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The Development of HOTS Instruments in Biology Learning

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ABSTRACT

This study aims to produce valid and reliable HOTS instruments in Biology Learning. The research is a Research and Development study with the ADDIE model. The research was conducted at SMA Negeri 12 Kerinci. The sample in the study came from 2 biology education lecturers and 3 biology teachers. The instruments in this study were a 20-item multiple-choice HOTS test sheet and a validation questionnaire. Data collection techniques are tests and validation questionnaires. Indicators of higher-order thinking Skills are the ability to analyze, evaluate and create. Data analysis is quantitative and qualitative data analysis with the help of the SPSS version 16 application. The results showed that the Higher Order Thinking Skills instrument had a validation value of 0.724 with decent criteria and reliability of 0.972 with high criteria. These findings explain that the Higher Order Thinking SSkills(HOTS) instrument is very valid and reliable for use in ecology and environmental materials

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INTRODUCTION

Higher Order Thinking Skills (HOTS) is a type of high-level thinking ability that students must have to solve problems (Almelweth, 2022). Puspitasari et al., (2020) hihigher-orderhinking skills encourage students to more easily understand complex subject matter. Students who have higher-order thinking Skills think critically and creatively in learning (Ong et al., 2020; Kim et al., 2022; Susanti et al., 2020; Rintayati et al., 2021). HOTS plays a very important role for students to make the right decisions and solutions in learning (Susanto & Retnawati, 2016; Utami et al., 2020; Syafryadin et al., 2022). Furthermore, HOTS encourages students to have 2121st-centurykills, namely Critical Thinking and Problem-solving, Creative, Collaborative, and Communicative (Haniah et al., 2020; Kim et al., , 2020).

Students' Higher Order Thinking Skills (HOTS) level in Indonesia is still low (Ahmad et al., 2018; Setiawan et al., 2018). This can be seen from the PISA Study in 2018, the quality of Higher Order Thinking Skills (HOTS) of Indonesian students obtained a score of 396, ranked 72 out of 78 member countries (Rahmi et al., 2021; Suharyat et al., 2023). In addition, the 2011 TIMSS results

explained that Indonesian students' math and science scores obtained a score of 386 far behind the international average score of 500 (Cahyaningsih & Roektiningroem, 2018). The low level of Higher Order Thinking Skills (HOTS) is influenced by teacher-centered teaching and learning activities (Ramirez & Ganaden, 2008; Ichsan et al., 2019; Alharbi et al., 2022;Putranta & Supahar, 2019), making the learning process less enjoyable Hanifah (2019) stated that teachers have not been able to create questions that encourage Higher Oder Thinking Skills (HOTS). In addition, students have difficulty in understanding those related to analysis, evaluation and creation in biology learning (Umami & Rusdi, 2021).

Biology is one of the compulsory subjects in class X SMA Negeri 12 Kerinci which must be completed by students in accordance with the Teaching Completeness Criteria (KKM) of 75. In learning biology students have many difficulties in learning (Dama, 2021). Research results (Avina & Winarsih, 2014) stated that not many teachers have developed instruments for Higher Order Thinking Skill questions in learning biology in ecology and environmental materials. Furthermore, the material of ecology and the environment many students get scores below KKM. Therefore, there is a Higher Order Thinking Skills (HOTS) instrument in ecology and environment material. Research results (Rahmawati & Trimulyono, 2021) stated that the development of HOTS instruments in biology learning encourages students to think critically and scientifically.

Research Setiawan *et al.*, (2021) stated that the development of HOTS instruments in learning encourages students to be more active in learning. Valid and reliable learning instruments help the quality of students' learning in HOTS questions (Rahmi et al., 2021). Research results Suprapto *et al.*, (2020) Explaining that giving the right questions will stimulate students' Higher Order Thinking Skills in solving problems. Not only that, the right HOTS instrument will encourage students to think critically, innovatively and creatively in learning (Poppy et al., 2020; Supriyatin et al., 2020). Furthermore, research results Pratiwi *et al.*, (2015) stated that the development of HOTS instruments can improve student discipline in learning. Based on this problem, this research aims to produce a valid and reliable Higher Order Thinking Skills instrument in learning biology.

METHOD

This research is a type of Research & Development research with the ADDIE model developed by Dick & Carry in the ADDIE model Boyman *et al.*, (2020). In the ADDIE model there are five stages of development namely Analysis, Development, Implementation, and evaluation. This research was conducted at SMA Negeri 12 Kerinci. The research sample came from 2 biology education lecturers and 3 biology teachers. Data collection in this study through tests and validation questionnaires. The test aims to determine the Higher Order Thinking Skills (HOTS) of students in learning biology. The questionnaire aims to determine the feasibility of Higher Order Thinking Skills (HOTS) questions. The instrument used in the validation questionnaire consisted of 20 statement items which were analyzed with the Minitab version 18 application.

The research indicators of Higher Order Thiking Skills (HOTS) consist of students' ability to analyze (C4), evaluate (C5) and create (C6). Data analysis was obtained by analyzing the validity of the instrument and the reliability of the instrument. Instrument validity consists of content,

language and material validity tests. To perform content validity using the Gregory formula with criteria can be seen in table (1). Furthermore, the reliability of the instrument is calculated by the Cronbach's Alpha formula with the criteria can be seen in Table 2.

RESULTS AND DISCUSSION

The results of the development of Higher Order Thinking Skills (HOTS) instruments in learning biology. The first stage is needs analysis, curriculum analysis and analysis of student evaluation. The second stage is to design the Higher Order Thinking Skills instrument in accordance with the Basic Competencies (KD) and Core Competencies (KI) of ecological and environmental materials. Furthermore, the third stage is Develop. At this stage, the instrument was validated by content validation, language validation, and material validation by lecturers and biology teachers. The results of the validation of the Higher Order Thinking Skills (HOTS) Instrument in learning biology of ecology and environmental material can be seen in Table.3.

Table. 3 HOTS Instrument Validation Results

No	Validasi	Skor	Peresentase (%)	Kriteria
1	Content	40	83 %	Valid
2	Language	49	87 %	Valid
3	Material	48	90 %	Very Valid
Mean		**45.67**		**Valid**

Based on Table. 3 explains that the content validation value obtained a score of 42 with valid criteria, language validation score 45, material validation score 47 and the average value of the validity test obtained a score of 45.67 with valid criteria. This shows that the Higher Order Thinking Skills instrument is suitable for use in learning class X biology. The next stage is implementation. At this stage, the instruments that have been validated by experts and revised are then carried out limited trials on students by giving Higher Order Thinking Skills (HOTS) questions. The results of the limited trial validation can be seen in Table 4. The development of Higher Order Thinking Skills instrument in learning biology ecology and environment material is very feasible to be developed. HOTS instruments are very important for teachers in developing students' higher order thinking skills in learning (Rahmawati et al., 2022; Razak et al.., 2021). The development of valid and reliable HOTS instruments will encourage students' critical and creative thinking skills in learning (Wantoro et al., 2019; Utama, 2020; Ahmad & Syafii, 2020; Ratna et al., 2018; Elfira et al.,, 2023). In developing HOTS instruments for biology learning, questions must refer to indicators of analyzing, evaluating and creating (Hidayatullah et al., 2022), so that students can think critically in learning.

Table 4. Results of HOTS Instrument Validation for Limited Tests

Index	Criteria	Limited Product Trial	
		Item Frequency	%
0.81 - 1.00	Very Hight	7	35
0.61 – 0.80	Hight	8	40
0.41 – 0.60	Simply	4	20
0.21 – 0.40	Low	1	5
0.00 – 0.20	Very Low	0	0
Total		20	100

Based on Table 4. Shows the results of a limited trial of Higher Order Thinking Skill instruments in learning biology of ecological and environmental material there are 7 (35%) questions that have very high validation, 8 (40%) questions have high validity, 4 (20%) questions have sufficient validity and 1 (5%) has low validity. From the results of the limited trial, the Higher Order Thinking Skills (HOTS) instrument in biology learning is very feasible to be used in learning ecology and environmental materials. Furthermore, from the limited test results of the HOTS instrument, the lowest rcount was 0.270 with low criteria while the highest rcount was 0.958 with very high validity. With an average score of 0.724 with valid criteria. Furthermore, the results of the HOTS instrument reliability test in learning biology of ecology and environment material can be seen in Table 5. Avina & Winarsih (2014) stated that HOTS instruments that have good validity, reliability and difficulty index values will result in appropriate use to measure students' higher order thinking skills. The validity test results obtained an average score of 0.724 and reliability of 0.972 with very high criteria. The use of appropriate HOTS instruments in biology learning will be able to be used in evaluating the quality of student learning (Tanujaya, 2016; Dungsungnoen, 2016; Supriyatin et al., 2020; Ramadhan et al., 2019). Baidlowi et al., (2019) stated that the development of HOTS instruments can encourage students to solve problems related to HOTS-based questions in biology learning more easily.

Table 5. Reliability Test Results

Product Trial	α	Criteria
Limited Product Trial	0.972	Very Hight

Based on Table 5. Explaining the results of the HOTS instrument reliability test in the limited product trial obtained α = 0.972 with very high criteria. This shows that this HOTS instrument is very valid and reliable to be developed in learning biology of ecology and environment material. Higher Order Thinking Skills (HOTS) help students in solving difficult questions in ecology and environment materials. A valid and reliable HOTS instrument will be able to measure students' science literacy level in biology learning (Kahar et al., 2021; Riswanda, 2018). Ansori (2020) stated that the development of HOTS instruments improved the cognitive dimension and thinking characteristics of students in biology learning. Therefore, the development of this instrument has a positive impact on teachers and students in ecology and environmental materials (Setiani et al., 2022)

CONCLUSION

Based on this research, it can be concluded that the Higher Order Thinking Skilss instrument has a validation value of 0.724 with decent criteria, reliability of 0.972 high criteria. This finding explains that the Higher Order Thinking Skilss (HOTS) instrument is very valid and reliable for use in ecology and environmental materials. So, the HOTS instrument is very feasible to be developed in biology learning in ecology and environment materials in schools

REFERENCES

Ahmad, I. F., & Syafii, A. (2020). Trends in the Implementation of Higher-Order Thinking Skills in Islamic Religious Education in Madrasahs and Schools : A Systematic Literature Review. *Jurnal Pendidikan Islam*, *9*(2), 195–216. https://doi.org/10.14421/jpi.2020.92.195-216

Ahmad, S., Prahmana, R. C. I., Kenedi, A. K., Helsa, Y., Arianil, Y., & Zainil, M. (2018). The instruments of higher order thinking skills. *Journal of Physics: Conference Series*, *943*(1). https://doi.org/10.1088/1742-6596/943/1/012053

Alharbi, M.S., Elfeky, I.A., & Ahmed, S.E. (2022). The Effect Of E-Collaborative Learning Environment On Development Of Critical Thinking And Higher Order Thinking Skills. *Journal of Positive School Psychology*, *6*(6), 6848–6854. http://journalppw.com

Almelweth, H. (2022). The Effectiveness of a Proposed Strategy for Teaching Geography through Artificial Intelligence Applications in Developing Secondary School Students' Higher-Order Thinking Skills and Achievement. *Pegem Egitim ve Ogretim Dergisi*, *12*(3), 169–176. https://doi.org/10.47750/pegegog.12.03.18

Ansori, A. Z. (2020). Analisis Soal Biologi Berdasar Dimensi Proses Kognitif Dan Karakteristik Hots. *Jurnal Ilmiah Mandala Education*, *6*(2), 190–199.

Avina, Y. P. Al, & Winarsih, &. (2014). Pengembangan Instrumen Penilaian Sebagai Contoh Paket Soal Higher Order Thinking Skills (Hots) Materi Pencemaran Lingkungan Kelas X Sma . *BioEdu Berkala Ilmiah Pendidikan Biolog*, *3*(3), 571–579.

Baidlowi, M.H., & Sunarmi, S. (2019). Pengembangan Instrumen Soal Essay Tipe Higher Order Thinking Skills (Hots) Materi Struktur Jaringan Dan Fungsi Organ Pada Tumbuhan Kelas Xi Sman 1 Tumpang. *Jurnal Pendidikan Biologi*, *10*(2013), 57–65.

Boyman, S. N., Jamal, M. B., Razali, N. A., & Aziz, S. A. (2020). ADDIE Model Design Process For 21st Century Teaching and Facilitation Activities (Pdpc) In Nationhood Studies Module. *International Journal of Psychosocial Rehabilitation*, *24*(09), 2115–2124.

Cahyaningsih, F., & Roektiningroem, I. E. (2018). Pengaruh Pembelajaran IPA Berbasis STEM-PBL Terhadap Keterampilan Berpikir Kritis Dan Hasil Belajar Kognitif. *E-Journal Pendidikan IPA*, *7*(5), 239–244.

Dama, R. M. E. N. L. (2021). Pengembangan Instrumen Berbasis Higher Order Thinking Skiil (Hots) Untuk Melatih Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Biologi. *Jurnal Normalita*, *9*(2), 188–194.

Dungsungnoen, A. P. (2016). Student's Perceived Level and Teachers' Teaching Strategies of Higher Order Thinking Skills ; A Study on Higher Educational Institutions in Thailand. *Journal of Education and Practice*, *7*(12), 211–219.

Elfira, I., & Santosa, T. A. (2023). Literature Study : Utilization of the PjBL Model in Science Education to Improve Creativity and Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 133–143. https://doi.org/10.29303/jppipa.v9i1.2555

Haniah, A.R., & Aman2, R. S. (2020). Integration of strengthening of character education and higher order thinking skills in history learning. *Journal of Education and Learning (EduLearn)*, *14*(2), 183–190. https://doi.org/10.11591/edulearn.v14i2.15010

Hanifah, N. (2019). Pengembangan instrumen penilaian Higher Order Thinking Skill (HOTS) di sekolah Dasar. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *3*(2), 197–202. https://ejournal.upi.edu/index.php/crecs/article/view/14286

Hidayatullah, A. R., Yamtinah, S., & Masykuri, M. (2022). Development of A Two-Tier Multiple-Choice Instrument Based on Higher Order Thinking Skills (HOTS) on Acids , Bases , and Salts. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 932–938. https://doi.org/10.29303/jppipa.v8i2.1423

Ichsan, I. Z., Sigit, D. V., Miarsyah, M., Ali, A., Arif, W. P., & Prayitno, T. A. (2019). HOTS-AEP: Higher order thinking skills from elementary to master students in environmental learning. *European Journal of Educational Research*, *8*(4), 935–942. https://doi.org/10.12973/eu-jer.8.4.935

Kahar, M. S. (2017). Analisis Kemampuan Berpikir Matematis Siswa SMA Kota Sorong terhadap Butir Soal dengan Graded Response Model. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *02*(1), 11–18. https://doi.org/10.24042/tadris.v2i1.1389

Kahar, M.S., Syahputra, R., Arsyad, R.B., Nursetiawan M.M. (2021). Design of Student Worksheets Oriented to Higher Order Thinking Skills (HOTS) in Physics Learning. *Eurasian Journal of Educational Research*, *96*, 14–29. https://doi.org/10.14689/ejer.2021.96.2

Kim How, R. P. T., Zulnaidi, H., & Rahim, S. S. A. (2022). HOTS in Quadratic Equations: Teaching Style Preferences and Challenges Faced by Malaysian Teachers. *European Journal of Science and Mathematics Education*, *10*(1), 15–33. https://doi.org/10.30935/SCIMATH/11382

Kim, H.J., Yi, P., & J. I. H. (2020). education sciences Students ' Academic Use of Mobile Technology and Higher-Order Thinking Skills : The Role of Active Engagement. *Educ. Sci.*, *10*(47), 1–15.

Ong, E. T., Singh, T., Singh, M., Kaur, R., & Singh, A. (2020). How to cite this article: Singh, C. K. S., Gopal, R., Tek, O. E., Masa Singh, T. S., Mostafa, N. A., & Ambar Singh R. K. (2020). ESL teachers' strategies to foster higher-order thinking skills to teach writing. *Malaysian Journal of Learning and Instruction*, *17*(2), 195–226.

Poppy, Y., Siti, M. M., IN, S., & Dahlia, F. (2020). Mathematics Mobile Blended Learning Development: Student-Oriented High Order Thinking Skill Learning. *European Journal of Educational Rea*, *11*(1), 69–81. https://pdf.eu-jer.com/EU-JER_9_4_1591.pdf

Pratiwi, U., Fisika, P., Purworejo, U. M., & Matematika, P. (2015). Pengembangan Instrumen Penilaian Hots Berbasis Kurikulum 2013 Terhadap Sikap Disiplin. *Jurnal Penelitian Dan Pembelajaran IPA*, *1*(1), 123–142.

Puspitasari, R. P., Sutarno, S., & Dasna, I. W. (2020). Pengaruh Model Problem Based Learning terhadap Kemampuan Berpikir Tingkat Tinggi dan Hasil Belajar Siswa Kelas V SD. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(4), 503. https://doi.org/10.17977/jptpp.v5i4.13371

Putranta, H., & Supahar. (2019). Synthesis of the Cognitive Aspects' Science Literacy and Higher Order Thinking Skills (HOTS) in Chapter Momentum and Impulse. *Journal of Physics: Conference Series*, *1397*(1). https://doi.org/10.1088/1742-6596/1397/1/012014

Rahmawati, D. E., & Trimulyono, G. (2021). Validitas Instrumen Penilaian Higher Order Thinking Skills (Hots) pada Materi Keanekaragaman Hayati. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *11*(1), 138–147. https://doi.org/10.26740/bioedu.v11n1.p138-147

Rahmawati, N.D., & Komarudin, S. (2022). urnal Program Studi Pendidikan Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(2), 860–871.

Rahmi, Y. L., Habibah, I. N., Zulyusri, Z., & Darussyamsu, R. (2021). HOTS assessment in circulatory system learning: Validity, reliability, and item quality. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *7*(2), 171–178. https://doi.org/10.22219/jpbi.v7i2.15513

Ramadhan et al. (2019). The Development of an Instrument to Measure the Higher Order Thinking Skill in Physics. *European Journal of Educational Research*, *8*(3), 743–751. https://doi.org/10.12973/eu-jer.8.3.743

Ramirez, R. P. B., & Ganaden, M. S. (2008). Creative activities and students' higher order thinking skills. *Education Quarterly*, *66*(December), 22–33.

Ratna, A. M., Retnawati, H., Firmansyah, E., & Mubarika, M. P. (2018). Development of Higher-Order Thinking Skills (HOTS) Questions of Probability Theory Subject Based on Bloom ' s Taxonomy Development of Higher-Order Thinking Skills (HOTS) Questions of Probability Theory Subject Based o n Bloom ' s Taxonomy. *IOP Conf. Series: Journal of Physics: Conf. Series*, 1–14. https://doi.org/10.1088/1742-6596/1188/1/012025

Razak, Abdul, Santosa, Tomi Apra, Lufri., et al. (2021). Meta-Analisis: Pengaruh Soal HOTS (Higher Order Thinking Skill) Terhadap Kemampuan Literasi Sains dan Lesson Study Siswa Pada Materi Ekologi dan Lingkungan Pada Masa Pandemi Covid-19. *Bioedusiana*, *6*(1), 79–87.

Rintayati et al. (2021). Development of Two-Tier Multiple Choice Test to Assess Indonesian Elementary Students ' Higher-Order Thinking Skills. *International Journal of Instruction*, *14*(1), 555–566.

Riswanda, J. (2018). Pengembangan Soal Berbasis Higher Order Thinking Skill (Hots) Serta Implementasinya Di Sma Negeri 8 Palembang Development Of Test-Based Higher Order Thinking Skill (Hots) And Its Implementation In Sma Negeri 8 Palembang. *Didaktika Biologi: Jurnal Penelitian Pendidikan Biologi*, *2*(1), 49–58.

Setiani, A. E., Hernawan, A. H., & Herlambang, Y. T. (2022). Pengembangan Instrumen Penilaian " Hots " dari Buku Tematik dengan Menggunakan Quizizz di Sekolah Dasar. *El-Ibtidaiy: Journal of Primary Education*, *5*(1), 90–103.

Setiawan, A., Malik, A., Suhandi, A., & Permanasari, A. (2018). Effect of Higher Order Thinking Laboratory on the Improvement of Critical and Creative Thinking Skills. *IOP Conference Series: Materials Science and Engineering*, *306*(1). https://doi.org/10.1088/1757-899X/306/1/012008

Setiawan, J., Sudrajat, A., Aman, & Kumalasari, D. (2021). Development of higher order thinking skill assessment instruments in learning Indonesian history. *International Journal of Evaluation and Research in Education*, *10*(2), 545–552. https://doi.org/10.11591/ijere.v10i2.20796

Suharyat, Y., Santosa, T. A., & Satria, E. (2023). The Effectiveness of STEM-Based Learning in Teaching 21 st Century Skills in Generation Z Student in Science Learning : A. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 160–166. https://doi.org/10.29303/jppipa.v9i1.2517

Suprapto, E., Sumiharsono, R., & Ramadhan, S. (2020). The Analysis of Instrument Quality to Measure the Students ' Higher Order Thinking Skill in Physics Learning. *Journal of Turkish Science Education*, *17*(4), 520–527. https://doi.org/10.36681/tused.2020.42

Supriyatin, S., Aulya, N. R., Ichsan, I. Z., Rahman, M. M., & Gomes, P. W. P. (2020). HOTS Analysis to Develop E-Supplement Book Based on Plant Physiology Research. *Universal Journal of Educational Research*, *8*(12B), 8461–8466. https://doi.org/10.13189/ujer.2020.082654

Susanti, A., Retnaningdyah, P., Ayu, A. N. P., & Trisusana, A. (2020). Improving EFL Students' Higher Order Thinking Skills Through Collaborative Strategic Reading in Indonesia. *International Journal of Asian Education*, *1*(2), 43–52. https://doi.org/10.46966/ijae.v1i2.37

Susanto, E., & Retnawati, H. (2016). Perangkat pembelajaran matematika bercirikan PBL untuk mengembangkan HOTS siswa SMA. *Jurnal Riset Pendidikan Matematika*, *3*(2), 189–197. https://doi.org/10.21831/jrpm.v3i2.10631

Syafryadin, E.C..D., Noermanzah, A.R., & Awaluddin. (2022). Students' perspective and problems in implementing higher order thinking skill (HOTS) in speaking for presentation class. *Journal of Language and Linguistic Studies*, *18*(1), 477–487. https://doi.org/10.52462/jlls.196

Tanujaya, B. (2016). Development of an Instrument to Measure Higher Order Thinking Skills in Senior High School Mathematics Instruction. *Journal of Education and Practice*, *7*(21), 144–148.

Umami, R., & Rusdi, M. (2021). Pengembangan instrumen tes untuk mengukur Higher Order Thinking Skills (HOTS) berorientasi Programme for International Student Asessment (PISA) pada peserta didik. *Jurnal Penelitian Pendidikan Dan Pengajaran Matematika*, *7*(1), 57-68.

https://doi.org/10.37058/jp3m.v7i1.2069

Utama, C. (2020). The Instrument Development to Measure Higher-Order Thinking Skills for Pre-Service Biology Teacher. *International Journal of Instruction*, *13*(4), 833–848.

Utami, S. W., Sunandar, A., & Kurniawan, A. D. (2020). Application of two problem solving cycles to students' higher-order thinking skills on reproductive system material. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(3), 383–388. https://doi.org/10.22219/jpbi.v6i3.12024

Wantoro, J., Sutama., & Zuhriah, S.H.N.H. (2019). Pengembangan Instrumen Penilaian Pendidikan Profesi Guru Sekolah Dasar Bebasis Hots. *Profesi Pendidikan Dasar*, *6*(1), 11–20. https://doi.org/10.23917/ppd.v1i1.8453