



Scientific Curiosity of Biology Teacher Candidate

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Abstract: The purpose of this study was to identify the scientific curiosity of prospective biological teachers based on gender. Scientific curiosity in this research consists of three components, namely 1) Practice Science, 2) Stretch, and 3) Embrace. The survey method used in this study involved 100 prospective students of education teachers as samples. Scientific curiosity data was collected using Science Curiosity in Learning Environments (SCILE) which has been declared reliable (Cronbach alpha: 0.91). Differences in the scientific curiosity of males and females were analyzed descriptively and statistically using t-test and Mann-Whitney test. The results showed that the scientific curiosity of science teacher candidates was in a good category, male and female teacher candidates were significantly different only in the science practice component ($p: 0.020$), while the stretching ($p: 0.505$) and embracing components ($p: 0.05$): 0.185). no significant difference was found between male and female students. Scientific curiosity based on gender only differed in the component of science practice, while stretching and embracing were not significantly different. Based on these findings, the scientific curiosity of prospective biology teachers, in general, must be increased.

Keywords: scientific curiosity, biology, teacher candidate

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INTRODUCTION

The character of curiosity is one of the 18 characteristics that are demanded in the National education system in its implementation, it can be applied through learning, for example, strengthening, and habituation (Jannah et al., 2021). The development of science and technology today requires everyone to have the character of curiosity and high-order thinking skills (Hunaepi et al., 2021b). In fact, the character of curiosity is one that must be developed in 21st-century learning and becomes the basis for education (Bialik et al., 2015a; Rowson et al., 2012). Basically, everyone has a curiosity about something that has just been seen or observed so they put forth efforts to obtain information (Gottlieb and Oudeye (2018) everyone has a curiosity to seek non-instrumental information. This curiosity includes perceptual curiosity (certain interests and stimuli), diversive curiosity (novelty or sensation seeking), and epistemic curiosity (interest in specific topics) (Berlyne, 1954).

Curiosity is the desire that every individual has to explore, investigate the environment (Arnone et al., 2011a) it aims to answer problems and find novelty. Curiosity becomes an important variable in the stages of life as a basic instinct to learn new things in the environment (Mussel, 2013). Curiosity becomes the center of intellectual and behavioral roles that play a role in everyday life (Murayama et al., 2019). Curiosity is the desire for knowledge that leads to exploration to answer any questions that arise from observations. In line with this opinion, Nasrullah (2021) states that curiosity is the desire to acquire new knowledge through exploration in order to grow and expand understanding which refers to the tendency of students to ask, investigate, and discover new knowledge obtained from their environment. Meanwhile, Kendra (2020) & Ten et al. (2021) states that curiosity is the basis of a student's cognition or mental processes that occur about something that results from thinking process activities about the surrounding environment.

Devoting more attention to one activity, processing information more deeply, remembering information better, and being more likely to work on a task to completion, are forms of curiosity from students (Kashdan, 2010). Through curiosity, students do not need to be encouraged to learn, they can experience learning on their own. Therefore, (Fadilah & Kartini, 2019) fostering student curiosity is something important and a necessity in learning to develop creativity (Gurning & Siregar, 2017; Hagtvedt et al., 2019). The curiosity of the learner becomes a strong driver for success in the learning environment (Raharja et al., 2018). Gurning and Siregar (2017) and as a disposition to inquire, investigate or seek knowledge. With high curiosity, they will have a greater desire to question gaps in learning, seek information, and explore knowledge (Gurning and Siregar (2017), and Kashdan et al. (2011) have an open attitude to find newness.

Some researchers define curiosity as an important basis in the learning process. Stumm et al. (2011)

Curiosity is related to a strong desire to learn more about something new and is a metacognitive skill to prepare learners for lifelong learning. Maslow (1954) and Rouleau (2018) recognized curiosity as one of the most important factors driving the success of learners to acquire knowledge. Kidd and Hayden (2015) Curiosity is a basic element of cognition. Abakpa et al. (2018) basically, curiosity is the desire to learn. Meanwhile Berlyne (1954), Kashdan et al. (2011), Litman (2010) and Oudeyer et al. (2016) stated that curiosity is an intrinsic desire to find new information and experiences that motivate learner behavior and become the key to active learning. Scientific curiosity can be stimulated when individuals feel a lack of information, and the emergence of high motivation to find out (Litman, 2005; Noordewier & van Dijk, 2017). Strong desire to explore uncertain events in new ways through the process of thinking and investigating (Kashdan & Silvia, 2009; Arnone et al., 2011b). Curiosity can be a strong behavioral motivation to explore the environment to master new things, use technology and create new technology Silmi and Kusmarni (2017) through the investigation process. Weible and Zimmerman (2016a) curiosity is an important part of scientific inquiry

Curiosity is one of the characters developed in 21st-century education that is integrated into learning (Bialik et al., 2015b). Characters that are in accordance with the 21st century include attention, curiosity, courage, resilience, ethics, and leadership. Prasetyo and Fitri (2018) states these characters are important to be developed in students. These efforts can be seen in the implementation of the KKNi which provides a paradigm shift were in the final results of learning students not only master knowledge but also master attitudes and skills, in accordance with the achievements of graduates. Learning objectives include the development of collaborative attitudes, knowledge, and skills for each level of education. To be able to achieve the three competencies planned, the scientific curiosity of students must be developed. Aktas and Ustun (2017) to achieve efficient education and consequences because curiosity is one of the key factors for education (Sinha et al., 2017). Curiosity is an important metacognitive skill in educational contexts. Attitude Scientific curiosity is very important in the learning process because this attitude has a positive impact on the student learning process. Curiosity can create an independent learning cycle, because curiosity motivates people to learn and acquire new information, and allows them to see wider differences and a more concrete and complex view of what they are learning (Spektor-Levy et al., 2013a)

Several studies have shown that the existence of curiosity possessed by students has a positive effect on the learning process and outcomes. Keung et al. (2012) & Harrison and Dossinger (2017) observed that students with curiosity showed higher intrinsic motivation to acquire knowledge in certain subjects, and, in improved performance through the Kashdan and Steger (2007) inquiry process. Pluck and Johnson (2011a) Curiosity can motivate students to practice and explore information about what is being learned. Gurning and Siregar (2017) stated that the group of students with high curiosity had higher achievement than the group of students with low curiosity. Raharja et al. (2018) characterizes curiosity based on gender which states that there is no difference between male and female students.

The results of the research above indicate that the sense of knowledge possessed by students is very important in determining students' motivation, interests, thinking skills, and academic results. Thus, student curiosity needs to be identified to support the learning process. Herianto and Wilujeng (2020) states biological education as a way of thinking includes belief, curiosity, imagination, reasoning, causality, self-examination and skepticism, objectivity and open-mindedness. Biology as part of science have the essence of learning that requires curiosity. Carin and Sund (1989) the three elements of science are human attitudes, scientific processes or methods, and scientific products. This study aims to identify the scientific curiosity of biology education students. Curiosity is viewed from three components, namely Science Practices (practice science), Stretching (searching for new information and experiences), and Embracing (new experiences from everyday life) (Kashdan et al., 2009).

METHODS

This research is a quantitative descriptive study with a survey method (Fitriani et al., 2019) to explore the curiosity of biology education students. The subjects of this study were 100 prospective biology education teacher students at the Mandalika Education University: 25 students; Mataram State Islamic University: 25 students; Hamzanwadi University: 25 students; Nahdlatul Wathan University: 25 students) with 53 male students and 47 female students. The instrument used is the Science Curiosity in Learning Environments (SCILE) questionnaire. SCILE is a tool to measure scientific curiosity attitude which consists of 12 statement items and is divided into 3 (three) indicators, namely Science Practices (4 items), Stretching (6 items), and Embracing (2 items) indicators with a level of reliability based on the scale. Cronbach is 0.91 (Weible & Zimmerman, 2016a). The questionnaire instrument was distributed online using a google form to 100 prospective science education teacher students.

In this type of research, the researcher collects quantitative data, the data is in the form of a

questionnaire that can be analyzed statistically to show the trend of the responses given by the target population about the phenomenon being discussed (Creswell, 2014). Scientific curiosity was analyzed descriptively using the equation [SC = score obtained/maximum score]. The results of the descriptive analysis of scientific curiosity data were further categorized into 5 rating scales as presented in Table 1.

Table 1. Curiosity's Scientific Criteria (Prayogi et al., 2018)

Interval	Criteria
$X > 4.6$	Very Good
$3.6 < X \leq 4.6$	Good
$2.6 < X \leq 3.6$	Adequate
$1.6 < X \leq 2.6$	Less
$X \leq 1.6$	Poor

Differences in SC male and female were statistically analyzed using the t-test and the Mann-Whitney test after going through the prerequisite test using the Kolmogorov-Smirnov test with the help of IBM SPSS 23 software.

RESULT AND DISCUSSION

The main objective of this study was to identify the scientific curiosity of prospective students for Biology teachers which were analyzed descriptively using the formula. After applying the one-sample Kolmogorov-Smirnov Z test, this study found that the normality distribution of data collected from the scientific curiosity indicator, as shown in table 1.

Table 2. Test Results One-Sample Kolmogorov-Smirnov Test

Components	Gender	N	Mean	Std. Deviation	Sig	Normality
SP	Male	53	3.3523	.73114	.524	Yes
	Famale	47	3.0976	.77218	.104	Yes
STR	Male	53	3.6921	.75343	.777	Yes
	Female	47	3.6265	.66539	.228	Yes
EM	Male	53	3.4545	.87586	.011	No
	Female	47	3.2254	.83836	.000	No

The table above shows that the components of science practices and stretching for men and women are normally distributed ($p >$ test) so that the scientific curiosity difference test of the sample was tested using the independent sample t-test. The embracing component was declared not normally distributed so that the Mann-Whitney test was carried out to determine the significance of the differences between men and women in these components. The results of the scientific curiosity difference test based on gender are presented in the following table.

Tabel 3. Independent sample t-test

Indicator	Gender	n	Mean	t	df	p
Science practices	male	53	3.3523	2.344	99	.020
	female	47	3.0976			
Streching	male	53	3.6921	.668	99	.505
	female	47	3.6265			
Mann-Whitney test						
Embracing	Male-female	100	3.4545	1.895	99	.185

Descriptively, the scientific curiosity of prospective science education teachers is categorized into good and quite good categories. The results of the descriptive analysis of the research data are presented in table 3.

Table 4. Category Scientific Curiosity

Interval	Scientific Curiosity (%)	Criteria
$X > 4.6$	6	Very Good
$3.6 < X \leq 4.6$	42	Good
$2.6 < X \leq 3.6$	44	Adequate
$1.6 < X \leq 2.6$	8	Less
$X \leq 1.6$	0	Poor

Curiosity is an aspect of intrinsic motivation that has the potential to increase the desire to learn and

develop students' academic abilities and behavior (Gross et al., 2020; Pluck & Johnson, 2011b). Scientific Curiosity is a desire to obtain information about the surrounding environment through scientific activities. (Krapp & Prenzel, 2011) desire to understand and seek knowledge of natural phenomena. The results showed that the scientific curiosity of men and women differed significantly only in the component of science practices ($p: 0.020$), while the components of stretching ($p: 0.505$) and embracing ($p: 0.185$) did not differ significantly between men and women.

Different results are presented by Weible & Zimmerman (2016b) there is no significant difference between the male and female groups in both the scientific curiosity, stretching, embracing indicators. The results of data analysis show that the scientific curiosity of prospective science teachers has a significant difference between men and women. In line with the results of the study by Raharja et al. (2018) there was no difference in curiosity between male and female students. However, this study has a review of scientific curiosity indicators that are different from this study, namely the explore, discover, adventurous and questioning indicators. In general, the scientific curiosity of prospective science teacher students is the insufficient category (44%) this indicates that scientific curiosity needs to be increased through learning activities that emphasize the development and improvement of Scientific Curiosity. Scientific curiosity is very important for prospective science teacher students to have in carrying out the lecture process (Spektor-Levy et al., 2013b). Scientific curiosity possessed by people will enrich scientific knowledge by conducting research, reviewing literature through the process of applying inquiry such as asking questions, observing, predicting and drawing conclusions.

Exploration of the existence of scientific curiosity of prospective biology education teacher students is important because it will be able to assist lecturers in directing and mobilizing students' motivation and interest in the learning process, both in the classroom and in the laboratory. The existence of curiosity possessed by students can be an intrinsic motivation in understanding the material concepts presented by lecturers, besides that it can encourage students to explore the surrounding environment (Fuadati & Wilujeng, 2019; Hunaepi et al., 2021a). This scientific curiosity is important to develop in prospective biology teacher students because it will be able to help (Jannah et al., 2021) students in; 1) improve and activate students' reasoning power so that it is beneficial for themselves and others, 2) students become active observers, 3) what is observed and studied always has interesting challenges for them to learn, and 4) scientific curiosity will eliminate the boredom of students to continue learning through library research, observing, exploring, and experimenting.

Several studies show that there is a difference in the effect of the level of curiosity possessed by men and women, this is like the results of research conducted by Hanshaw-King & Shari (2004) that men are more likely to act on their curiosity than women. Meanwhile Nugroho (2019) there is a significant difference between the curiosity of boys and girls. In addition, it can be seen that the average value of curiosity in male adolescents is 36.40 higher than female adolescents with an average curiosity value of only 33.76. This study uses the Curiosity and Exploration Inventory which was developed by Kasdan.

CONCLUSION

The research findings show that the scientific curiosity of men and women differs significantly only in the component of science practices ($p: 0.020$), while the stretching ($p: 0.505$) and embracing ($p: 0.185$) components of men and women are not different. This shows that scientific curiosity based on gender only differs in the component of science practices, while stretching and embracing are not significantly different. The existence of these findings became the basis for developing the curiosity of prospective biology teacher students in learning. In general, the scientific curiosity of prospective biology teachers should be increased.

REFERENCES

- Abakpa, B. O., Abah, J. A., & Agbo-Egwu, A. O. (2018). Science Curiosity as a Correlate of Academic Performance in Mathematics Education: Insights from Nigerian Higher Education. *African Journal of Teacher Education*, 7(1). <https://doi.org/10.21083/ajote.v7i1.3904>
- Aktas, N., & Ustun, U. D. (2017). The Measurement of Curiosity of Teacher Candidates: A Study Based on Breadth and Depth of Interest. *Advanced Education*, 3(7), 33–36.
- Arnone, M. P., Small, R. V., Chauncey, S. A., & McKenna, H. P. (2011a). Curiosity, interest and engagement in technology-pervasive learning environments: A new research agenda. *Educational Technology Research and Development*, 59(2), 181–198. <https://doi.org/10.1007/s11423-011-9190-9>

- Arnone, M. P., Small, R. V., Chauncey, S. A., & McKenna, H. P. (2011b). Curiosity, interest and engagement in technology-pervasive learning environments: A new research agenda. *Educational Technology Research and Development*, 59(2), 181–198. <https://doi.org/10.1007/s11423-011-9190-9>
- Berlyne, D. E. (1954). A Theory of Human Curiosity. *British Journal of Psychology. General Section*, 45(3), 180–191. <https://doi.org/10.1111/j.2044-8295.1954.tb01243.x>
- Bialik, M., Bogan, M., Fadel, C., & Horvathova, M. (2015a). *Character Education for the 21st Century: What Should Students Learn?* Center for Curriculum Redesign Boston, Massachusetts. www.curriculumredesign.org
- Bialik, M., Bogan, M., Fadel, C., & Horvathova, M. (2015b). *Character Education for the 21st Century: What Should Students Learn?* https://curriculumredesign.org/wp-content/uploads/CCR-CharacterEducation_FINAL_27Feb2015.pdf
- Carin, A. A., & Sund, R. B. (1989). *Teaching science through discovery* (6th ed). Merrill.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed). SAGE Publications.
- Fadilah, I., & Kartini. (2019). Identifikasi Sikap Rasa Ingin Tahu Siswa Terhadap Pembelajaran Fisika Di MAN 1 Batanghari. *Sukma: Jurnal Pendidikan*, 3(2), 217–231. <https://doi.org/10.32533/03205.2019>
- Fitriani, H., Asy'ari, M., Zubaidah, S., & Mahanal, S. (2019). Exploring the Prospective Teachers' Critical Thinking and Critical Analysis Skills. *Jurnal Pendidikan IPA Indonesia*, 8(3). <https://doi.org/10.15294/jpii.v8i3.19434>
- Fuadati, M., & Wilujeng, I. (2019). Web-Lembar Kerja Peserta Didik IPA terintegrasi potensi lokal pabrik gula untuk meningkatkan rasa ingin tahu peserta didik. *Jurnal Inovasi Pendidikan IPA*, 5(1), 98–108. <https://doi.org/10.21831/jipi.v5i1.24543>
- Gottlieb, J., & Oudeyer, P.-Y. (2018). Towards a neuroscience of active sampling and curiosity. *Nature Reviews Neuroscience*, 19(12), 758–770. <https://doi.org/10.1038/s41583-018-0078-0>
- Gross, M. E., Zedelius, C. M., & Schooler, J. W. (2020). Cultivating an understanding of curiosity as a seed for creativity. *Current Opinion in Behavioral Sciences*, 35, 77–82. <https://doi.org/10.1016/j.cobeha.2020.07.015>
- Gurning, B., & Siregar, A. (2017). The Effect of Teaching Strategies and Curiosity on Students' Achievement in Reading Comprehension. *English Language Teaching*, 10(11), 191. <https://doi.org/10.5539/elt.v10n11p191>
- Hagtvedt, L. P., Dossinger, K., Harrison, S. H., & Huang, L. (2019). Curiosity made the cat more creative: Specific curiosity as a driver of creativity. *Organizational Behavior and Human Decision Processes*, 150, 1–13. <https://doi.org/10.1016/j.obhdp.2018.10.007>
- Harrison, S. H., & Dossinger, K. (2017). Pliable Guidance: A Multilevel Model of Curiosity, Feedback Seeking, and Feedback Giving in Creative Work. *Academy of Management Journal*, 60(6), 2051–2072. <https://doi.org/10.5465/amj.2015.0247>
- Herianto, H., & Wilujeng, I. (2020). The correlation between students' curiosity and generic science skills in science learning. *Jurnal Inovasi Pendidikan IPA*, 6(2), 237–246. <https://doi.org/10.21831/jipi.v6i2.37382>
- Hunaepi, H., Ikhsan, M., Suwono, H., & Sulisetijono, S. (2021a). The Contribution of Epistemic Curiosity and its Relevance to Science Process Skills on Biology Prospective Teacher. *Jurnal Penelitian Pendidikan IPA*, 7 (Special Issue), 112–117. <https://doi.org/10.29303/jppipa.v7iSpecialIssue.1070>
- Hunaepi, H., Ikhsan, M., Suwono, H., & Sulisetijono, S. (2021b). Curiosity in Learning Biology: Literature Review. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 9(2), 343–353. <https://doi.org/10.33394/j-ps.v9i2.4272>
- Jannah, F., Fadly, W., & Aristiawan, A. (2021a). Analisis Karakter Rasa Ingin Tahu Siswa Pada Tema Struktur dan Fungsi Tumbuhan. *Jurnal Tadris IPA Indonesia*, 1(1), 1–16. <https://doi.org/10.21154/jtiii.v1i1.63>
- Kashdan, T. B. (2010). *Curious?: Discover the missing ingredient to a fulfilling life*. Harper.
- Kashdan, T. B., Gallagher, M. W., Silvia, P. J., Winterstein, B. P., Breen, W. E., Terhar, D., & Steger, M. F. (2009). The curiosity and exploration inventory-II: Development, factor structure, and psychometrics. *Journal of Research in Personality*, 43(6), 987–998. <https://doi.org/10.1016/j.jrp.2009.04.011>

- Kashdan, T. B., McKnight, P. E., Fincham, F. D., & Rose, P. (2011). When Curiosity Breeds Intimacy: Taking Advantage of Intimacy Opportunities and Transforming Boring Conversations: Curiosity and Intimacy. *Journal of Personality, 79*(6), 1369–1402. <https://doi.org/10.1111/j.1467-6494.2010.00697.x>
- Kashdan, T. B., & Silvia, P. J. (2009). Curiosity and Interest: The Benefits of Thriving on Novelty and Challenge. In S. J. Lopez & C. R. Snyder (Eds.), *The Oxford Handbook of Positive Psychology* (pp. 366–374). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780195187243.013.0034>
- Kashdan, T. B., & Steger, M. F. (2007). Curiosity and pathways to well-being and meaning in life: Traits, states, and everyday behaviors. *Motivation and Emotion, 31*(3), 159–173. <https://doi.org/10.1007/s11031-007-9068-7>
- Kendra, C. (2020). *The Importance of Cognition in Determining Who We Are*. Verywell Mind. <https://www.verywellmind.com/what-is-cognition-2794982>
- Keung, Y. H., Kan Man-shan, & Cheng Alison Lai-fong. (2012). The Impact of Curiosity and External Regulation on Intrinsic Motivation: An Empirical Study in Hong Kong Education. *Journal of Psychology Research, 2*(5). <https://doi.org/10.17265/2159-5542/2012.05.003>
- Kidd, C., & Hayden, B. Y. (2015). The Psychology and Neuroscience of Curiosity. *Neuron, 88*(3), 449–460. <https://doi.org/10.1016/j.neuron.2015.09.010>
- Krapp, A., & Prenzel, M. (2011). Research on Interest in Science: Theories, methods, and findings. *International Journal of Science Education, 33*(1), 27–50. <https://doi.org/10.1080/09500693.2010.518645>
- Litman, J. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition & Emotion, 19*(6), 793–814. <https://doi.org/10.1080/02699930541000101>
- Litman, J. A. (2010). Relationships between measures of I- and D-type curiosity, ambiguity tolerance, and need for closure: An initial test of the wanting-liking model of information-seeking. *Personality and Individual Differences, 48*(4), 397–402. <https://doi.org/10.1016/j.paid.2009.11.005>
- Maslow, A. H. (1954). *Motivation And Personality*. <https://www.eyco.org/nuovo/wp-content/uploads/2016/09/Motivation-and-Personality-A.H.Maslow.pdf>
- Murayama, K., FitzGibbon, L., & Sakaki, M. (2019). Process Account of Curiosity and Interest: A Reward-Learning Perspective. *Educational Psychology Review, 31*(4), 875–895.
- Mussel, P. (2013). Introducing the construct curiosity for predicting job performance: Curiosity Predicts Job Performance. *Journal of Organizational Behavior, 34*(4), 453–472. <https://doi.org/10.1002/job.1809>
- Nasrullah, B., Fatima, G., & Nayab, D. e. (2021). *Strategies Used by Public Primary School Teachers for Enhancing Students' Curiosity in Science*. <https://doi.org/10.26710/JAFEE.V7I1.1568>
- Noordewier, M. K., & van Dijk, E. (2017). Curiosity and time: From not knowing to almost knowing. *Cognition and Emotion, 31*(3), 411–421. <https://doi.org/10.1080/02699931.2015.1122577>
- Oudeyer, P.-Y., Gottlieb, J., & Lopes, M. (2016). Intrinsic motivation, curiosity, and learning. In *Progress in Brain Research* (Vol. 229, pp. 257–284). Elsevier. <https://doi.org/10.1016/bs.pbr.2016.05.005>
- Pluck, G., & Johnson, H. L. (2011a). *Stimulating curiosity to enhance learning*. 9.
- Pluck, G., & Johnson, H. L. (2011b). *Stimulating curiosity to enhance learning*. *GESJ: Education Science and Psychology, 2*(19), 24–31.
- Prasetyo, T., & Fitri, A. M. (2018). The Effect of Scientific Approach Combines Learning Guided Discovery to Curiosity of Students. *Didaktika Tauhidi: Jurnal Pendidikan Guru Sekolah Dasar, 5*(1), 15.
- Prayogi, S., Yuanita, L., & Wasis. (2018). Critical-Inquiry-Based-Learning: Model of Learning to Promote Critical Thinking Ability of Pre-service Teachers. *Journal of Physics: Conference Series, 947*, 012013. <https://doi.org/10.1088/1742-6596/947/1/012013>
- Raharja, S., Wibhawa, M. R., & Lukas, S. (2018a). Mengukur Rasa Ingin Tahu Siswa. *Polyglot: Jurnal Ilmiah, 14*(2), 151. <https://doi.org/10.19166/pji.v14i2.832>
- Rouleau, K. (2018). *Curiosity Works Moving your school from improvement to innovation*. <https://files.eric.ed.gov/fulltext/ED588753.pdf>
- Rowson, J., Young, J., Spencer, N., Lindley, E., & Gecius, E. (2012). *The Power of Curiosity How Linking Inquisitiveness to Innovation Could Help to Address Our Energy Challenges*. RSA Social Brain Centre. <https://www.thersa.org/globalassets/pdfs/reports/rsa-social-brain-the-power-of-curiosity.pdf>

- Silmi, M., & Kusmarni, Y. (2017). Menumbuhkan Karakter Rasa Ingin Tahu Siswa dalam Pembelajaran Sejarah Melalui Media Puzzle. *FACTUM: Jurnal Sejarah Dan Pendidikan Sejarah, 6(2)*. <https://doi.org/10.17509/factum.v6i2.9980>
- Sinha, T., Bai, Z., & Cassell, J. (2017). A New Theoretical Framework for Curiosity for Learning in Social Contexts. In É. Lavoué, H. Drachsler, K. Verbert, J. Broisin, & M. Pérez-Sanagustín (Eds.), *Data Driven Approaches in Digital Education* (Vol. 10474, pp. 254–269). Springer International Publishing. https://doi.org/10.1007/978-3-319-66610-5_19
- Spektor-Levy, O., Baruch, Y. K., & Mevarech, Z. (2013a). Science and Scientific Curiosity in Pre-school—The teacher's point of view. *International Journal of Science Education, 35(13)*, 2226–2253. <https://doi.org/10.1080/09500693.2011.631608>
- Spektor-Levy, O., Baruch, Y. K., & Mevarech, Z. (2013b). Science and Scientific Curiosity in Pre-school—The teacher's point of view. *International Journal of Science Education, 35(13)*, 2226–2253. <https://doi.org/10.1080/09500693.2011.631608>
- Stumm, S. v., Hell, B., & Chamorro-Premuzic, T. (2011). The Hungry Mind: Intellectual Curiosity Is the Third Pillar of Academic Performance. *Perspectives on Psychological Science, 6(6)*, 574–588. <https://doi.org/10.1177/1745691611421204>
- Ten, A., Kaushik, P., Oudeyer, P.-Y., & Gottlieb, J. (2021). Humans monitor learning progress in curiosity-driven exploration. *Nature Communications, 12(1)*, 5972. <https://doi.org/10.1038/s41467-021-26196-w>
- Weible, J. L., & Zimmerman, H. T. (2016a). Science curiosity in learning environments: Developing an attitudinal scale for research in schools, homes, museums, and the community. *International Journal of Science Education, 38(8)*, 1235–1255. <https://doi.org/10.1080/09500693.2016.1186853>
- Weible, J. L., & Zimmerman, H. T. (2016b). Science curiosity in learning environments: Developing an attitudinal scale for research in schools, homes, museums, and the community. *International Journal of Science Education, 38(8)*, 1235–1255. <https://doi.org/10.1080/09500693.2016.1186853>