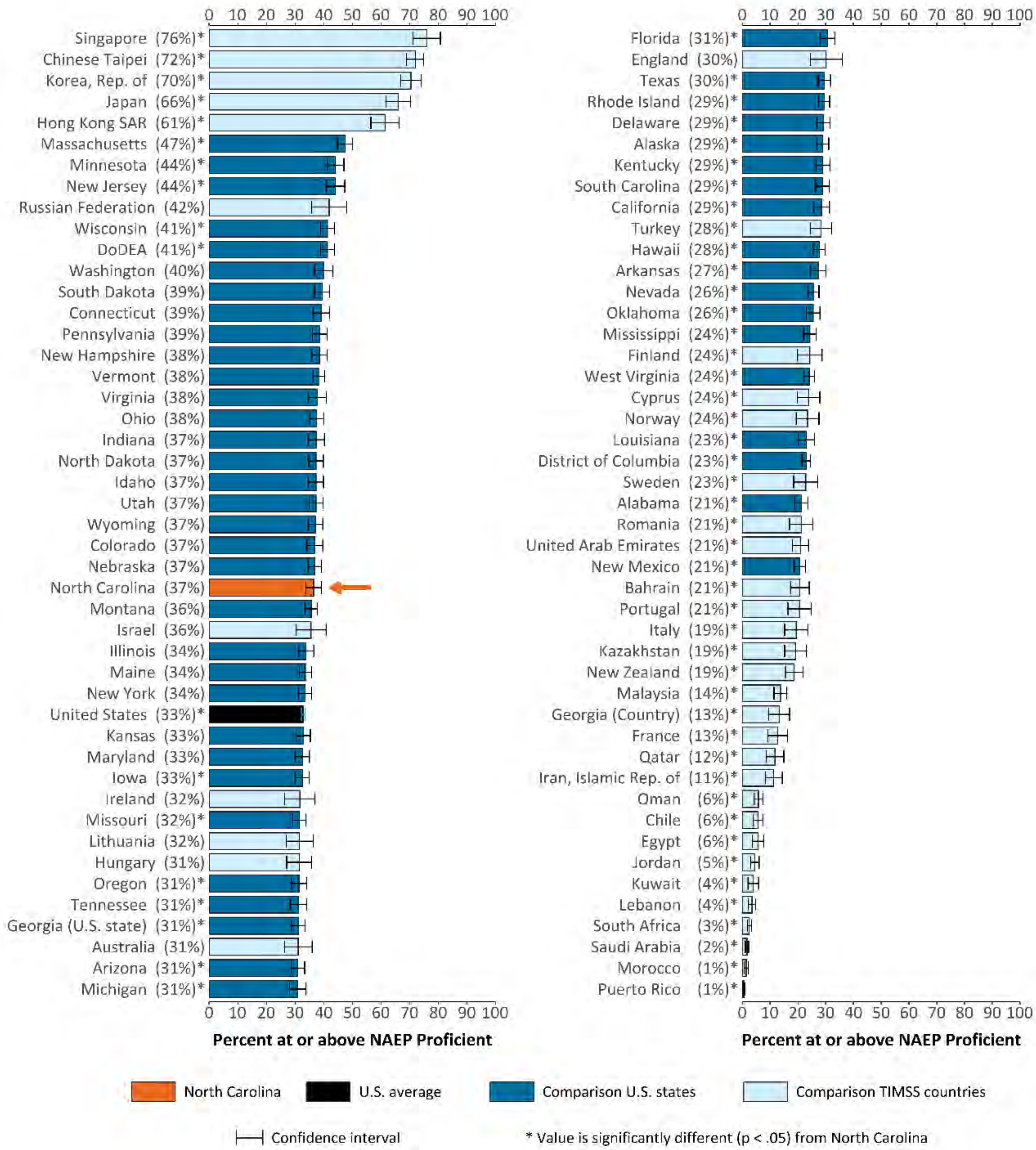
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.32. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to New York



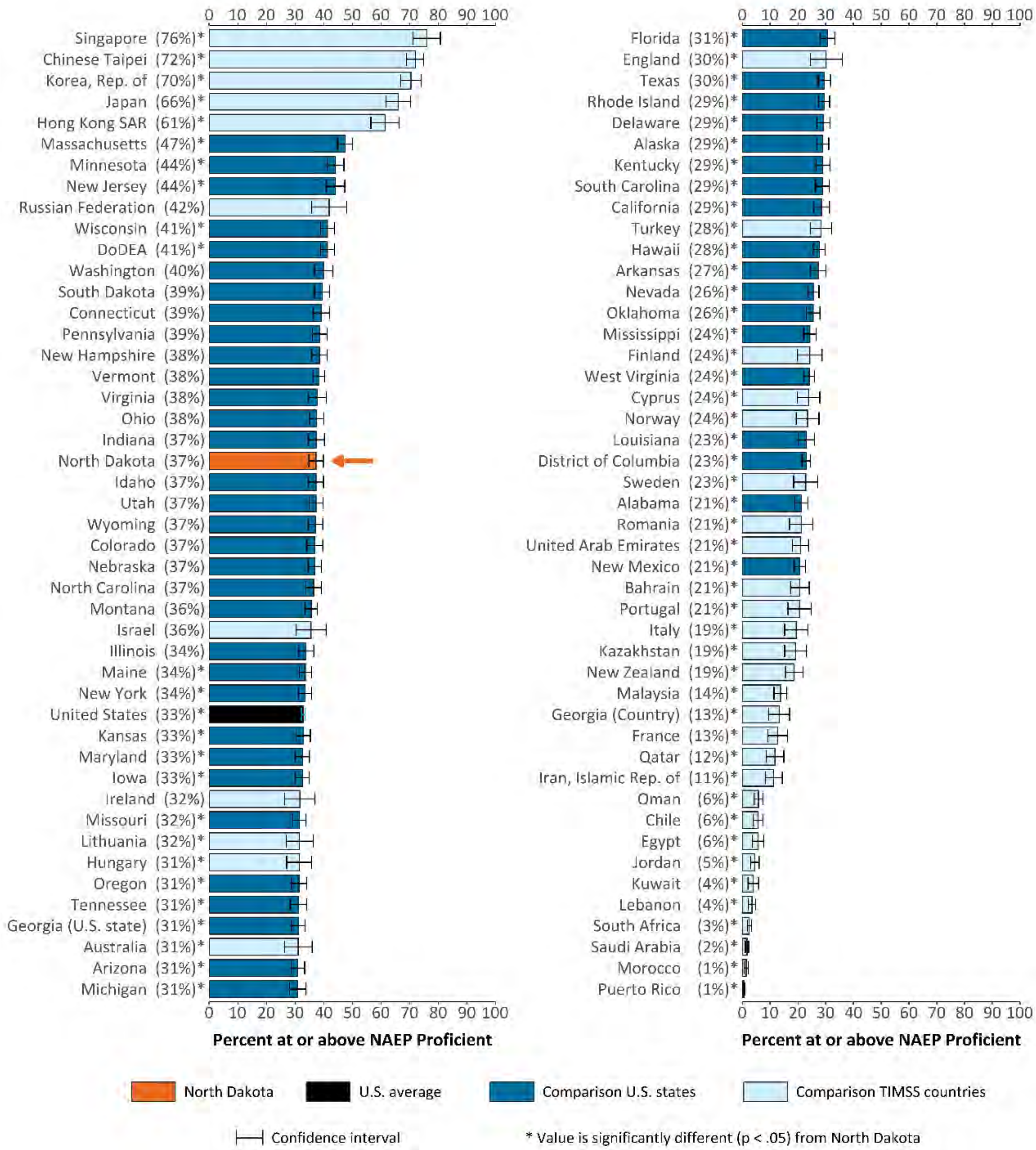
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.33. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to North Carolina



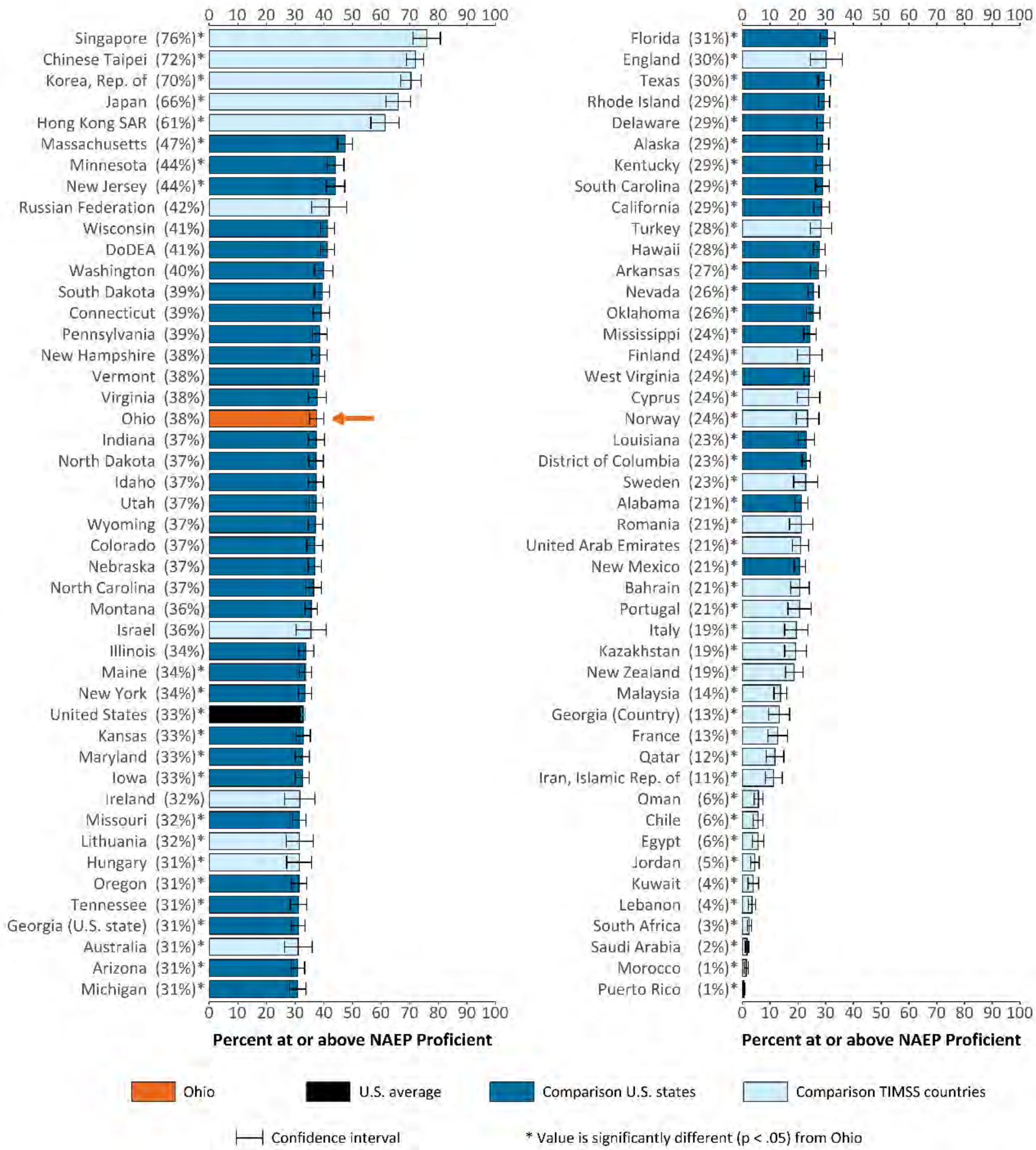
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.34. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to North Dakota



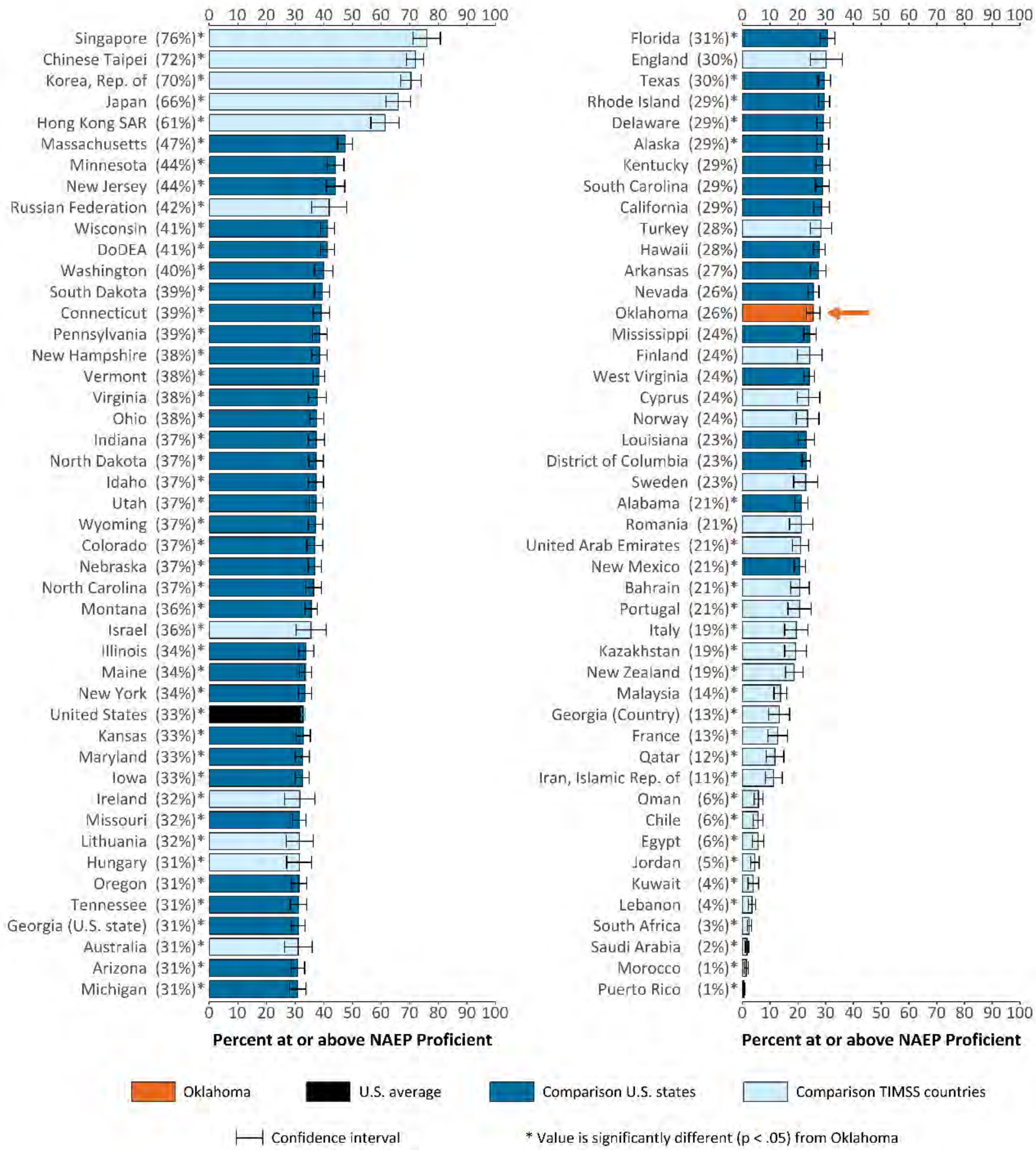
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.35. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Ohio



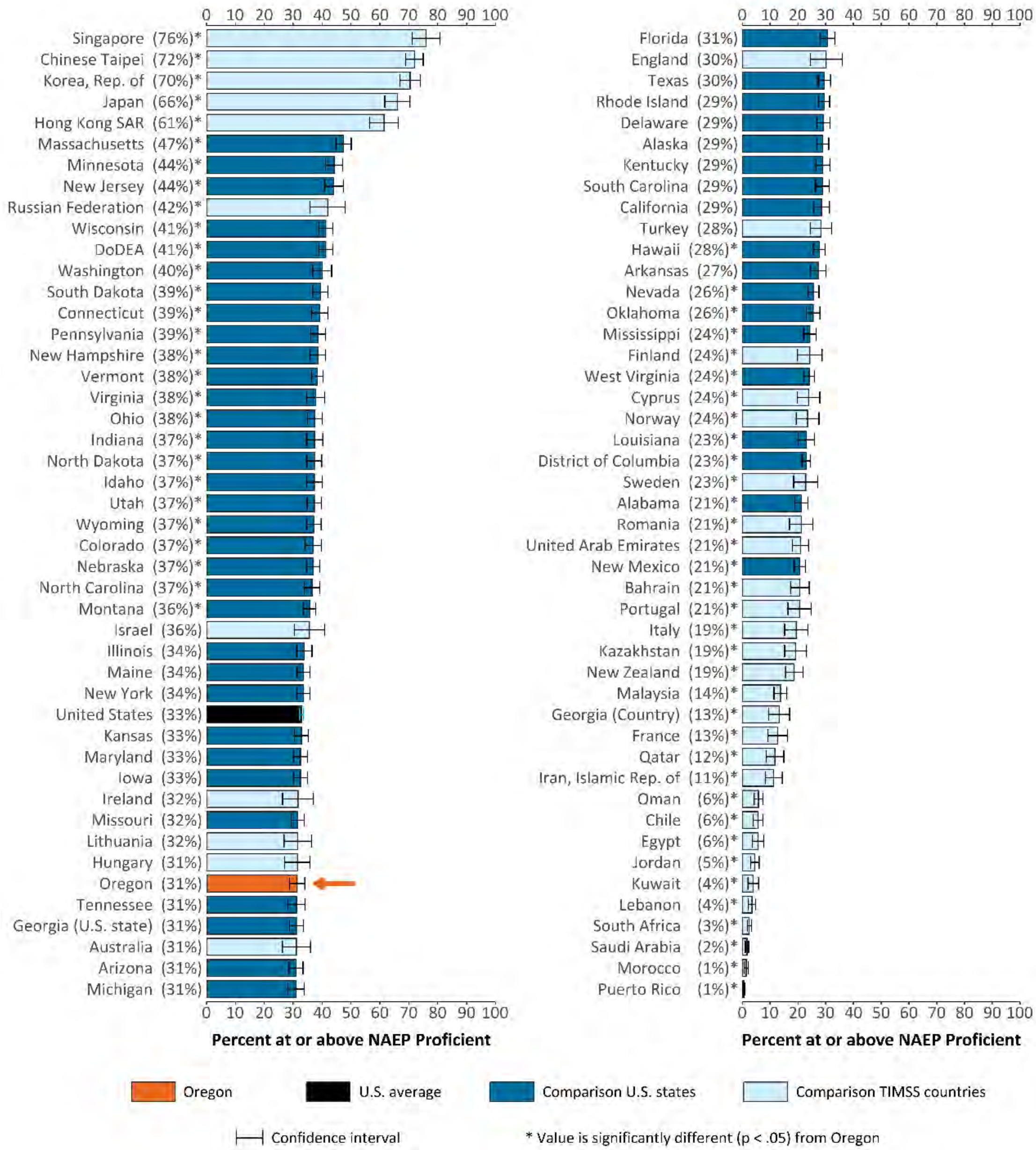
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.36. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Oklahoma



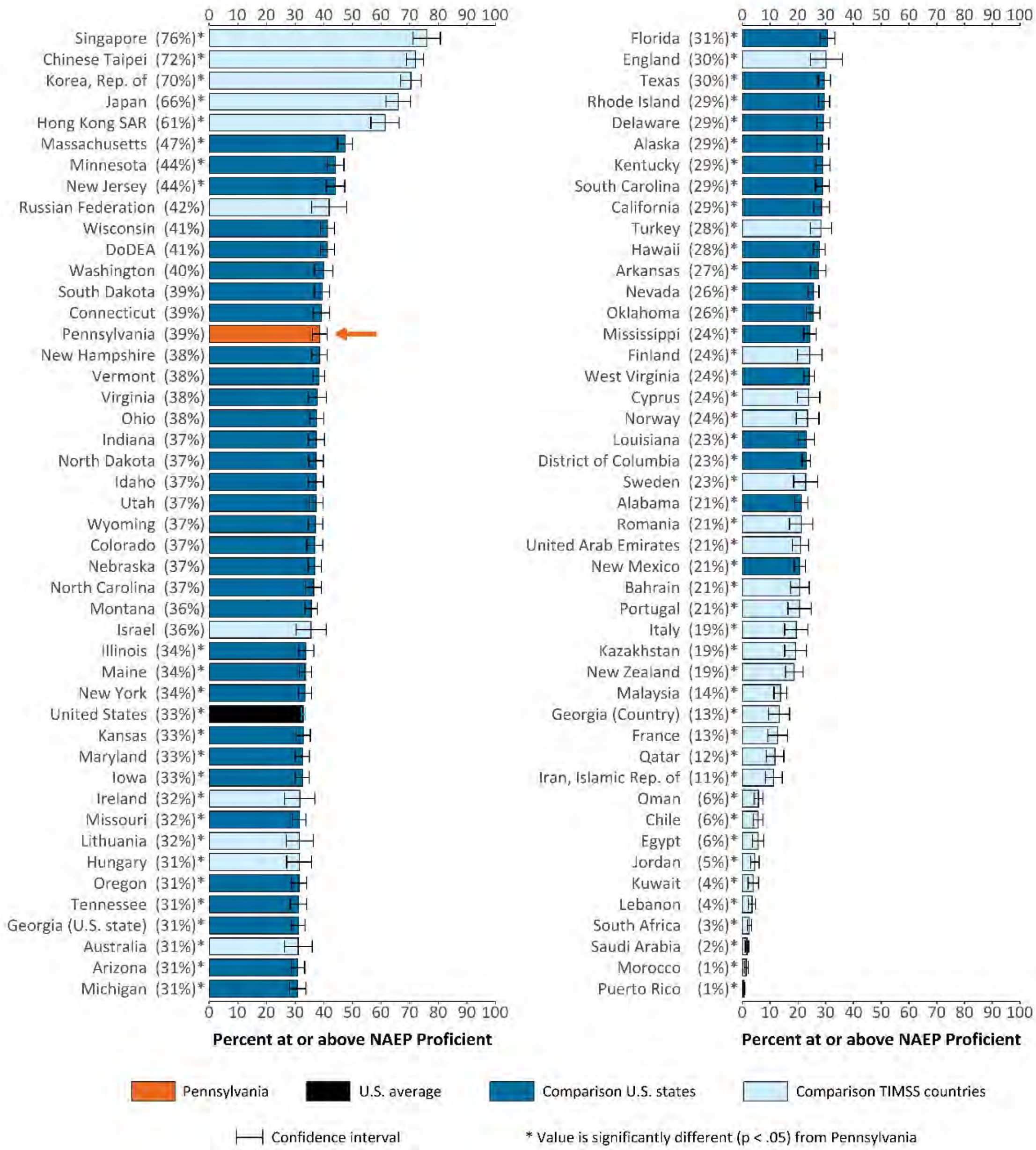
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.37. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Oregon



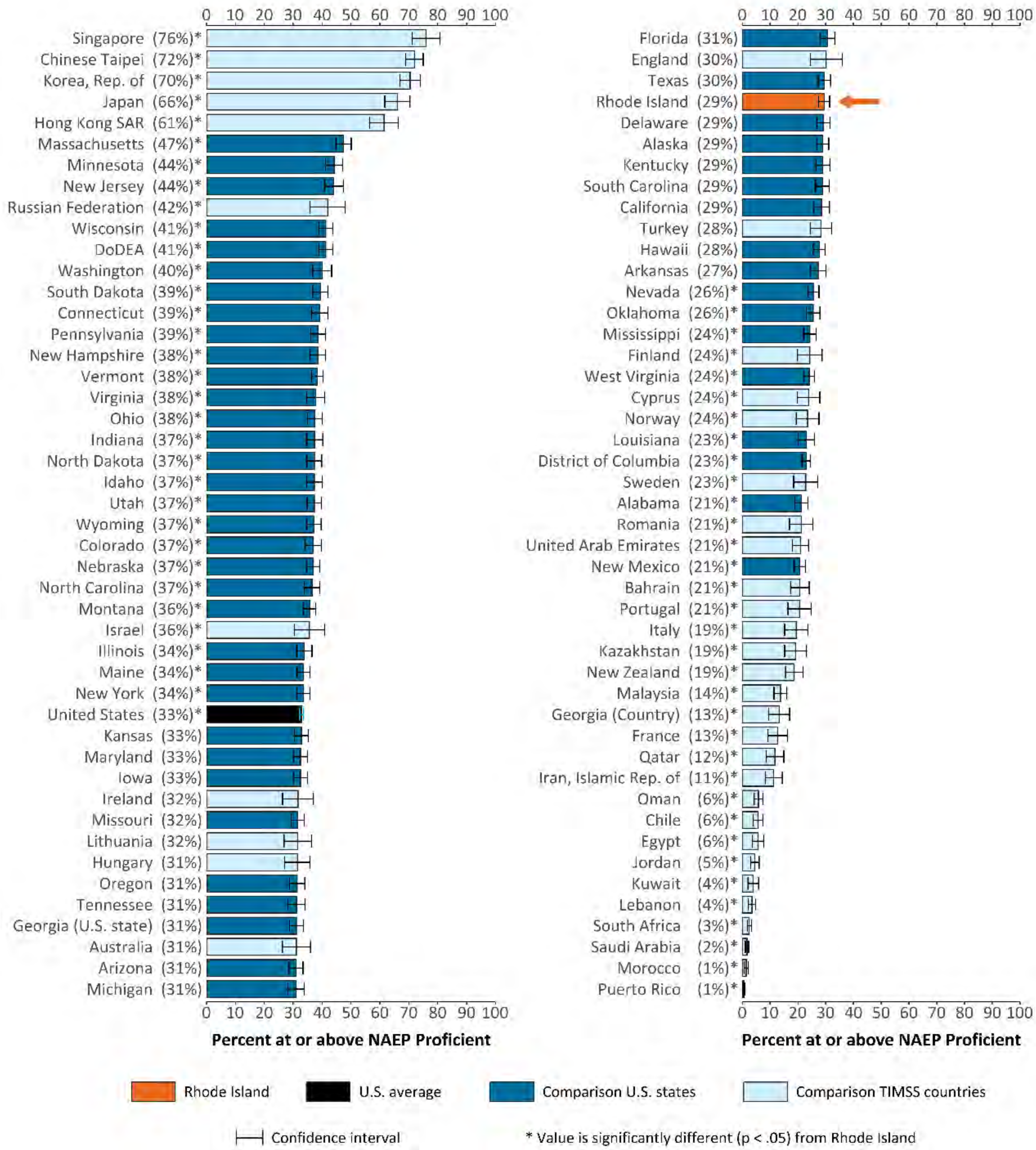
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.38. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Pennsylvania



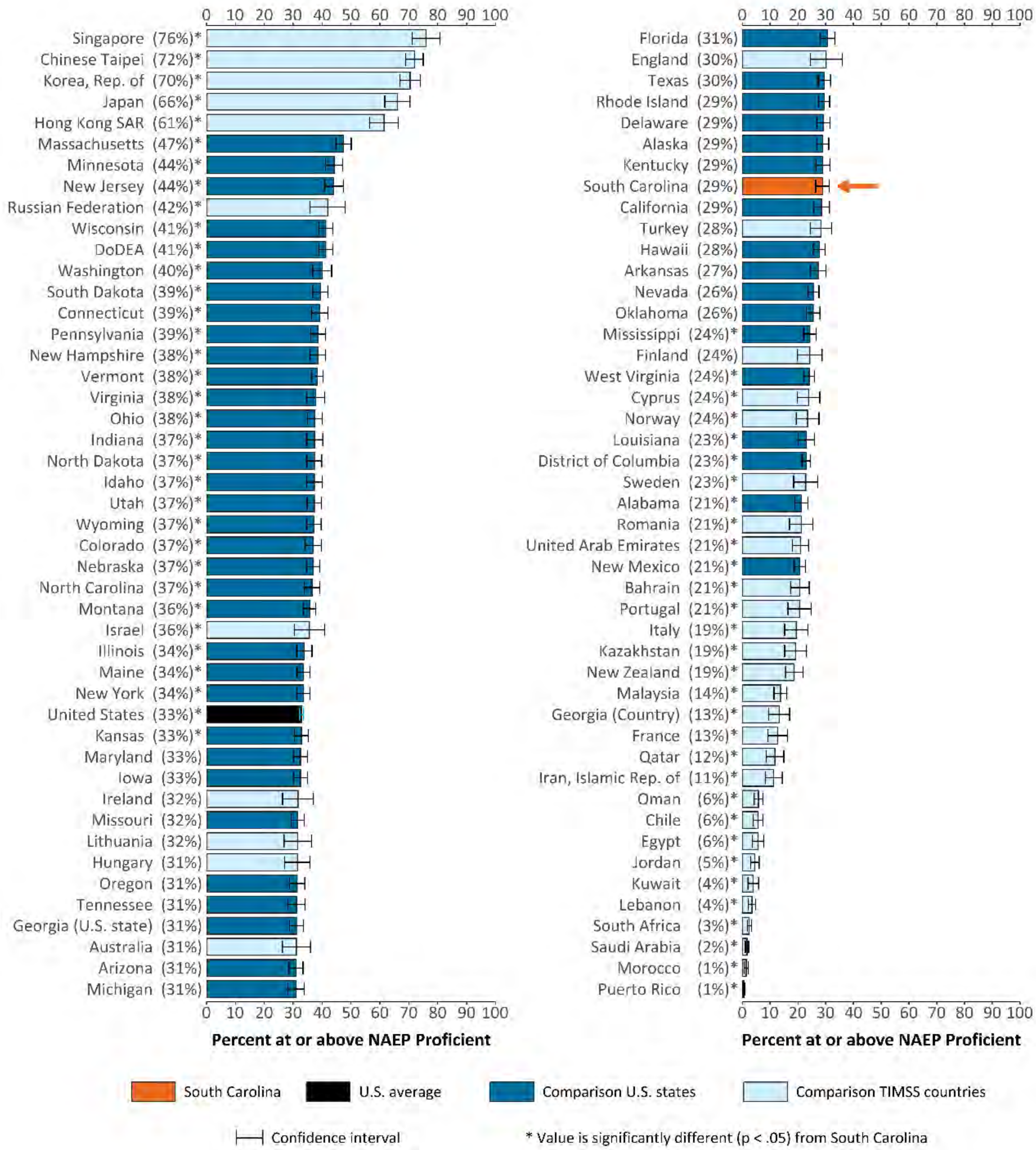
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.39. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Rhode Island



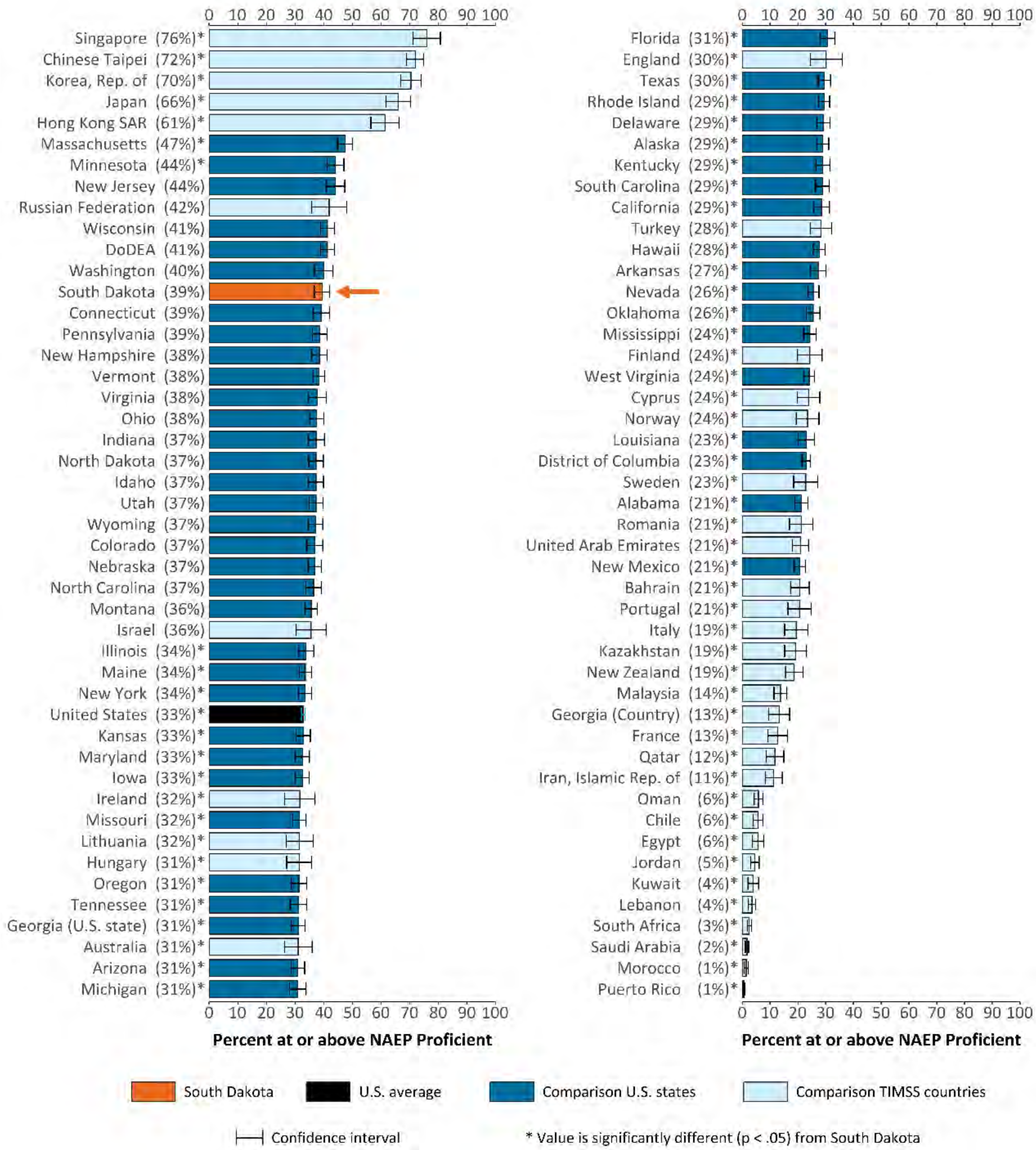
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.40. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to South Carolina



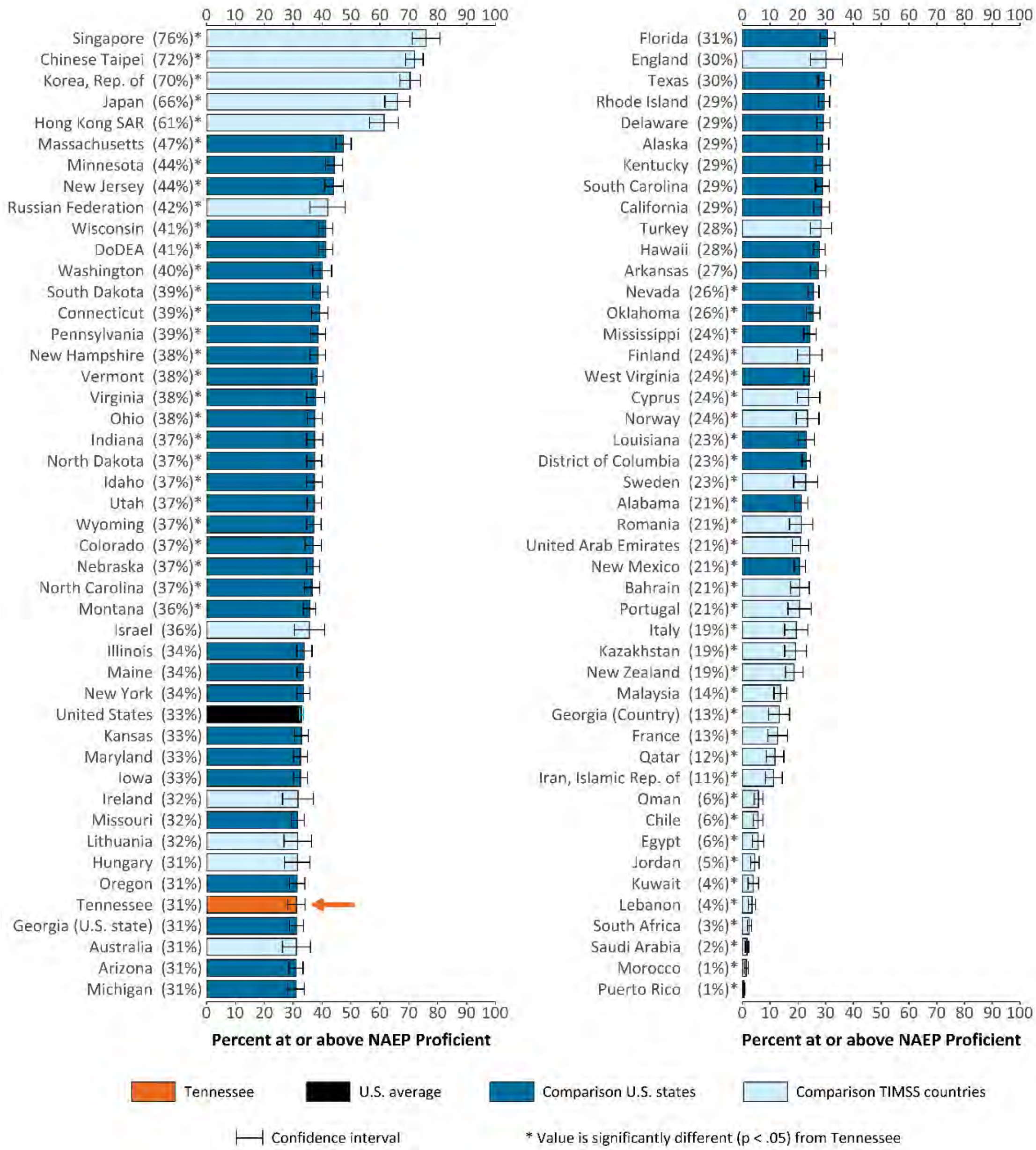
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.41. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to South Dakota



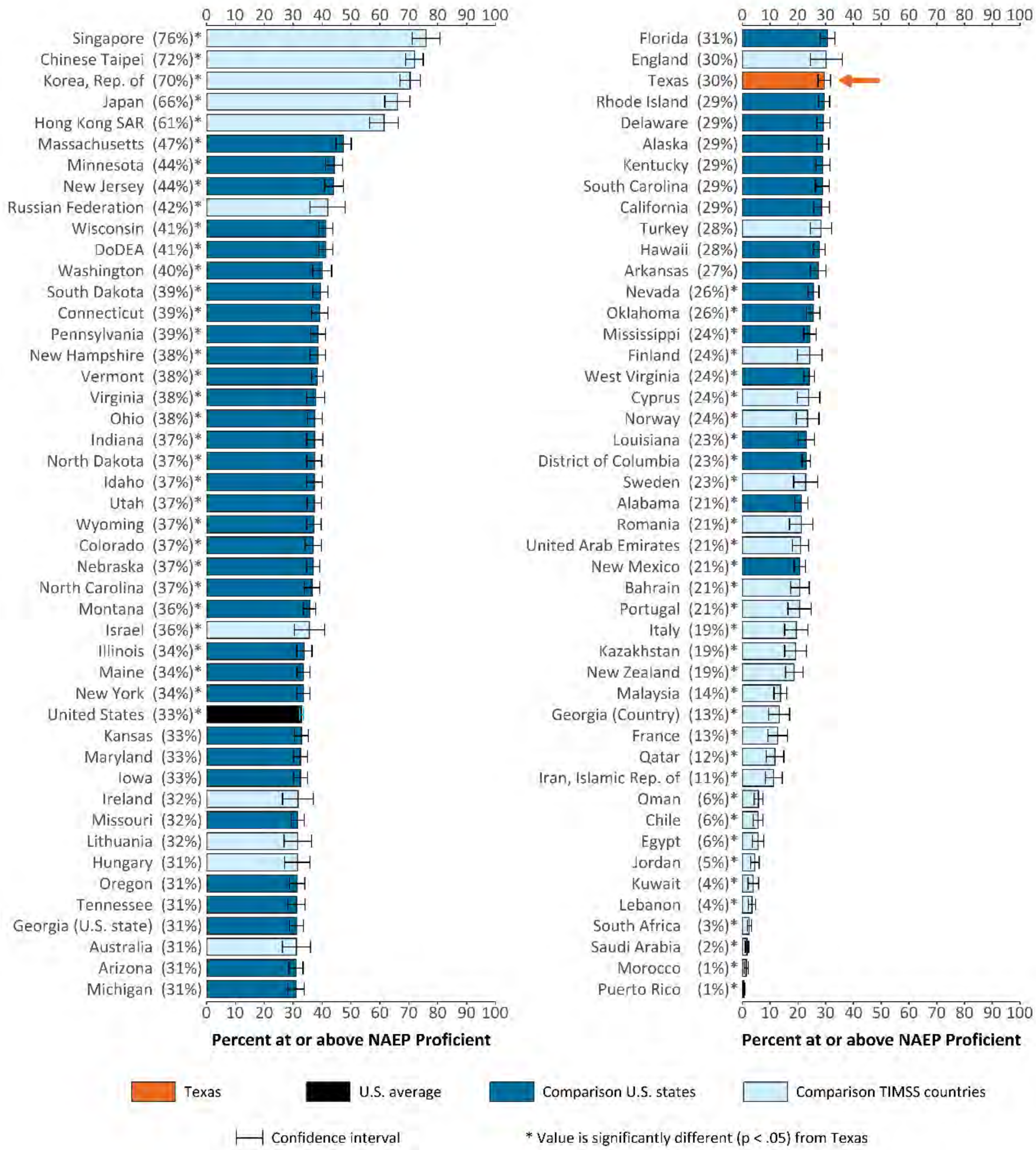
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.42. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Tennessee



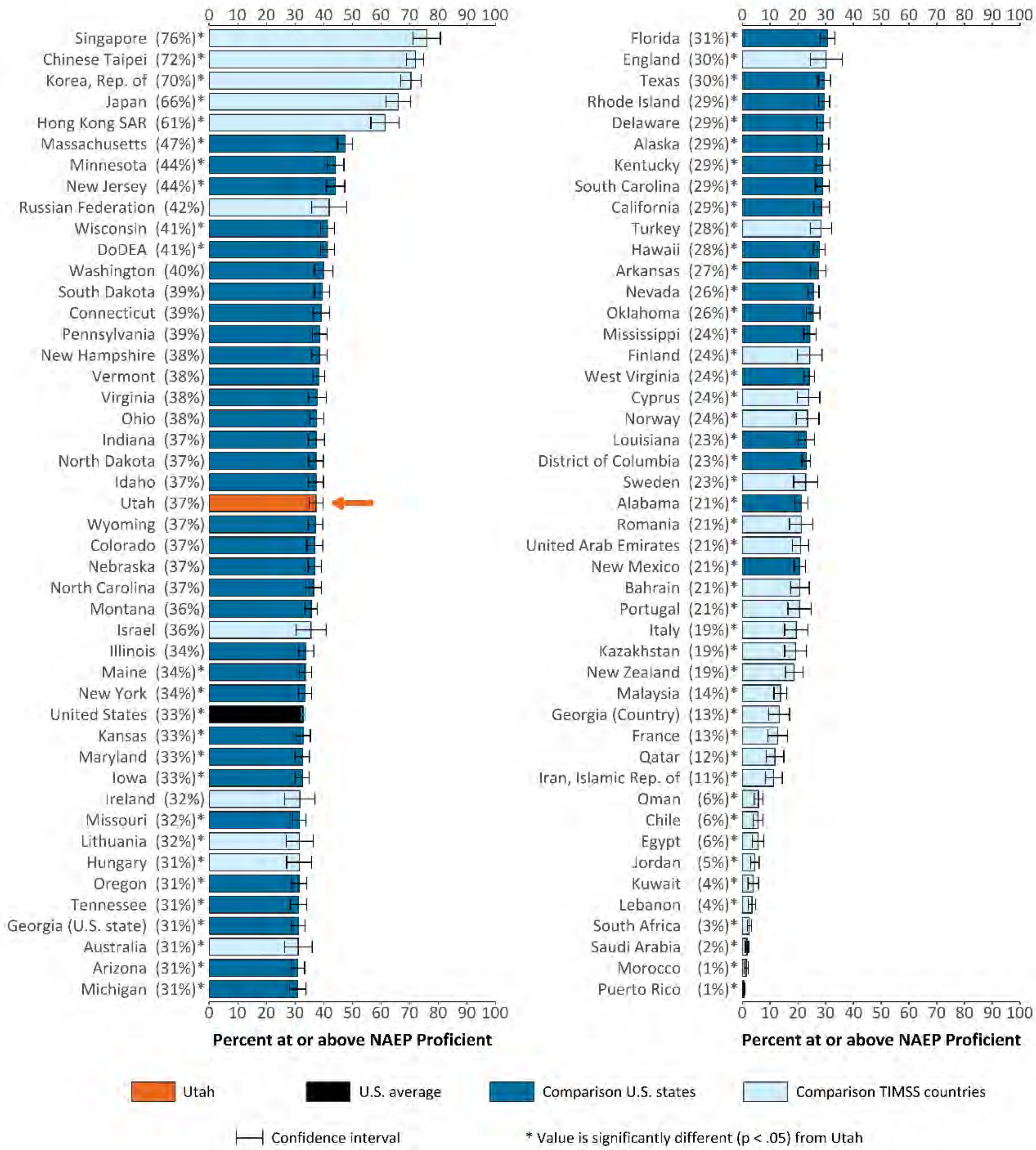
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.43. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Texas



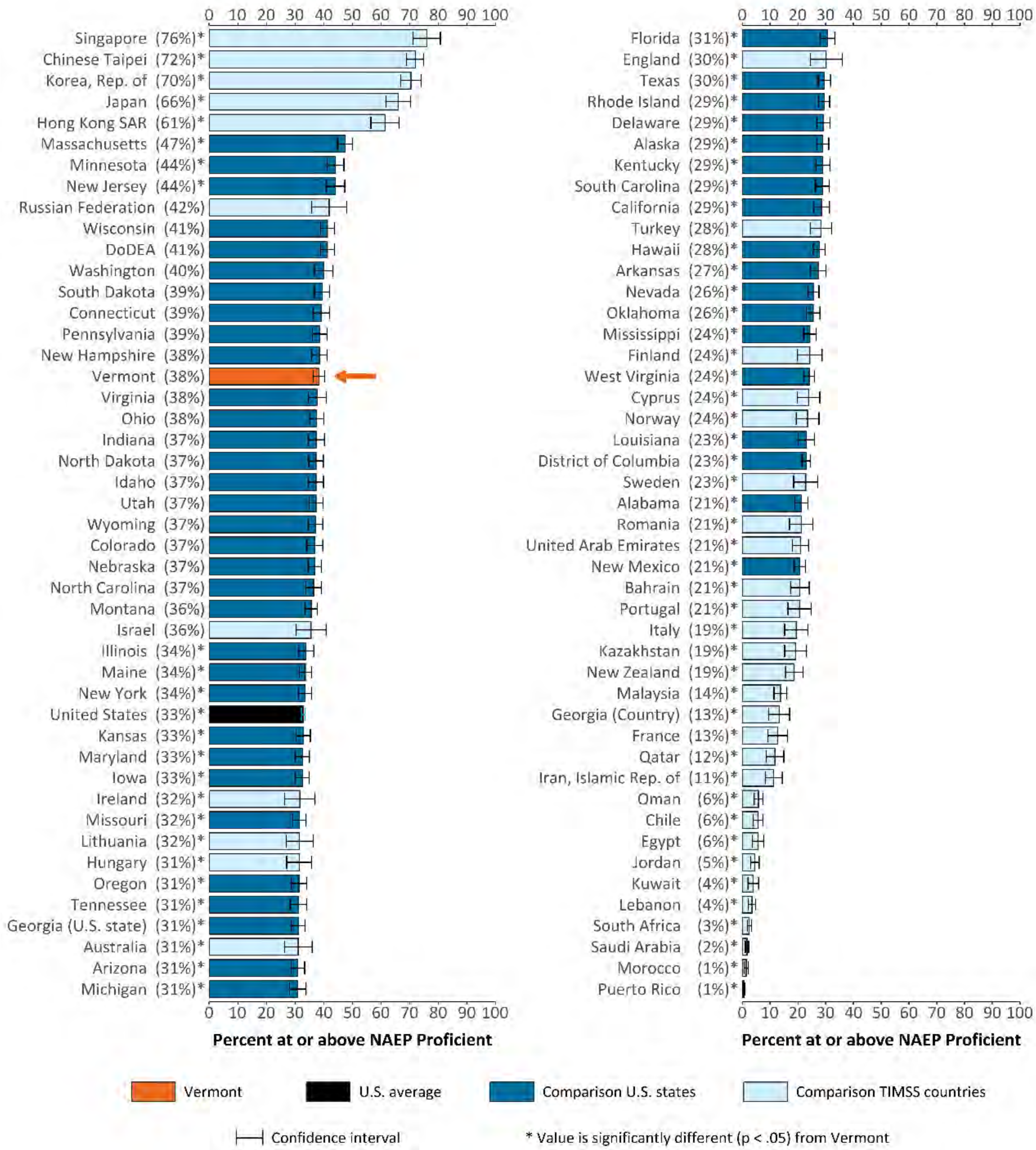
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.44. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Utah



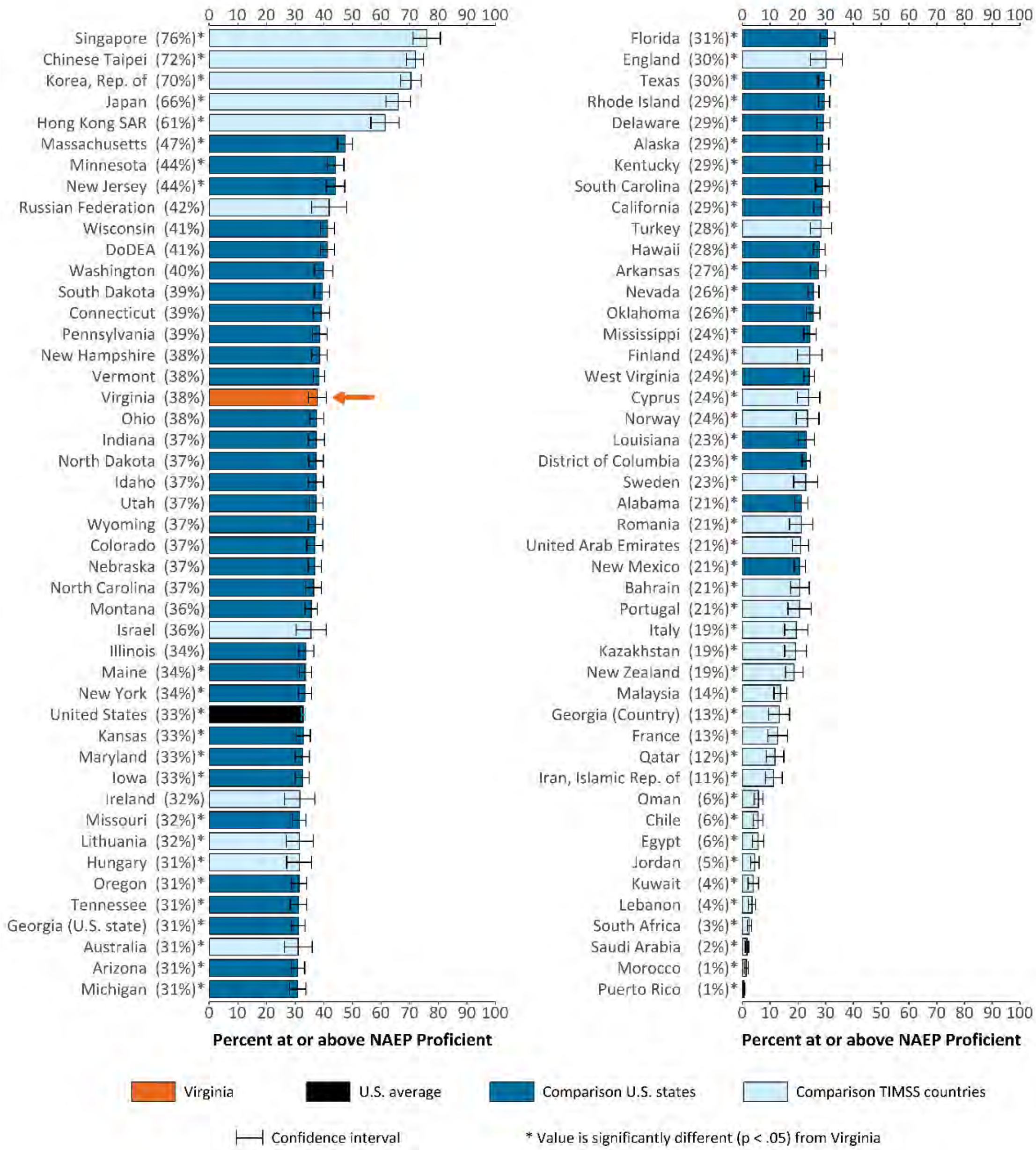
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.45. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Vermont



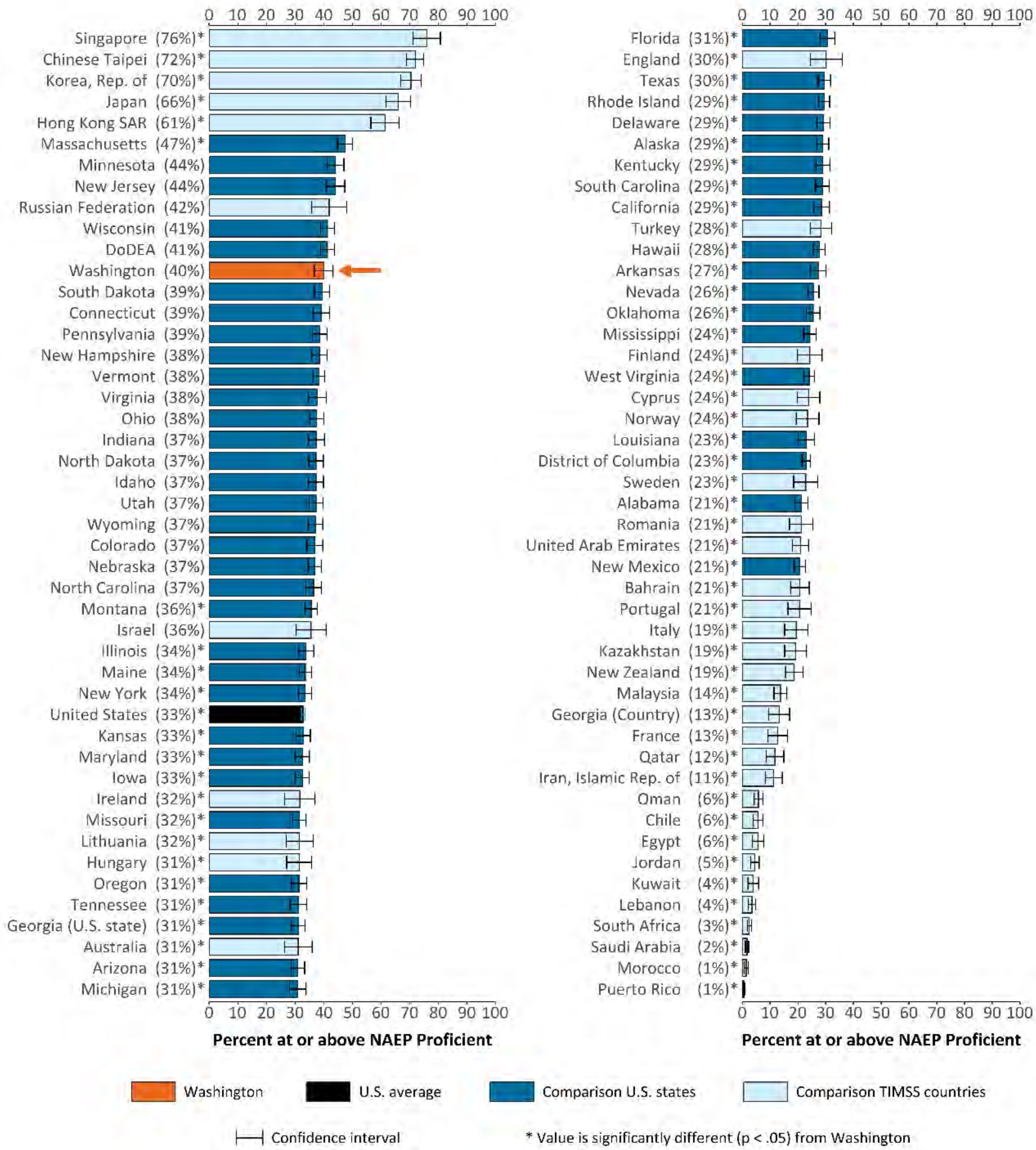
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.46. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Virginia



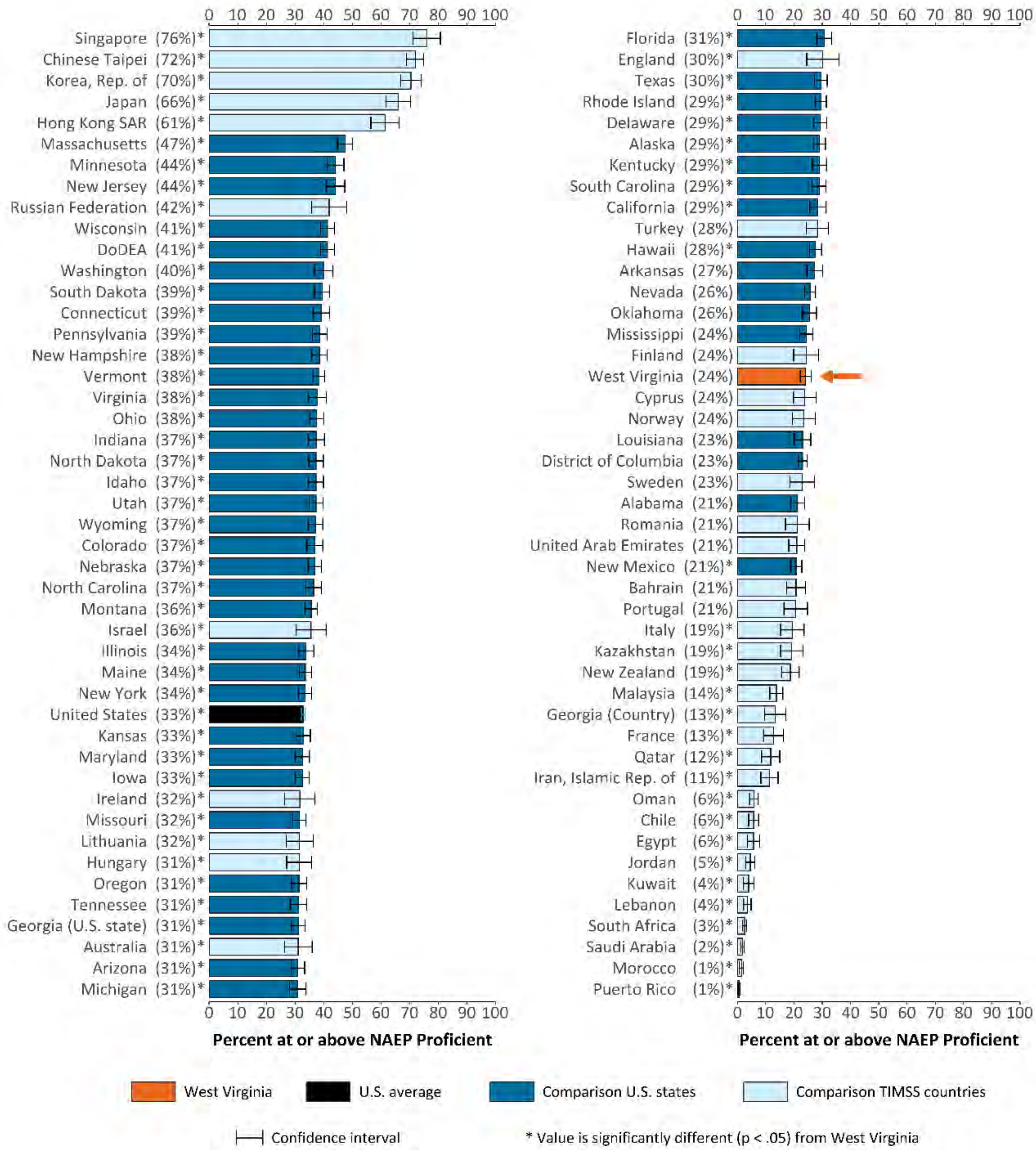
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.47. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Washington



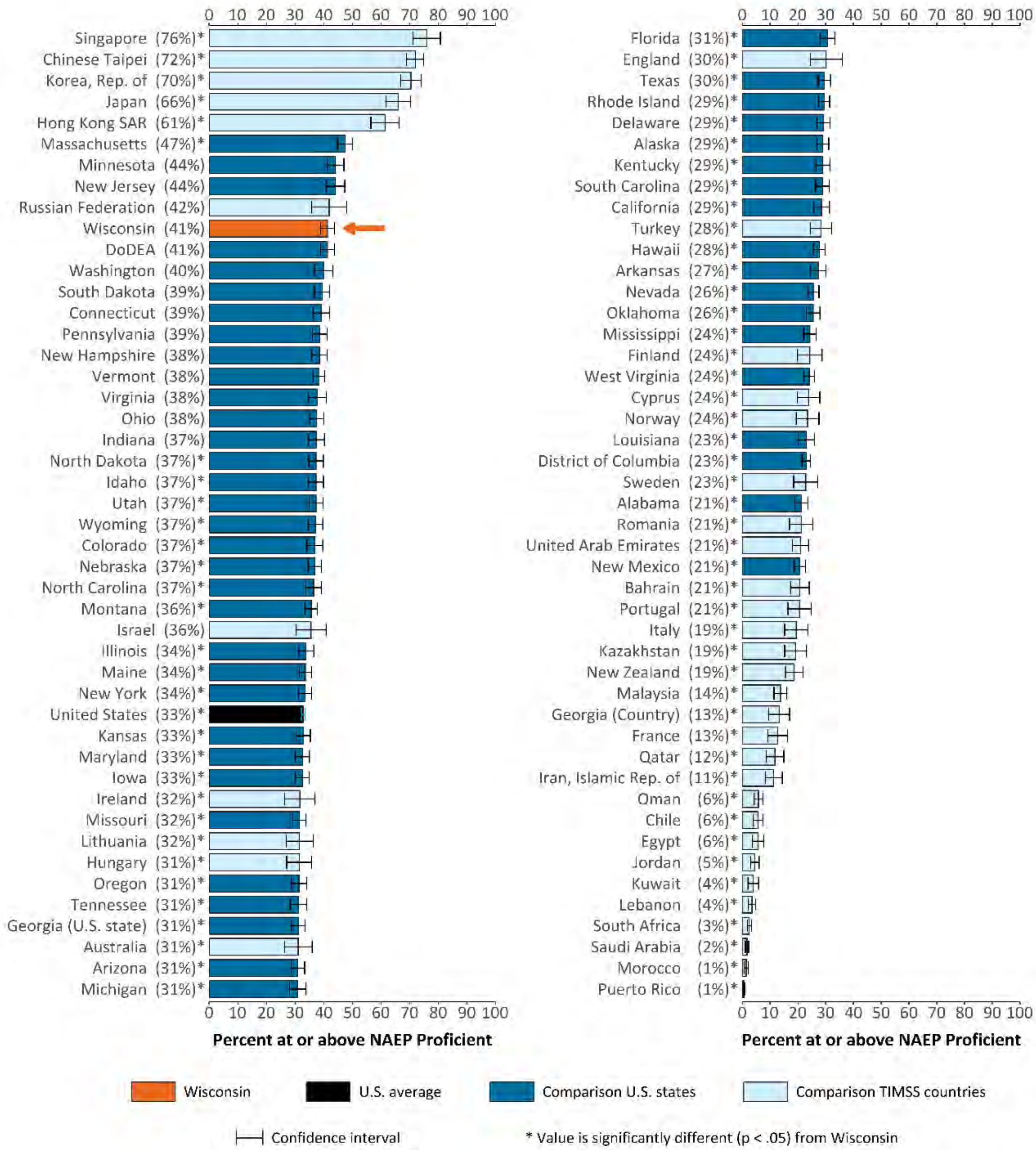
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.48. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to West Virginia



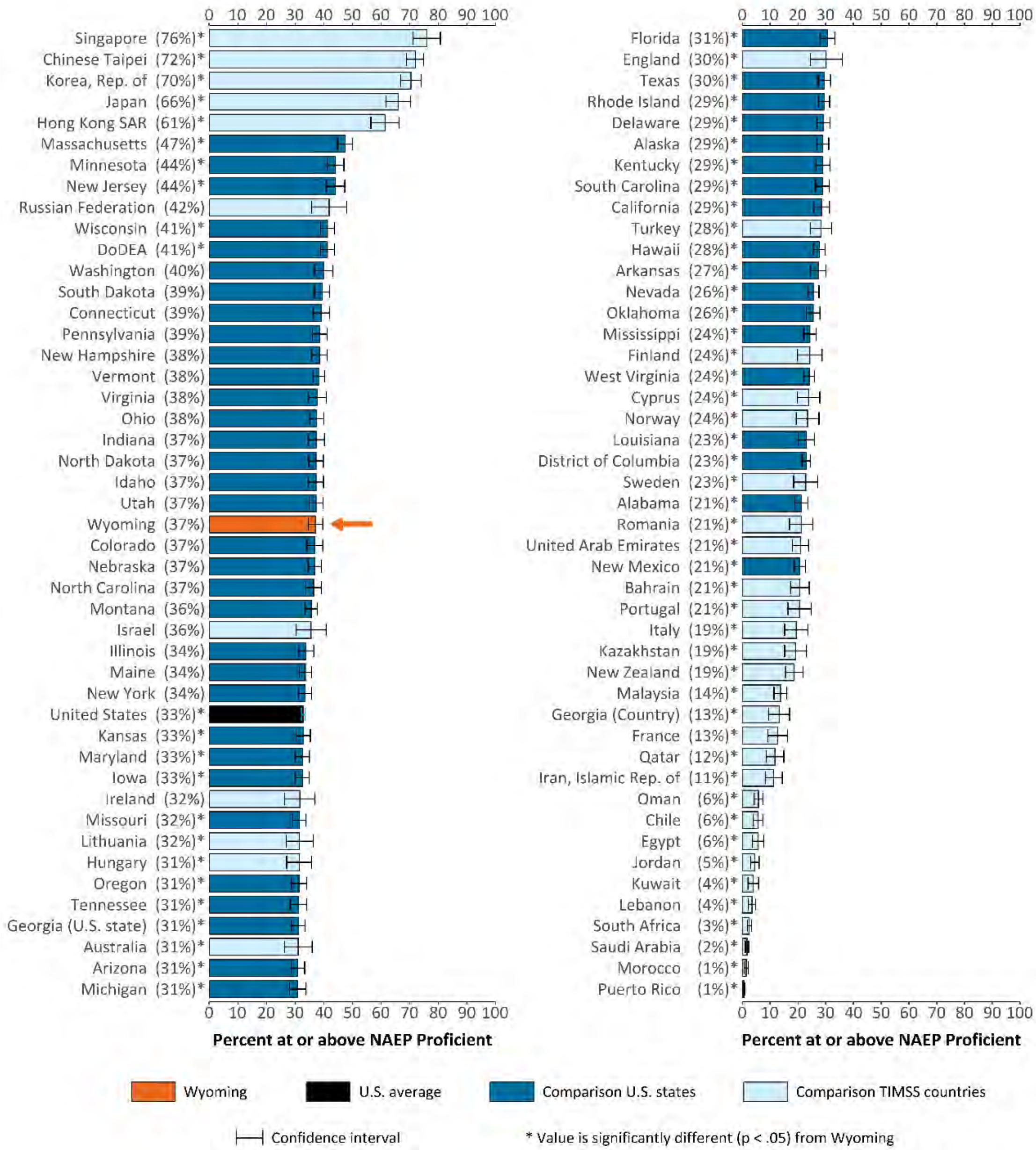
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.49. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Wisconsin



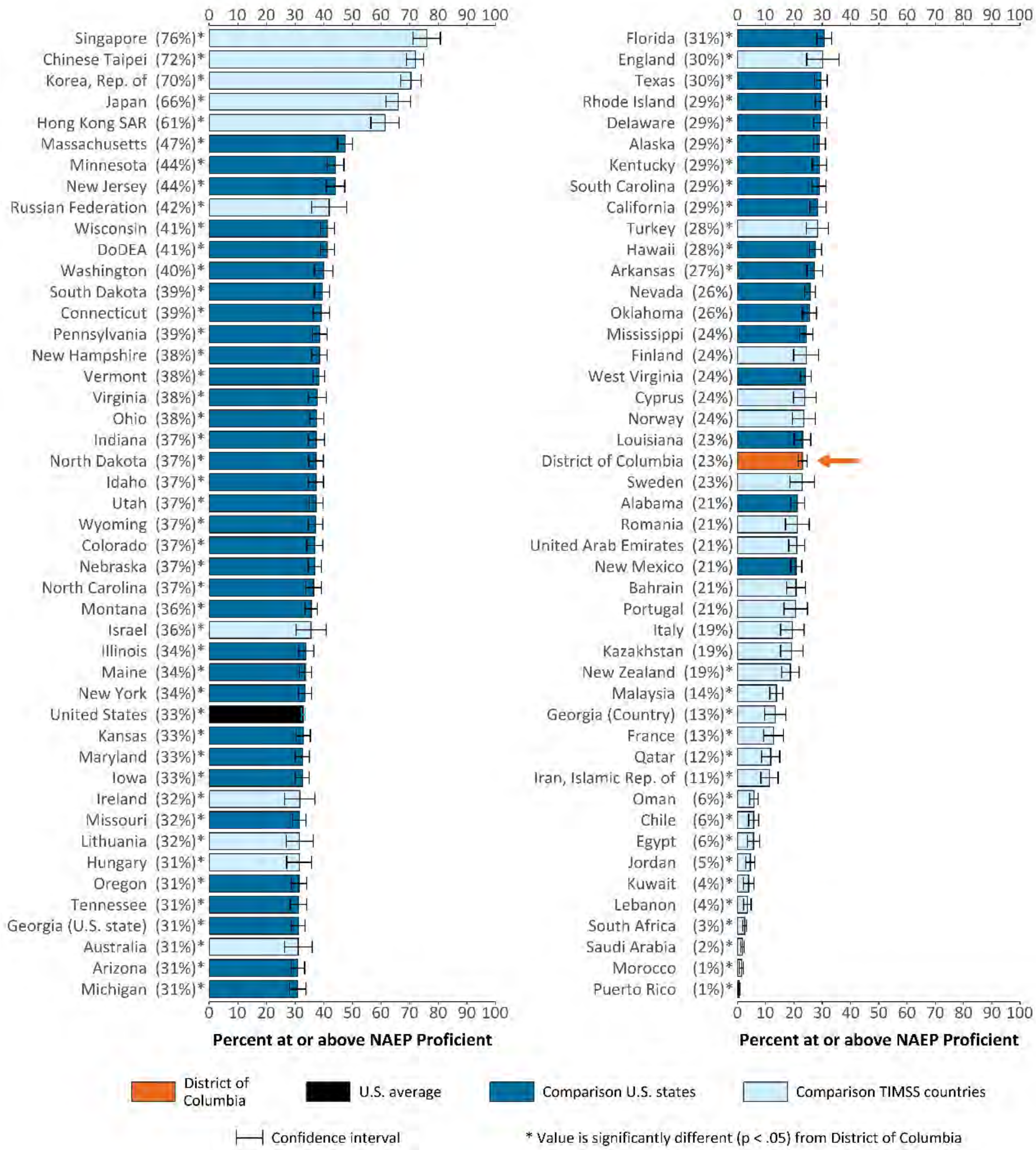
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.50. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Wyoming



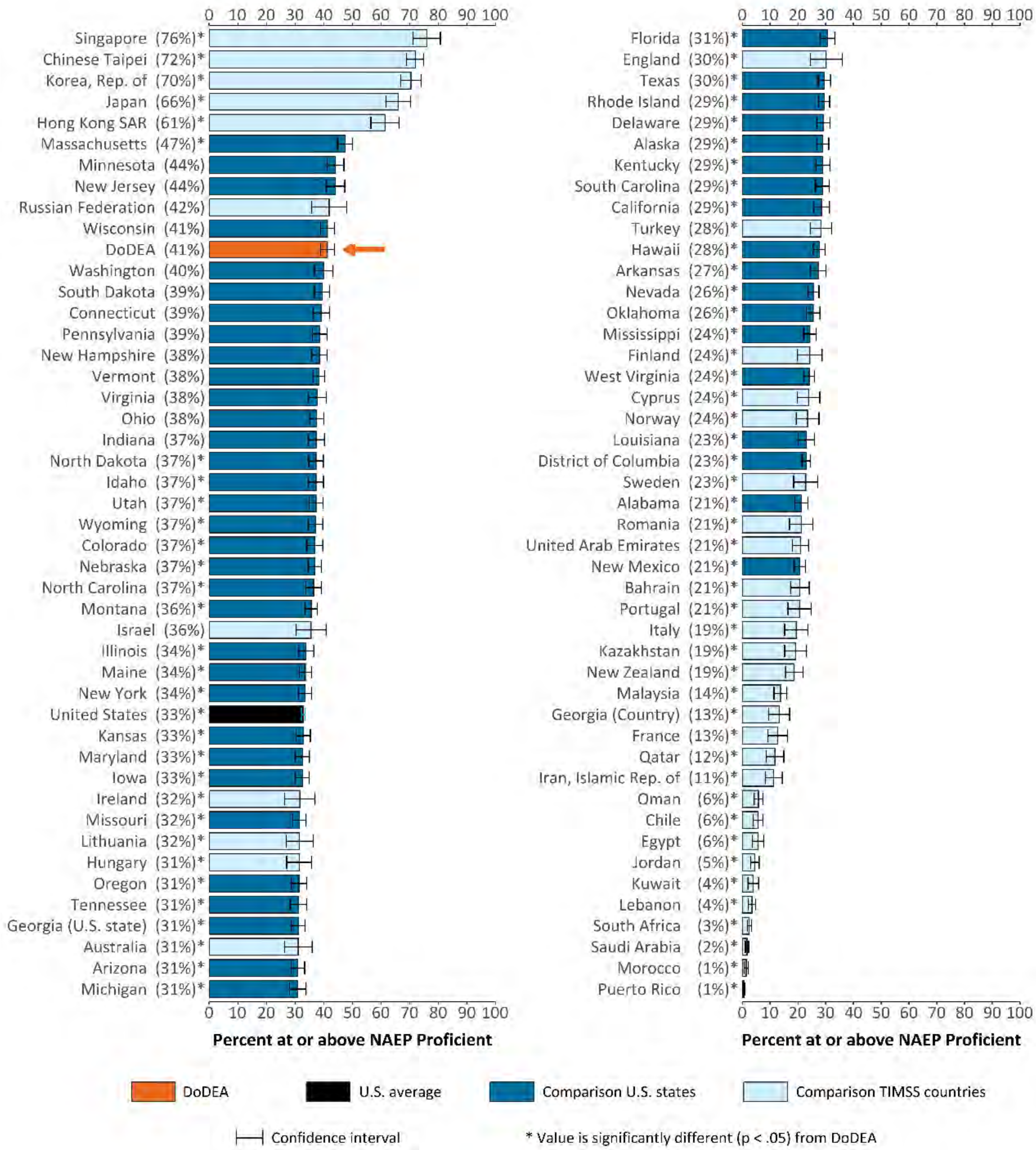
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.51. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to District of Columbia



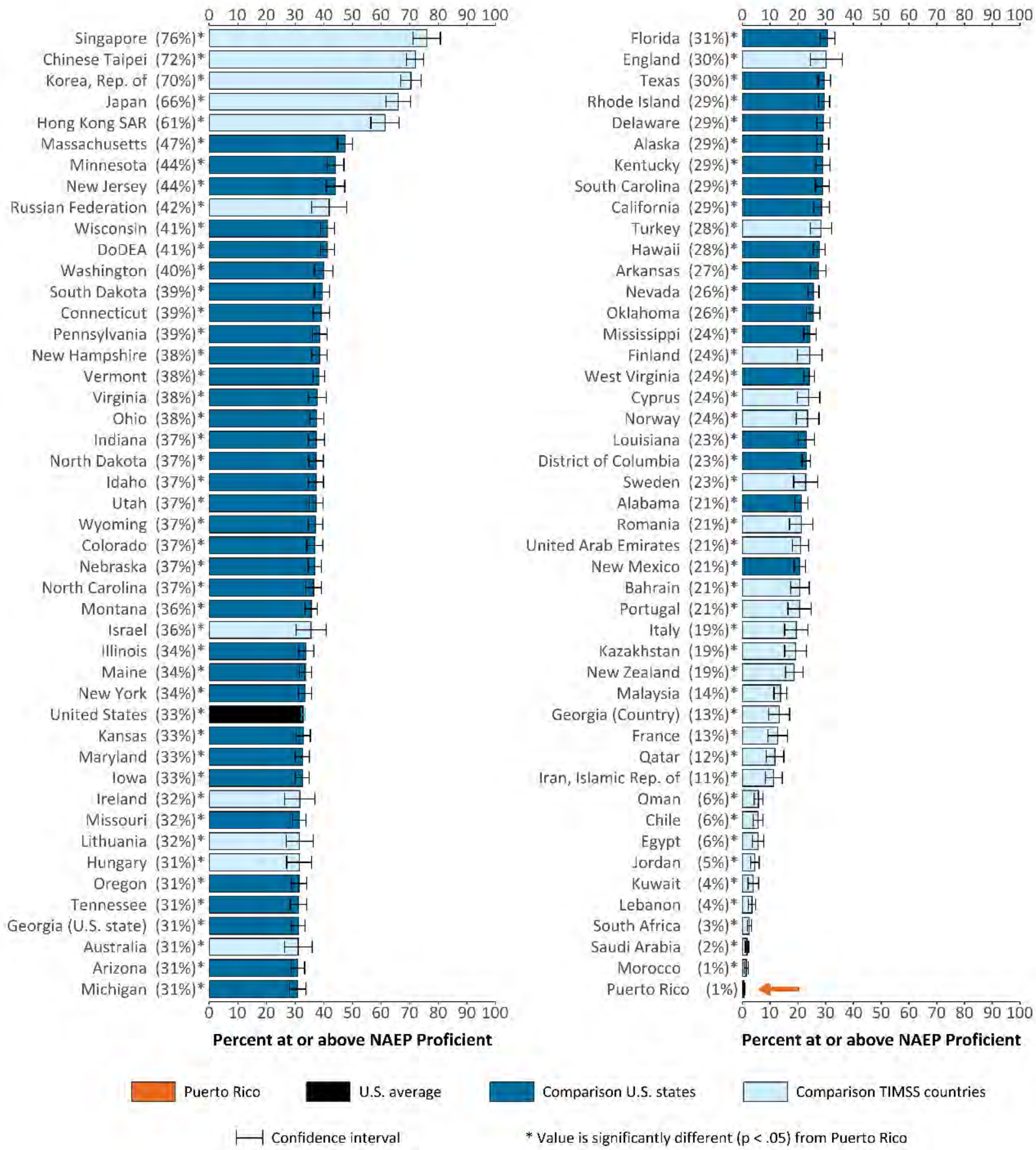
NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.52. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to DoDEA



NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

Figure A.53. Percentage of students performing at the NAEP Proficient level in grade 8 mathematics across the U.S. national public school sample, U.S. states, and TIMSS countries; comparison to Puerto Rico



NOTE: The NAEP *Proficient* percentage for the U.S. national public sample and the U.S. states was measured using NAEP. All non-U.S. NAEP *Proficient* percentages were measured using TIMSS and statistical moderation.

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